WOSC 2014

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Universidad de Ibagué

WOSC 2014

16th Congress of the World Organization of Systems and Cybernetics

Our self-organizing world:

from disruption to reparation

15-17 October 2014

University of Ibagué

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Designed by: Daniel Lopera

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Opening WOSC 2014

University of Ibagué

October 15th, 2014

<Protocol Greeting>

The New Atlantis is a beautiful utopia, written in 1623 by the English philosopher Francis Bacon, and published after his death, in 1627. It describes an ideal society, where people have achieved happiness, through scientific and technological development. Knowledge was considered as the most precious of treasures.

The book tells the journey of a group of sailors, who in the late seventeenth century depart from Peru to China, along the South Sea. A few weeks later, strong winds diverted them, and after several months of sailing aimlessly,they reach an island that was not registered in his navigation maps. Right from there, Baconaccurately describes the relation of the lost travelers with the inhabitants of that place. It is impressive how he anticipates, at that time, the seventeenth century, the invention of the submarine, the airplane, the microphone andhow to growth fruits artificially, among other achievements of technology. At the same time, Bacon carefully describes the social and political organization of the inhabitants of Bensalem, which was the name of this nation.

My interest, however, is not to go in depth into the description of the New Atlantis. I would like to propose, instead, and with your permission, a radicalchange in thestory. The new story starts exactly the same way... The ship departs from Peru, gets lost on its journey, but reaches another island. I would like to share with you some of the aspects that these intrepid sailors wrote in their diary, about how the society, that they found, was organized.

One day after they arrived, and after they enjoyeda frugal breakfast with exotic tropical fruits, they noticeda prison building,right before the place they had been assigned as temporary housing, while their boat was being repaired. The ship's captain, who in his early years had been a judge in Peru, inquired if he could see the place. Indeed, they went to visit it, being escorted by the prison´s director.

The first shock was the clear overcrowding. Cells designed to hold two inmates, housed up to ten. There were health problems, violence, malnutrition and corruption that wereprobably related to the overcrowding. The captain inquired for how long they had this problem. "For about 70 years," was the sharp reply. And what you have done to fix it? "Almost everything". Every four years we build new prisons but we keep having more prisoners, as well. The overcrowding rate in the country is 52% when the maximum allowed is 10%."

After talking to some of these prisoners, he learned that many had not been condemned.Intrigued, he asked the prison´s director if this was not against the presumption of innocenceprinciple. The director replied thatclearlythis was the case, but the judges preferredsend them to jail while they are prosecuted in order to avoid the possibility that they escape. And, how long can they stay in prison before their process is finished?"On the average three years. In fact, some of them start working,so they get a reduction of their sentence even before they get a conviction. It is a bit oddwhen some of them get free and they have worked in jail to reduce their sentence. It is as if they had a positive balance that allows them to commit a crime without having to go to jail".

And, they do not sue the state for damages? "Yes, they do, at this time we have demands for $21 billion pesos. This is about 10% of the annual state budget. "

The captain decided to investigate a little more about the organization of the criminal system. They told him they had changed the system 12 years ago. Instead of an inquisitive and mainly written system, now they have anoral accusatory model. And how effective has the change been? He asked the Minister of Justice, with whom he was talking about this issue.

"Well, you see,the cases where the person iscaught in the act of committing a crime operates very fast. Ittakes only a couple of months to finish it, instead of a couple of years that it was the case in the previous system. Similarly, the system is considerably quicker when the accused accepts the charges. Theproblem arises when neither of these situations occurs and it is necessary to follow thecomplete process. "Why is that? the captaininquired. "It is because trials are too long". But they are oral in order to be faster. "Yes, but what happens is that the prosecutor writes down, in advance, what he wants to

say in his accusation and the defendant does the same with his defense. During the trial, the judge simply gives the word to each one.But in this case, why they don´t send their writings tothe judge by electronic mail? “Well, because the hearing must be oral,according to the law. But what the judge does, after that,is even stranger,"continued the minister.

"After listening, for several days, the interventions of the prosecutor and the lawyers, the judge takes several weeks to write down the sentence. On the average, each sentence is about 200pages. When he finishes writing it, he calls the parties involved in the process, to read it. As this reading can take several hours, neither the lawyer nor the prosecutor attend because their attendance is not mandatory, although it is mandatory that the audience takesplace. The result of this practice is that, if you happen to pass by the courtrooms, you will find that in several of them,only the assistant of the judge will be there reading the sentence,for several hours, in an empty room".

According to the minister, the design of the system changed when the rules changed, but none of the key players for its operation, for instance, neither the prosecutors nor the defense lawyershave changed the way they participatein the new model. All of them had been educated, from the University, under the written inquisitorial system; none was educated for the oral debate of ideas.

Later,the captain learned that this practice of changing the rules, under the belief that this would also change the behavior of those involved, was common in this country. In fact, they have changed their constitution 23 years ago and, since then, it had been modified in 35 times. Of course, they were thinking about changing the Lawgoverning the present accusatory system but, interestingly enough, they have not changed thecurricula in the Law schools.

In those days there was a meeting of government accountability. As this practice was not usual in Peru at that time, the sailors decided to attend. There, they were interested in the fact the corruption in public institutions was regarded as a serious problem. They understood that an institution called, the GeneralAccounting Office was in charge of dealing effectively with this problem. They got impressed to hear that the head of this institution was claiming proudly that in the last ten years, shehad increasingly recoveredmore money,that were mismanagedby public institutions. At this moment, the

captain thought that with this logic, in order for the General Accounting Office to be more effective is that public institutions became more corrupted and steal more money. He also noticed thatin her report, the comptroller showed, with amazing detail, how the money had vanished every single time. He thought that this practice was very similar to carrying out an autopsy.

This is a perverse indicator, isn´t it? one of the marine told to another person attending to the event. "Well, there are worst," he answered. "Here, the police grants days off to those policemen who manage to overcome a minimum number of individuals captured per month, and the army, at one time, did the same in accordance to the number of subversives that were killed".

At the same meeting, the government announced a major achievement: an increase of 30% of young people who had been trained, for free, in technological programs during the last two years. And how many of them are working? asked the same sailor. "I think that only 5%", was the answer.

Also, it was announced as another major achievement of the government that they haveincreasedthe number of academic programs offered in small rural cities. But later on, it was said, in a tone of concern that unemployment in these cities were raising. Furthermore, at the end of the meeting,thedirector of the National Statistics Office informed that migrations from municipalities to cities were increasing. “It seems that nobody is making a connection between these data”, the captain thought.

The next day, the vessel was ready to depart. The sailors and the captain said goodbye, they were happy to leave, and not having to stay in this nation.

Although this narrative, I have presented is picaresque, the numbers mentioned are real, as well as the situations described. These correspond to current practices in several of our countries. The question is why do they occur and keep onhappening? In most of these cases, there appears to be incapacity to observe systems as a whole. It seems that people in charge of designing these systemstry to make each component as much as efficient as they could. This failure to anticipate unintended consequences, when designing fragmented systems, is what Stafford Beer, sometimes called the "culpabliss error". Also,

Notdistinguishing between the domain of discourse and the operational domain of the system in focus, leads to believe that by changing a rule, the regulated behavior will change. On the other hand, those who are responsible for carrying out the primary activities of any public service, do not have neither the ability nor the means to observe their long-term effect, which prevents them from closing the necessary learning loops.

I am sure that if we look carefully, we can find other cases of this sort of problems, in different latitudes. The recent financial crisis in Europe, in 2008, for example, could have be associated with this incapacity to understand the complexity of the patterns that emerge form relationships that grow exponentially, in an increasingly interconnected world.

To In-corporate, that is, to interiorize a new way of thinking, understanding and acting seems necessary to design effective public systems. I think that the conceptual, epistemological and methodological developments insecond-ordercybernetics, organizational linguistics, social cybernetics, cultural biology, the design of recursive organizational structures and the approaches of other forms of systemic thinking, as well as the recentadvances in the theory of complexity, could help in this moment. To me, this is the importance of maintaining existing organizations like WOSC and the relevance of this kind of congress.

I would like to thank the board of WOSC, and in particular to its general director, Dr. Raul Espejo, for choosing the University of Ibagué to carry out the 16th Congress. Additionally, my gratitude to allkeynote speakers, thematic coordinators, participants, to the people dealing with the logistics and to all of you for being here.

Welcome.

Alfonso Reyes A.
President.
University of Ibagué

WOSC 2014: "Our Self-organising World: from disruption to reparation"

Professor Raul Espejo
Director General of the World Organisation of Systems and Cybernetics
Ibague, 2014

About the Congress

As we read, listen and watch today's news we become increasingly aware that we are living turbulent times. Whether we talk about the impacts of climate change, the several conflicts in the Middle East, the geo-political problems in Eastern Europe, the Ebola crises in Western Africa or the many local problems that we all experience in our communities, humanity is confronting pressing disruptions that need our attention and reparation. These are large and small problems currently taxing us all to different degrees. They trigger conflicts and collaboration and with more or less pain and satisfaction challenge the self-organisation of a wide range of collectives' to repair their ecosystems. Indeed this is a self-organising world.

An aim of the World Organisation of Systems and Cybernetics (WOSC) is understanding collaboration with the support of holistic thinking and the epistemology of second order cybernetics. We need tools to penetrate the complexity of our highly interrelated world; to overcome the fragmentation of the disciplines and to take advantage of the scalability of natural and social phenomena. Related concepts, models, tools are the concern of our Congress; we will debate developments and applications in the next three days. We want to converse about the globalisation of the local and the localisation of the global. Our challenge is discussing and producing transferable knowledge to deal, among others, with today's global ecological, organisational and managerial concerns and also with the pressing local problems of communities, cities and regions.

WOSC is bringing together participants with a wide range of experience in issues such as ecological sustainability, communities, communications, information technology, education, management and organization, modeling, policy-processes, resources management, urban challenges and other concerns. The Proceeding of this Congress includes contributions of scientists, professionals and practitioners coming from five continents covering all these topics. My thanks go to all of you.

The University of Ibagué and WOSC have invited a powerful group of plenary speakers to contribute to a deeper social, scientific and professional appreciation of issues such as ecological stability, economic policy, biological culture, language and communications, self-organisation, social organisation and governance. The list includes:

Humberto Maturana, Chile´s National Science Award for his work towards an understanding of living systems (autopoiesis), is contributing together with Ximena Dávila a new paradigm of cultural biology published in their book "El Arbol del Vivir" (The Tree of Life), a powerful contribution to processes of cultural transformation. Dario Rodriguez will further develop the idea of autopoiesis from sociological and organisational perspectives, along the lines of the work of the German

sociologist and systems thinker Niklas Luhmann; he is author and co-author of several books, such as “Organizaciones para la modernización”.

Fernando Flores is regarded a world class expert in how people work together and co-author of books such as "Understanding Computers and Cognition", "Disclosing New Worlds", “Building Trust" and more recently “Conversations for Action and Collected Essays”. He will bring to the Congress political, managerial and philosophical depth. Flores was the initiator of the Cybersyn Project in Chile in the 1970s, whose meaning for today’s technology will be discussed by Eden Medina, from the United States. She is author of the book "Cybernetic Revolutionaries". Raul Espejo was Operational Director of this project and in the context of this Congress will offer methodological and epistemological contributions emerging from this project’s vision. He is author and co-author of many publications, including "Organizational Systems; Managing Complexity with the Viable System Model" together with the Chair of this Congress, Dr Alfonso Reyes. Cybersyn was the invention of Stafford Beer; Allenna Leonard has contributed to the dissemination of Beer´s work over decades and in particular in this Congress she will talk about two of his greatest inventions; the Viable System Model and Team Syntegrity.

Economics is one of the most influential bodies of knowledge in policy-making. Another of our keynote speakers Geoff Mulgan has contributed to policy processes at the highest levels in the UK from an often forgotten systemic perspective. He has captured this systemic view in his writings on power and capitalism, in books such as “Good and Bad Power” and “The Locust and the Bee”.

Clas-Otto Wene, a physicist and member until recently of the Swedish National Council for Nuclear Waste will offer a powerful alternative to traditional economic arguments about energy technology learning. Grounded in second order cybernetics, self-organisation and organisational learning he will contribute to energy policy debates here in this Congress and beyond.

Finally, Carlos Gershenson from Mexico, will share his work in aspect of guided self-organisation as crystallised in his PhD thesis "Design and Control of Self-Organising Systems"; he is one of an emerging new generation of worldwide systems, cybernetics and complexity scientists. In their hands rests the future of our organisation.

Norbert Wiener Gold Medal

WOSC’s Executive Committee -represented by its President, Professor Robert Vallée, its Vice-President, Professor Brian Rudall, and its Director General Professor Raul Espejo- have agreed awarding to Prof. Dr. Humberto Maturana, at WOSC 2014, the Norbert Wiener Memorial Gold Medal in recognition for his outstanding contributions to Cybernetics.

University of Ibague

This Congress will not have been possible without the support and commitment of Dr. Alfonso Reyes Rector of the University of Ibague. He and his colleagues at the University have energised the Congress´s design and implementation. The structural couplings between WOSC and Ibague, grounded in many years of collaboration between their representatives have made possible much of what you will experience during week.

My best wishes to all of you.

Keynote speakers

Rethinking Algorithmic Regulation: Lessons from Project Cybersyn

Eden Medina, Indiana University
WOSC 2014 Meeting
Ibague, Colombia

According to the IT research firm Gartner, Inc., the Internet of Things has now replaced Big Data as the most hyped emerging technology. The phrase "Big Data" began picking up steam in 2011 as judged by the number of times the phrase appeared in indexed news headlines. References to the "Internet of Things," in contrast, began to rise in 2013 with headlines ranging from the deterministic "How the Internet of Things Changes Everything" to the self-referential "The Internet of Things is becoming a Huge Thing."

Yet, we can also view this transition as one form of data enthusiasm giving way to another. Indeed, the public fascination with data collection and data storage, the increasing prevalence of these practices, and the parallel investments that are being made by government and the private sector to extract new knowledge from these growing banks of data suggest that this enthusiasm shows no sign of waning.

Pundits such as publisher Tim O'Reilly argue that developments in data collection, storage, and computer power promise to make governments more efficient and adaptive and thus improve governance. In an essay published earlier this year, O'Reilly sings the praises of "algorithmic regulation," a form of data-driven governance where policy makers first, develop a clear sense of the outcome they desire; second, take measurements in real-time to see if the outcome is being achieved; third, use algorithms to assess the new data and adjust government actions accordingly; and fourth, conduct periodic assessments to see if the algorithms are performing as expected (O'Reilly, 2014). He points to the dynamic approach used by the central banks to regulate the money supply as an example of the kind of regulation that the government could implement more broadly.

O'Reilly also finds inspiration in companies such as Uber, the on-demand car service that that allows people to request rides via a mobile phone app and specify the kind of car that will pick them up (ranging from a normal everyday car for budget customers to an SUV or luxury sedan for high end users). Users provide feedback on the drivers, which the company then uses to regulate the continued employment of drivers. Drivers similarly rate passengers and low ratings can result in the passenger being blocked from the driver's phone app and, eventually, from the service. O'Reilly asserts

that in the context of taxi service, reputation does a better job of regulating than the government. For example, the constant customer/driver feedback allows the company to block drivers and passengers from using the system. O'Reilly sees this as a form of community self-regulation, where drivers and passengers collectively work to create a positive ride share experience. However, as a recent spate of articles have show, there are other ways we could construe the Uber model, including as a means of worker abuse or new source of anxiety about being judged. We could also view such reputation-based forms of governance as a way for a company to increase its regulatory control while distributing the labor of regulation across the community.

We could argue that arguments such as O'Reilly's—and indeed he in not the only person to express such views—stem from a *technological moment*. For example, it has only recently been feasible to collect and process data on this scale. Technological innovations such as smart phones also provide new data collection and transmission capabilities (how else could drivers and passengers evaluate each other almost anywhere and at anytime?) Social media sites such as Twitter collect spontaneous reactions to world events and celebrity photographs alike and store them for subsequent processing. Sensors embedded in our phones, refrigerators, thermostats, and cars can now generate a continuous stream of data documenting our activities in virtual and physical spaces. Data farms too have grown in capacity from terabytes to petabytes to exabytes and now to speculations of zettabytes and yottabytes. Certainly these technological capabilities play a central part in our fascination with data-driven analytics.

One could also argue that arguments such as O'Reilly's argument represent the kind of technological enthusiasm—*ideology* even—that is often found in high tech cultures. This kind of enthusiasm frequently celebrates technology as a magic bullet for societal problems with also embracing values such as individuality, personal responsibility, and the superior innovative power of the private sector when compared to government. Journalist and former *Wired* magazine writer Paulina Boorsork characterized this stance as "cyberlibertarianism," which according techopedia is an ideology that advocates "for the use of technology as a means of promoting individual or decentralized initiatives and less dependence on central government." This often translates into an expanded role for the private sector. We can see this, for example, in O'Reilly's call for government to place its data in a form that is "timely, readable, and complete" so that private companies can step in and build services for "consumers." With assistance from the private sector, the government can then spend more time on more serious matters.

Yet, if we move beyond technology and ideology, it is clear that we have seen similar calls for data driven, dynamic regulation. As Evegny Molotov recently noted in *The Guardian*, discussions of algorithmic regulation are highly reminiscent of cybernetics, the interdisciplinary science that emerged in the aftermath of World War II

and brought together a diverse group of scholars including Norbert Wiener, Margaret Meade, Gregory Bateson, Warren McCulloch, Heinz von Foerster, and Arturo Rosenblueth. Cybernetics moved away from linear understandings of cause and effect and toward investigations of control through circular causality or feedback. Cybernetics influenced developments in areas as diverse as cognitive science, air defense, industrial management, and urban planning. It also shaped ideas about governance.

The content of cybernetics, moreover, varied according to geography and historical period. In the United States early work on cybernetics was associated with defense, in Britain it was associated with understanding the brain, in China cybernetic thinking influenced the one child per family program, and in Chile cybernetics led to the creation of a computer system to further socialist change.

Many of you will recognize this last example as the work of cybernetician Stafford Beer in collaboration with several of the people in this room. The remainder of my talk will focus on the Cybersyn history and it will use the project to suggest how the Chilean experience with cybernetic thinking might enhance and improve discussions of algorithmic regulation. Some of you may find it strange that I have chosen to use a technology developed for socialist revolution in South America as inspiration for thinking about algorithmic regulation in the twenty first century. To that I say this is precisely the value of studying the relationship of political innovation and technological innovation in different parts of the world. Each political context can produce alternative technological ways of being and potentially inspire new possibilities for technological development in other parts of the world.

But before I get there, I would like to say a few words about Stafford Beer. Like many cyberneticians, Beer embraced complexity, emphasized holism, and did not try to describe the complex systems he studied—biological or social—in their entirety. Instead, he wanted to develop mechanisms to help these systems self-regulate and survive. To that end, he believed that cybernetics and operations research should drive action, whether in the management of a firm or governance on a national scale. He writes, “The company is certainly not alive, but it has to behave very much like a living organism. It is essential to the company that it develops techniques for survival in a changing environment: it must adapt itself to its economic, commercial, social and political surroundings and learn from experience.”

Such adaptive regulation would require a regulator that has as much flexibility as the system it wishes to control. “Often one hears the optimistic demand: ‘give me a simple control system; one that cannot go wrong,’” Beer writes. “The trouble with such ‘simple’ controls is that they have insufficient variety to cope with the variety in the environment. … Only variety in the control mechanism can deal successfully with variety in the system controlled.” This observation, as many of you will recognize, is a paraphrasing of Ashby’s Law of Requisite Variety.

For Beer, computers in the 1960s and 1970s presented exciting new opportunities for regulation. In 1967, he observed that computers did not need to reinforce existing management hierarchies and procedures; instead, they could bring about structural transformations if they were linked to new communications channels that enabled the generation and exchange information and dynamic decisionmaking. His 1971 essay "The Liberty Machine" extended this thinking to the domain of government, which uncharitably described as an "elaborate and ponderous" machine" with "immense inertia." Ineffective organization meant that the government had limited its ability to act in the present and respond to the future.

Beer proposed the creation of a "Liberty Machine," a sociotechnical system that treated information, not authority, as the basis for action; operated in close to real-time so as to facilitate instant decision-making and eschew bureaucratic protocols; and prevented top-down tyranny by creating a distributed network of shared information. Beer posited that such a Liberty Machine could create a government where "competent information is free to act," meaning that once government officials become aware of a problem, they could address it quickly. In the Liberty Machine, expert knowledge grounded in data guided policy, not bureaucratic politics. Such similarities suggest that we could reasonably position Beer's Liberty Machine as a predecessor to algorithmic regulation.

Examining Beer's attempt to construct an actual Liberty Machine in the context of political revolution further strengthens this comparison. In 1971, Beer received an invitation from Fernando Flores to apply cybernetic thinking to Chile's peaceful road to socialist change and make possible the economic nationalization program outlined by Chilean president Salvador Allende. This resulting project, Cybersyn, remains one of the most ambitious applications of cybernetic ideas in history.

The system worked by providing the government with up-to-date information on the production activity within the nationalized sector. Factory managers transmitted data on the most important indices of production to the Chilean government on a daily basis. Typically this included data on raw materials and energy as well as data on worker satisfaction (as measured by the percentage of workers present on a given day). Operations research scientists conducted studies to determine the acceptable range of values for each index—what would be considered normal and what would be considered cause for alarm.

Engineers from Chile and Britain developed statistical software to track the fluctuations in the index data and signal if they were abnormal. The software also used statistical methods to predict the future behavior of the factory and thus give government planners an early opportunity to address a potential crisis.

In terms of hardware, the system relied on a national network of telex machines that connected the factories to the central mainframe computer. The computer processed the production data and alerted the government agency in charge of the nationalization

effort (CORFO) if something was wrong. Project Cybersyn also included an economic simulator, intended to give government officials an opportunity to play with different policy alternatives and, through play, acquire a heightened sense of the relationship among the different economic variables. It also included a futurist looking operations room, which was built in downtown Santiago.

The system worked by having managers transmit the factory data to the mainframe computer in Santiago using the telex network. The computer then ran the statistical software and checked for production anomalies. If all of the indices were in an acceptable range, the system did not intervene in factory activities. If the system did detect an anomaly, however, it would send an alert to the factory and give the factory manager a limited window to resolve the situation. If the manager could not resolve the situation, the system sent an alert to CORFO. Government officials would then convene in the operations room to examine the economic data and figure out an appropriate cause of action. Beer viewed Project Cybersyn as implementing a form of decentralized control because the government intervened from above only if it was necessary to preserve economic stability. Otherwise factory managers retained their autonomy.

In 2011, I published a book on the history of Project Cybersyn titled *Cybernetic Revolutionaries: Technology and Politics in Allende's Chile.* In it I made the argument that the system provided a compelling example of how different political contexts open up new possibilities for technical innovation. I also used the system to illustrate how technologists, workers, and members of government tried to instill political values in the form and function of a technological system, a process I refer to as sociotechnical engineering. Indeed, the approach to decentralized control found in Project Cybersyn mirrored the approach to democratic socialism articulated by the Allende government. For example, both extended the reach of the state while still preserving individual freedoms and both were centrally concerned with increasing participation in government. I will not say more about these aspects of my argument in this talk, although I am happy to say more during the question and answer period if there is interest.

Instead, I will spend the remainder of my time making the following argument. First, Project Cybersyn bears several similarities to the argument O'Reilly makes in favor of algorithmic regulation. For example in the case of Project Cybersyn, the government had a *clear purpose* of increasing industrial production (Step 1); it created a way to *measure* production in the nationalized sector in as close to real-time as was possible given Chile's technological resources (Step 2); it *used computer algorithms to detect changes* in factory behavior that could decrease production levels; these algorithms also alerted government officials and factory managers to make policy adjustments (Step 3). Given that the system never made it past its initial stages—the project ended with the demise of the Allende government on September 11, 1973—Cybersyn's creators did not have much of an opportunity to evaluate the correctness of their statistical algorithms

(Step 4), although it is easy to imagine this kind of activity taking place had Allende stayed in power and work on the project continued.

Project Cybersyn thus offers a historical example of algorithmic governance. It also allows us to consider what algorithmic governance looks like in a political, geographic, and historical context other than the United States in 2014. We might even say it provides a perspective of what algorithmic governance might look like from the Left.

The fact that system was developed in Chile, which at the time was lumped as part of the Third World, and during a moment when politicians and technologists made political values an explicit part of technological production also makes Cybersyn an important example for further consideration. My point today is not to condemn algorithmic regulation out of hand, but rather to think of what kinds of alternative forms it might take. I argue here that proponents of algorithmic regulation have missed some of the central lessons from the Cybersyn Project. Returning to Cybersyn's history, therefore, can guide our understanding of and improve our approach to present day forms of cybernetic governance.

Lesson #1: The State Matters

Algorithms are a series of instructions for carrying out action. When coupled with computers, they provide a way to execute a series of instructions without human intervention. They perform tasks at a speed and scope that human beings cannot match and thus seem to promise greater efficiency. However, this removal of human beings from the loop can also generate anxieties, and we have seen these kinds of anxieties about computer technology before. Consider the reaction to twentieth century efforts to automate production processes via computerized forms of industrial control.

In the *Human Use of Human Beings*, written in 1954, Norbert Wiener projected that computers would usher in a second industrial revolution and lead to the creation of an automatic factory. He writes that automated machinery would be "the precise economic equivalent of slave labor. Any labor which competes with slave labor must accept the economic conditions of slave labor."

In the 1970s, labor scholar Harry Braverman writes that the "automated system for data-processing resembles the automatic systems of production machinery in that it re-unifies the labor process, eliminating the many steps that had previously been assigned to detail workers." According to Braverman, computers not only allowed office work to become increasingly routinized, but also gave management an easy way to see how much work each operator or department had accomplished. As the speed of labor intensifies, Braverman notes, so do the layoffs.

In the 1980s, business scholar Shoshana Zuboff found that the introduction of microprocessor-based control systems in the Piney Wood pulp mill created hierarchical

forms of centralized control. These control systems replaced workers' tacit knowledge with intelligent sensors and transformed the mill workers into machine operators with little control or knowledge of the systems they used.

Beer was working on Project Cybersyn around the same time as Harry Braverman was writing his famous critique of twentieth century work, *Labor and Monopoly Capital*. Both men were operating in contexts that were critical of capitalism and drew inspiration from Marx's writings. Unlike Braverman, however, Beer believed computers could *improve* the quality of work by providing a new mechanism for workers to participate in production processes. Indeed, the computer system Beer designed did not automate labor. Given the Popular Unity commitment to raising employment levels, automating labor would not have made political sense.

The context of Chilean socialism gave Beer the latitude to think beyond efficiency and envision new forms of worker participation that were more substantial than what Braverman saw in the United States. The Chilean state, and its priorities, made it possible for Beer to prioritize employment and worker participation in his system design. This, in turn helped him conceptualize computers as tools of labor empowerment. The state matters because it can require engineers and other technologists to emphasis values other than profit, market success, efficiency, or technical elegance in the design of technological systems.

For this reason, O'Reilly's suggestion that the government increasingly delegate the creation of its governing algorithms to the private sector gives me pause. Project Cybersyn reminds us that the state cannot and should not be dismissed as an inefficient and bureaucratic machine. Indeed, government often moves at a slower pace because it includes mechanisms to protect minority and vulnerable groups from the abuse of the majority. This can lead to the creation of technologies that protect the rights of vulnerable groups.

Lesson #2 The Value of Older Technologies

Project Cybersyn was built in South America during the 1970s when Chile had limited technological resources. Today Chile has a government program dedicated to cultivating high-tech startups. In 1970, however, Chile had approximately fifty computers in the entire country, and most were outdated. The National Computer Corporation, or ECOM, controlled most of the computer resources owned by the Chilean government. In 1971 ECOM had access to four mainframe machines. Three were IBM System/360 mainframes and one was a Burroughs 3500 mainframe. All were low- to mid-range machines.

Chilean access to imported technologies, such as computers, was further limited by the U.S.-led "invisible blockade," which the Nixon administration put in place to try to destabilize the Chilean economy. The computer manufacturer Burroughs closed up

shop during the Allende period fearing that the Chilean government would nationalize its operation. IBM reduced its staff to a bare minimum for the same reason and sent many of their Chilean employees to other Spanish speaking countries.

Seen in this context, we can appreciate the technical ambition of the Cybersyn team. Indeed, the team managed to create a computer network using one, and sometimes two, mainframe computers.

We can also appreciate the elegance of the engineering solution Beer and the Chilean team proposed of connecting this one computer to several hundred telex machines, telex being another dated technology. Granted, the resultant system could not compete with the contemporaneous ARPANET, which by 1971 had 15 nodes, spanned the continental United States, and had email capability. But Chile's network also improved communication, enhanced the exchange of economic data considerably, and used fewer resources and had a substantially lower cost than ARPANET.

The operations room provides another example of how Project Cybersyn re-envisioned the possibilities for older technologies. The room simulated television display screens by placing a series of slide projectors behind a wall. The projectors then back projected slides of economic data onto the acrylic screens in the room and created the effect of a high-tech display. Project Cybersyn thus challenges the assumption that advanced technologies need to be complex and cutting edge. Sophisticated systems can be built using simple technologies, provided that particular attention is paid to how humans interact and the ways that technology can change the dynamics of these interactions.

One of the more pervasive arguments for data collection and storage today is that it's cheap. Why not collect large amounts of data when you can do so economically? When Google gives us 15GB of email storage for free, why should we ever clean out our inboxes? As media scholar John Durham Peters notes, even the metaphor of "the cloud" projects the image that data lacks a physical presence.

The problem is that data actually has a tremendous cost, but these costs are often externalized as the natural resources that required to cool data farms and generate electricity or as the environmental pollution that results from the manufacture of electronic goods. Data farms, for example, depend on large volumes of water to remove the heat generated by a high number of servers in close proximity. According to a data center designer at Amazon.com, a 15 MW data center uses 350,000 gallons of water per day.

According to the EPA, sales of new electronic devices drive increases in use, storage, and end-of life management. Sales of electronic devices doubled between 1997 and 2009. In 2009, people in the U.S. disposed of 29.4 million computers and 129 million mobile devices. The U.S. had the highest amount of e-waste in the world in 2012, with a reported 9.4 million tons of waste generated. Much of this waste is handled in places like

the China, India, and Pakistan, where processes to recover valuable materials such as gold can expose workers to toxic metals such as lead.

The production of new electronic devices also has environmental costs, and this is nothing new. During the 1980s and 1990s high tech processing plants in the Silicon Valley area leaked hazardous substances from underground storage tanks, dumped toxic substances, and exposed blue collar workers to dangerous chemicals. Even places like Bloomington, IN, the small town where I currently live, continue feel the effects of the electronics industry. Although Westinghouse Electric ceased dumping its toxic chemicals in Bloomington in 1979, the chemicals contaminated the groundwater and made it unusable in parts of the city. Today there is well water that still cannot be drunk, fish that shouldn't be eaten, and lakes where parents do not allow their children not to swim.

Big Data has costs. One way to lessen these costs is to not only think about new smart devices, but also about ways to extend the life of older devices through repair and maintenance. Project Cybersyn provides a valuable example of how older technologies can be re-envisioned—recycled even—to create new cutting edge systems.

Project Cybersyn, also demonstrates that much can be done within a framework of data economy. Beer insisted that factories only transmit 10-12 indices of production daily. This required factory modelers to spend more time at the front end of the project identifying the indices that were the most important. Today we can collect and store increasing amounts of data—petabytes, exabytes, zettabytes perhaps. Selective data storage, however, may help us preserve our natural resources while also increasing our ability to make sense of the data we collect.

Lesson #3 Privacy Protection is Necessary for Decentralized Control

Project Cybersyn implemented a form of decentralized control because it included mechanisms to protect and preserve factory autonomy. This protection was engineered into the system at the level of its design. The government, for example, could only intervene from above after the software detected a production anomaly *and* the factory manager failed to resolve the anomaly within a specified period of time.

However, technological limitations placed an additional check on government intervention. Human operators in the factory could not track thousands of production indices per day, but they could track 10-12. Limiting the number of indicators also made it easier for the software to detect the signal above the noise. Yet, such restrictions also made much of the factory's activity invisible to the Chilean government, preserved freedom, and protected Chilean workers from Orwellian abuse.

While in Chile, Beer also proposed building a series of algedonic meters capable of registering levels of happiness or unhappiness. The meters worked by having a user move a pointer on a dial somewhere between total dissatisfaction and absolute happiness. The position of the knob on the meter determined the voltage output on the device. Beer

wrote that the meters could be installed in any location with a television set, such as in a Chilean home or in select community centers. Chileans could record their level of happiness as they watched televised political speeches. These signals would then provide a form feedback to the government, and government officials could collect public responses easily by adding up the voltage output from the various machines and dividing the figure by the number of machines present. Because these signals were aggregate voltages with no additional information, government officials would be unable to determine the reaction of any particular person or household. Privacy was maintained via technological simplicity.

These technological limitations forced Cybersyn engineers to consider which data were the most important as they could only record human action in the most general sense.

Today, data collection is much easier and more complete. We are no longer constrained by humans typing numbers into telex machines, or the processing power of computers run by punched cards. We can also record human reactions in ways that are substantially more complex than aggregated voltages. Since technology no longer provides a form of built in protection, we need to be more vigilant about privacy. We must continually ask ourselves: what data do we need to perform a certain action? While it may be easy to collect more data than we need, we should also reflect on how such collection might generate privacy concerns.

In 2013, we learned of NSA activities to collect cell phone metadata within the United States as a way to identify terrorist activity. Such revelations generated outrage within the United States, and internationally, and were widely seen as an egregious violation of individual privacy. In the aftermath of these revelations, President Obama formed a Review Group on Communications and Intelligence Technologies and charged the group with making recommendations for reform. The group concluded that the government should not be able to store bulk telephone metadata for domestic surveillance. They recommended instead that the data reside with the telecommunications companies and that the government have access only to specific data after demonstrating need and acquiring a court order.

The government should not be able to collect and store a wide swath of data because it can and because such data might prove useful at a future time, even in a domain as important as national security. Instead the government should only be able to collect and store the data it needs for a national security investigation of recognized merit.

More recently MIT announced a system called openPDS, which stores the data from your digital devices all in one location. This system changes the ecology of data sharing in a fundamental way. Now you have little control over how the applications on your phone collect and store personal data. Oftentimes these applications collect data on

your activities that are not essential to the service they provide. OpenPDS shifts the dynamics of control so that instead of sending your data to each application, each application instead needs to send a query to your central repository. The repository then provides the application with only the information it requires. As one openPDS designer noted, Pandora requires a list of the last 10 songs you listened to in order to make a recommendation. "You don't need the list of all the songs you've been listening to," he observes.

Project Cybersyn reminds us that asking "what data do we need" does not limit our ability to produce systems that improve management capabilities. Instead this question can serve to bring privacy to the forefront of system design and guide the creation of new technologies that do a better job preserving individual freedom.

Lesson #4 Those effected by algorithmic regulation need to be able to see inside the algorithmic black box.

Beer believed Project Cybersyn would increase worker participation. Instead of having trained engineers and operations research scientists build models of the state-controlled factories, Beer thought the government should assign this task to the workers. "There is no-one better qualified to model a plant than the man whose life is spent working in it. He *knows*," Beer writes.

These models would inform the coding of the statistical software and provide the parameters for the production indices. Thus, Cybersyn incorporated worker knowledge in factory management and provide another avenue for workers to use their minds as well as their hands in factory production.

Beer, however, missed (or at least did not articulate) another crucial facet of his plan to make modeling participative. By participating in the modeling process, workers gained an understanding of how the system worked. It gave them a way to open up the black box of the computer and understand the operation of the algorithms that governed Cybersyn's output. If the system flagged an index as abnormal, the workers would have some understanding of why because they had been involved in setting the parameters for what constitutes normalcy.

As a disclaimer, I must point out that Project Cybersyn minimally encouraged worker participation in practice. The engineers working on the project, for example, often felt that they were the experts in the area of factory modeling and therefore did not include worker input in the modeling process. Moreover, there was no time to train the workers on modeling techniques. In fact such a proposition seems a little silly when you consider that many workers were struggling to keep their factories running in the face of sabotage attempts by the political opposition and the U.S. government.

Nevertheless, I think Beer's framing is useful to think with because it reminds us of the democratic value in algorithmic transparency. If code is law, as Lawrence Lessig,

famously proposed, then algorithms that regulate should be subject to public inspection and debate. Only a public that is able to understand how these new forms of government regulation function will be able to practice self-determination.

Consider the use of data analytics by law enforcement. The New York State police, for example, use a computerized management tool to allocate police resources based on past incidents of crime and the statistical prediction of where future criminal activity will take place. The LAPD similarly uses a form of data-driven predictive policing. However, you might be surprised to know that forms of computer-driven data analytics are also entering the world of criminal sentencing.

A number of states are starting to use risk assessment tools in the sentencing process and there is now a push to develop at the federal level "actuarial instruments or processes…that will estimate the relative risk that individual offenders pose to public safety through their future criminal conduct." Current risk assessment tools, which are more commonly used to predict the risk an offender poses if released and reintegrated into society, use information like education level, employment history, family circumstances, and demographic information. Such metrics have a disproportionate effect on offenders from lower socioeconomic brackets and those who are racial minorities.

In a recent op-ed in the *New York Times*, legal scholar Sonja B. Starr noted that 20 states have implemented some form of data-drive predictive sentencing and that some states require the generation and use of risk scores in every sentencing decision. Supporters of such tools argue that such forms of data-driven risk assessment are more objective and fair than the subjective assessments of a judge. While I don't agree with this point, I will concede that human subjectivity shapes sentencing practices regardless of whether the sentence is made using quantitative tools. However, the use of data-driven risk assessments in this context concerns me because it seems to convey objectivity while simultaneously obscuring the forms of bias at work.

Shouldn't defendants have a right to understand the way the justice system calculates risk and the effect such calculations may have on the sentence they receive? How can the communities unfairly affected by these data driven methods push for the creation of more just sentencing practices if they do not understand how such systems work in the first place.

Project Cybersyn tells us that making the operation of a computer system transparent and participative is not simply a technical decision, but also a way to promote democracy. It is easy to say, "we need systems that are transparent and participative." However, we know from Project Cybersyn that this requires sociotechnical engineering and the creation of institutional infrastructures as well as technological ones.

Lesson #5 Keep humans in the loop

Project Cybersyn was designed to improve management, but Beer always insisted that it

was designed to assist, not replace human decisionmaking. He recognized that human beings made the best regulators and presented some of the best possibilities for achieving homeostasis in situations involving high variety.

When we think of algorithmic regulation, there is a tendency to envision sluggish human processes being replaced with the faster, more efficient, and more analytically robust machines. Yet the fact is that algorithms are often poor regulators, especially in complicated situations.

O'Reilly asserts that law should regulate in the same way as an algorithm, with a clear goal, data measuring whether the goal is being achieved, and algorithms that use this data to make regulatory adjustments. The problem is that different stakeholders may articulate the goal in very different ways. If more powerful groups are able to shift the goal to their benefit, algorithmic adjustments may change not only the nature of regulation, but also the structure of the underlying system.

YouTube, for example, uses an automated Content ID system to identify when users upload copyrighted material. When this occurs, the system automatically divert ad revenue from the offending video to the original rights holder. However, it recently came to light that music companies had been claiming copyright ownership of works in the public domain. Not only did the system recognize the music company's claim, it also allowed the company to profit off the work of other YouTube users and required those users to invest the time and resources needed to challenge the music industry claim.

In an article for Salon magazine on the YouTube system, technology journalist Andrew Leonard wonders who will regulate the regulating algorithms once humans are removed and replaced by bits of computer code. "The more we take humans out of the picture," he writes, "the harder it will be for real people to fight the power." Thinking cybernetically, we might say the more we take people out of the picture, the harder it will be for the system to reach homeostasis in a way that balances property claims with those of free expression.

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It is tempting to think that the flood of data being generated by the Internet Things will generate more forms of algorithmic governance. And it probably will. Project Cybersyn, however, suggests ways that we might move away from this technological determinism and begin exploring the alternative forms that algorithmic regulation might take. In this talk I have argued that five considerations should receive greater weight in these discussions.

First, we should recognize that the state plays an important role in making sure technologies and technology design processes reflect goals other that speed, profit, and efficiency. Indeed the state is uniquely positioned to make certain technologies protect

and reflect the interests of marginalized and vulnerable groups.

Second, we should question the belief that data collection and data storage are cheap, be more thoughtful about data economy, and consider how we might extend the life of older technologies.

Third, we need to put privacy at the front end of technological design and regularly ask "what data do we need" instead of "what data can we collect?"

Fourth, we must develop ways to bring those affected by algorithmic regulation into conversations of how regulatory algorithms operate and, when possible, provide mechanisms for public participation. This may not be possible in all instances of algorithmic regulating, but it should be mandatory in areas that affect the civil rights of vulnerable groups. While those in favor of algorithmic regulation often use phrases such as consensus and transparency, the reality is that technical experts often overlook asking for input from members of non-technical communities (and this, too, is a lesson from Project Cybersyn.)

Finally, we should be designing ways to keep humans in the loop rather than designing ways to automate them out of the system. We know that humans are still the best equipped to respond to and regulate human behavior and to understand what is at stake when the algorithms get it wrong. We also know that algorithms left untended are vulnerable to the interests of those who have the resources to understand and shape their operation.

Of course, people are also subject to the whims of powerful interests. I don't mean to suggest otherwise. However, there is something about technical infrastructure that is different. It endures. As historians of technology say: it has momentum. And this should make us wary.

The good news is that we have another infrastructure: law. This infrastructure has developed over time through the democratic process. Instead trying to make law behave more like an algorithm, perhaps we should be theorizing ways to make our algorithms function more like law. This means we would need to not only think of algorithms as regulators, but also pay attention to the *process* of their development and adoption. We also need to develop *organizational infrastructures* that can oversee and ensure that computational forms of regulation do not impinge upon civil rights and civil liberties.

Cybernetic scholarship, in particular certain lines of cybernetic scholarship such as that of Stafford Beer, has been centrally concerned with how to make regulators more democratic. This talk, I hope, is a provocation to continue this line of research and to bring these cybernetic and political insights into discussions of Big Data, the Internet of Things, and algorithmic regulation.

From desruption to reparation

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The theme of 'from desruption to reparation' calls on us to be aware that things are always changing – in more or less dramatic or catastrophic ways – and that entropy is a fact of life as it is a fact of physics. We see it in the panarchy cycle which goes from growth to consolidation to collapse to reorganization in nature as well as in human affairs. The situation in Chile that we reflect upon this week has been analyzed by many but is at a minimum a reminder that local islands of stability and growth can be overwhelmed by external forces.

Many times, when we think of repair after disruption, we think of response to natural disaster where a combination of local self-organization and external help leads to recovery. Hurricane Katrina was a good example of that combination and of the role self-organization played as described by Rebecca Solnit in her book "A Paradise Built in Hell: the extraordinary communities that arise in disaster." (Solnit, 2009) Political disaster is a different story because recovery time is usually much longer because there have been tensions and fractures in society. Recovery after political disruption must cope with restructured institutions and communities. The external environment will not have stood still but developed in such a way that a return to previous plans and practices is not realistic.

We had an example in the aftermath of World War II. Much of Continental Europe had suffered loss of life, property and infrastructure. What could be replaced was often rebuilt according to better technology and peacetime uses were found for many wartime inventions. Both physical and social inventions had been developed and were applied with differing emphasis and enthusiasm. But the social inventions had less sticking power and were often put aside as soon as they were no longer seen as necessary.

I had the great privilege of being Stafford Beer's partner and colleague for twenty one years. He had been one of the young men who came back eager to apply the knowledge of Operational Researchhe gained as a soldier in WWII to peacetime activities.He began this work in the British steel industry. Through publications and friendships with people such as Grey Walter and Ross Ashby in Britain and Warren McCulloch and Norbert Wiener in the United States he became aware of cybernetics and its strong neurophysiological connections. These became the basis for his research culminating in the Viable System Model and Team Syntegrity process..

One of the things he found most frustrating was that the benefits of interdisciplinary collaboration that occurred in the war effort under the rubric of operational research and later cybernetics and systems thinking were carried through into peacetime in such a limited way. The War was a situation where the whole country understood the risks and

was committed to success. In peacetime, that unity of purpose was hard to come by. Such unity was recalled in the promise exemplified in the Allende government's initiation of Project Cybersyn and the team assembled to carry it out.

World War II was not, of course, the beginning of cybernetics and systems thinking. The idea of feedback-controlled purposive systems goes back thousands of years to the float valves that farmers used to keeptheir ponds from either flooding or drying up. The nineteenth century saw the introduction of the Watt Steam Governor that regulated engine speed that is featured on the poster for this Conference. In the early twentieth century Walter Cannon (Cannon, 1932) and Ludwig von Bertalanffy (1968) extended the thinking into medicine and biology. However, it was solving problems in WWII that led to the development of machinery such as feedback controlled anti-aircraft artillery and the wider use of operational research that brought interdisciplinary thinking into public prominence.

Ashby's Law of Requisite Variety (Ashby, 1952) was especially influential. If cybernetics involves the regulation of complex probabilistic systems, then the regulatory model must be able to marshal at least as much variety as the system to be regulated. Stafford began to see the human nervous system as a time tested and evolved means of regulating the interacting processes in the human body and extended its structure to be used as a template for diagnosing and designing management functions in human organizations. The Viable System Model – of which you will hear more about during this Conference – was the result.

While peacetime OR was welcomed when the problems it addressed were logistical or production oriented, that welcome cooled as soon as its sights were turned on executive decision making and the status quo. The benefit to the whole took second place to the (often short-term) benefit to owners and shareholders and interdisciplinary collaboration was too often replaced by internal turf battles.

Stafford became an advocate of these new methods and later a critic of those governance structures that took little notice of the opportunities and risks inherent in the post-war technical and political developments. His concernsabout the effects of automation and the threats to privacy – to name two- echoed those of others. Norbert Wiener's arguments in "The Human Use of Human Beings" (Wiener,1954) are relevant today. Ashby, Von Foerster and most of the other first generation pioneers also engaged with the larger social issues of the day from the perspective of applied epistemology and of their own specific areas of research.

When the invitation came to come to Chile and help the new Allende government to manage the state-run economy according to these principles, he accepted with great enthusiasm. Stafford had just written "Brain of the Firm", the first of his books on the Viable System Model, and brought the manuscript with him when he went to Chile.

The Viable System Model is a powerful tool for exploring and understanding the governance of an organization by looking its management functions and their appropriate

and evolving balances. They include:the between the operation and its environments; the focus on the present and on the future; horizontal autonomy and vertical authority; and between the system and the meta-system. As the VSM will be discussed in more detail later in the Conference, I would like to concentrate on its context.

It is crucially important when building any organizational model to begin by questioning basic assumptions. Answers to questions such as 'what are our environments?', 'whom do we serve?', 'what business are we in?', and in what formal and informal structures and networks are our activities embedded?' should be asked and it is difficult to do so unless a formal procedure is used. This helps to identify some of the corners we might want to 'see around' as they are unlikely to escape our notice otherwise.

We might start by looking at the contractual and contextual environments of the system and trying out several scenarios and their likely effects. Any system has the potential to be buffeted by changes in its natural, social, technical, economic or political environment as well as by changes in leadership or philosophy.

A next step is to look closely at our System One activities. How many ways can distinctions be made among them? Many will be irrelevant but at least three should be explored. It is probable that the chain of recursion levels will be somewhat different for each. That is another crucial exploration. It is a good idea to at least sketch them out as far as they might usefully go.For example, Schwember(Schwember, 1977)identified eleven different levels in the Cybersyn project.

The basic journalistic questions: who, what, when, where and why are a good start. A technique called the four whys is a good way to confirm your assumptions. It asks 'why' four times to get a look at – and perhaps change – the framework under study.

When the choice is made as to the 'system-in-focus', it is customary to model one level of recursion up and one down for the sake of consistency and to see where local autonomy can prevail and where decisions need to be taken at a more comprehensive level.

The next stage is to populate the model with specifics: the products produced or services rendered and the main probes exploring the future. Among those that can be identified will be some that can produce consistent time series that are appropriate to name as indices to be measured and monitored in real (or bogus real) time. Most of the variables will be comparable to those that are usually measured – the difference being one of measurement frequency. Statistical filters are then applied to tell if any new value is one that is unexpected and may represent incipient instability.

Eight or tenindices are typically chosen to be reported up the line for each level of recursion although sometimes people want to add indices for use at their own level. This is compatible with George Miller's 'Magic number seven – plus or minus two' (Miller, 1956)that described the number of independent distinctions in a variable most people could perceive.

These indices came together in an operations room that was designed to bring a wide range of information together in one place for decision-making. In today's operations rooms, some of the information comes from the indices but there are also likely to be computer graphics or video, graphs, charts and perhaps physical models of the products involved. Photographs of the room designed for the Allende government were published on the inside of the dustcover of Platform for Change (Beer, 1975). Modern versions of the operations room have been designed and delivered by Malik Management in Switzerland. Their offerings include other cybernetic tools but the Viable System Model, the Operations Room and the Team Syntegrity process are central to their business.

Technological measurement capabilities have increased markedly since the 1970's since Cybersyn operated with one main frame computer fed by telex machines. Now, computers, 'smart' materials and 'the internet of things' record the information although it is an open question whether they add more wisdom to deliberations.

Real time measures have become easy to install and have become commonplace. However, some of the purposes for which they are used have become controversial. Traffic light synchronization is generally accepted as a good thing while the customer load measures that facilitate just-in-time staffing and zero hours contracts are problematic. Retail competition that encourages employers to pare employee hours down to the last fifteen minutes amplifies savings on wages while attenuating worker purchasing power and educational mobility. Even the thinking that introduced just-in-time parts and materials delivery has not been without cost – mainly to the air pollution and other effects of increased traffic.

But, the capacity to engage in real time measures has lagged with respect to whether or not they cover sufficient variety. Unlike the Cybersyn design, they are not situated within a holistic model nor are they likely to go beyond one or two recursions. This makes it difficult to detect incipient instability. Indeed, the recent record suggests that actual instability is often ignored until the effects become catastrophic – either in terns of physical damage or damage to reputation.

The need for real-time integrated monitoring across a wide variety of applications is very real. Recently Alanna Mitchel, a Toronto science journalist, wrote a book called "Seasick" (Mitchell,2009). She visited a number of individual scientists and research facilities in ocean science to pull together a comprehensive picture of the threats. This broader picture showed a more serious level of threat than was visible from the perspective of any of the single investigations. It was shocking to many of the scientists because they had not seen the implications of their interacting variables and their additive affects.

The potential for real time measures is huge in many areas that are usually the province of governments. Environmental factors, intra and interstate conflicts, public health and epidemic tracking, structural employment trends, the impact of tax policies and many others do give early indications that something is going wrong. But, under present

circumstances it takes time before the information registers and more time while the will and the resources are assembled to take action. To take a current example, the very first cases of Ebola to be identified late in 2013 should have triggered an algedonic signal that would have had teams on their way within a matter of days if not hours. Having teams ready to go in an emergency is how fire departments have been organized for a very long time. Sometimes these initiatives are less about seeing around corners than about simply looking ahead.

Part of the Cybersyn work was the effort to design a measure of public sentiment in general that could also be applied to particular situations. The algedonic meter was a simple analogue device to measure the general sense of well-being. It could be used to measure satisfaction levels among the public or could be installed factories so that the management had an ongoing (and anonymous) sense of how people on the shop floor were feeling. A sample of the public might be asked to turn a dial from orange to blue to answer a question like 'how are things going?'. The interviewer could then report or ask basic demographic questions to be able to analyze differences in satisfaction based on age, gender, location or other characteristics. In the case of a factory, workers could adjust a common dial and their input could be aggregated. The managers would know the reading and the workers would know that they knew.

The other problem area where Stafford Beer's cybernetic thinking was applied was the question of how to access the multiple perspectives of stakeholders and tap the knowledge held by the whole group. Although work was begun on this aspect – and partially written up in an unpublished manuscript – the design was not piloted for another twenty years.

Hierarchy had demonstrated limitations, such as loss of information and low morale in complex situations and was, in any case, not consistent with democratic ideals. Even in the public sphere where there is no formal hierarchy, many remain unconvinced that engaging multiple perspectives is of value. One of our mayoral candidates in Toronto has actually been criticized for being willing to consult with members of City Council and the public. Apparently 'strong leadership' is what is needed – never mind that with one vote on a forty five member Council, a mayor that attempts to move without consultation generates resistance and gridlock.

Proceeding by consultation and consensus also had limitations in that it could be inefficient and/or consume a great deal of time if more than a few people were involved. Various group processes have been used successfully to engage multiple stakeholders in a formal and time constrained process– most often in land use or urban design. But, there is substantial misunderstanding about the role of public participation. The most effective designs have engaged both design professionals and representatives of the user community. Yet some think that this represents a case of 'designers getting the public to do their jobs'. They don't seem to realize that their position is akin to ordering a house from an architect with only the site and budget supplied.

Stafford had been exploring the work of Alex Bavelas with respect to centrality and peripherality of social networks.(Beer, 1994)Early versions of what became the Team Syntegrity design were part of this effort. Stafford defined an'infoset' as a group of people who share information about and engagement with a possible outcome. An infoset should contain a good representation of the perspectives on the situation – whether it was an organization, a community or even a loose group of individuals committed to a particular cause or project. These people would gather together for several days to share their ideas and come to, if not agreement, at least understanding of where others were coming from. It could at best yield a way forward that satisfied almost everyone's priorities and at worst, at least lower the likelihood of surprise.

Team Syntegrity addressed the questions of centrality vs. peripherality and constraining hierarchy by using a three dimensional geometric solid – the icosahedron – as a framework. It has twelve vertices, and any question worthy of substantial attention should have at least a dozen aspects to explore. The agenda or the topics of the meeting – are arrived at beginning with individual statements that are discussed in small fluid groups and gradually selected and combined until they are reduced to twelve.

Participants are mapped onto the thirty edges of the figure, each with a unique and equivalent position connecting two vertices. A well-selected group of thirty people is large enough to represent a wide range of perspectives yet small enough for people to become acquainted over several days even if they had not known each other before. Each participant/edge will be a member of the two topic teams their strut connects. A group of five team members is small enough for people to keep one another's positions in mind and also for the silence of any member to be noticed. These relations cover the outer skin of the icosahedron.

Yet, further connection was desirable. W. Buckminster Fuller's icosahedral structures used a balance of compression vs. tension. This feature was added to the process by the introduction of the 'critic' role that made connections internal to the icosahedron. Each participant has two critic memberships drawn from a next but one removed team. While the team members discuss their issue, the critics would have a portion of the meeting time to make comments that would point out connections or omissions or comment on the way the process was working.

In a Syntegration, it is common for one or two ideas to come up in several topic teams and reverberate around the structure. Such ideas often lead to insight or to an emerging sense of what is important and why. Syntegrations have been used to address different levels of conflict situations. The most relevant one for me was an event sponsored by the Israeli Palestinian Centre for Research and Information to discuss issues surrounding the West Bank. (Leonard, 1997). The participants included Israelis, Palestinians, subject matter experts and a representative of the funding agency. The groups came up with a number of areas where negotiation and compromise was possible including some where their needs were not, after all, in conflict, Many of the participants had been advising the Oslo Peace Process and hoped to continue in that role. It was not to be. Several weeks

after the event, the Israeli Prime Minister, Yitzhak Rabin, was assassinated by an Israeli zealot. That conflict continues and is farther from resolution now than it was in 1995.

Too often the time and cost of holding a Syntegration, or a Future Search or other group process is an obstacle to resolving conflicts or issues in anything approaching a comprehensive manner. Citizens become understandably frustrated if they are invited to an afternoon's public discourse where the input is fragmented and there is little sense of what, if any, of the recommendations will be acted upon.

However, if such group processes were instituted to repair the civic body after a disruption, natural or political, there would be a better chance of getting it right rather than either rebuilding what wasn't working well in the first place or, worse, in the case of politics, turning the wheel of government sharply in the other direction and excluding a different group of people from the advantages of the society. More usefully, processes such as Syntegration, if employed before the situation reached a crisis point might pick up emerging discontent before it threatened the stability of the whole.

Governments often try to solve problems by passing new laws or writing regulations. It seems unlikely that legislative bodies can adequately consider the ramifications of their changes unless they engage in extensive exploration of questions such as 'who will this affect and how?' 'what are the long term implications of this move?' and, most important, 'how could this go wrong?'. Stafford would often express disappointment that perfectly obvious implications would be ignored and fixed only after much distress.

Instead we hear, often after the fact, that the legislation was drafted by lobbyists or, in the case of Canada, that the government has put everything but the kitchen sink into an Omnibus Bill of hundreds of pages and left it to the courts to fix the errors. Not only does this approach fail to even attempt to look around corners, it actually designs blinders to reinforce partisan tunnel vision.

Stafford often reminded us that 'the purpose of a system is what it does'. Regardless of its stated goals, all of its consequences, intended or not, are part of its purpose. It often seems that a certain amount of collateral damage is seen as the cost of doing the government's or a company's business. Sometimes the type of short term thinking that continues to install a cheaper part years after reports of fatal accidents leads to huge payouts in law suits and a massive hit to reputation as recently happened to General Motors. At other times, subordinates risk their careers if they choose to become whistle blowers when their manager makes it clear that he or she doesn't want to hear it if something has gone wrong.

Debate on the issue of climate change includes a sizable group of deniers who would have to do things differently if they acknowledged strong signals never mind the weak signals that should be enhanced. In the case of people running for office, we hear the 'I'm not a scientist so I can't say' dodge. Of course, legislators are no smarter than anyone else and cannot possibly have the level of expertise to make an informed judgment on most of the matters that come before their committees. That's why they

have expert witnesses and staff. But, when a political process is awash with tens of millions of dollars invested in candidates by special interests, they can't even claim tunnel vision. Perhaps a better image would be that they have been issued blindfolds. Of course, the very wealthy countries or individuals will not be the ones to pay the costs of rising sea levels and heavy storms. Those costs will be downloaded to those least able to accommodate them.

Today we face opportunities and threats in a broader context than that addressed in the Cybersyn project. These are areas where we must point out what is likely to be around those corners. Interestingly, a great deal of cybernetics in academia is now being done in schools of design and architecture as well as business schools and schools of computer science. That is no doubt a good thing as architects are used to thinking in terms of whole packages that will be inhabited by people with different needs.

One threat is the new capacity to monitor one's physical state. Devices can record blood pressure, sugar levels, heart rate, number of steps taken and brainwaves to name just a few. While it might be useful for individuals and their doctors to have some of this information, does the same apply to one's supervisor or insurance company? How far does an individual's right to privacy extend?

What about the health consequences of stress due to lack of control of one's pace of work? When computers monitored typists' numbers of keystrokes, productivity went down because no typist would want the standard to which she or he was to be held to be at the high end of their range. This program was actually designed for military use in emergency situations where it could be important to know whether someone could respond in time to deal with a problem. Its transfer to non-emergency civilian life was intrusive as well as counter-productive. Employers who think they can make more profits if they squeeze every last ounce out of their lower level employees do not inspire loyalty or productivity and, in the larger context, reduce the markets for their own products.

Another current example comes from Britain. The Tory government is proposing to give benefit claimants smart debit cards that could only be used in 'approved' retail outlets to prevent them from buying alcohol, cigarettes or lottery tickets. But, the list of 'approved' outlets is not likely to extend to pound stores, charity shops or farmers markets. The poor will be punished with higher prices as well as humiliating restrictions and, if alcohol or cigarettes are what they want, they will find a way to get them. The United States food stamps program has comparable restrictions in that the stamps can only be used for food despite the fact that people also need hygiene products and other inedibles. The difference is that the US food stamp recipient also has cash from work or government benefit. Presumably the legislators don't ever need or want to use vending machines, make telephone calls from a call box (if they can find one) or buy a coffee from an establishment that doesn't have debit machines.

It is already possible to use meta-data to know a great deal about anyone's habits and activities. Doesn't this level of surveillance diminish the health of both the individual

and society? And, what about machines that talk to each other without human intervention once their programs have been set in motion? Such arrangements have already sent stock markets into free fall to say nothing of the housing crisis and its aftermath.

One of the stories Stafford told was when he was invited to take on a consultancy assignment by a large bank to protect it from unauthorized transactions. He spent a few hours talking to people at the bank and refused the offer.He told them that their system was so riddled with vulnerabilities that it would be impossible to fix them in the context of a consultancy. A few years later a single erroneous keystroke shut down banking services for large segments of the population in Toronto. This was unintentional. Intentional mischief could have caused much more damage and may have done so. If it did happen, it would be unlikely to become public knowledge.

Going forward, from major or minor disruptions to massive or incremental repair, there are lessons to be applied. Paying attention to assumptions, examining initial conditions, looking carefully at feedback loops and the behaviours they reward or sanction and trying to understand the perspectives of all the people involved is a good start. It will give us some tools to look around corners for unintended consequences.

It is possible to use cybernetic concepts to design more human-friendly situations and to bend the arc toward more autonomy and more democracy as was tried in Chile. It is a severe criticism that no country has since seen fit to seize the opportunity that Allende and his team grasped with both hands.

In closing, I am reminded of the Cybersyn exhibit tha Enrique Rivera and Raul Espejo were instrumental in presenting. The overwhelming impression was one of passion to make things work for everyone. We should encourage such feelings and commitment wherever it can be found. I hope this Conference represents a step on that path.

The wicked problems remain wicked: has the craft and science of transforming whole systems moved forward, and how could we do better?

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Summary

Let me start with a familiar problem – an isolated woman in her early 80s living in a fairly prosperous western city. She is suffering multiplehealth conditions, and repeated episodes and crises which take her in and out of hospital. She lacks close friends and family. She is high risk and high cost from the perspective of the state. She is not very happy with her situation, interacting with multiple formal systems none of which really understands her. Even when the elementsof the system work well – for example, the ambulance comes fast when she calls, the net effects of optimised elements are visibly sub-optimal. Better prevention; better care in her own home; more everyday emotional support; better quick responses to minor crises: all of these would make her life better but are difficult for the system to provide.

Drawing on current practical examples of work on systems change in the UK I will talk about how we should theorise, understand and change the systems that surround someone like this, and what this tells about the praxis of systems.

THE THEORETICAL CHALLENGE

The holy grail of half a century has been how to understand the dynamics of systems, how to be able to influence change in them, how to strike a balance between planners' excessive faith in the existence of a tool for everything and its mirror fatalism. Many of the building blocks have moved forward greatly, including the

conceptual armouries of systems thinking; modelling tools; physical systems management; understanding of network dynamics &c. However surprisingly few complex, wicked problems are proving much more tractable than in the past, and there is disappointment about the gap between the intellectual fertility of the field and the failures of use. Here I suggest how we can address the needs of our 82 year old, understanding systems thinking as a praxis that can make sense not just for the state and professionals but also for the individuals and communities involved.

THE PRACTICAL CHALLENGE

To do so I break a systems approach into ten elements, which have a roughly linear order (though some are in practice parallel).

IDENTIFICATION

First, how does a society identity the problems it needs to solve? Civil society and the media play roles here in a constant iteration of claim and argument that turns individual experience into recognised common problems. Social media are increasingly important as social sensors. In the case of the elderly 82 year old the rise of isolation as a recognised problem is a good example, which has moved from being a private to a public concern. But there is also the identification of unsustainable realities – such as the rising costs of eldercare and hospital based systems.

DEFINITION

Second, how do societies turn these into well-formed questions – susceptible to action. That usually means translating them into recognisable forms – economic, social, behavioural, political, legal. In this particular case we can see the convergence of several representations: the problems of ill-health; high cost; unhappiness – requiring a combination of clinical, organisational, technological and mobilisational solutions. The challenge is to make these combinations coherent.

EVIDENCE

Third, how do organisations then decide what to do? In some cases there are available pools of knowledge: there is a huge amount of clinical evidence relevant to 82 years with multiple conditions, and a fair amount of service organisational evidence, collected in programmes like the Cochrane Collaboration, or tools like NHS Evidence. We in the UK are creating networks of 'what works' centres to better orchestrate this knowledge, and have done pilots of what we call 'Health Knowledge Commons' to combine formal clinical knowledge with emergent, and patient generated, knowledge. However there is surprisingly little knowledge at the system level that's useful in this case – most evidence focuses on particular interventions rather than combinations.

EXPERIMENT

Fourth, we then come to the creation of new knowledge to fill these gaps, and the formal organisation of innovation – generating understanding, options, trials, either focused on discrete interventions, on pathways, or on systems, which then require that resources are mobilised, some public, some private, some informal and some formal. So for example in this case the resources include those of the paid professionals, but also important roles for volunteers. There are many modes of experiment, and growing interest in combining formal trials and pilots with faster, more iterative modes of experiment. In this case we have focused on combining pathway innovation with innovation around new linking elements. These include: common assessment tools and language; common triage methods; common protocols on data sharing; common call centres and case tracking. Some external help may be crucial in designing these in collaboration with insiders. There are also new inputs (egsupervolunteers) and new coordination mechanisms.

BOUNDARIES

Fifth, when the system is the unit of innovation, how is it defined, and what are its boundaries? The simple answer is that the boundaries are defined by whoever can have a significant impact on a definable part of the problem. In this case, acute unplanned hospital admissions provide a focus (and a source of measurable targets – how do we reduce these numbers by 50%?). The limits of the system boil down to who can be brought together recognising the problem as their own, or as something they can contribute to. But there will be fuzziness around the edges – particularly when we recognise the roles of family and community

COMMITMENT

Sixth, how do we ensure motivation and will to change, rather than just intellectual acceptance? External pressures help. But intense emotional processes seem decisive in getting local systems to change: visible commitment by system leaders; visible time periods within which results have to be achieved (eg 100 day processes); strong peer pressures; all supported by building up relationships amongst the main players and a sense of mutual personal responsibility.

ALIGNMENT AROUND NEW SYSTEMS MODELS

Seventh, action then moves onto options for change. Some are about alignment – and the use of the new linking tools described above, which help the parts of the system to connect more effectively; some aim at minimum necessary alignment rather than complete alignment; some are about generating new deals andmicro collaborations – with multiple interactions to generate these; someinvolve structural recursion with micro examples of the bigger system (such as the individual case,surrounded by its microsystem of supports).

COMMONS

Eighth, we then find that we are effectively creating a series of new commons- with conscious orchestration of quasi-public goods of data, information, knowledge and

judgement. These draw on the knowledge commons mentioned earlier but combine general and more context specific knowledge. A key insight is that these are likely to be underprovided – with a lack of institutions with the resources, incentives or skills to fulfil these roles (these types of common are also recursive, with links between micro pools and macro, the micro commons being such things as the study circle, the conversation with patient and doctor mirrors the formal knowledge system).

FEEDBACK

Ninth, we build into the changed system a series of new feedback tools. Some of the most important focus on the key outcome changes – targets for reducing unplanned hospital admissions; health outcomes; satisfaction and well-being outcomes. We should only be confident about the changes if they can demonstrate success by these measures. But we can also layer onto these feedback tools to help the system know itself : tracking sentiment, anxiety, commitment in real time for the community to know itself; or using SNA type tools to analyse who is helpful to who across networks of collaboration.

DISTILLATION AND SYNTHESIS

Finally we try to routinize as many of the elements as possible and distil the key process elements into forms which can be adopted elsewhere.

This is a brief description of a work in progress – but an approach that appears successful in achieving quite fast results. But where does this go? I will argue that a glaring gap is the skill set in doing this itself – the lack of enough systems framers andorchestrators with a craft knowledge built up through action. Too often there is a gap between very abstract systems methods and very prosaic everyday needs.

In many fields we need to think of systemic change as a mutual reinforcement of elements – technologies, business models, laws and social movements or

behaviours. A good example from the last generation is the dramatic change in attitudes to waste, that has left us all sharing responsibility for the handling of waste, and with a huge expansion of recycling and EFW. It's possible we may we see a comparable transformation of old age, using new assistive technologies, business models, everyday norms (about responsibilities to parents or neighbours) and professional practices. As in the case of waste these are likely to draw on multiple resources – financial incentive, professional commitment, altruism, and civic duty, but tied together around clear and measurable goals.

But there is little transfer from one field of success to another. So my interest is in how this largely craft knowledge can be improved and spread, recognising that this is likely to be a praxis rather than a purely theoretical knowledge – where some of the knowledge will be tacit, experiential and not easily formalised. There are few more pressing challenges in public administration and policy – but for now not much sign of serious progress.

Requisite Variety, Autopoiesis, and Self-organization

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Abstract

Ashby´s law of requisite variety states that a controller must have at least as much variety (complexity) as the controlled. Maturana and Varela proposed autopoiesis (self-production) to define living systems. Living systems also require to fulfill the law of requisite variety. A measure of autopoiesis has been proposed as the ratio between the complexity of a system and the complexity of its environment. Self-organization can be used as a concept to guide the design of systems towards higher values of autopoiesis, with the potential of making technology more "living", i.e. adaptive and robust.

Complexity

Cybernetics has studied control in systems independently of their substrate (Wiener, 1948). This has allowed to use the same formalisms to describe different phenomena, such as neuronal and electronic circuits, offering the advantage of allowing the transfer of solutions in one domain to another. For example, understanding adaptive behavior in animals can help us build adaptive machines (Walter 1950; 1951).

The cybernetic tradition of studying systems independently of their substrate has propagated into other fields, one of them being the scientific study of complexity. The term *complexity* derives from the Latin *plexus*, which means interwoven. We can say that a complex system is one in which its elements are difficult to separate, as they depend on each other. This dependence is caused by relevant *interactions* (Gershenson, 2013a). Interactions are relevant when they co-determine the future of elements. Thus, it is not possible to describe the future of an element studied in isolation, its interactions have to be taken into account, and that is why they are relevant. Interactions generate novel information which is not specified in initial nor boundary conditions, limiting the predictability of complex systems (Gershenson, 2013b) because of their inherent computational irreducibility (Wolfram, 2002), *i.e.* you can only know the future once you have

been there.

Complex systems are pervasive, as it is more difficult to find isolated phenomena compared to phenomena which interact. It is not that science had not noted the relevance of interactions. We just did not have the proper tools until a few decades ago. It is difficult to describe complex systems in detail with traditional analytic methods, as we have a rather limited number of variables we can fit in a paper or blackboard. The scientific study of complex systems has progressed in parallel with the technological development of electronic computers. This is because computers allow us to study systems with multiple components and their interactions. More recently, data availability has made it possible to contrast different theories of complex systems in all branches of science. In an analogous way to microscopes permitting the study of the microworld and telescopes enabling the exploration of the cosmos, computers are tools which are giving us access to a greater understanding of complexity (Pagels 1989).

A central question in the scientific study of complex systems is related to their control, given their inherent limited predictability (Gershenson, 2007). It is desirable to predict the future of systems and their environment to be able to act before a perturbation occurs which might damage or destroy the system. In such situations, feedforward control is suitable. Still, depending on the predictability of a system, different control approaches are required (Zubillaga et al., 2014). The less predictable a situation is, the more adaptive a system should be, *i.e.* feedback control would be more appropriate. To be able to decide over different control approaches, measures of predictability and complexity are needed.

In the context of telecommunications, Shannon (1948) used Boltzmann's entropy from thermodynamics to define a measure of uncertainty which he called *information*. Intuitively, a message will carry few information if new data is predictable, *i.e.* it is known beforehand with certainty derived from a skewed probability distribution (few states highly probable). A message will have a high information content for homogeneous probability distributions (most states equally probable), because new data cannot be predicted from data already received. Shannon's information can be used to measure emergence, self-organization, and complexity (Fernández *et al*., 2014).

Emergence can be understood as the creation of novel information. For example, interactions between atoms of hydrogen and oxygen generate novel properties in a molecule of water. Interactions between molecules of water generate novel properties such as wetness, temperature, and pressure. The properties at a higher scale are not present in the elements at the lower scale, so we can say that the properties emerge from the interactions between elements. In other words, emergence occurs when interactions generate novel information. Shannon's information can be used precisely to measure this novel information, and thus emergence. Maximum emergence will occur with maximum information, *i.e.* minimum predictability, while minimum emergence will occur with minimum

information, *i.e.* maximum predictability.

Self-organization occurs when interactions between elements of a system produce a global pattern or behavior, as in the stripes of a zebra of a flock of birds. There is no central or external control, but local interactions between elements lead to global regularities. Maximum organization is achieved with maximum regularities. Thus, self-organization can be seen as the inverse of entropy, and thus information and emergence. Self-organization will be high when emergence is low and vice versa. A maximum self-organization occurs with minimum information, *i.e.* maximum predictability, while minimum self-organization occurs with a maximum information, *i.e.* minimum predictability.

Complexity requires both emergence and self-organization. Following López-Ruiz *et al*., (1995), we can define complexity as the multiplication between emergence and self-organization. Thus, complexity will be minimal when emergence (chaos) or self-organization (order) are extreme, and complexity will be high when there is a balance between emergence and self-organization. Control of systems with a high complexity will benefit from having both prediction and adaptation. For a formal derivation of these measures of emergence, self-organization, and complexity, please refer to Fernández *et al*. (2014).

Requisite variety

Ashby's *law of requisite variety* states that an active controller must contain as much variety as the phenomenon it attempts to control (1956). This is because if the controlled has, say, ten states, the controller must be able to have enough variety to respond appropriately for each of those ten states. For example, if an industrial robot should be able to install four different types of screws, it requires enough variety to discriminate at least four different situations and act accordingly to each of them. If we now require the robot to manage two new types of screw, it will require a greater variety to consider six different situations than the one required in the four screw scenario.

Bar-Yam (2004) noticed that variety can be seen as a synonym of complexity, which had not been defined in its current usage when Ashby proposed his law. This law can be generalized to a *law of requisite complexity*: an efficient active controller will require at least the same complexity as the complexity of the controlled. In other words, a controller for a complex system requires to be at least as complex as the system it attempts to control. In practice, this requires a balance between predictability and adaptability of the controller (Gershenson, 2013b) to face both the emergence and self-organization of the controlled.

Living systems can be described as control systems. Thus, the law of requisite variety also is found in life, as organisms have to match the complexity of their environment at different scales.

Autopoiesis

Maturana and Varela (1980) coined the concept of *autopoiesis* to define living systems. Autopoiesis means self-producing, so it is related to autonomy (Ruiz-Mirazo and Moreno, 2004). Even when the original concept focussed on the emergence of biological systems from chemical components, the use of autopoiesis has been generalized to other domains, such as sociology (Luhman, 1986).

A measure of autopoiesis has been proposed recently (Fernández, *et al*., 2014), taking inspiration from the law of requisite variety and the concept of "life ratio" (Gershenson, 2012a). Autopoiesis can be defined as the ratio between the complexity of a system and the complexity of its environment. If autopoiesis is less than one, it implies that the environment has a higher complexity than the system, thus dominates its dynamics. If autopoiesis is greater than one, it means that the system has a greater complexity than its environment, *i.e.* it fulfills the law of requisite complexity. An autopoiesis greater than one also implies a higher degree of autonomy of the system. Notice that autonomy is gradual: having a certain autopoiesis does not mean that a system is independent of its environment. This suggests that life is also a gradual property: the transition from non-living to living is smooth (Gershenson, 2012a). Moreover, the concept of life can be generalized to domains other than biology as well (Langton, 1997; Aguilar, *et al*., 2014). In this view, we can build systems with the features of the living (Bedau, *et al*., 2009; 2013). But how to do it?

Guided self-organization

We can use self-organization to guide the dynamics of complex systems (Prokopenko, 2009; Ay *et al*., 2012; Polani *et al*., 2013; Prokopenko, 2014; Prokopenko and Gershenson, 2014). It was already mentioned that self-organization consists of an internal increase in order of a system. Since most systems have certain emergence (entropy) for free (thermodynamics), self-organization can be used guide systems towards a higher complexity (Gershenson, 2012b), and thus autopoiesis and variety.

Guided self-organization can be understood as the steering of the self-organizing dynamics of a system toward a desired configuration. We can assume that environmental variety (emergence) is given for free, because of the second law of thermodynamics. Therefore, we can focus on applying self-organization to match the particular (required) variety to control the environment. Few emergence will require few self-organization, as there will be few variety. High emergence will demand a high self-organization to match the high variety.
One approach for designing and controlling self-organizing systems consists on minimizing friction (negative interactions) and maximizing synergy (positive interactions) (Gershenson, 2007) through the implementation of *mediators*. These mediators must match the required complexity of the environment to be

able to cope with the variety of different possible interactions and states which might occur. Moreover, this has to be done at multiple scales (Gershenson, 2011), as complexity is dependent on scale (Bar-Yam, 2004).

An example where these ideas have been applied is in the coordination of traffic lights (Zubillaga *et al*., 2014). Comparing a self-organizing method (Gershenson, 2005) with a traditional non-adaptive method, we have shown that the self-organizing method is close to a theoretical optimal performance for all densities (Gershenson and Rosenblueth, 2012). This is achieved because the controller (traffic lights) manages to adjust its complexity to the complexity of its environment (vehicles), leading to an autopoiesis greater than one for almost all densities. The densities where autopoiesis is less than one is precisely where the performance is farther from the optimum.

A similar approach can be generalized to other domains (Gershenson, 2007), such ascognitive systems (Haken and Portugali, 2015) or urbanism (Gershenson, 2013c). Most urban systems are complex because of their interactions and thus generate novel information (emergence) at different temporal and spatial scales. This limits their predictability, while urban problems change in time, *i.e.* they are non-stationary. Self-organizing urban systems can adjust their complexity to match the variety of the urban problems as they change in time, thus maintaining an autopoiesis greater than one, as it occurs with traffic lights. In this sense, we can speak about cities becoming more living (Gershenson, 2013c).

Discussion

The approach presented so far can also be used to describe and understand the evolution of complexity (Gershenson and Lenaerts, 2008). If we assume random variations in information, some information will be able to propagate better. This implies that information able to cope with the complexity of its environment will have a higher probability of persistence, leading to the natural selection of more complex information. Since this information will be part of the environment of other systems, this will push other systems towards an increase in their complexity as well. In this sense, complexity and life as understood here is to be expected in evolution with very few assumptions considered (Gershenson, 2012a).

Life as a systemic property, more general than the original concept of autopoiesis (Froese and Stewart, 2010). It might be useful to use a more abstract conception of life because it allows us to study the properties of living systems beyond biology. Since it is desirable to have these properties to face the complexity around us, from a pragmatic perspective we can say that such a description can be useful.

Conclusions

Systems will be viable if their complexity (variety) is higher than the complexity of

their environment. This is also true for living systems. Thus, we can define a measure of autopoiesis as the ratio between the complexity of a system and the complexity of its environment. To achieve higher complexities, self-organization can be used to guide the properties and dynamics of systems towards a balance to match the emergence imposed by the environment.

Such a general formulation can be rather abstract, but is useful to direct efforts to design and control complex systems. Its benefits have been already shown for urban systems. There is a potential to be explored in other domains, where artificial systems can be designed to be more like living systems.

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Autopoiesis

Darío Rodríguez

Autopoiesis is a concept coined by the Chilean biologists Humberto Maturana and Francisco Varela to describe living systems as autonomous unities characterized as closed networks of processes of production of components that, through their interactions, compose the network of production of components which produces them, specifying their unity by defining their boundaries. Given that the components of living systems are molecules, "living systems are molecular autopoietic systems that exist in the molecular space as closed networks of molecular productions that specify their own limits" (Maturana 1975).

The philosophical and scientific background of this concept can be found in self-reference, a classic concept formerly attributed to human consciousness that was generalized afterwards to account for every kind of object (i.e. actions, sets, systems, sentences) which directly referred to its own constitutive operations. A further step was self-organisation, a concept designed to describe recursive self-reference operations which build and change structures, such as recursive operations that generate dynamic stability (Foerster 1990). Autopoiesis means an advance in the same direction by characterizing self-reference operating systems that produce themselves through producing their own components.

Maturana and Varela proposed autopoiesis as the defining feature of living beings. Autopoiesis was developed as an answer to biology's fundamental question: What is life? Or what are the necessary criteria to distinguish something as a living being? Different criteria have been elaborated along the history of biology to cope with this important problem. Some scientists suggested looking at the chemical composition of living and non living objects, others indicated the capacity to move as the distinctive characteristic of living systems, others maintained that reproduction was the principal difference between living beings and inert objects, and still others made a list of properties which could not be absent in any living system. Nevertheless, according to Maturana, all these criteria were not conclusive, because it was practically impossible to know for sure whether the list was complete, and it is highly probable that in the near future machines will be constructed, which will be able to reproduce i.e. to produce similar machines made out of steel and plastic, not out of organic molecules. After these considerations, Maturana and Varela concluded that the only way to discern if a certain object can be classified as a living being is to observe whether it is capable or not of continually producing itself. In more specific terms, the molecular components of an autopoietic unity must be dynamically interrelated in a continuous interaction network, whose chemical transformations are called cellular metabolism. The autopoietic peculiarity of this cellular dynamic is that it produces components, every one of which becomes part of the same transformation network that produced it, and some of them additionally make up the border of this transformation network. Both the dynamic transformation network that produces its own components and its border are each other's conditions of possibility. In other words, the transformation network that produces its components is a necessary condition of the boundary that separates it from its environment, and the frontier is also a necessary condition for the transformation network to operate. The relationship between these two processes is therefore not a

sequential, but simultaneous one. They are just two aspects of a unitary phenomenon. The most particular characteristic of an autopoietic system is that it emerges as a distinct unity through its own dynamic of self-production (Maturana and Varela 1984: 24-28).

Niklas Luhmann abstracted the concept from living systems, i.e. from life, defining autopoiesis as a general form of system building based on self- referential closure. After this abstract formulation, it is possible to distinguish living systems (cells, nervous systems, organisms, etc), psychic systems and social systems (societies, organisations, interactions) as different kinds of autopoietic systems. According to this abstract approach, life and meaning represent different ways of system building through autopoietic self-referential closure, and both psychic and social systems are meaning-based autopoietic systems (Luhmann 1985).

Dirk Baecker argues that from its very beginning sociology has regarded the nature of society as a self-organised and even an "autopoietical" process, i.e. long before this notion was introduced by Maturana and Varela as an explanation of life, because its concepts have always corresponded to an operational understanding of society (Baecker 2007).

As long as social systems were understood as self-organising systems, the theoretical problem was to describe the specific conditions which made probable either the repetition of a similar action or the expectation of the repetition of a similar experience. Understanding social systems as autopoietic systems changes the fundamental theoretical problem to one of explaining the system's capacity to bond one element to the next element. Social system's structures must make probable the connection capacity of the autopoietic reproduction of elements in order to make the system's existence possible, and this condition delimits the realm of the system's possible structural changes (Luhmann 1984: 62).

Luhmann conceives social systems as autopoietic communication systems. An autopoietic communication system is recursively circular and its primary units refer to other units within the same system. Social systems consist of communications which can be analytically broken down into a synthesis of three selections: the selection of a piece of information, the selection of an utterance and the selection of an understanding. Nevertheless, these three selections do not exist independently outside of this framework, because their selectivity and field of selection are generated through communication. There is no piece of information outside of communication, there can be no utterance outside of communication, and no understanding exists outside of communication. The elemental unit of a system cannot be broken down any further by the system, and it does not need to be in order to operate. Autopoietic social systems emerge by producing and connecting their communications. Social systems process communications by imprinting form into the medium of meaning that allows for further connections between them. Autopoietic systems generate their own emergence, and social systems do so by producing meaning. Meaning is a product of the operations that use it and not a pre-existing quality of the world (Luhmann 1997: 44). Communications, the elemental units of a social system, are also set up by the same system. This does not mean that there cannot be communications outside a certain social system. Society is the only one social system outside of which no communications exist, but both in the environment of interactions and in the environment of organisations there are other organisations and interactions which, as social systems, also consist of communications.

This fact however does not deny that every one of those social systems operationally closed produces its own communications, and does not pick them up from its environment. The elements that constitute a social system as a self-referent production system are made up at the system's emergence level (Luhmann 1984: 168).

Autopoiesis is an ongoing recursive production of elements through the production net they constitute. A social system's autopoiesis requires constructing its unity as a self-referent circle. The basic elements of a social system are events which disappear as soon as they appear, and the system's operative dynamic continues producing events to replace previous events and to be replaced by the next events to appear. Communications are transient events that give place and bond to the coming communications. Even though social systems are made up of unstable elements, they continue to exist through permanently producing and bonding elements. In his way, social systems are temporal, complex systems whose element's disintegration gives place to new elements, making them necessary too. At the elemental level there can be no causal circularity because being ephemeral these elements disappear before any possible feedback. In the system, elements present the irreversibility of time. A system composed of transient irreversible elements must set up recursive relationships to make the reciprocal fit of elements possible. These recursive relationships can be set up through meaning. The ongoing elements' replacement takes place within meaning. From a phenomenological standpoint, meaning appears as a surplus of references to other action and experience possibilities. It focuses on something alluding to something else as a horizon of other possible connections to keep on acting and experiencing. Meaning bonds communications to each other, making it possible to remember past communications and to refer present communications both to the past and to the future. Both past and future are available in the present as horizons, and each communication can be oriented to a memory, to a foresight and also to a predicted memory, i.e. in a circular way (Luhmann 1984: 609). Social boundaries are meaning limits that make a divide between those communications that are recognized as belonging to the system, i.e. contributing to its autopoiesis, and those communications that do not belong to it and must remain outside it. Meaning boundaries operationally close the social system constituting it as a self-referent circle that can internally operate with the difference between system and environment. Autopoiesis involves the operational closure of the system and its structural coupling to its environment (Maturana and Varela 1984: 59). Both operational closure and structural coupling require a clearly defined boundary line between the system and its environment. Operational closure implies that every component of a social system is a product of the operation of the same social system and cannot be produced anywhere outside it, and imported into it. Structural coupling is a dynamic structural relationship between an autopoietic system and its environment, in which the system maintains its own identity and its adaptation to its environment as well.

Social systems are operationally closed, but they can communicate about their environment, and in so doing, they distinguish between self-reference and hetero-reference, both being attributions made inside the social system. In the course of a conversation, for instance, some sentences, such as "It's a sunny day" or "People say…" can refer to the environment, while other, such as "We have done a good job" or "This conversation makes things clear" refer to the same system that produces them. Self-reference bases itself on this distinction between self-reference and hetero-reference; in this way the system differentiates itself from its environment while maintaining both its

structural coupling and its operational closure. Using self-reference, a social system can observe itself by drawing a difference between itself and everything else.

Social systems are structurally coupled to psychic systems maintaining the limits that clearly separate their operations. Psychic systems are autopoietic thought systems whose operational closure means that there can be no thoughts beyond the boundaries of a certain consciousness. Thoughts are thought in the self-referential closure of psychic systems, and communications are communicated in the self-referential closure of social systems. No thought is imported as such into the operationally closed network of communications that constitute social systems. No communication is imported as such into the recursively closed operation of a psychic system. The structural coupling between psychic and social systems means that these coupled systems trigger each other, and react to each other's provocations through their own respective operation modes, which being operationally closed never intersect. "Only the mind is capable of perception (including the perception of communication). Perceptions remain locked in the activated mind and cannot be communicated. Reports about perceptions are possible, and, in this way, perceptions can stimulate communication without ever becoming communication, and can suggest the choice of one theme or another" (Luhmann 2002: 177).

Language makes the structural coupling between psychic and social systems possible because it functions without being particularly noticed. Given that psychic systems unthinkingly use language and social systems make use of it without comments, thoughts and communications can rapidly proceed. Although people on occasion meticulously select the words to precisely express their feelings and social systems can communicate about the words which have been said if, for example, a comprehension problem arises or to agree the terms of a contract, these are exceptional circumstances that nevertheless also continue to use language without thinking or commenting too much about it (Luhmann 1997: 110). Communication would be very slow if psychic systems had to carefully choose every word they needed to speak and had to work hard to understand the words they heard or if social systems commented on any sentence they communicated.

Language constitutes a medium whose loose-coupled words can be bound in tight-coupled forms, i. e. sentences, which do not exhaust the medium, but revitalize it by using it instead. Sentences can be referred to in the recursive network of linguistic communication, they can be more or less anticipated, and their meaning can be remembered: through coupling/uncoupling the word stock, sentences carry on the autopoiesis of the social system. They build an emergent level of the communicative constitution of meaning, and this emergence is the autopoiesis of linguistic communication which produces its own medium {Luhmann, 1997 #18: 220}.

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Key-note Speech

Future energy system development depends on past learning opportunities

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Abstract
Learning curves measure how cumulative production and use of a technology reduces cost and improves performance. Examples illustrate that learning curves pervade all levels of industry and economy and also characterised production before the industrial revolution of the 19th century. For energy policy, learning curves suggest deployment programmes to buy down the cost of presently too-expensive environment-friendly technologies. Such programmes have been successfully applied to solar PV and wind technologies. However, the legitimate role of the learning curves in a low-carbon strategy depends on the validity of extrapolations and forecasts of the curves. Understanding the mechanisms behind the curves could support a pro-active, efficient energy technology policy that leads around the present, incessant discussions on CO2-emission reductions and burden sharing. Mainstream economics provides no explanation of the stability and pervasiveness of the learning phenomenon and reduces learning curves to stochastic alignment of well-known features, events and processes (FEPs) such as R&D, economies of scale, spill-over, changing input shares. However, in cybernetic analysis a completely different picture emerges, indicating that the learning curves express fundamental and stable properties of the learning system and making them reliable policy tools. Based on the work of von Förster, Maturana and Varela, the learning system is analysed as an operationally closed non-trivial machine. The eigenvalues for the learning system explain the distribution of measured learning rates for a very broad spectrum of technologies, including energy technologies. The unperturbed system is in a non-equilibrium steady state. Applying Prigogine's theorem of minimum entropy production to this state and assuming that this production is constant in the eigentime of the system provide the learning curve. The conclusion is that by following basic laws of second order cybernetics and of non-equilibrium thermodynamics the learning system self-organises its learning to follow the optimal path described by the learning curve. The self-organisation includes the use of FEPs as natural elements in the learning loops, but the system learns as a whole. Second order cybernetics does not favour *ceteris paribus* arguments.

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Future energy system development depends on past learning opportunities

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1. The pervasive Learning Curve

I would like to start on the local level with a very personal note.

My apartment is on the top floor of an eight store co-op with eight entrances. The house is almost fifty years old. One day I found in my mail box a message from the Board of the Co-op telling me that all elevators have to be exchanged for more modern ones. Each entrance has one elevator and the work would be done by one team moving from one entrance to another. Each exchange would last three weeks during which time there would be no elevator service for that entrance.

First I despaired! I foresaw a major crisis after two weeks when my stocks of fresh food would run low.

Then I started to reflect. Once the team started their work, they would have *operational closure,* i.e., they would be the masters of all their operations. In the formulation of Maturana and Varela (1992, p. 89), their identity would be "specified by a network of dynamic processes whose effects do not leave that network". Following the cybernetic approach to learning curves their expected learning rate would be 20% (Wene, 2007) and from the team's point-of-view the job is unique. This meant that the time for exchange would be reduced by 20% every time they doubled the number of accomplished elevator exchanges. The three weeks of no elevator service would then *only* apply to the first entrance and the first elevator exchange! My entrance was number 4, which represented 2 doublings. Assuming 5 workdays in each week, the out-of-service time for me would then be

$$15 * (1 - 0.2)^2 = 9.6 \text{ workdays}$$

On the evening of the ninth day of climbing stairs I went to elevator and bravely pushed the button. There was a slight hesitation, a slight purr and then the door to the new elevator opened. The learning curve had asserted itself – quite consistent with the predictions of the cybernetic approach.

My elevator experience has anecdotal value, but it illustrates some serious questions about the application of the learning curve to different systems and technologies, about the benefits of the learning curve and how this benefits can be asserted and put to use, and of course who is to gain. I as a consumer certainly benefitted from the elevator exchange learning curve, and I hope a competitive contracting procedure ensured a fair sharing of economic benefits between co-op and supplier.

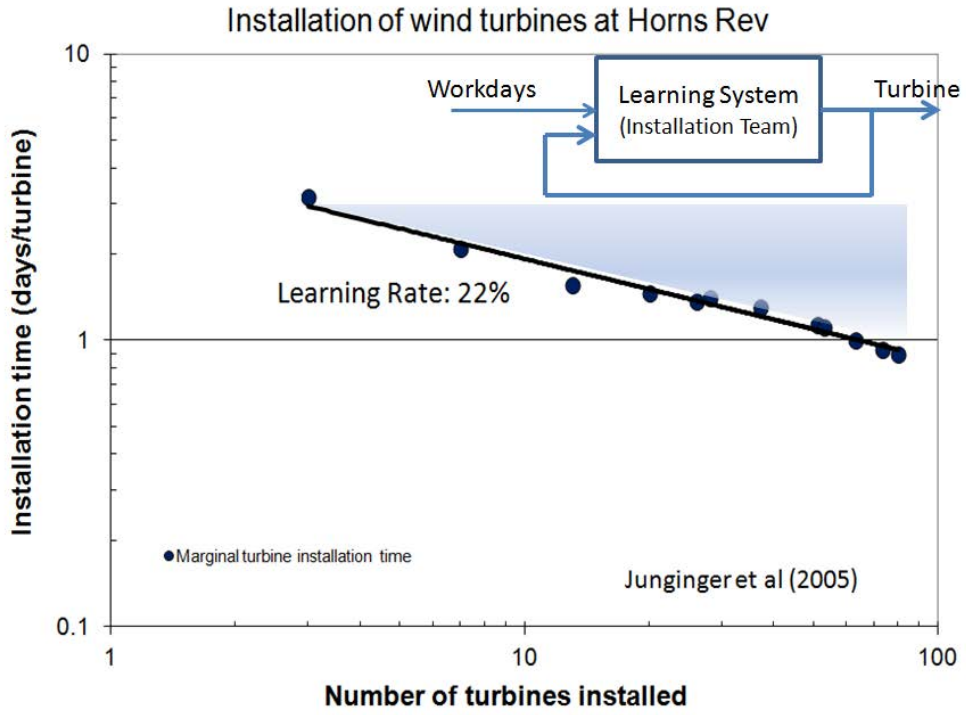

Figure 1. Installation of wind turbines at Horns Rev, Denmark (Junginger et al, 2005)

Figure 1 shows a documented case study expressing the same learning phenomenon following the same logarithmic logic as the elevator exchange. The learning system is in this case a team installing off-shore wind turbines outside Denmark. The learning rate is 22% in fair agreement with the cybernetic prediction (notice that the diagram is double-logarithmic). The lightly shaded area indicates the benefits of the learning which in this case reduces the total workdays by 2/3! The learning curve has the deviously simple form

$$P = \text{workdays/turbine} = C_0 * (\text{Number of turbines installed})^{-E} \quad . \qquad (1)$$

C_0 is a constant equal to the number of workdays to install the first turbine. E is a parameter called experience parameter and the learning rate, LR, is

$$LR = (1 - 2^{-E}) \qquad (2)$$

The in-fold interprets the learning curve (Eq. 1) as the performance, P, of an input-output machine with continuous feedback from the output. The performance, P, is the ratio input/output determined by cumulative output. Following the analysis of von Förster (1984, 2002), the learning system is therefore a non-trivial machine, whose response depends on its history, which is represented by its cumulative output.

We want to investigate the use of learning curves for energy policy. Then we must move up the recursive ladder from small installation teams to whole industries producing, investing in and operating energy technology. The first issue is the realm of the learning curve. It turns out that the learning curve pervades all competitive industrial activities and Eq. 1 can be generalized to

$$P = \text{input/output} = C_0 * (\text{cumulative output})^{-E} \qquad (3)$$

For industrial production input is measured by total cost and P = total cost/produced unit. Figure 2A shows the measured learning rates for 108 cases of production in a wide variety of enterprises (Dutton and Thomas 1984). Following the cybernetic theory, the broad distribution around LR = 20% is the result of the learning system adapting to external perturbations (Wene, 2010, 2011)

Figure 1A illustrates the learning curve pervading processes in the firm. However, energy policy focuses on the performance of industries. On the industrial level cost data are very sparse and one has to rely on price data. The scientific literature has accepted this limitation with the argument that in equilibrium markets measured learning rates will be the same for priced and cost. Figure 2B shows the first measured distribution for energy technologies by McDonald and Schrattenholzer (2001). The results confirm the distribution around 20% learning rates but also indicate a peak around 4-8% learning rates. The two-peak structure is consistent with later measurements and is explained by the cybernetic theory (Wene, 2010, 2011).

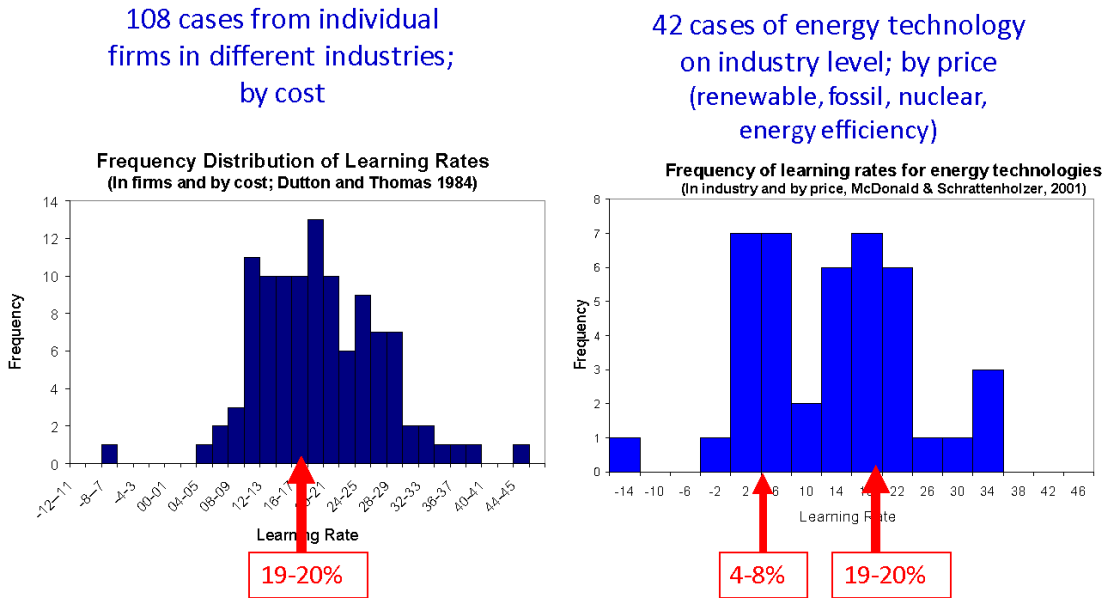

Figure 2. Distribution of learning rates (A) in firms and (B) in industries.

We thus find learning curves as a pervasive phenomenon in all industrial activities. They promise very large benefits for government deployment programmes for low-carbon technologies. However, to harvest such benefits requires very large costs up front, for one low-carbon technology it can be up to 100 billion USD or more. The reliability of the learning curve over larger periods then becomes key question. The learning curve and the deployment programmes based on this curve is now criticised from the perspective of neo-classical, mainstream economy (Nemet, 2009; Nemet and Baker, 2009; Nordhaus, 2014). However, the

findings of the cybernetic analysis are that learning curves measures a stable and fundamental property of competitive activities in human systems of interaction.

We will briefly discuss the meaning of learning curves in energy policy and then turn to the cybernetic analysis of the curves.

2. Learning Investments are needed to exploit the benefits of the learning curves

Figure 3 shows the learning curve for solar PV modules based on data from the period 1976-2001. The curve has been extrapolated until the price reaches a level where solar PV would be competitive with incumbent power technologies on mass markets. One could say that figure 3 represents the situation for an energy policy maker in 2002. Should he trust the extrapolated learning curve? The situation is similar to the uncertainties facing the policy maker today regarding support for far off-shore wind power or wave power.

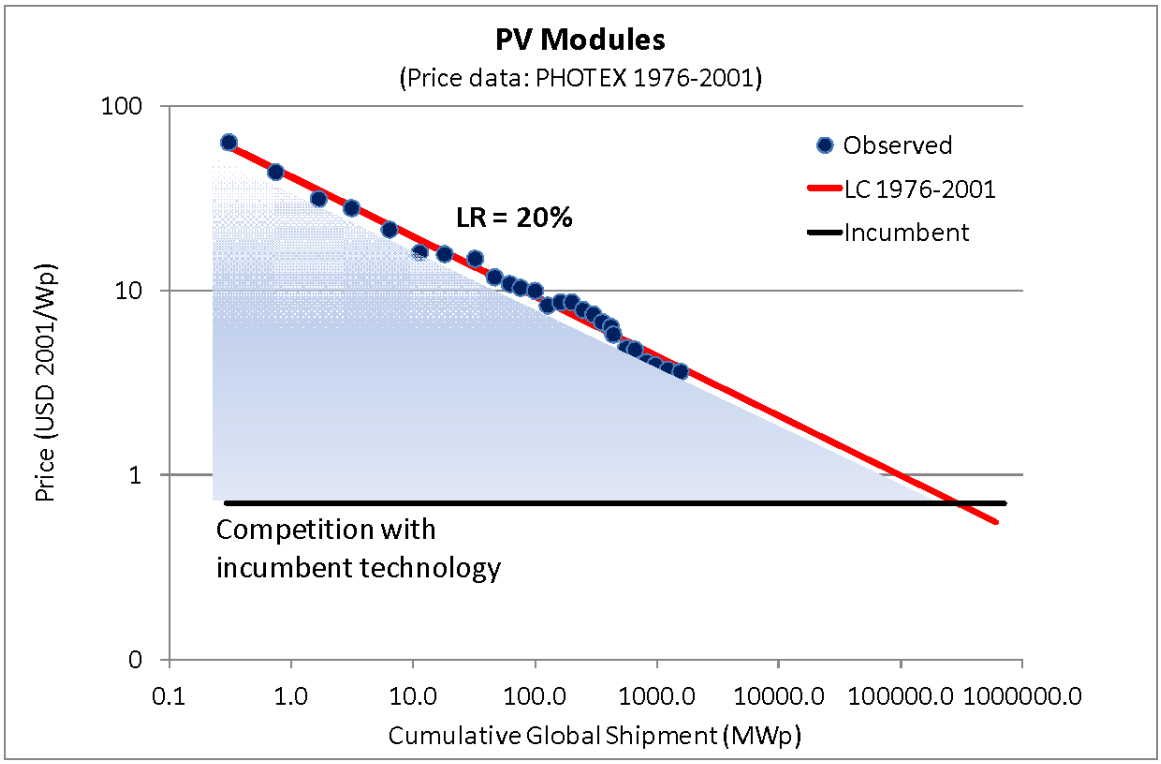

Figure 3. Learning curve and Learning Investments for solar PV modules (data 1976-2001 from Schaeffer et al., 2004)

The measured learning rate is 20% quite in line with the predictions from cybernetic theory (Wene, 2007). However, small changes in learning rate would move the break-even with the incumbent and have considerable economic consequences (IEA, 2000; Nemet, 2009). As long as PV-modules cost more than the price at break-even the PV-technology will need support from government deployment programmes, either directly or through e.g. feed-in tariffs, where the support ultimately is paid by the electricity consumer. Niche markets with high willingness-to-pay for PV-technology can reduce the demand on deployment programmes but the majority of support has to come from these programmes. When the PV modules have reached the break-even we can start harvesting the benefits of the learning curve, but large

investments are needed up front to reach this point. In economic literature such extra cost for investments are usually referred to as subsidies. However, considering that these extra costs are made for the purpose of future benefits, we will use the term of IEA(2000) and refer to them as *learning investments.* The shadowed region under the learning curve in figure 3 indicates the needed learning investments which on the global level are of the order of several 100 billion USD. The diagram is double logarithmic, so the 2002 policy maker finds that some learning investments are already made but the major part remains to be provided.

Figure 3 emphasizes the need for reliable extrapolations, which requires analysis built on good theoretical understanding of the learning phenomenon. Approaches based on mainstream economics and cybernetic approaches disagree on the theoretical status of the learning curve and ultimately come up with different policy recommendations. It is the duty of proponents of both schools to study and discuss each other's arguments. However, at this occasion I consider it legitimate only to refer to what I believe to be the basis for disagreement and then proceed to the cybernetic arguments.

3. Basis for learning: not FEPs but Operational Closure

Approaches based on mainstream economics search causes for observed improvements in performance in features, events and processes, FEPs[1], in the system and its environment. . Generic processes proposed in the literature are learning-by-doing, learning-by-searching[2], learning-by-using, learning-by-interacting (see e.g., Rosenberg, 1982; Arthur, 1990; Lundvall, 1992). Features and events such as plant sizes exploiting economy-of-scale, spill-over from other industries, waste reductions, input shares, usually appear as deliberate actions (Hall and Howell, 1985; Nemet, 2006; Lapré, 2011). Nemet (2006) finds seven FEPs responsible for the learning curve for PV modules in figure 3, among them module efficiency as result of R&D, plant size, silicon cost and yield.

The cybernetic approach recognises that the system may use different FEPs to improve performance in the competitive environment, however, these FEPs are *not* the basis for learning. The seminal analysis of Watanabe et al. (2000) of the Japanese PV industry shows a system with feedback loops binding together a wide net of operations. Consistent with these finding, our hypothesis is that the *learning system is operationally closed and that this closure forms the basis for the self-reflection needed in learning*. The well-known OADI-SMM model (Kim, 1993) exposes this need for self-reflection to achieve learning (Espejo et al., 1996). The FEPs are used in design and implementation, but the system learns as a whole.

Following Varela (1979, p. 55) operational closure means that the operations (1) are related as a network and recursively depending on each other to generate and realize themselves and (2) together constitute the system as a unity in their competitive environment. An Observer will find that more and different types of operations are folded into the network as the learning system moves up the recursive ladder from individual installation teams for, e.g., wind plants as in figure 1 to whole industries as in figure 3. Operations classified as "Research and

[1] The acronym FEP (feature, event, process) will be used to denote the class of elements forming or imported to the technology learning system. The term FEP was originally introduced in the Sandia methodology to analyse safety of repositories for nuclear waste (Cranwell et al., 1990).

[2] "learning-by-searching" usually refers to the process of Research and Development (R&D).

Development, R&D" start to be important at the levels of the firms and of industries and are of special interest.

The distinction between public and private industry R&D is crucial for the cybernetic approach. On the levels of individual firms and of industry the industrial R&D are entangled in the network of the learning system, while the public R&D is in the environment (IEA, 2000; Wene, 2008b). Nordhaus (2014) strongly criticizes the use of learning curves in scenario and policy analysis because of "a fundamental statistical identification problem in trying to separate learning from exogenous technological change" and concludes that learning curves "have a weak empirical foundation and can lead to misleading results for policy". The answer from the cybernetic viewpoint is that learning curve analysis controls this separation but mainstream economic analysis seems to have more homework to do regarding the distinction between public and private R&D.

Operationally closed systems develop eigenbehaviour (von Förster, 1984; Varela, 1984). The task for the cybernetic theory is to calculate the learning rates for these eigenbehaviours. Wene (2007; 2008a) proposed the non-trivial machine as starting point for the calculations.

The learning model in figure 4 consists of three feedback loops. The external loop closes over the market, M, and the internal loop over Producing. Together with the third self-reflecting loop, SRL, they provide the double closure proposed by von Förster (2003) as the process required for an organization to modify its behaviour in order to manage environmental perturbations without losing operational closure (Wene, 2010). The internal and external loops reflect the double closure over production and sales as analyzed by Baecker (1996). "Producing" is a trivial machine, which transforms input into output and whose performance is set by the system internal state function, Z. The inputs and outputs to Producing are equal to the inputs and outputs observed for the learning system. Z is set in the self-reflecting loop through the operation Computing, where the observations in the external and internal feedback loops are assessed.

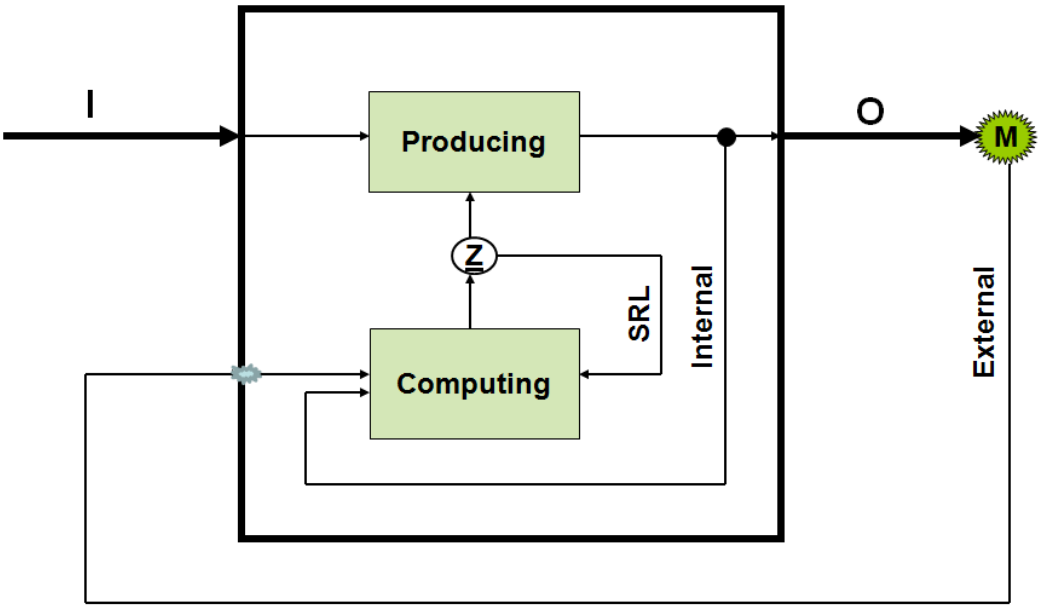

Figure 4. The elements of the technology learning system (modified from Wene (2007))

Second order cybernetics suggests an operator approach, which permits the operator to operate on itself. The operational network in figure 4 is described by the following matrix equation (Wene, 2011)

.

$$\begin{matrix} & & \tau & \\ i & & & \\ 1 & & & \\ \Delta P_0 & 0 & & \\ 0 & 1 & & \\ C_{SRL} & W_{12} & & \\ W_{21} & C^+ & & \end{matrix}$$

$$\underline{\mathbf{Z}}_\infty = \lim \qquad (4) \qquad \tau \to \infty$$

The diagonal operators C_{SRL} and C^+ refer to the self-reflecting and internal loops, respectively. Their form is described in Wene (2007). .The off-diagonal operators, W_{21} and W_{12}, describe perturbations from the external loop. At equilibrium markets and no external perturbations $W_{21} = W_{12} = 0$, and the eigenvalues for the C_{SRL} operator provides the experience parameters. In the limit the operator has a discrete spectrum of eigenvalues given by

$$E(n) = 1/[(2n + 1) \cdot \pi] \qquad n = 0, 1, 2, 3, \ldots \qquad (5)$$

Following equation 2, the four first modes of learning are then

$$LR(0, 1, 2, 3) = 20\%, 7\%, 4\%, 3\%, \ldots \qquad (6)$$

The learning rates for the fundamental, unperturbed learning modes are therefore independent of technology or learning system. Equations 5 and 6 express a general property of human systems of interaction in a competitive environment. The result is consistent with the mean values of learning rates for the distributions in figure 2. However, there is a wide distribution of learning rates around the mean value.

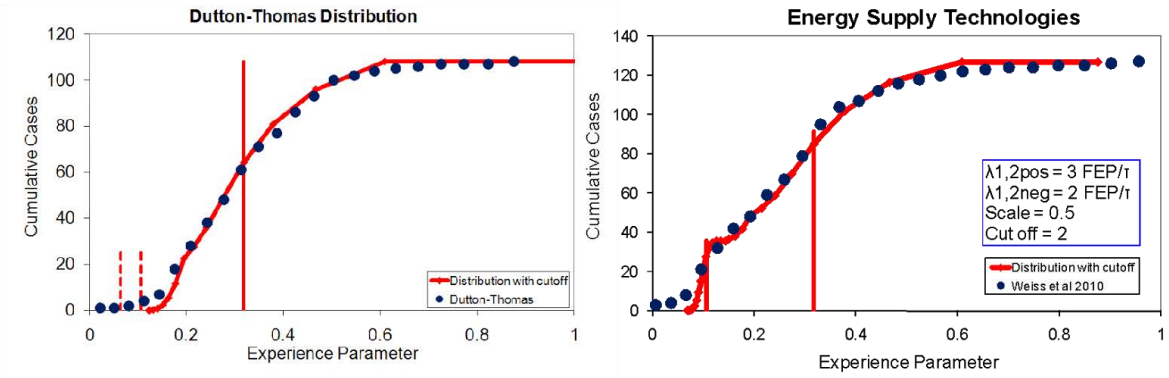

Figure 5. Theoretical fits to observed distributions of experience parameters. (A) Distrbution of measurements based on cost from a wide spectrum of firms (same as figure 2A, Dutton and Thomas, 1984). (B) Distribution of measurements based on price for energy supply technologies (Weiss et al., 2010).

Wene (2010, 2011) looks at the effects of perturbations from the external feedback loop. The operator W_{12} remains zero but the operator W_{21} is assumed to be C^+ times a Poisson distributed scaling factor indicating strength and occurrence of the perturbation. The learning system adapts to the perturbation by changing the learning rate. Figure 5 shows fits to two measurements of learning rate distribution. The agreement between observations and theory is good and provides support for the explanation of learning curves by cybernetic theory.

4. Learning systems move in Time – but what Time?

A valid theory for learning curves must explain the shape of the curve as given in Equation 3. Also here, approaches based on mainstream economics and cybernetics disagree about the status of the relation in Equation 3.

The work of Ferioli and Zwaan (2009, 2012) can be taken as representing the perspective of mainstream economics. The authors deconstruct the learning phenomenon into two processes depending on calendar time; technology growth and technology progress. Their model indicates that FEPs randomly distributed in time can simulate a learning curve in an exponential growth environment. They conclude that "in an environment of exponential growth for a product or technology (or company, industry, or sector for that matter), every improvement that reduces costs, whatever its nature, can in principle result in a power law relation between costs and cumulated production" (Ferioli and Zwaan, 2009, p. 4006).. From their neoclassical or mainstream economic perspective Ferioli and Zwaan (2012) conclude that "observed learning curves can be considered the results of a growth cycle" and "learning rate cannot be considered a constant property".

Wene (2013) agree that Time is the natural starting point for explaining dynamic processes like technology learning but argues that present explanations based on mainstream economics suffer from a major fallacy. The explanations ignore the distinction between Observed and Observing systems. The Obs-centric fallacy assumes a privileged position for the Observer and subsumes that all phenomena should seek explanations in the calendar time of the

Observer. Based on findings in thermodynamics, classical and quantum physics, and for biological systems (e.g., Fock, 1937; Prigogine, 1947; Andresen et al., 2002), Wene (2013) proposes that the learning system moves in *eigentime* and that explanations should be searched in this eigentime.

Wene (2013) uses non-equilibrium thermodynamics (Prigogine, 1947, 1980) to derive a relation between the eigentime of the learning system and the calendar time of the Observer. The key assumption prescribes that the unperturbed, operationally-closed learning system is in a steady non-equilibrium state. This means that the net flow of entropy out from the system is equal to the entropy production inside the system.

The competitive environment has important double roles; firstly, it forces the system away from thermodynamic equilibrium and, secondly, it keeps the system on a path of minimum entropy production, i.e., it keeps the system optimised. Andresen and Gordon (1994) and Andresen et al. (2002) find that such optimal path corresponds to a fixed rate of entropy production in the systems eigentime. This finding holds also outside the linear near-equilibrium region. Applying this finding to the entropy production in the learning system of figure 4 yields an eigentime that is proportional to the logarithm of cumulative production measured in Observer's calendar time. The performance of the learning system, i.e., the input/output ratio expresses the net flow of entropy from the system. Applying the key assumption of a steady non-equilibrium state then provides the learning curve of Equation 3. The experience parameter, E, becomes equal to the fixed rate of entropy production in eigentime multiplied by scaling factors.

An important conclusion from the cybernetic approach is that the learning curve expresses the optimality criterion for technology learning.

We can now return to the policy maker of 2002. Figure 6 shows that she or he has passed through some bewildering experiences since 2002. However, based on the cybernetic approach she/he should be able to understand the observations and draw conclusions for policy from these observations.

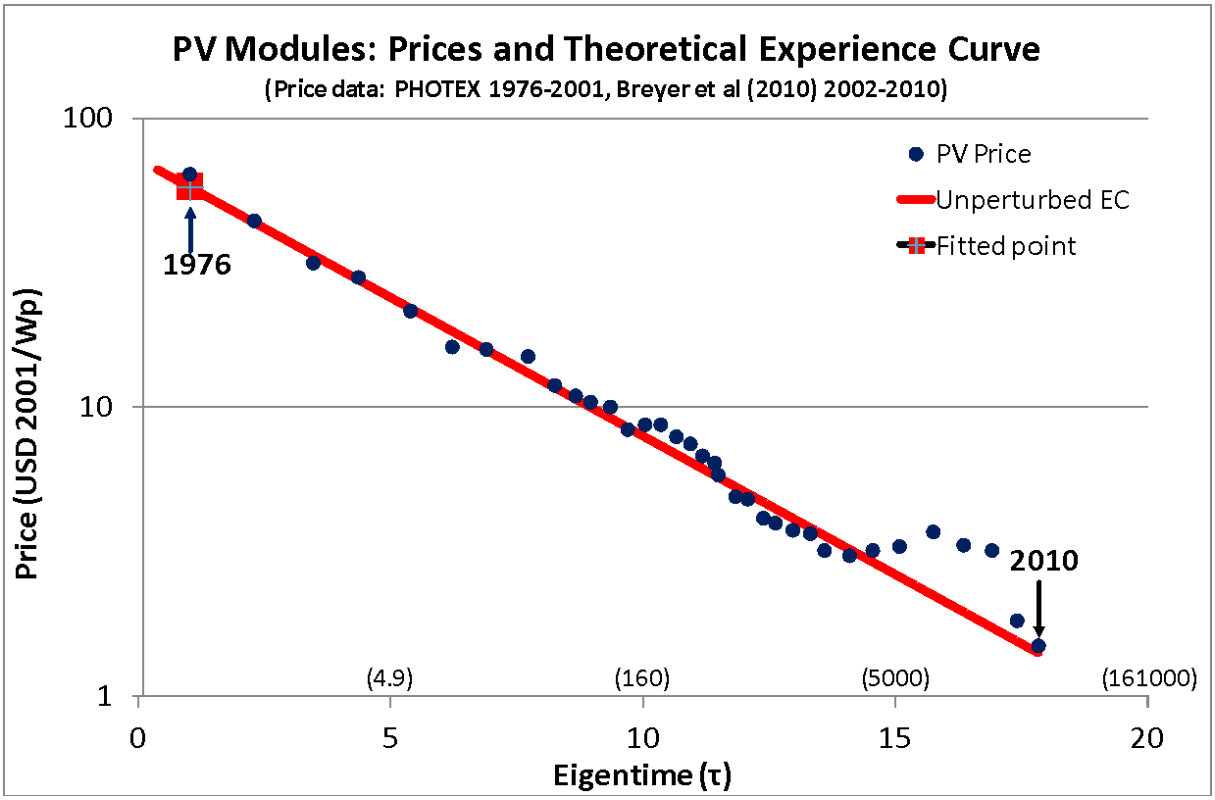

Figure 6. Theoretical experience curve and observed prices for PV modules. The numbers in parentheses show the cumulative world shipments in MW_p at eigentime 5, 10, 15, 20. (From Wene, 2013; price data from Schaeffer et al., 2004 and Breyer and Gerlach, 2010)

The red line represents the theoretical learning curve for the basic zero learning mode with learning rate of 20%. The curve is fitted to the price data in *one* single point, marked with a square in the figure. The point can be arbitrarily chosen, the only condition is that it must represent a period with equilibrium markets. The strong growth of PV in 2000 resulted in large scarcity cost for crystalline silicon, which is a primary input to the PV module learning system. This shows up in the price of modules and created a silicon bubble 2005-2008 (Maycock and Bradford, 2007). New factories for PV grade silicon came on line 2008-2009. In 2010 the price for PV modules is back on the learning curve, in line with the forecasts in Wene (2008b). Equipped with the cybernetic analysis the policy maker would have no reason to change technology policy during the silicon bubble. However, the cost to the economy of the silicon bubble is close to 100 billion USD(2013) and could probably have been avoided through concerted action among IEA governments.

5. Conclusion: CO_2-policies or technology policies to manage risk of climate change

Most scientists and policy analysts would agree with the title of this paper. Early investments in new technologies reduce their prices and improve their efficiency thereby influencing later investment decisions. However, there are major disagreements regarding the reliability of the

learning phenomenon and the legitimacy of expensive deployment programmes for new technologies.

From the economic perspective technology learning appears as a label for well-known features, events and processes such as economy-of-scale, R&D, changing shares of production factors. Although these FEPs are important tools for an efficient economy they cannot be relied upon as strategic tools to obtain a low-carbon world. They must be embedded in general and mandatory strategies to reduce CO2-emissions.

From the perspective of second order cybernetics the learning curve express the optimal strategy for a system to adapt to the challenges of a competitive environment. The learning system appears as tightly woven system with technology learning as major stratagem for survival. The cybernetic perspective provides the basis for a technology-led strategy focussing on policy measures for non-carbon technologies and energy efficiency and general CO_2 policies in a supporting role.

The practicality of the two strategies to manage the risk of climate change underscores the need to research and understand the learning curves. The global implementation of general and mandatory strategies to reduce climate-forcing gases has met large difficulties. However, deployment programmes for low-carbon technologies such as PV and wind powee have proven track records and have the advantage that they can by set in motion by individual nations or concerted action among a group of nations.

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WOSC 2014
16th Congress of the World Organisation of Systems and Cybernetics
Ibaqué, Columbia 15-17 October 2014
Key-note Speech

Future energy system development depends on past learning opportunities

Clas-Otto Wene
Chalmers University of Technology and
Wenergy AB, Sweden

The Learning Curve: A Personal Note on a very Local Experience

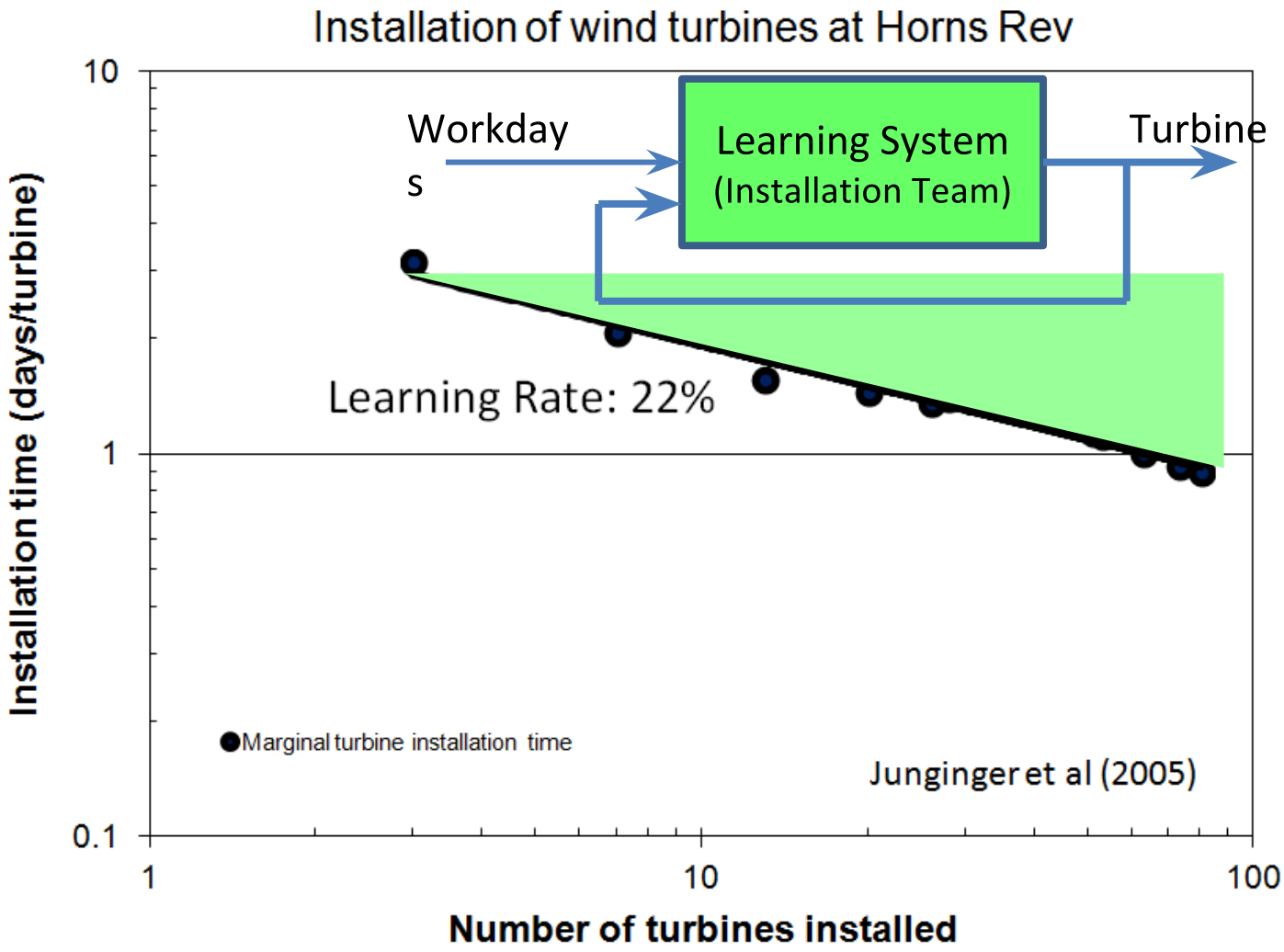
Changing Elevators: A View from the 8th Floor

- **Operational Closure**: the Team is master of all its operations.
  Identity "specified by a network of dynamic processes whose effects do not leave that network" (Maturana & Varela, 1992)
- **Cybernetic Theory for Learning Curves:**
  - Learning Rate 20% (Wene, 2007)
  - From team's perspective the job was unique
- **This meant for me:**
  - 3 ▪ 5 = 15 workdays only for the first entrance
  - 20% reduction at each doubling of elevator exchanges
  - My entrance was no 4 so refurbishing would be completed in
    $15 \cdot (1 - 0.2)\uparrow 2 = 9.6$ workdays

- **The Learning Curve asserted** itself on the evening of the 9th day!!

Learning Curve: Project Level

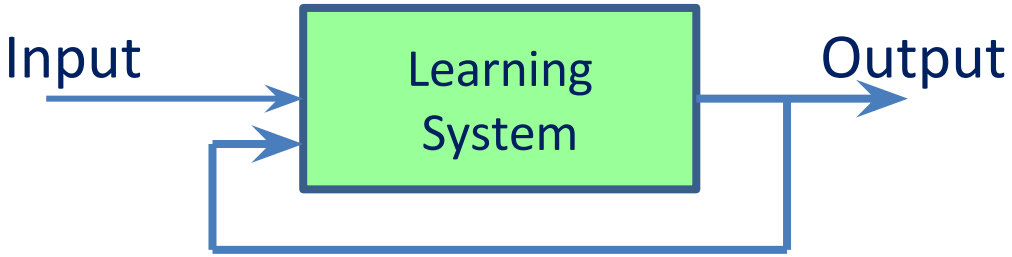
$$P = \text{workdays/turbine} = C_0 \cdot (\text{Number of turbines installed})^{-E}$$



Learning Rate

$$LR = 1 - 2^{-E}$$

Learning Curves for Energy & Climate Policy



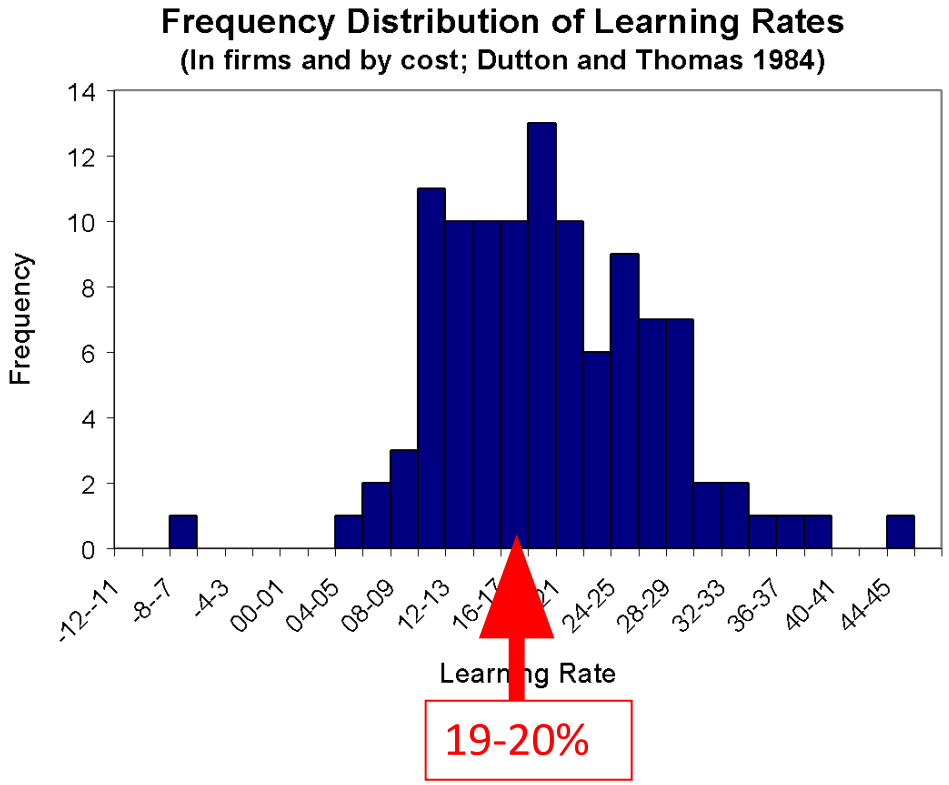
$$P = \text{input/output} = C_0 \cdot (\text{cumulative output})^{-E}$$

Learning system is a non-trivial machine
(von Förster, 1984, 2003)

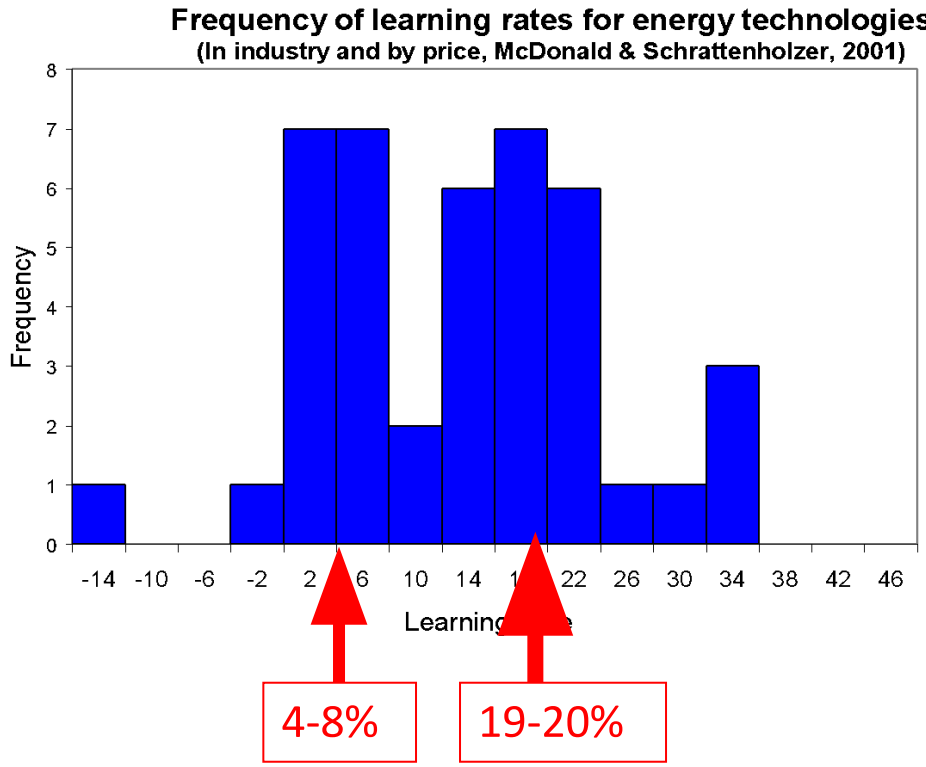
- **Realm:** Learning Curves pervade all competitive industrial activities
- **Policy Message**: No learning without market action → Gov't Deployment programmes → Controversial intervention on the markets
- **Reliability & Stability**: Theoretical explanations but mainstream economics and second order cybernetics come to different conclusions on (1) learning rates and (2) learning curve shape → different policy recommendations

The Pervasive Learning Curve

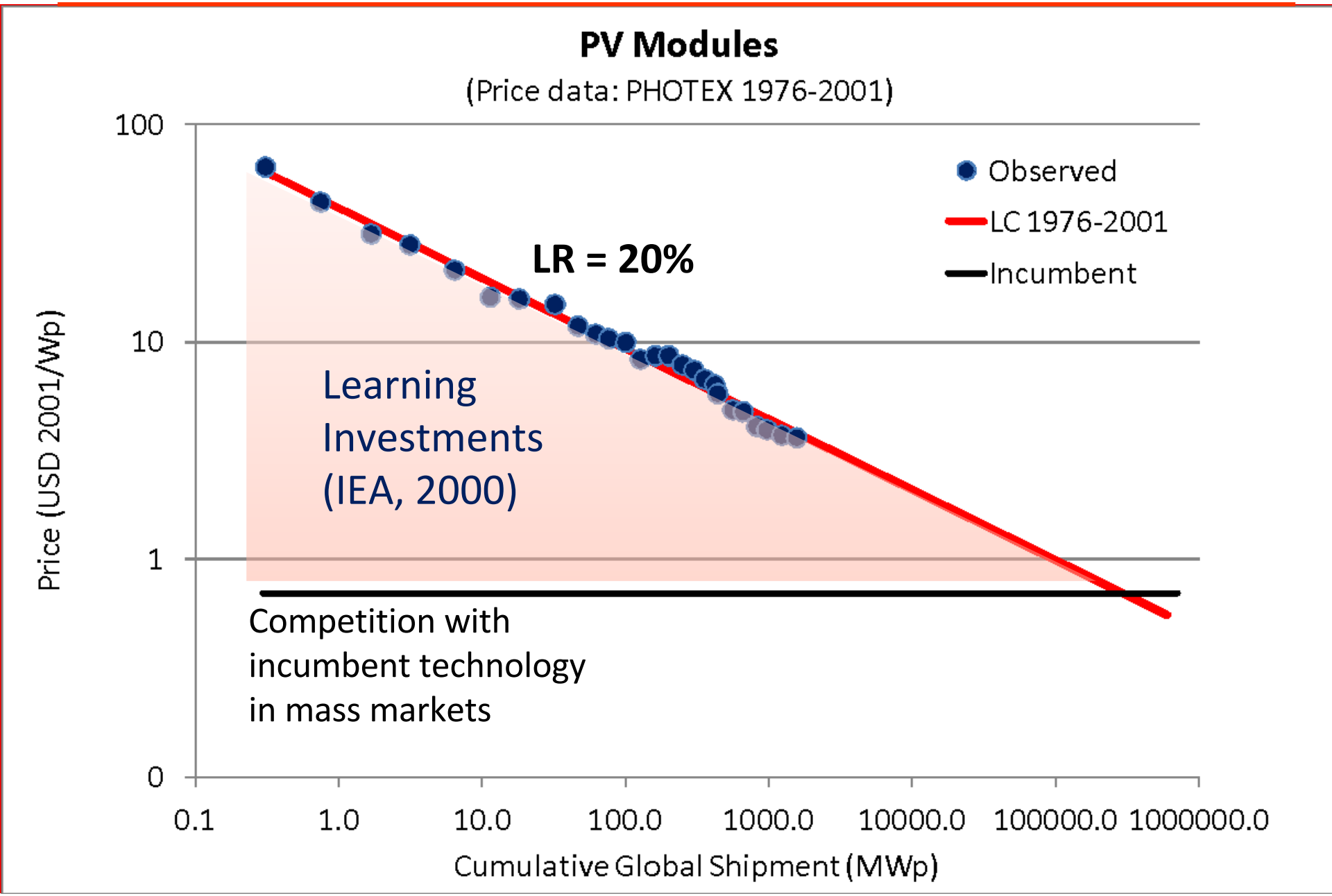
108 cases from individual firms in different industries; by cost



42 cases of energy technology on industry level; by price (renewable, fossil, nuclear, energy efficiency)



Using the Learning Curve: Making Solar PV competitive



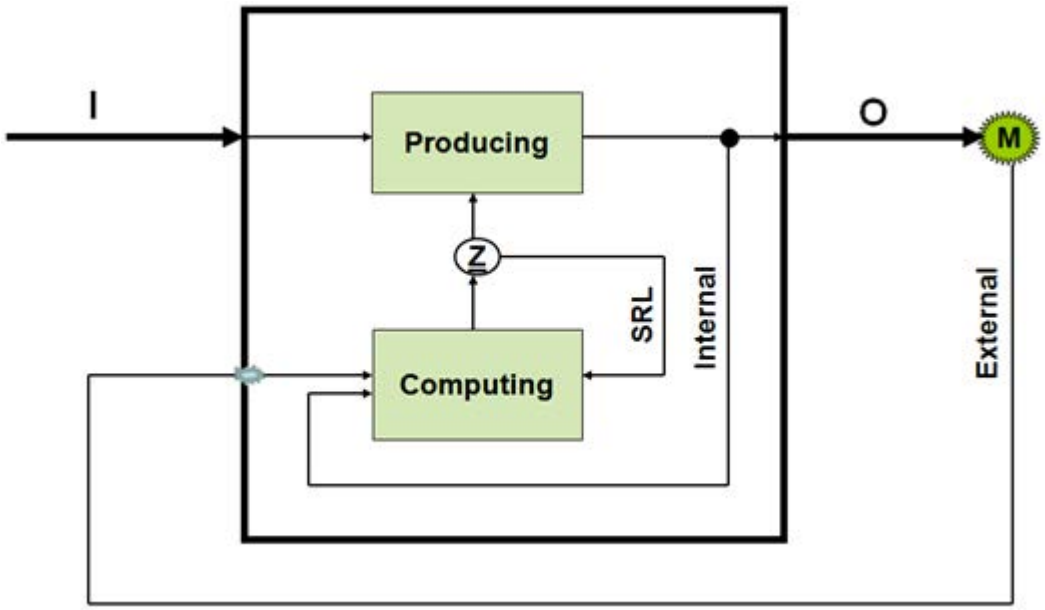
Basis for observed learning: FEPs or Operational Closure?

- **Mainstream Economics**: Identifying **Features, Events, Processes (FEPs)** leading to improved performance.
  - Nemet (2006): 7 FEPs explaining PV module learning curve (module efficiency(R&D), plant size, silicon cost, yield)

- **PV-production system with feedback** (Watanabe et al, 2000): Feedback loops binding together a wide net of operations. (private industry R&D entangled in the net, public R&D external source)

- **2nd order Cybernetics**: learning curves express the eigen-behaviour of the operationally closed learning system (Wene, 2007)
  - More and different types of operations are folded into the network moving from project to industries
  - R&D classified operations become important parts of network on the levels of firm and industries. But distinction private/public R&D crucial.

Cybernetic theory for Learning Curves: Formalism



$$\underline{Z}_{\infty} = \lim_{\tau \to \infty} \begin{pmatrix} C_{SRL} & W_{12} \\ W_{21} & C^{+} \end{pmatrix}^{\tau} \begin{pmatrix} \Delta P_0 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} i \\ 1 \end{pmatrix}$$

Equilibrium Markets:

$W_{12} = W_{21} = 0$

Eigenvalues for E

$E = 1/[2 \cdot n + 1) \cdot \pi]$

$n = 0, 1, 2, 3\ldots$

LR = 20%, 7%, 4%, 3%...

Wene (2007)

Perturbations

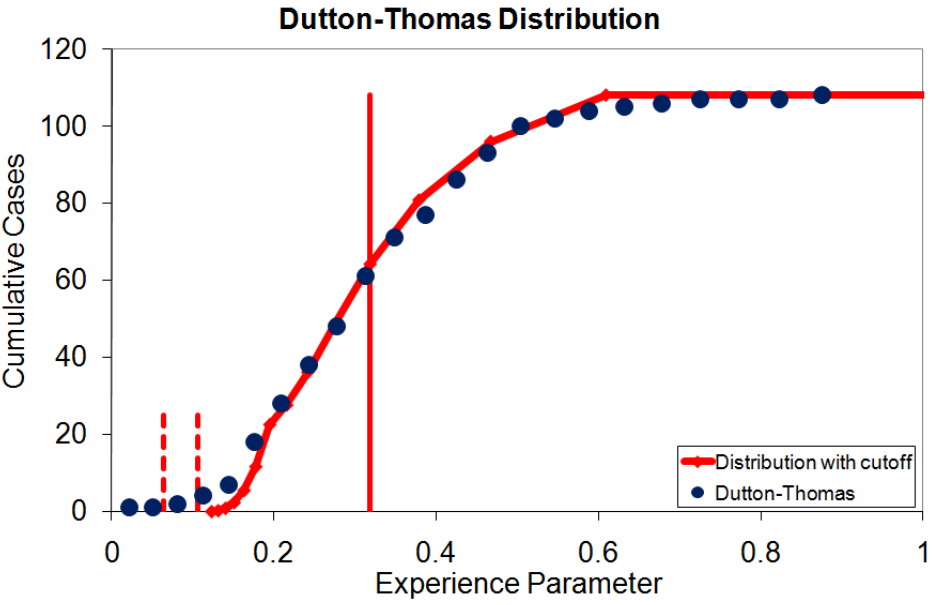
$W_{12} = \alpha(\tau) \cdot \Delta P_0 \cdot C^{+}$

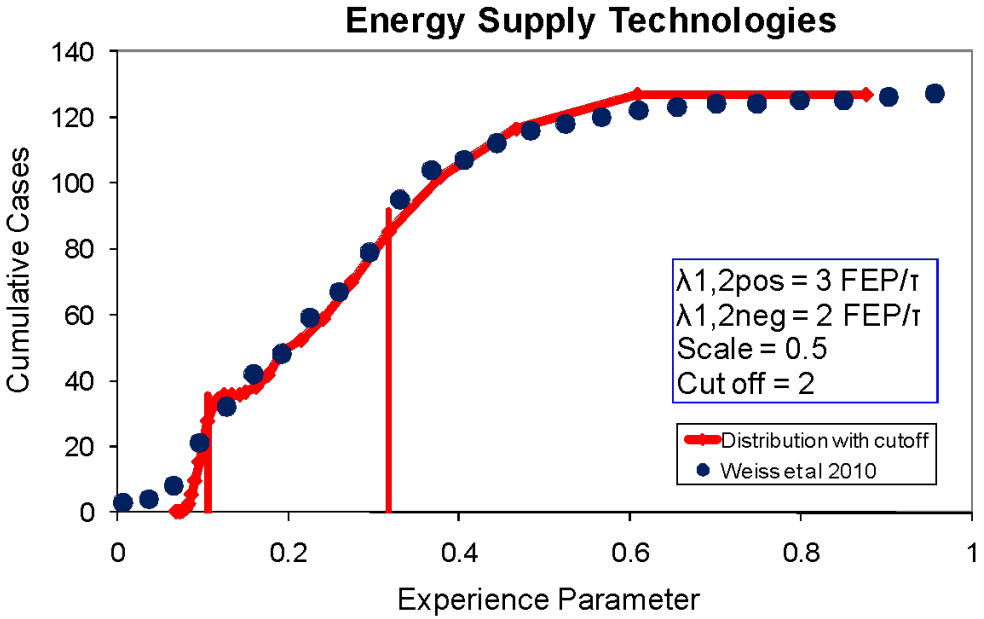
$W_{21} = 0$

Management through Double Closure (von Förster, 2003)

Application of the cybernetic theory

(Wene 2010, 2011)





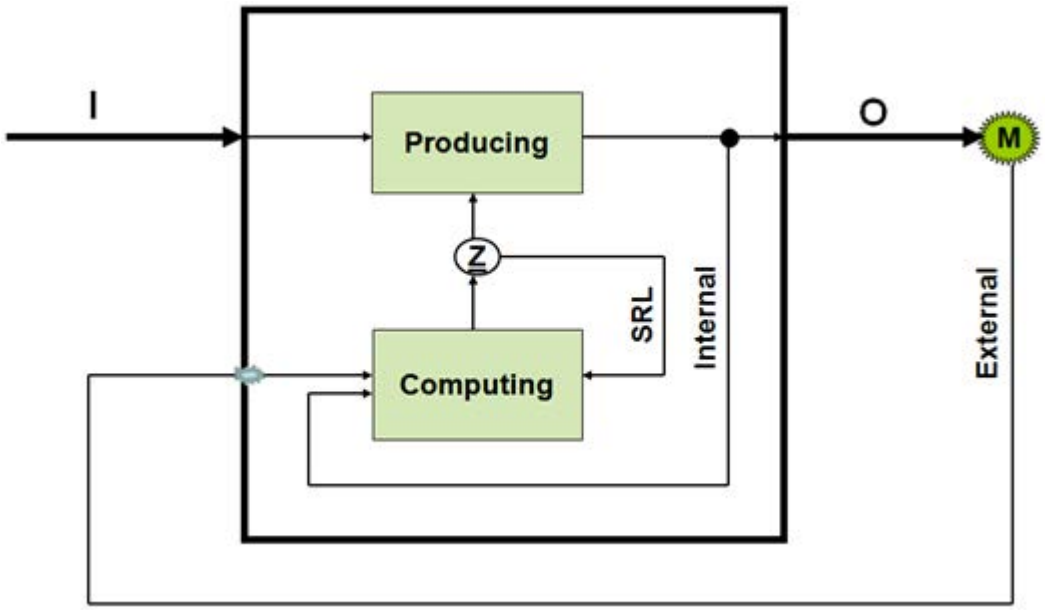
- The cybernetic theory for learning curves can explain observed distributions of learning rates
- But assumed form of operators rely on shape of learning curves
- Shape of learning curves need theoretical grounding

Shape of Learning Curve: Random FEPs or Optimal Path?

- **Mainstream Economics**: In exponentially growing markets, FEPs randomly distributed in calendar time can generate a learning curve (Ferioli and Zwaan, 2009; 2012)
  - ”every improvement that reduces cost” can ”result in a power law relation between costs and cumulated production”
  - ”learning rate cannot be considered a constant property”

- **2nd order Cybernetics**: learning system moves in eigentime and the learning curve describes the path of minimum entropy production, i.e. an optimality criterion (Wene, 2013)
  - **Obs-centric fallacy**: mainstream economics give Observer a priviledged position.
  - **Task:** find relation between the eigentime, τ, of the learning system and calendar time, t, of the Observer.
  - **Learning system as non-trivial machine:** eigentime is a function of cumulative output, X, that is $\tau = f(X(t))$

Thermodynamic Perspective on Technology Learning



- The learning system is in a steady state, i.e.,
  $d_eS = - d_iS \qquad d_iS > 0$
- Competitive market at market equilibrium but with double role
  - Keeping thermodynamic *non*-equilibrium
  - Ensuring minimum entropy production
- The minimum entropy production is constant in eigentime (Andresen and Gordon, 1994)

Relation eigentime, τ and calendar time, t:

$$\tau = \ln(X(t)/X(t_0)) / \ln 2$$

X is cumulative output

At exponential growth

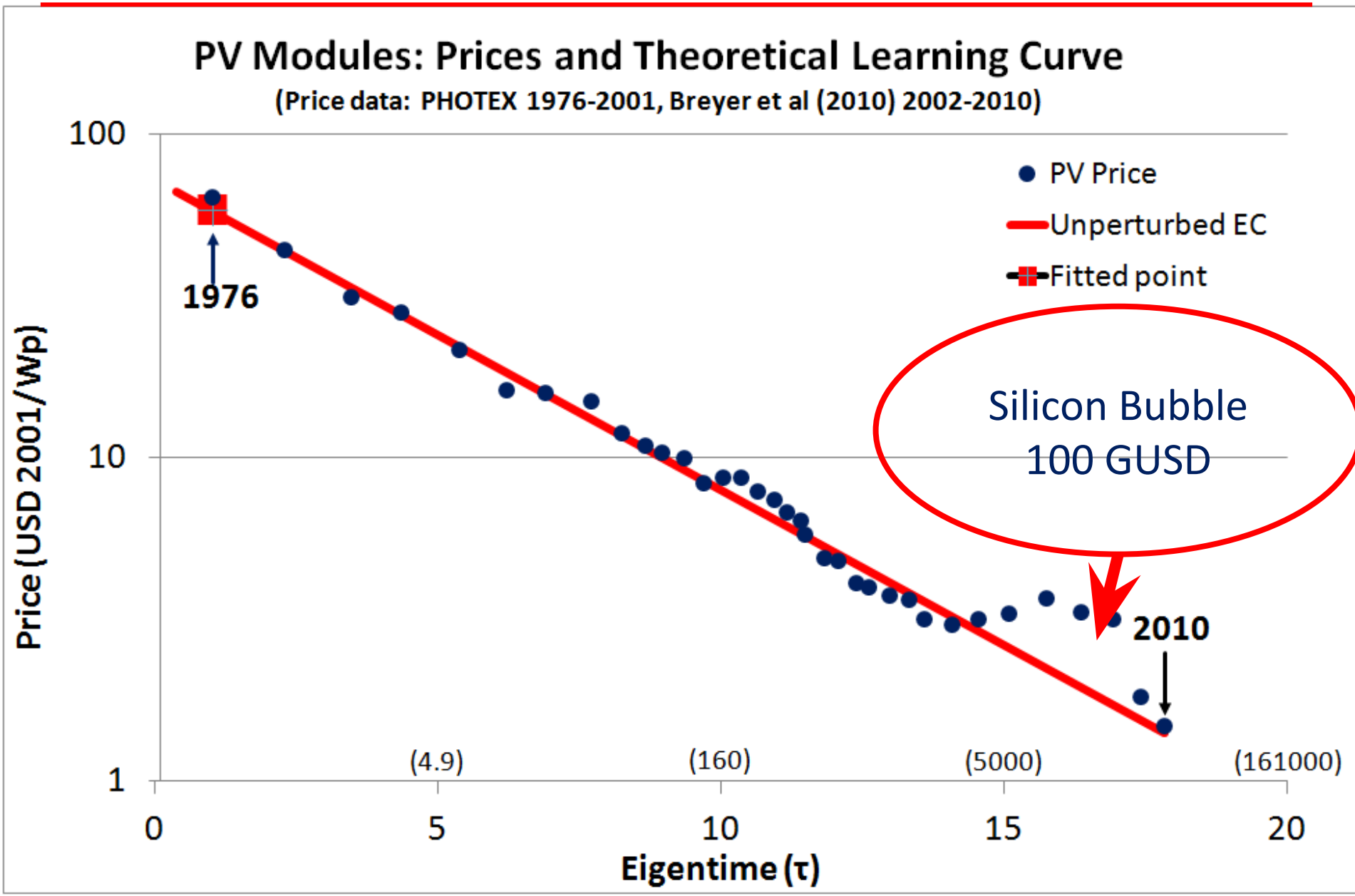
τ = constant ▪ t

Wene (2013)

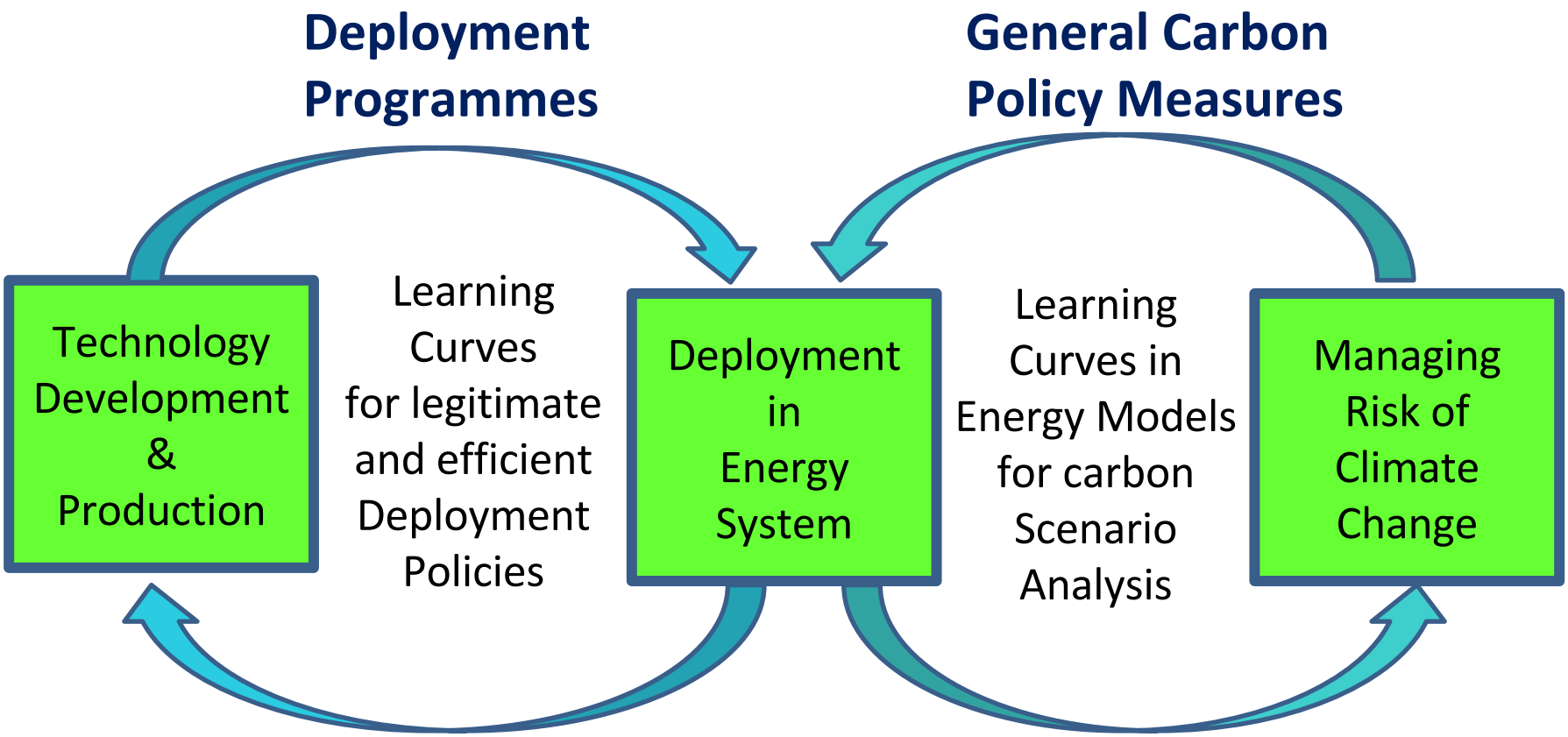
Statistical Physics

Assuming I and O are proportional to accessible phase space provides d_eS and the learning equation.

A fully theoretical Learning Curve



Conclusion: Deployment programmes and Energy&Climate Policy



Thank you !

Self-Organisation and Policy Processes: Recursive Structures and Self-Reference

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WOSC 2014

Introduction

We need strategies to improve policy processesto respond to issues such as climate change, children care, customer services and so forth. Multiple social and economic agents are interacting in the creation and production of these policies and it is the structures of these interactions that, to different degrees, create and produce their meanings. Why is it that diverse agents, with their own purposes, interests and resources will come together? These are processes that produce policies. My concern is the viability to these policies.

Evolving policies in democratic settings need the backing of stakeholders; the challenge is nurturing inclusivity and avoiding abuses of power. I argue that both aspects need clarifying strategies to manage their complexity. What kind of structures foster people's freedom and wellbeing? These should be structures that enable creativity and develop capabilities through communications. Structures always imply constrains but the challenge is transforming coercive constraints into liberating constraints.

Self-organisation may bring together agents with shared but not necessarily explicit interests and purposes. But for critical policy concerns happenstance may take too long and catalysts,such as political leadership and the articulation of survival instincts are necessary. These are catalysts to constitute desirable organisational systems. This constitution, in which agents become actors, can be guided by sound complexity management strategies. I discuss these strategies below but the overarching heuristic is removing undesirable constraints with ingenuity.

In an organisational system relationships emerge from the recurrent interactions among and between actors and between actors and agents. Complexity management strategies are enabled by technologies that increasetheir variety absorption capabilities.As actors detect and seize challenges and opportunities,technologies may enable flexible reconfigurations of their resources and thus their dynamic capabilities.

It is not unusual for actors to have a poor appreciation of these relationships, leading to policy failures that go from the small to the large; from small marketing failures to large ecological and financial failures. I discuss here these failures.

In this paper first I focus on the concepts of organisational systems and self-organisation, variety and management of complexity and finally on dynamic capabilities,organisational potentials and performance; second I offer reflections, supported by four vignettes, of situations where policy failures are explained by actors with poor strategies to manage complexity. The conclusion is focused on performance and technology enabled management of complexity.

Cybernetic and system concepts relevant to Policy Processes

Organisational Systems and self-organisation

It is not enough proposing relevant policies, it is also necessary to anticipate their embodiment in dynamic structures that increase the chances for their development and successful implementation. In general policies emerge under the umbrella of shared purposes and values. Indeed, agents from varied provenances may form networks as they share common interests and an ethos that facilitates their interactions. Organisational systems may emerge as an outcome of tough and often unpredictable interactions. Aspects that influence the emergence of these systems are myriad interactions. For instance a policy for child care, as I discuss later, needs contributions of at the very least social, health and police services. Often these services are fragmented, at the cost of child care. Equally, the development of commons software may involve large numbers of people who may not even know each other; they evolve as networks and to a degree their success producing a product will require much coordination and integration of their activities. Most likely their purposes will not coincide. However, they will share the tacit purpose of producing a piece of software and the purpose of that (organisational) system is what it does! (Beer, 1985).

Self-organisation takes place as agents coalesce around tacit or explicit policies[1]. What is necessary for success is that they find forms of creating, regulating and producing these policies, around tacitly agreed purposes. *As they progress in their interactions agents are constituted as either autonomous or non-autonomous roles*(Espejo 2002). The autonomy of autonomous roles depends on *operational closure* and *self-reference;* they enable themselves to create policies and make them happen; they are becoming an organisational system. A collection of autonomous roles, sharing a tacit orexplicit purpose,*produce*a larger organisational system; contribute with their resources to its embodiment. Autonomous roles within an organisational system are the key actors *amplifying* itscapabilities. As they align their own interests theyunfold the organisation's complexity and amplify the organisation's capabilities (Espejo and Reyes 2011). This unfolding, in network structures, is driven by self-organisation and happens at multiple levels up to the most local, where actors align their self-constructed policies with those of the organisational system they constitute. This process of

- [1]In general, self-organization is defined as the transition of asystem into an organized form in the absence of external orcentralized control. Thus, one may emphasize two keyfeatures of a self-organized system or process: (i) anincrease in organization (structure and/or functionality)over some time, and (ii) the local interactions are notguided by any external agent.Ay, N., Der, R., and Prokopenko, M. (2012), Guided self-organization: perception–action loops of embodied systems, Theory in Biosciences, 131, 3, 125–127, http://dx.doi.org/10.1007/s12064-011-0140-1.

enabling autonomy within autonomy, as long as it is successful, is a powerful amplifier of social complexity. Indeed it produces complexity at a vastly larger scale than hierarchical structures. Non-autonomous roles, on the other hand, contribute to the organisational system's norming, management and regulation. They create and regulate the policies of concern (Espejo, 2000).

Autonomy has to go hand in hand with a cohesive structure. Two aspects contribute to cohesion; self-regulation and actors' moment-to-moment coordination. Both aspects are necessary for amplification and attenuation of complexity (Espejo and Reyes 2011). Self-regulation depends on responsible trust and coordination depends, among other aspects, on sharing ethos, language and standards. Responsible trust requires means for mutual testing of competencies and sincerity. On the other hand, moment to moment coordination of actions requires communications with and without channel capacity (Conant 1979). All these are aspects of the Viable System Model (Beer 1979, 1985, Espejo& Reyes, 2011).These requirements for cohesion can today be enabled by digital technology as they increasecoordination opportunities and the chances for local problem solving.

Managing Complexity: Strategies for Variety Balance

Variety is the next important concept; it is the number of possible states of a situation and measures complexity (Ashby, 1964). This measurement is principally relational: when is the variety of a situation matched by the variety of its regulator?This requires clarifying expected outcomes. If a collective work producing a particular software application and computer users are their intended customers, the matching of their varieties may be appreciated by the scope and quality of the services they receive. Customers' expectations about this relation are a way of measuring the variety balance between them and producers. Should producers meet the expectations of customers we would say that they have *requisite variety for this purpose*(Ashby, 1964). Better understanding of customers' expectations allows establishing whether the relation has requisite variety and this relates to performance measurement. The argument of requisite variety applies to all relations, from opening a door with your hands, implementing a children's care policyin a country to a system maintaining viability in its environment. Relations of all sorts beg complexity management strategies; going from achieving more with fewer resources, to creating a survival niche, to social systems *naming* different relations anchored in value co-creation with environmental agents. For commercial enterprises often value co-creation is defined by profits;but more and more organisational systems add social and ecological aspects to this value co-creation.

Complexity asymmetries in the relations between actors andagents are natural. If managing asymmetries is left to happenstance the likelihood are abuses of power, destruction of the environment and in general poor performance. Strategies to reduce hierarchies or strategies to limit the exploitation of customers and environmental resources or strategies to counter lobbies hijacking the policy agenda are necessary to make asymmetries more effective. All these are instances of relations that require strategies to achieve requisite variety at a minimum cost to people, enterprises, society and the environment. Since asymmetries are natural,their rebalancing to comply with the Law of Requisite Varietymust relyon the self-

organisation and self-regulation of actors and agents. In situations where environmental agents possess more variety than actors the more effective is their self-organisation and self-regulation the smaller will be the residual variety that they leave locally unattended and that requires actors' attention. On the other hand, the more effective is the actors' self-organisation and self-regulation the larger will be their variety to meet agents' expectations.

Thus, enabling self-organisation and self-regulation is an important complexity management strategy between actors and agents. Communications, if well designed, imply absorbing much relational complexity within the organisational system and the environment themselves. I propose the following criteria for complexity management:

1) Actors' self-regulation and self-organisation requires autonomy and cohesion. Effective unfolding of actors' complexity triggers more cohesive autonomous units with larger capabilities to match agents' expectations. Digital technology can play a role enabling interactions with agents and supporting recursively interlinked value co-creation processes.
2) Empowered agents are necessary to stretch actors and engage in value co-creation. Particularly, when agents are dispersed citizens and customers, their empowerment requires enabling their self-regulation and self-organisation.
3) Input and output transducers between actors and agents, with the clear understanding of the required ontological transformations to cross the boundaries from one side to the other of their communications. These are myriad loops recognising interactive recursions and languages.
4) Contextual amplifiers and attenuators to deal with the residual varieties left unattended by actors and agents. For instance this is a role played by the markets.Internet companies like Google and Alibaba facilitate this role of the markets by providingone to many, many to many (e.g.person to enterprise or enterprise to enterprise or person to person) matching of varieties.
5) Constituting autonomous and non-autonomous actors is an outcome of purpose-in-use. Autonomous actors produce what the organisational system does, regardless of the collective's espoused purposes. Non-autonomous actors may have the ingenuity to create new meanings, but unless they are *produced*by moment-to-moment interactions with agents they will remain as created but not produced meanings. Agents in the environment have their own purposes and produce their own meanings, and it is in the on-going communications between actors and agents that value co-creation takes place. It is as an outcome of this process that autonomous actors emerge in the organisation system and also in the environment for different purposes. In these communications actors constituted as operationally closed autonomous systems are not only producing products and services for their "customers", but also, are self-aware of this production and are more or less successfully computing models of their doing. Autonomous systems, with identity, are self-referential; they can reflect upon their doing and learn as they compare this doing with their computation of this doing. Agents and actors are learning when they are mutually engaged in value co-creation. It is in these communications that meanings emerge. In the language of Heinz von

Foersterin this process “eigen behaviours” shape the “objects” emerging from interactions (Foerstervon, 1984, Kauffman, 2003). Epistemologically, whenever the products of an organisational system are objectified it signals that this system is not engaged in a formative process (eigen formation). In the language of variety, the asymmetry between actors and agents is dominated by one at the expense of the other limitingvalue co-creation. Today, supported by digital technology and internet,the complexity absorption capacities of agents and actors is being increased. The structural implications of these technological developments are large indeed. An “objective” product is more likely to emerge from hierarchical organisations, on the other hand value co-creation relies on purposeful recursive structures with large capacities to create distributed, but aligned, meanings. This situation is mirrored in the environment. Disempowered agents, as ordinary customers usually are, have a limited capacity to stretch the organisational system and fail realising its structural recursion; this situation makes more likely “objective” products, lacking the advantages of co-creation. On the other hand empowered agents may move in the direction of self-regulation and self-organisation and through these strategies articulate their needs and demands as stronger “consumer” groups; the organisational system will need structural recursion to satisfy their expectations.

6) Balanced value co-creation processes has the potential of getting the best out of actors and agents,increasing the chances of fairer variety balances. Kim’s OADI-SMM model (Kim 1993, Espejo el al 1996) for organisational learning (observe, assess, design and implement and shared mental models)makes apparent cognitive learning; observations are inputs to the organisation’s assessment of customers’ expectations and actions and these actions are inputs to the actors’ collective computation of the organisational system’s doing. Actors compute and reflect as the situation unfoldabout their actions. The stronger is the system’s identity the more chances for self-reference. However, if there is no operational closure any doing comes back to individualsand not to the organisational system; this may support their individual learning, but not organisational learning, as these “actors” lack shared mental models. Operational closure is necessary to compare the actors doing with their computation of this doing. This needs real-time reflection about the doing or self-reference. If the computation is a good model of the situation being regulated (Conant and Ashby, 1970) the chances of learning grow over time. Beer’s argument for real time[2] is a strategy to improve these computations; unfortunately actors often manage a surrogate world (Beer 1973). Actors’ actions underpinned by good self-referential complexity management strategies contribute to value co-creation with agents. This is an important issue for the network society; much effort is lost by networks as agents aim chaotically at value co-creation. Beer’s Viable System Model offers a powerful complexity management heuristic for those aiming at transforming a collective of agents into actors of a self-referential organisational system.

[2]The complexity absorption capacity of a good model grows with data in real-time. This was the vision of the Cybersyn Project in Chile (Beer, 1981, Medina 2011, Espejo 2014a)

Dynamic Capabilities, OrganisationalPotentialsand Performance

Threeadditional conceptual clarifications are necessary before I discuss four vignettes of complexity management strategies for policy processes; these are dynamic capabilities, organisational potentials and organisational performance: how effective is policy creation and implementation and how good is the balancing of environmental and organisational varieties.

I argued earlier that the relations between actors and agents are driven by expectations, demands and the need to perform. These are learning relations of value co-creation, constantly changing as contextual and environmental conditions change. For instance environmental complexity grows for an enterprise as it moves from solely economic performance to social, ecological and economy performance. These are conditions stretching actors to sense and seize opportunities to meet learning challenges and create and produce new dynamic capabilities (Teece, 2008).Environmental stretching is a drive for re-configuring resources. For instance environmental challenges may trigger alternative unfoldings of complexity. New autonomous units may emerge thus de facto changing capabilities. But, making effective different constellations of autonomous actors requires attention to maintaining and extending the cohesion of autonomous units. Two aspects need attention; empowering autonomous actors as roles capable of value co-creation in their interactions with agents and, as said before, contributing to a cohesive network of actors with responsible trust and operational coordination (Espejo, 2001). Today the scope for this real time dynamic construction of capabilities is orders of magnitude larger than it was at the time of the Cybersyn Project in Chile (Espejo, 2014a); today network formation is enabled by digital and the internettechnologies.

Building dynamic organisations is more than reconfiguring operational resources (i.e. dynamic capabilities). Interactions with agents different to those related to the current doing offer long-term possibilities. This is necessary for operational closure and self-reference with the ability to innovate. Actors need to be part of interactions offering potentials for co-evolution in a wider context. These interactions should be sensitive and responsive to agents distributed recursively in response to the nature of the policy issues at stake. Policy networks may be global, national, sectorial and local. At all these levels agents need gliding in demanding environments The recursive nature of these policies suggests several levels of “gliding conversations” with relevant agents shaping the future to “detect and anticipate concerns". Reflection and self-reference open possibilities to work out who these agents are; interactions with these agents are not driven by “product” eigen forms but by “potentiality” eigen forms anticipating the need for new organisational forms to glide in stormy conditions in the problematic environment. It is driven by “issue” co-creation with environmental agents. I’m talking of organisational potentials beyond dynamic capabilities.

Finally, organisational performance is the outcome of product value co-creation and issue co-creation. The first is measuring variety balances between the organisational system and the operational environment, the second is measuring variety balances between the organisational system and its problematic environment.

Case Studies

I now illustrate networks of agents and actors, such as individuals, government agencies, enterprises coming together over time, through design and self-organisation, into organisational systems to manage the complexity of policy processes. In four vignettes I show shortcomings in these strategies using the framework developed above. The first vignette illustrates some of the shortcoming of child services in England in recent years. The second makes apparent the degree to which weak autonomy in an enterprise hinders its marketing policy. The third shows learning limitations in energy innovation derived from energy technology development enterprises having energy production enterprisesas their markets rather than energy users. The last vignette illustrates, with reference to the 2008 financial crisis, some of the costs of an economic policy that failed to understand its impact in society in general and the economy in particular.

Case 1: Two Interdependent Policies: Community Empowerment and Local Child Services

In the early 2000s the Home Office in England was engaged in a policy to empower local people to increase their influence in local policies. Through the programmes Active Learning for Active Citizenship and Take Part, significant resources went to increase individual capabilities and enable self-organising processes in the community. The aim was strengthening people's stretching of local services, among others children care. At the same time child care failures were being highly publicized. These failures led to parliamentary debates and government responses. The performance of a service in its relations with a local community was under scrutiny.

There is evidence that a majority of citizens feel that their influence in local decisions is very limited (Espejo and Mendiwelso 2011) but my point is that even more influence may not be enough for more effective interactions with local services. Increasing performance is more complex than increasing citizen's capabilities. Achieving a better relational performance requires more than building agents' capabilities, it requires improving organisations.

This vignette illustrates aspects of the organisational system for child care in a London district. As many other policies, child care brings together a wide range of resources such as health services, education, police and local government. Additionally in England national regulatory bodies monitor its performance. Local communities challenge government services. Though learning may increase people´s strength and independence to stretch operationally and strategically these services, increasing performance is more difficult. For instance a local authority's initiative to build up partnerships with third sector voluntary organisations may backfire if making resources available to them, with the expectation of strengthening their long-term viability, reduces local independence in aspects where they have to be critics of local service providers. Value co-creation is debilitated. This is compounded when the structure of the organisational system is weak. I suggest this was the case with child care in Haringey.

People in general and politicians in particular are uncomfortable with re-organisations. Unfortunately politicians under pressure often fail to see that it is necessary more effective complexity management strategies. The example of 'The Tortured Life of Baby P' tragically illustrates this point. This was the case of baby "p" in the London district of Haringey (Economist, Nov 20th 2008).

The death of a one and half year old child in the hands of his mother and two others gives a painful reminder of these failures. The child was in the list of the children 'at-risk' of Social Services in this London District. In the last six months of his life the child had been seen not less than 60 times by doctors, social workers and others. In spite of that the child had a cruel death. Anprevious public inquiry triggered by a similar event in the same district had recommended yearly child care performance reports in the context of an overhaul of social services in England. However, sadly, this response was not good enough to avoid the recurrence of a similar event. Not long after baby P's death a report was issued by English Child Protection regulator. The new tragedy had made apparent the inadequacies of the earlier response; in the future yearly visits to every child protection unit in the country were to take place once a year to assess performance on the ground. The organisational system for child protection in England was again off the mark; child protection services are part of local authorities and not of a national child protection agency, thus in terms of structural recursion it should be expected an autonomous child protection unit monitored by its local authority and not by a national body. The reason for this is simple, one must assume that corporate managers in local authorities negotiate with their child protection services (as with all other service departments) the allocation of resources for their programmes and therefore monitor regularlytheir capabilities, and not only once a year. In the end, the local authority should be accountable for the services' performance. Local authorities with weak resources bargaining are more likely to experience poor performanceas local agents find it more difficult to engage in appreciative value co-creation with them. The earlier similar events in the same district were pointing the finger to its local authority. Yet at the time no one was asking publicly for a revision of the Haringey District Council's processes and structure. Indeed, since the monitoring was being carried at the national levellocal authority had their authority undermined. From a structural perspective, to have a national regulator monitoring the performance of hundreds of local child services around the country suggests a poor complexity management strategy andin particular a poor appreciation of monitoring. It should not be a means of hierarchical control, but a means of building up trust and cohesion within the local authority. Trust and cohesion are unlikely to happen with a well-rehearsed annual visit by a national regulator.

Visualising a recursive structure should help seeing communication requirements for effective interactions between citizens and policy-makers. This case illustrates that beyond increasing agents' capabilities it is necessary improving actors' structures for a better policy performance.

Case 2 Autonomy and market penetration

Trident

Trident was, and is, a small metal-mechanic enterprise in England (Espejo 2012). Its management was aware of the advantages of fostering autonomous agents inside the company and decided to implement a cell structure. My focus here is Trident's interactions with the market.

When a collective succeeds producing a recursive organisation, de facto autonomous units at several structural levels are communicating with environmental agents in their own niches. Autonomous actors, with operational closure, create their own cognitive domains different to that of the organisational system they are part of. They construct their own problems and develop their own problem solving capabilities. Autonomous units amplify the organisation's problem solving capabilities in the market but at the same time increase communication difficulties between structural levels. Each autonomous actor is structure determined and therefore more concerned absorbing environmental changes with reference to its own identity, rather than with reference to a more global identity. Their exchanges are disturbances that need accommodation in each other's realities rather than hierarchical impositions; there is the risk of significant communication gaps between them.

The purpose of this vignette is studying communications of local actors with customers. Trident and its embedded "autonomous units" needed to develop recurrent interactions with customers to develop their business. These were structural couplings between "autonomous units" - *business accounts* in Trident- and customers. Through the interviews I wanted to establish the strength of these accounts'*internal relationships*; were they successfully embodying their autonomy?Significant and recurrent internal interactions gave more chances for cohesion, self-reference and autonomy. Trident's autonomy was not in doubt; the company was responsible for its decisions and viability, the doubt was with its business accounts. Inquiries about interactions among actors confirmed that *within* Trident communications were hierarchical and that *business accounts'* decisions were made at the corporate level; they lacked cohesion and self-reference. There was no structural recursion within Trident.

This meant that communications were between Trident's,and not Accounts', representatives and customers. Trident was limiting the possible benefits of autonomous accounts dealing with and solving customers' problems. Achieving internal cohesion would have implied an organisation developing its dynamic capabilities, with distributed cognitive capacity, managing far more complexity than with no structural recursion. However, structural recursion would have made necessary communications between two different cognitive domains –those of Trident as a whole and of each of the accounts- which were far more demanding than hierarchical communications. In the end they settled for a hierarchical relationship.

The implications of this evolving relationship for business accounts interactions with customers were significant. Meanings for the organisation's products were not the outcome

of value co-creation. Demand and product supply were not the outcome of eigen processes but of unilateral customer requirements. Indeed, better quality communications were necessary to produce creative meanings for their products. But, however much corporate managers wanted to develop rich interactions with customers they had many other problemsin their plate. It is apparent that clarifying meanings in both directions requires more than one-off, occasional, interactions. These clarifications require *recurrent* interactions. Communication is a process of mutual adjustments and in-forming triggered by the *structural couplings* between actors and agents (Maturana 2002). This requires crossing each other's boundaries; clarifying purposes and understanding utterances. These are demanding processes that require time and dedication. Among other aspects, a *good communication*, beyond transmitting information, is the outcome of a history that requires efforts to see eye-to-eye and develop mutual understandings.

Whenever communicationshappen mutual adjustments and learning are happening in one form or another. The implications of adjustments and learning are particularly important for the relationship between customers and actors. Managing relationships with customers is crucial to a business strategy and encompasses far more than occasional interactions; among other aspects they encompass aligning business processes and mutual understanding of *capabilities* and problems. Trident's account managers were not creatively challenging customers nor were customers *stretching* them. There was no evidence that in the eyes of customers the accounts were co-creating products with them. Equally there was no evidence that accounts had conversations with customers beyond contacts with their buyers at the expense of communications with their planners and managers to learn about customers' programmes and problems.

Trident had two business accounts and 10 production cells; in the end value co-creation with customers was dominated by corporate managers at the expense of business accounts and cells, something that was reflected in their performance. Their viability was sustained by responding as sub-contractors to customers bringing their own designs rather than, as they wished, as innovators of new products. Their profitability was marginal and size had stayed unchanged over decades.

Case 3: Energy Producers as markets of Energy Technology Enterprises

Sharing a Policy Framework

This vignette illustrates aspects of variety balance between organisational systems and between customers and an organisational system. Many companies, institutions and institutional parts contribute to an energy organisational system. This vignette shows that for a particular policy self-organisation constitutessome of them as autonomous and others as non-autonomous units.

A challenge today, in a world threaten by climate change, is increasing the adoption of energy clean technologies. The question is which type of relations between energy consumers, energy producers and energy technology developers is most likely to support

socially responsible technology learning. In particular, who are customers for those developing new technologies? (Espejo, 2014b)

One option is making energy *producers* the markets for technology development enterprises (IEA 2003) another is making energy *users* the markets. The first option puts the emphasis in learning by doing; energy producers deploy new technologies as they buy them and through market preferences give more chances to particular technology development enterprises. Learning by searching remains within the energy development enterprises. This option fragments learning and makes less likely recursive learning and inclusion. It restrictsthe influence of final users in this learning and reduces the flexibility of adjusting technologies to local conditions.

When energy producers are the markets for energy technology developers their learning is restrictedby embedded autonomous unitswith limitedscope for recursiveenergy technology innovation. The challenge is structuringless constraining learning mechanisms.

To support our discussion I'll focus on the wind energy sector, whose development depends on the contributions of different types of enterprises, some of them doing exclusively R&D, others mainly deploying technology, others producing energy and so forth. Should these enterprises be autonomous or non-autonomous units? In the end, as I explain below, this is a policy decision.

In a recursive organisation with the purpose of producing energy only those producing wind energy for final customers should be autonomous.These are units aligned with the sector's purpose, amplifying its complexity through their autonomous performance. Those enterprises doing research and R&D are contributing to the sector's innovation and therefore should not be autonomous, *but often they are large enterprises with purposes of their own*. It is thus tempting to see them as autonomous and make energy producers their markets (cf. IEA, 2003). In this context, performance relates to products' deployment and not to energy use. This policy supports fragmentation. This is in contrast to integrating energy producing and technology development in a recursive wind energy organisational system;this offers the possibility of learning by doing and learning by searching at several structural levels. A recursive structure, if properly implemented, has distributed governance; each autonomous unit –sector, enterprise or plant- has its own capacity for creating, regulating and producing aligned policies.

The wind energy sector is responsible for developing capabilities with its embedded enterprises, that is, through resources allocation it should integrate, reconfigure and gain and release resources to deal creatively with the operational stretching of the sector's environment.

Considering thatrequired investment for innovative technology often goes beyond the possibilities of individual enterprises, developers of energy technologies need funding from the public purse and consumers [through prices]. Therefore they should contribute to an energy producing organisational system that is accountable to public energy stakeholders. The values of producers and stakeholders should be transparent and aligned with the viability

of this organisational system. Beyond expert opinion the judgments of policy-makers should be supported by stakeholders in virtuous loops of influence aligning their values (Espejo, 2014b). It is necessary designing variety balance loops between these stakeholders and the energy producers. It is necessary building capacities to increase the stretching power of the silent majorities and it is necessary enabling the dynamic organisation of a largely self-organising wind energy sector. Together to the stretching of energy producers by customers (i.e. the silent majorities), the stretching of new technology by active (perhaps vociferous) representatives should shape policy-making.

From a learning perspective, making wind technology development enterprises businesses in their own right is a boundary judgment with significant implications for the related enterprises; as independent businesses, rather than as R&D components of an energy system, their customers are energy enterprises buying and deploying these turbines. Their relations with these enterprises are commercial. The final energy user is decoupled from them, thus making it less likely that their decisions and learning will take into account the *social*and *ecological* implications of exploiting wind technology. Additionally, they are decoupled of recursive policy processes within the wind sector reducing the chances for innovation and change. Independent R&D enterprisesincrease their distance from energy consumers and reduce opportunities for an integrated 'learning by searching' and 'learning by doing'. Their learning will be mostly by doing at the sectorial level and driven by corporate commercial values, rather than by doing and searching at all structural levels driven by social, ecological and commercial values. The policy-making process would fail to close an appreciative cycle with stakeholders and thus makes*weaker the energy technology learning*.

On the other hand, as R&D components of the wind energy system they share with energy producers the same *policy framework* [that of the energy wind sector] and therefore the chances of a stronger alignment with energy consumers. In this latter case resources for technology development can contribute to innovative energy production at several more local levels of recursion. Energy and R&D resources would be monitored by 'recursive policy-makers' in the search for policy options at several structural levels. For an effective 'learning' R&D wind turbine enterprises and enterprises energy producers should operate under the same policy framework. Their learning is grounded at the same time in the sector's doing and searching. In this context producing energy is accepted as the purpose of developing wind turbines and improving communications between policy-makers and stakeholders as a means of improving learning processes. This is a mechanism for value co-creation, reflexivity and self-reference.

As for energy learning, at least in theory, bringing energy technology enterprises within the energy system should help resourcing innovation recursively and improving the recursive checks and balances of deployment enterprises. These structural changes should make more robust technology learning. The performance of the energy organisational system will be the outcome of improved variety balances between the energy system and stakeholders (energy users) at several recursions.

Several aspects need to be considered about these variety relations. They are the outcome of myriad variety balances each contributing to the overall performance of the energy system. Beer´s Viable System Model andEspejo´s VIPLAN Methodology (Espejo and Reyes, 2011, Chapter 11) provide heuristics to deal with distributed performance.

Case 4 The Economy as an Organisational System

The 2008 Financial Crisis: the risk of constituting dysfunctional autonomous roles.

The economy of any social system is largely self-organising. It is constituted by multiple agents each striving for their own viability. In this context it is natural to find all forms of cooperation and competition; however the problem in the end is an economy aimed at the wellbeing of the most rather than at the wealth extracting of the few holding the levers of power. It is in this overwhelmingly competitive jungle that autonomous and non-autonomous roles are constituted and not always with the wellbeing of the whole in mind. Agents' self-organisation needs regulation and support. This vignette illustrates how a collective's lack of appreciation of complexity management strategies leads to unnecessary cost to people, organisations and society. It is a reflection of the 2008 financial crisis.

Risk management is necessary to reduce the consequences of failure. In a forest a forester response to the trade-off between high yield and possible fires is building 'fire breaks' restricting connectivity between the trees; these are the breaks - structural constraints- that the regulators of the economic and financial systems failed to visualise before the 2008 financial crisis and unfortunately it would appear are still failing to appreciate.

From their own accounts economists failed to see the non-linearity of the financial system. They thought that each banking institution could contain its potential failure, without considering rippling effects in the wider system. Policy-makers and senior managers failed to see that the financial services were strongly interconnected, in particular by derivatives leveraging several times over their capital across the globe; rather than fire contained in individual banks the situation was a financial ecosystem catastrophe (Haldane and May 2011). Big banks were effectively global banks that affected the global economy; these banks 'were too big to fail'.

Applying the concept of complexity unfolding, it can be argued that this domino effect was more than a systemic failure of the financial system; it was a failure of the economy's organisational system. The big, global, banks were operating, and still are, largely weakly coupled to national, regional and local economic systems. Finance should be a service to the economy and not an autonomous system, detached from it. Its autonomy should be contained. The fact that before 2008 they leveraged assets several times over capital makes apparent that their purpose was making money and not making viable the economies they were supposed to serve. In fact, in the UK, the growth of financial instruments before the crisis outpaced three times the growth of the economy (Haldane and May, 2011). The country was not only extracting wealth from the rest of the world but dangerously fragmenting financial services from economic activities.

Complexity unfolding implies autonomous systems within autonomous systems. At the global, national, regional and local levels it implies successful, viable countries, regions and localities with economies underpinning quality of life and full employment. These systemic levels emerge from variety balances; whenever the regulator, in this case the mechanisms of governance, overreachesits regulatory capacity a new structural level may be necessary. The problem is avoiding unfair extraction of wealth from the powerless and enabling the emergence of self-organising and self-regulating social and economic units with their own regulatory capabilities, which may lead to further unfolding into contained autonomous units. These regulatory levels trigger structural constrains to manage the huge complexity emerging from the global connectedness of billions of people; these should be autonomous units with high internal connectivity weakly related to other autonomous units with high internal connectivity. By containing complexity through autonomous systems the strategy is adding resilience to the economic system; regulation is just that that is necessary to enable the cohesion of autonomous but not independent systems. Market economies often misunderstand this strategy; free for all is a strategy blind to social connectivity. The financial crisis could have been ameliorated had banking activities been contained by smaller autonomous economic systems focused on local economies rather than on extracting resources for the wellbeing of powerful nations and few bankers. Evidence supporting this argument is the better performance during the crises of economies like the German, where smaller local banks are common, compared to more financially oriented economies. For instance in the UK, where small banks are less common, decoupling retail and investment financial activities has proved far more difficult, even if recognised as necessary. It is necessary to address risk at the economic systemic level and not only at the financial level.

For Haldane and May addressing risk at the systemic level implies tinkering with retail and 'casino' (investment) banking. The UK government wants shaping financial structures, especially among institutions deemed 'too big to fail'. Though breaking banks this way may help reducing risk, it does not address the issue of financial services as non-autonomous services distributed in the economy. Still there is the view of banks as businesses pursuing their own purposes rather than those of their related economic systems. At the national level the organisation of the economy (as an organisational system) continues to be driven by blind fragmentation and not by the wellbeing of the people at the global, national, regional and local economic levels. Making the financial system an autonomous unit is fragmenting the economy dangerously; it is accepting working for the viability of financial institutions rather than for the viability of the economies they are supposed to serve. Constrains have to be placed encompassing financial services together with social and economic interests. This is a means of regulating their unrestricted, wealth extracting. To limit risks, and restrict the diffusion of failure, large and small banks need to work out their embedding in the several levels of the economic system; the German system with small banks gives more stability to the economy and decouples risks for smaller banks from larger ones.

My argument is for distributed regulation of the economic activities. Cybernetically a good regulator of a system is a model of that system (Conant and Ashby, 1970). Financial services should be regulators of the economy, and following Conant and Ashby, good regulation

should map the economy's unfolding of complexity from the global to the local; economic aspects have to intertwine with financial aspects at all structural levels under the economic system umbrella. Furthermore, the strategy of structurally large financial services, that is, financial services dominated by large international banks, located in financial centres like New York, London or Frankfurt and in their turn regulated by centralised regulators like the Federal Reserve, the Bank of England or the European Central Bank, is dangerous. Tough this structural arrangement appears to accept finance as a service it lacks requisite variety for the very same reasons that led to the 2008 financial crises; global banking assumes an integrated economy that is not the case and the large interconnectivity of financial services fails to see economic structural recursion, something that strengthens the fragmentation of the economy. Accepting that it is a tall order, decentralisation of financial services and financial regulation should be beneficial to the global economy in the longer run.

To summarise, if agents that should not be autonomous become autonomous and therefore dysfunctional to the policies of the social system, their evolution as autonomous, dynamic non-linear systems, makes them sensitive to small changes and to self-organised criticality, which in this case may threaten not only their viability but the viability of the larger system that they should support and regulate. In other words, a small addition of risk may produce a big unexpected change as the system reaches its self-organised criticality: "a single sub-prime grain produced the self-organised criticality of the financial sector" (Haldane and Nelson, 2012) and challenge the stability of the whole economy. Without building appropriate 'walls' within the system crises may spread rapidly throughout.

Coda

Performance of a Social Market

Exploring a Third Way

I have focused my contribution on variety engineering and strategies to manage complexity. Only to a limited extent I have mentioned the relevance of digital technologies in variety engineering. These technologies increasingly dominate relationships between organisational systems and stakeholders/ consumers. They permit higher resolution relationships and allow the visualisation and co-production of new products and services. Drivers of these relationships are self-organising processes producing organisational systems and shaping environments.

Enabling of self-organisation and autonomy can significantly change market relationships. The market's invisible hand can now be made far more transparent, including social, ecological and economic aspects. The potentials for coordinated policies are significantly larger than with hierarchical controls or independent loosely regulated enterprises. With digital technologies it is possible to counter structural hierarchies by increasing cooperation and coordination. This trend, based on cooperation and trust, may have important structural consequences; capitalist markets controlled by large and powerful enterprises, at the expense of the creativity and innovation of smaller enterprises and the voice of communities and

localities, can now be reverted as larger associations or commons allow bottom-up production of complex products and services. New complexity enterprise models are possible where the *economic market* plays a smaller role.

Potentially, the environments for these new enterprise forms are now dominated by consumers and civil societies concerned with social and ecological responsibility, rather than exclusively economic interests. These new consumers have now the chance to understand that they are not necessarily in the hands of whatever producers want them to consume but share the driving sit co-creating and selecting the products they need. The power of these stakeholders and consumers can be enhanced by self-organising processes that stretch producers with the richness of their local understanding.

I have highlighted self-organisation to underpin producer/consumer relationships. Organisational systemsneed processes to build up dynamic capabilities to deal with increasingly challenging environments. Stakeholders/ consumers gain strength through social partnerships and interest groups. The relative complexities of these relationships vary according to their purposes. The complexity of environmental stakeholders is much higher than that of organisational systems if the purpose is making apparent ecological and social concerns. If the purpose is making apparent to stakeholders the opportunities offered by new products and services, the relative complexity of organisational systems may be larger. In the former case person to person and person to group relationships supported by digital technology can absorb ecological and stakeholders' complexities in the environment thus making more meaningful their requirements. In the latter case improved organisational structures can add flexibility and diversity to whatever is offered to stakeholders. Together these two directions of complexity management should increase opportunities for sophisticated social, ecological and economic products and services, in tune with the values and sensitivities of today's societies.

The role played by technologies in these recurrent interactions is particularly significant since they enhance or restrict possibilities and make more likely that natural complexity asymmetries are overcome with good power rather than bad power (Mulgan, 2007). Variety engineering offers a third way to build up relationships between organisational systems and markets and environments.In this contribution I'marguing for organisational systems capable of co-producing powerful products through recurrent interactions with social, ecological and economic stakeholders.

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Zero-time Cybernetics

Ximena Dávila & Humberto Maturana / Humberto Maturana & Ximena Dávila
Santiago de Chile, Winter 2014

In our presentation we will talk from the understanding of what we call in Matríztica the science and art of ontological / epistemological thinking in cultural biology. In this research framework of the biological-cultural nature of being human, and in order to expand our understanding of the relational-operational domain in which the human arises –where it is daily made and preserved- we propose changing the perspective of cybernetic processes to what we call Zero-time Cybernetics.

Speaking of Zero-time cybernetics, we talk about the happening of recursive systemic processes, which are observed and understood in the continuous changing of their present. Thus we speak of a cybernetic process when we refer to a recursive dynamic operational conservation of a relational configuration, in a continuously changing system in the realization of its identity.

In Matríztica we are distinguishing the understanding of the changing dynamic architecture of our living in the no-time or zero time, to examine, to see and understand the current operation of the systems without the use or introduction of semantic arguments or notions to explain what is going, in and with them, in the flow of their existence.

Moreover, we are particularly interested in understanding how the imaginative past invented (that we generate) as an explanatory notion using the imaginary time dimension, operates at time zero of the continuous changing present in the daily life preserving pains, trivia, joys which were experienced in the past, as if they were valid in the now that is being lived, and therefore leading to suffering and blindness that do not belong to the present that is being lived now.

In this drift, and from the confidence that the validity of what we say is in our understanding of the realization of our living as molecular autopoietic systems, we show how it arises and it is possible a liberating conversation, through the understanding of the biology of love, which in its reflective openness enables us to see and understand our living and living from ourselves in our biological-cultural living in languaging, conversing and reflecting, as human beings whose origin and evolutionary conservation is the foundation of their way of life and living together that is primarily loving.

Congress Themes

1

Digital Society & Business Ecosystems

Transforming educational practices at University of Los Andes with ICT

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Abstract

University of los Andes in Bogota, Colombia, is a private university with institutional accreditation by the Ministry of Education since 2005. Excellence in teaching has been a constant through its academic life. Information and Communication Technologies--ICT--for academic management and in support of teaching has been part of Uniandes´ resources for decades. With its 65th birthday the University launched CONECTA-TE, the Center for Educational and Technological Innovation, organization that intends to transform educational practices at all educational levels of Uniandes. Undergraduate campus-based programs will increase ICT-based methods and tools, in order to foster student´s autonomy with support of flexible learning environments; graduate programs will become predominantly blended (online / offsite) with the aim of reaching regional and international students that can learn while working and studying from their workplace; Massive Open Online Courses will be available for the academic community across the world, with the best of our faculty; future students at Uniandes will be able to participate in online learning communities that will prepare them for the challenge of studying in one of the best universities of the country. These initiatives require a transformation from within, and Uniandes is working on it. This presentation will share strategies in place to transform educational practices, commenting on educational, organizational and financial issues, human capital, technology and educational technology issues.

Keywords

Higher education innovations, educational transformation with ICT, blended learning, flexible learning environments

About the Authors

Luz Adriana Osorio Gómez is an associate professor at the Center for Research and Teaching in Education (CIFE), director of the Laboratory for Research and Development on Informatics and Education (LIDIE) and director of Center for Technological and Educational Innovarions (Conecta-TE), both at the University of the Andes, Bogotá, Colombia. Her doctorate is in Information and Knowledge Society (UOC, 2009).Her research interests include informatics and education, and hybrid and e-learning environments.

Alvaro H Galvis is a full professor from the Faculty of Engineering at Uniandes, as well as educational innovation´s advisor for the CONECTATE´s Center at Uniandes. His background is in Systems and Computing Engineering (Uniandes, 1973); his doctorate is in Adult Education (PSU, 1984). For nearly four decades he has been very active in the educational technology field, both in Colombia as in Costa Rica and USA. Some of his educational innovations projects have received international recognition, such as Ludomatica, project that was given the Global Bangemann Challenge by the major of Stochholm in 1999.

Revisión de literatura

La transformación de prácticas educativas con apoyo de tecnologías de información y comunicación en la Universidad de los Andes (Uniandes) exige revisar literatura sobre innovaciones con TIC en educación superior, así como de los procesos de cambio que hacen posible que esto se dé, para luego ubicar la transformación dentro del contexto de una universidad privada y orientada a investigación, con certificaciones de calidad, como lo es Uniandes.

Estamos de acuerdo con Salinas (2004, p.4) cuando dice que "la innovación es una forma creativa de selección, organización y utilización de recursos humanos y materiales, nueva y propia, que da como resultado el logro de objetivos previamente marcados; se trata de cambios que producen mejora, que responden a un proceso planeado, deliberativo, sistematizado e intencional, no de simples novedades, de cambios momentáneos,ni de propuestas visionarias". Indica que, tratándose de sistemas educativos, este cambio es complejo, pues implica nuevas formas de comportamiento y una consideración diferente de alumnos y señala que sigue vigente la afirmación de Fullan y Stiegelbauer (1991), en cuanto que "el uso de nuevos materiales y la introducción de planteamientos curriculares innovadores, o de las últimas tecnologías, sólo es la punta del iceberg: las dificultades están relacionadas con el desarrollo de nuevas destrezas, comportamientos y prácticas asociadas al cambio, así como con la adquisición de nueva creencias y concepciones vinculadas al mismo". Estamos, de este modo, en un terreno donde la transformación que conlleva la innovación educativa se da tanto al nivel organizacional como al personal, y en dimensiones múltiples que hacen que lo innovador gire alrededor de lo educativo, con participación de diversos actores y con el apoyo de las TIC y de otros medios que permitan avanzar en la dirección deseada. Según Salinas (ibid, p.6), la aplicación de TIC en acciones educativas abre diversos frentes de cambio y renovación, lo que exige considerar cambios en:

- Las concepciones educativas.
- Los recursos básicos: contenidos, infraestructuras, uso abierto de estos recursos.
- Las prácticas de los profesores y de los alumnos.

La gestión de los procesos de cambio que lleven a una innovación educativa involucra movimientos a nivel macro (institucionales, organizacionales, políticos, culturales, etc.) y micro (el aula de clase, los procesos enseñanza-aprendizaje), que le permitan a la institución educativa actuar de manera articulada, respondiendo a su misión y avanzando hacia propósitos compartidos que guíen la acción de los diferentes actores.

Collis (2004) sugiere tres fases en el proceso de innovación educativa: Iniciación del cambio, Escalabilidad del cambio (implementación), Institucionalización del cambio. Adicionalmente en cada una de estas fases, deben cuidarse aspectos institucionales y organizativos, pedagógicos y educativos (proceso enseñanza –aprendizaje) y tecnológicos, los cuales se articulan y complementan de muy diversas formas.

Por otra parte, dice Dima (2013) que las universidades no se entienden hoy en día como simples "organizaciones para aprender" sino esencialmente como "organizaciones que aprenden", lo que hace que la gestión de conocimiento en educación sea un tema fundamental. El conocimiento en la academia es uno de sus activos pero también uno de sus retos, pues hoy en día, dada la tasa de renovación del mismo y la existencia de medios digitales para almacenarlo, compartirlo, contrastarlo y renovarlo continuamente, hace que la diferencia radique en lo que se hace con el conocimiento y en su cultivo como fuente de saber nuevo, más que en los repositorios, sin que estos pierdan importancia. En dicho contexto los docentes, sus saberes y su saber-hacer en función de la impronta institucional de la organización en que colaboran, siguen siendo pieza esencial de la formación que brindan, y la gestión de

conocimiento a su cargo, para estar a tono con la era en que vivimos, requiere pasar de ser solamente transmisiva, para propiciar también aprendizaje activo e interactivo (Forté y Forté, 1998), de modo que los alumnos aprendan a aprender y los docentes sean co-aprendices que facilitan el proceso desde el lado (Collison y otros, 2000). Por esta razón coincidimos con Dima (ibid) en que "los procesos de innovación en gestión de conocimiento en educación hacen posible el cambio de la enseñanza como transmisión de conocimiento a la enseñanza como facilitación del aprendizaje". Este es el corazón del proceso de innovación apoyada en tecnologías para apoyar el aprendizaje en que Uniandes está comprometida y que da origen y razón de ser a Conecta-TE, su Centro de Innovación en Tecnología y Educación.

Contexto – Universidad de los Andes

La Universidad de los Andes desde el año 2003, inició la implementación de una estrategia institucional de incorporación de TIC en los procesos educativos. Esta iniciativa fue movilizada por la Vicerrectoría Académica, con el apoyo del Laboratorio de Investigación y Desarrollo sobre Informática y Educación (LIDIE). La Universidad de los Andes, basa su estrategia institucional de incorporación de TIC en un modelo que parte del acompañamiento a los procesos educativos del aula y llega hasta la definición de políticas organizativas e institucionales.

El proyecto AVA – Ambientes virtuales de aprendizaje como apoyo a los cursos presenciales -, surge en el 2003 como una iniciativa a nivel macro, la cual consiste en disponer mecanismos de acompañamiento a los profesores, con el propósito de diseñar ambientes de aprendizaje apoyados con TIC, de tal manera que enriquezcan las propuestas educativas de los cursos presenciales (nivel micro). Posteriormente, en la fase de expansión, se definieron nuevas políticas y estrategias organizacionales que motivaron la participación de las diferentes unidades educativas, lo cual permitió contar con un grupo amplio de profesores y cursos (148 AVAs de las diferentes áreas del conocimiento). Finalmente, en la fase de apropiación institucional, se avanzó en un continuo entre los niveles micro y macro, puesto que los requerimientos de los profesores al participar en el proyecto, han llevado a la definición de políticas y estímulos que faciliten el avance y aprendizaje en el tema a nivel institucional.

A partir de los aprendizajes logrados con el proyecto AVA y dada la necesidad de articular las estrategias de incorporación de TIC a lo largo de la oferta educativa de la Universidad, en el año 2013 nace Conecta-TE – Centro de Innovación en Tecnología y Educación - con el propósito de llevar a la Universidad a un nuevo momento en su oferta educativa, conscientes de las oportunidades que ofrecen las TIC y de la forma como éstas han permeado los diferentes ámbitos de la sociedad. Para ello, se vienen diseñando, implementando y evaluando mecanismos de apoyo con TIC a los procesos de enseñanza y aprendizaje de la Universidad, en los diferentes niveles: pregrado, posgrado y extensión, combinando estrategias a nivel micro y macro y considerando las dimensiones pedagógica, tecnológica y organizacional en las diferentes fases de las innovaciones educativas: piloto, expansión e institucionalización.

Enfoque de la innovación en Conecta-TE

La innovación en Conecta-TE se entiende como la introducción de cambios que generan mejora en los procesos educativos, apoyados con las posibilidades que ofrecen las TIC. Los cambios en los procesos

educativos tienen que ver con cambios en concepciones, prácticas y recursos educativos, como lo plantea Salinas (op.cit.). Los cambios en las concepciones, tienen como propósito generar espacios y condiciones para recrear conceptos como: enseñanza, aprendizaje, evaluación, aula de clase. Los cambios en las prácticas, tienen como propósito la revisión y rediseño de: metodologías y estrategias educativas, el rol del profesor y el rol del estudiante. Los cambios en los recursos, tiene como propósito el uso, adaptación y desarrollo de materiales y recursos educativos, en especial, recursos TIC.

Misión de Conecta-TE

Conecta-TE, busca enriquecer los ambientes de aprendizaje de la Universidad de los Andes, a través de la innovación pedagógica y tecnológica. La innovación debe potenciar el desarrollo de la autonomía en el aprendizaje, la flexibilidad pedagógica en la oferta educativa y la interacción en el proceso de enseñanza- aprendizaje. Para ello, diseña estrategias de acompañamiento y apoyo a los profesores, en el diseño, desarrollo y mejoramiento de sus innovaciones educativas con énfasis en el uso de TIC.

Visión de Conecta-TE a 2017

En el año 2017, Conecta-TE es un centro reconocido en la Universidad, por los procesos asertivos, flexibles y dinámicos de acompañamiento y apoyo a los profesores, en el diseño, implementación y mejoramiento a las innovaciones educativas y tecnológicas en los diferentes niveles educativos (pregrado, posgrado y extensión).

Estrategias para propiciar el logro de la visión y cumplir con la misión del Centro de Innovación en Tecnología y Educación de Uniandes

En Uniandes se hace uso de una variedad de estrategias complementarias para lograr que la innovación educativa florezca en todos los niveles de formación y en todas las disciplinas. A continuación una breve síntesis de las mismas.

Sensibilización de docentes hacia la innovación educativa con TIC

La forma de enseñar de muchos docentes cuya disciplina no es educación es “como a mí me enseñaron”. Las buenas experiencias previas iluminan los procesos de enseñanza, y la experiencia reflexiva sobre las propias prácticas ayuda a refinarlas. Con esto como punto de partida se decidió abrir un portillo a la innovación en prácticas docentes, a través de sesiones demostrativas de experiencias de incorporación de TIC en procesos educativos. En las sesiones, los participantes tienen la oportunidad de discutir diferentes aproximaciones pedagógicas y experimentar con herramientas tecnológicas que abren un universo de posibilidades de innovación en sus propias prácticas.

Apalancamiento de innovaciones lideradas por docentes

Como en todas las universidades, en Uniandes hay docentes innovadores que,por motivación propia, buscan cómo mejorar sus procesos de enseñanza y se atreven a hacer cambios en una o más de las dimensiones en que se puede dar la innovación. Para lograr esto se han lanzado concursos anuales para que los docentes que deseen participar lo hagan; las innovaciones pueden proponerse en cualquier

disciplina y por parte de docentes de planta que deseen dedicar un año a hacer realidad sus sueños de innovación en docencia y a someterlos a prueba, como base para posible expansión de la innovación.

Flexibilización de estudios de posgrado en modalidad blended

La educación de adultos, a la que Malcom Knowles (1984, p.12) llamó *Andragogía* para diferenciarla de la educación de niños y jóvenes—pedagogía, exige tomar en cuenta sus características como aprendices, las cuales incluyen tener autoestima desarrollada, traer experiencia previa y conocimiento relevante al proceso de aprendizaje; contar con motivación por aprender que está muy ligada a su campo vital, en muchos casos intrínseca y en otros casos ligada a su rol en las organizaciones donde colaboran; así mismo, tener orientación para aprender a partir de situaciones problemáticas, no sólo a partir de estudios temáticos. Por otra parte, los adultos suelen tener barreras espacio-temporales para aprender (García-Aretio, 1986), pues su tiempo debe compartirse entre familia, trabajo y estudio, lo cual exige ambientes y recursos flexibles para tener acceso a educación continuada, recurrente o avanzada.

Desde la creación de Conecta-TE se ha sistematizado la experiencia previa sobre oferta semipresencial de programas de formación avanzada y se ha puesto en práctica lo que enseña la experiencia internacional acerca de *bLearning*—aprendizaje en ambientes mixtos [en aulas presenciales y virtuales]—en educación superior; para esto se hizo seguimiento a experiencias exitosas de universidades líderes en bLearning (Galvis y Pedraza, 2013) y se construye sobre dicho conocimiento. Se creó un modelo para diseño de programas y cursos en modalidad *blended* (Mariño, 2014) el cual se está aplicando en trece programas de posgrado (especializaciones y maestrías) y ha permitido que la oferta de los mismos se expanda más allá del vecindario geográfico de Bogotá.

Experimentación pedagógica y tecnológica

La experimentación debe ser parte de la innovación, por lo tanto, una de las estrategias de Conecta-TE es el diseño de escenarios de exploración de posibilidades pedagógicas y tecnológicas que surjan de las iniciativas de los profesores o de la revisión permanente de recursos, prácticas educativas, experiencias de referencia, etc. Estos escenarios deben desarrollarse como pilotos de innovación, los cuales deben ser evaluados y sistematizados con el propósito de ser expandidos e institucionalizados. Tendencias como: clase invertida, ambientes *blended* de aprendizaje, cursos abiertos masivos en línea, tecnologías móviles, laboratorios remotos, hacen parte de los escenarios de experimentación en Conecta-TE.

Proyección al mundo exterior

La proyección al mundo exterior es central en Conecta-TE, tanto para llevar los aprendizajes logrados a nuevos escenarios de aplicación, como para realizar alianzas estratégicas a nivel nacional e internacional que permitan el enriquecimiento en doble vía de los procesos y la oferta educativa.

Ámbitos de implementación de las estrategias de innovación educativa con TIC

La innovación en los diferentes niveles educativos (pregrado, posgrado y extensión), se orienta desde los principios misionales: autonomía en el proceso de aprendizaje, flexibilidad pedagógica e interacción en el proceso educativo.

A nivel de pregrado se busca la innovación en los procesos de enseñanza y aprendizaje en las disciplinas, potenciando la autonomía de los estudiantes. La convocatoria anual de innovación docente con TIC es el mecanismo que ha permitido la selección de los proyectos acompañados. Se han seleccionados **34 proyectos** en las dos versiones de la convocatoria.

A nivel de posgrado se busca ampliar la oferta educativa y llegar a nuevos destinatarios, a través del diseño de programas que integran presencialidad con virtualidad (*blended learning).* Actualmente se trabaja en el diseño de **12 programas de maestría y especialización** en esta modalidad.

A nivel de extensión se busca ampliar la oferta de programas de actualización, llegar a nuevos beneficiarios y tener impacto social en temas de interés y relevancia nacional e interancional. Se han diseñado y ofrecido dos cursos por educación continuada dirigidos a la formación de profesores y orientadores en educación secundaria. Actualmente, se están diseñando cuatro MOOCs (*Massive Open Online Courses*), uno de ellos se publicará en Edx (plataforma para publicación de MOOCs, diseñada y administrada por Harvard y MIT) en alianza con el BID – Banco Interamericano de Desarrollo -.

En las diferentes iniciativas de innovación educativa en Uniandes, Conecta-TE ha trabajado con: 11 facultades y centros, 147 cursos, 163 profesores, 3665 estudiantes.

Conecta-TE en pregrado

Las iniciativas de innovación educativa a nivel de pregrado buscan propiciar la creación de entornos de aprendizaje y de enseñanza acordes con los postulados misionales de la universidad, con empoderamiento de los distintos actores del proceso y mejor aprovechamiento de los recursos en uso.

Durante el primer año del programa de innovaciones educativas con apoyo de TIC en pregrado, se lograron dinamizar todas las facultades y la mayoría de los programas docentes de pregrado que ellas ofrecen. Con muy contadas excepciones, en la gran mayoría de los departamentos docentes de la universidad uno o más de los profesores tomaron parte sea en sesiones de sensibilización a las innovaciones apoyadas con TIC (Conecta-TE al almuerzo), en programas de revisión y ajuste de la práctica profesoral a nivel de unidad de aprendizaje (Conecta-TE en vacaciones, Conecta-TE innovando), o en (re)diseño de un curso o buena parte del mismo, con evaluación de efectos o de impactos de la innovación en estudiantes o profesores.

Lo anterior significó que las pedagogías y los recursos tecnológicos de los cursos ofrecidos por los profesores que aprovecharon estas oportunidades se repensaron e instrumentaron, con prueba de usabilidad de los recursos preparados o integrados, y con seguimiento a la puesta en marcha de las innovaciones, con evaluación de efectos y de impacto cuando se trató de cursos.

Por otra parte, la exploración de nuevas ideas pedagógicas y de oportunidades tecnológicas para innovar en el pregrado exige hacer inteligencia a buenas prácticas que se puedan potenciar, así como a tecnologías de punta que se puedan integrar. Este es otro reto en el que la colaboración con los departamentos puede ser muy fructífera, pues permite rescatar profesores innovadores y ayudarles a escalar su práctica docente con apoyo de TIC, al tiempo que identificar, evaluar y adoptar o adaptar innovaciones.

Las estrategias para la innovación en cursos de pregrado se espera que se afiancen como modos de agregar valor a la docencia en este nivel, mediante la participación creciente de profesores en iniciativas

que les permitan apropiar y aplicar pedagogías activas, integrar herramientas digitales en su docencia, pero mucho más importante aún, mediante la investigación evaluativa de soluciones innovadoras en el contexto de la práctica profesional docente. Estas actividades individuales permitirán la consolidación de comunidades de docentes que se preocupan por el mejoramiento continuo de los procesos a su cargo.

Conecta-TE en posgrado

En el ámbito de posgrado, Conecta-TE busca apoyar la misión de la Universidad de ofrecer una excelente educación de posgrado llegando a más colombianos, mediante la estrategia de extender los límites espacios-temporales de la formación, desarrollando programas y cursos en modalidad de enseñanza semipresencial.Para apoyar este propósito se realizan tres tipos de acciones:
1. Consolidación de una metodología de acompañamiento al diseño, desarrollo, montaje, capacitación, implementación y evaluación de programas o cursos en modalidad *blended*. 2. Información y sensibilización sobre la modalidad y la metodología a profesores y directivos de diferentes facultades. 3. Acompañamiento grupal e individual en todo el proceso tanto a nivel de programas como de cursos.

En este año y medio se ha logrado un impacto importante en términos de población atendida con esta nueva modalidad de formación tanto a nivel de los estudiantes como de los profesores formados y de las unidades que están diseñando estos programas. A nivel cualitativo, en las dos unidades en las que ha completado el proceso—Facultadde Administración y el Centro de Investigación y Formación en Educación, CIFE—sehan realizado evaluaciones internas y/o externas que arrojan resultados muy positivos.Tanto en los programas de Administración como en el de Educación, los estudiantes resaltan que la flexibilidad de la modalidad les ha permitido acceder a la opción de hacer un posgrado en equilibrio con su vida personal y laboral. A nivel de evaluación externa cabe señalar que la Maestría en Gerencia Ambiental de la Facultad de Administración fue reconocida como la mejor en temas de desarrollo sostenible en Latinoamérica, según el escalafón de EdUniversal (2013).

Si bien una evaluación comparativa de los aprendizajes en las modalidades presencial o *blended* no ha sido posible, ya que muchos de los programas sólo existen en esta modalidad, los resultados cualitativos obtenidos en estas dos facultades así como las evaluaciones institucionales realizadas por los estudiantes muestran el alto nivel de la formación y respaldan los resultados arrojados por el Departamento de Educación de Estados Unidos que muestran que la educación *blended* es más efectiva que la educación presencial y la educación completamente virtual (Means et. al., 2009).

Un criterio importante de logro en esta línea es el bajísimo índice de deserción que han tenido los programas. La maestría en Educación *blended* no ha tenido deserción. La especialización en negociación muestra una deserción del 4%, la maestría en Gerencia Ambiental del 18%. Estos números contrastan con lo que se da en general en las modalidades *blended* y online en las que el índice de deserción se sitúa alrededor de un 30%.

La estrategia de desarrollar programas de posgrado en modalidad semipresencial es una línea prometedora para la Universidad, que le permite, sin ampliar su infraestructura física, atender a una mayor población y llevar los conocimientos de alto nivel a las regiones del país.

A corto plazo, se busca culminar el desarrollo, implementación y evaluación de los programas en curso, al tiempo que se continúa con la sensibilización de directivos y unidades y en análisis conjunto de nuevas oportunidades de formación *blended*.

A mediano plazo se espera consolidar el campus virtual de la Universidad, es decir conectar los procesos de formación *blended* que han estado a cargo de Conecta-TE y de las unidades académicas, con los otros procesos de soporte de la Universidad: inscripciones y registro, derechos de autor, biblioteca, comunicaciones y montaje de la plataforma institucional de *blended*, entre otros.

A nivel interno se continuará afinando la metodología de acompañamiento y desarrollo y se divulgará el trabajo en escenarios especializados. Se consolidará el repositorio de herramientas de objetos de aprendizaje y a mediano plazo se organizará un repositorio institucional vinculado a la biblioteca de la Universidad y a las facultades.

A largo plazo se espera enriquecer la formación *blended* y online con innovaciones tecnológicas y pedagógicas de punta, para convertirnos en líderes suramericanos es este tipo de innovaciones.

Conecta-TE en extensión

En Conecta-TE, se están explorando las posibilidades que ofrecen las TIC en escenarios complementarios al pregrado y posgrado. Este ámbito de acción tiene como propósito apoyar el desarrollo de competencias básicas iniciales, llegar a nuevos beneficiarios, ampliar la oferta educativa e impacto social a través de cursos de extensión.

La Vicerrectoría Académica ha diagnosticado la necesidad de fortalecer el desarrollo de competencias básicas en matemáticas y lectoescritura, como condición para aumentar la retención en el primer año en varios de los programas académicos ofrecidos. Con el Centro de Español y el Departamento de Matemáticas, se han diseñado cursos apoyados con TIC en estas áreas.

Los cursos masivos abiertos en línea, son una de las tendencias actuales en educación superior. Las principales universidades del mundo están diseñando y ofreciendo estos cursos, como alternativa para ofrecer educación de calidad a personas que no tienen la posibilidad de acceder a ella. Desde finales del 2013, la Universidad inició el desarrollo de cuatro MOOCs, con el propósito de experimentar y aprender sobre este tema desde el punto de vista pedagógico y tecnológico. Para tal propósito, se han conformado equipos de trabajo con grupos de profesores de diferentes unidades académicas.

Las iniciativas a nivel de preuniversitario representan una importante oportunidad de fortalecimiento al desarrollo de competencias básicas. Con los desarrollos realizados es posible generar gran impacto social con diferentes propuestas de entrega: MOOCs, cursos en modalidad *blended learning*, materiales y recursos para cursos presenciales.El desarrollo y puesta en marcha de los MOOCs representa un escenario de grandes aprendizajes institucionales, así como de grandes oportunidades para visibilizar contenidos, estrategias metodológicas, profesores y su trayectoria académica, tener información de los procesos de aprendizaje en las diversas disciplinas.

El ofrecimiento de cursos y programas profesionales en modalidad virtual y *blended learning*a través de educación continuada, representa un escenario de grandes oportunidades para mantener una oferta amplia de actualización a nuestros egresados y para llegar a nuevos beneficiarios. En este sentido es fundamental la alianza con las unidades académicas y la exploración permanente de las necesidades del contexto.

Mirada al futuro

Conecta-TE como programa institucional encargado de apalancar prácticas innovadoras que eleven la calidad de la docencia o que la flexibilicen para hacer más ricos, diversos y auto-gestionados los espacios y recursos para interacción académica, es una apuesta conjunta con las unidades académicas de la universidad, a la cualificación educativa de la docencia, a la investigación aplicada acerca de las innovaciones en docencia, a la reflexión continuada acerca de buenas prácticas docentes, retos y oportunidades de las mismas con apoyo de pedagogías activas y tecnologías digitales, así como al diseño de mecanismos de apoyo, reconocimiento y estímulo de los procesos de innovación educativa apoyada con TIC.

Cualificación de la docencia

La educación continuada de los profesores, de planta y de cátedra, es uno de los grandes retos institucionales, pues la calidad de la docencia tiene que ver tanto con el dominio disciplinar, la experiencia práctica profesional, como con conocimiento pedagógico y tecnológico relevante.

Investigación aplicada acerca de las innovaciones en docencia

El nuevo estatuto profesoral abre una oportunidad muy importante para favorecer que la innovación educativa florezca en las distintas facultades.Es importante apoyar a los docentes innovadores en la creación e instrumentación de diseños de investigación evaluativa que alimenten la preparación de artículos que puedan publicarse en revistas reconocidas.

Reflexión continuada acerca de retos y oportunidades de la docencia con apoyo de pedagogías activas y tecnologías digitales

Los siguientes retos son bien conocidos y ameritan reflexión y acción por parte de las unidades académicas con apoyo de Conecta-TE, así como la focalización de las acciones desde las necesidades académicas identificadas en la Universidad.

- Enseñanza en cursos de los primeros dos años de las carreras. La intención es que sus contenidos sean muy relevantes, con metodologías que promuevan aprendizaje activo y con tecnologías que flexibilicen el acceso y compartición del conocimiento.
- Cursos en los que la mortandad es muy alta o donde la información de retorno de los estudiantes es poco favorable hacia la manera de llegar al conocimiento.
- Cursos numerosos a cargo de un profesor donde se busca que muchos estudiantes a la vez logren participar en la construcción de conocimiento a partir de interacción dialogal con el docente.
- Cursos de servicio con múltiples secciones de estudiantes, a cargo de múltiples docentes, muchos de ellos de cátedra. En estos casos el reto consiste en asegurar la calidad de los elementos esenciales del curso, en construir sobre la diversidad de los docentes y de sus estilos de enseñanza, enriqueciéndolos con oportunidades pedagógicas y tecnológicas con las que ellos se sientan cómodos y les permitan a los estudiantes llegar y demostrar el conocimiento buscado.

Mecanismos de apoyo, reconocimiento y estímulo de los procesos de innovación educativa apoyada con TIC

A nivel institucional, se ha avanzado en la definición de mecanismos de estímulo y reconocimiento:

- Diseño de estrategias de acompañamiento a los profesores desde Conecta-TE.
- Descarga de los profesores para el diseño de innovaciones educativas apoyadas con TIC.
- Préstamos de administración central a las unidades académicas, para el diseño y puesta en marcha de las innovaciones, condonables por resultados de calidad y productividad.

- Reconocimiento como producción académica en el sistema de promoción de profesores, para los profesores que participen en los procesos de innovación y logren la sistematización de los resultados.

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Indicators for Monitoring and Evaluation of ICT for education: a systematic review.

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Abstract

Problem: Among different ICT4E frameworks: ¿Which are the relevant indicators to desing an M&E scheme of Inclusion, Use and Apropiation, suitable for public institutions of primary and secondary education at the municipality of Tunja?

Objectives: To propose a M&E scheme of inclusion, use and appropriation of ICT in the public institutions of elementary and secondary education at the municipality of Tunja, a systematic search is made to identify the ICT4E indicators and international frameworks with progress report and implementation status.

Methods: Publications have been consulted from databases such as SCOPUS, Science Direct, Google Academic, ProQuest and EBSCO.

Findings: The information was clasified in 2 ways. First in Frameworks and Indicators; second in Core Indicators.

Conclusions: It's proposed the "Stages of evolution" as ways to assess over time the development achieved in the execution of a Framework. Relevant indicators in different frameworks were identified and categorized to design an M&E scheme of inclusion, use and appropriation of ICT, suitable for the public institutions of elementary and secondary education at the municipality of Tunja.

Keywords: Education, Framework, ICT4E, Indicators, M&E

Introduction

After more than 30 years of research on the field of integration of ICT in education, it is now understood that ICT should be the tool to deliver contents and implement better educational practices, based on study plans and learning principles well defined and clearly designed. ((Rodríguez, P. et al, 2012), (Crook, C., 2012), (Draxler, A., 2008), (Jones, A., 2004), (Law, N. et al, 2008), (Losada Iglesias, D. et al, 2012), (Wastiau, P. et al, 2013<). Thus, to guide ICT4E practices, organizations like UNESCO and nations such as Africa, Australia, United States and the Netherlands, have designed Frameworks to set a benchmark of needed skills for its effective implementation, use and appropriation in educational environments.

To propose a M&E scheme of inclusion, use and appropriation of ICT in the public elementary and secondary institutions from tunja, it was made a review and identification of

the ICT4E indicators and international frameworks that feature reports of progress and implementation status.

It is presented a conceptualization of: Indicator, TIC, ICT4E, Assessment and Monitoring, and Frameworks oriented to ICT4E.

Indicator

Are ways to deliver a state, trend or warning about ICT in an educational environment. InfoDev (global multi-donor program arm of the World Bank Group), developed the manual: "Monitoring and Evaluation of ICT in Education Projects: A Handbook for Developing Countries". It has been designed as an introduction and quick guide for the policy makers and professionals responsible for understanding and evaluating current investments related to ICT in education. Herein, Kozma, R. & Wagner, D. (2005) examine 4 ways to measure or describe:

- ;' Input indicators: For example, the type of ICT equipment and/or software and/or organizational design features deployed in a classroom or setting.
- /' Outcome indicators: For example, student and teacher impacts (cognitive, aff ective and attitudinal).
- 7' National educational and socio-economic indicators: For example, educational enrolment rates, gross domestic product, human development indicators (such as gender equity, literacy, etc.) that characterize and distinguish a country and enable and/or constrain a project or program.
- 4. Cost indicators: For example, fixed, variable and recurrent costs.

ICT

Colombia Digital Corporation, (2013) defines ICT, sometimes called new technologies of information and communication technologies (NICTs): is a concept that is often used as a extended synonym for information technologies (IT). Although, Murray, J. (2011) states that it is a more specific term that stresses the role of unified communications and the integration of telecommunications, computers, computer software and business nature.

ICT4E

Is the ICT integration with teachers' technical skills, technical support, maintenance and modernization, pedagogical skills, preferences and abilities, availability of resources and student's skills and motivations for building a more dynamic learning environment. (Lloyd, M., 2005)

Evaluation

Evaluation is a systematic and objective assessment of an ongoing or completed policy, programme or project, its design, implementation and results. According to Marriott, N., & Goyder, H. (2009), the aim is to provide timely assessments of the relevance, efficiency, effectiveness, impact and sustainability of interventions and overall progress against original objectives.

Monitoring

Marriott, N., & Goyder, H. (2009) also define the monitoring as an ongoing function that employs the systematic collection of data related to specified indicators. It provides an early indication of the likelihood that expected results will be attained, as well as an opportunity for validating programme theory and logic, and making the necessary changes in programme activities and approaches. Monitoring provides essential inputs for evaluation and therefore constitutes part of the overall evaluation process.

ICT4E Frameworks

Rodríguez, P. et al (2012) supports that ICT should be the tool to deliver content and implement educational practices in better ways, based on well designed curriculum and clearly identified learning principles. Thus, when ICT is used to support teaching and learning activities, is referred the concept of Technology-Enhanced Learning, TEL (Dillenbourg, P., 2008). Although, to guide ICT4E practices; Teachers, Institutions and Organizations like UNESCO or Nations such as Africa, Australia, United States and the Netherlands, have designed Frameworks to set a benchmark of the needed skills for its effective implementation, use and appropriation at educational environments. ((Battigelli, S. et al, 2010), (Fernández-Díaz, E., & Calvo Salvador, A., 2012), (Gravie, R. F. F., 2012< ϚPeeraer, J., & Van Petegem, P., 2012), (Prendes Espinosa, M. et al, 2010), (Solar, M. et al, /8;7 <<'

Thus, there were identified 7 ICT4E frameworks and their most relevant and immediate indicators for its use, implementation and appropriation, such as:

;' UNESCO ICT Competency Standards for Teachers, 63 indicators.
/' ICT-enhanced Teacher Standards for Africa, 48 indicators.
7' ISTE: National Educational Technology Standards for Teachers (NETS-T), 84 indicators.
4. Australia: ICT Competency Framework for Teachers, 58 indicadores.
E' ICT-tools for a balanced use of ICT in the Netherlands, 36 indicators.
K' Metas Educativas 2021, 4 indicators.
J' ICT for the profesional development of teachers, 45 indicators.

Metas Educativas 2021 is not really a framework but it is included because it is an unanimously accepted proposal by the Ministers of Education meeting at El Salvador, on the XVIII Ibero-American Conference; a joint commitment to meet the challenges of their people through an education program.

Frameworks and Indicators

The Frameworks were studied according to 2 factors: 1. *Stages of evolution*, wich helps locate the evaluated subject or institution in a performance. For this work, the lowest level was defined as Inclusion, the intermediate level as Use and advanced level as Appropriation. 2. The second factor to analyse was the *Indicators' Categories* defined by each framework.

"# Unesco Ict Competency Standards For Teachers

It is a project, part of a series of initiatives by the UN and its specialized agencies, such as UNESCO, to promote educational reform and sustainable economic development. Provides a comprehensive framework for "capacity building" and "e-learning". Its primary aim is creating inclusive knowledge societies through information and communication. It is organized in three documents: The first details the "Policy Framework" underlying. The second examines the components of the educational reform and sets the framework of competencies for teachers. The third provides a detailed description of specific skills that teachers should acquire.

It has 3 stages of evolution, called Approaches for Teaching and indicators. It groups the indicators into 6 categories called aspects of teachers' work: 1. Understanding ICT in Education, 2. Curriculum and Assessment, 3. Pedagogy. 4. ICT, 5. Organization and Administration, 6. Teacher Professional Learning.

Table 1. Unesco ICT Competency Standards For Teachers

1. UNESCO ICT Competency Standards for Teachers			*UN*
Approaches To Teaching			
Technology Literacy	Knowledge Deepening	Knowledge Creation	
Aspects of a teacher's work			
1. Understanding ICT in Education			UN-1
2. Curriculum and Assessment			UN-2
3. Pedagogy			UN-3
4. ICT			UN-4
5. Organization and Administration			UN-5
6. Teacher Professional Learning			UN-6

'# Ict-Enhanced Teacher Standards For Africa

It was conceptualized and launched in 2009 by the UNESCO International Institute for Capacity-Building in Africa (IICBA), as one of the strategies for capacity building to strengthen the development of teachers in Africa. The development of ICTeTSA was also based on a research conducted by UNESCO in Africa and ECA-IICBA in 2008.

It has 4 stages of evolution, called Rubrics. It groups the indicators into 6 categories called Areas: 1. Engage In Instructional Design Processes, 2. Facilitate And Inspire Student Learning, Innovation And Creativity, 3. Create And Manage Effective Learning Environments, 4. Engage In Assessment And Communication Of Student Learning, 5. Engage In Professional Development Model And Ethical Responsibilities, 6. Understand Subject Matter For Use in Teaching.

Table 2. ICTeTSA

2. ICT-enhanced Teacher Standards for Africa.				*AF*
Stages				
Emerging	Applying	Infusing	Transforming	
Domains of ICTeTSA				
1. Engage In Instructional Design Processes				AF-1
2. Facilitate and Inspire Student Learning, Innovation and Creativity				AF-2
3. Create and Manage Effective Learning Environments				AF-3
4. Engage In Assessment and Communication of Student Learning				AF-4
5. Engage In Professional Development and Model Ethical Responsibilities				AF-5
6. Understand Subject Matter for Use In Teaching				AF-6

+# ISTE: National Educational Technology Standards For Teachers (NETS-T)

The text contains six standards with performance indicators, designed to be appropriate for state, universities or district guidelines. But they are still specific enough to define the scope of the topic. Performance indicators for each standard provide specific outcomes that are measured during the development of tools for assessing them.

It has 4 stages of evolution, called Rubrics. It groups the indicators into 6 categories called Standards Areas: 1. Technology Operations And Concepts, 2. Planning And Designing Learning Environments And Experiences, 3. Teaching, Learning, And The Curriculum, 4. Assessment And Evaluation, 5. Productivity And Professional Practice, 6. Social, Ethical, Legal, And Human Issues'

Table 3. ISTE-NETS

4. Australia: Ict Competency Framework for Teachers

The Framework articulates the competency standards for teachers working in government schools at Western Australia. Competency rules describe the different degrees of effectiveness in which teachers demonstrate efficacy applying their professional knowledge, skills and attributes in the specific teaching context.

It has 3 stages of evolution, called Phases. It groups the indicators into 6 categories called Dimentions of Teachers' Work: 1. Facilitating Student Learning, 2. Assessing and Reporting Student Learning Outcomes, 3. Engaging in Professional Learning, 4. Participating in Curriculum Policy and Other Program Initiatives in an Outcomes-focused Environment, 5. Forming Partnerships within the School Community.

Table 4. Australia: ICT Competency Framework for Teachers

/# ICT-tools for a Balanced Use of Ict in The Netherlands

It is a framework designed by the ICT OP, that aims to support the effective and efficient use of ICT in primary and secondary education, the institutions of the Netherlands. Part of this support is to develop a group of ICT-tools, to help educational institutions in the balanced implementation of ICT.

It has 3 stages of evolution, called Expertice/Vision. It groups the indicators into 3 categories called Infraestructure/Content: 1. Instruction and Practice, 2. Adaptive Learning Material, 3. Personal Learning Environment.

Table 5. ICT-tools for a balanced use of ICT in the Netherlands

1# Metas Educativas 2021

It is a unanimously welcomed proposal by the Ministers of Education meeting at El Salvador in the XVIII Ibero-American Conference; a joint commitment to meet the challenges of their people future as an update through an educational program leading to a more just society for all.

The paper presents indicators to assess progress of the program until 2021. There were identified 4 indicators related to the implementation of technology in education: Indicator 16: Computer's use frequency at school by students for learning tasks, Indicator 20: Ratio of students per computer, Indicator 23:% Design of Technical and Professional Careers, Indicator 24: % Practices at enterprises.

Table 6. Metas Educativas 2021

6. Metas Educativas 2021, 4 indicators.	*ME*
From 2015 Towards 2021	
General and Specific Goals	
INDICATOR 16: Computer's use frequency at school by students for learning tasks	ME-16
Indicator 20: Ratio of students per computer	ME-20
INDICATOR 23:% Design of Technical and Professional Careers	ME-23
INDICATOR 24: % Practices at enterprises	ME-24

3# ICT Competencies for the Professional Development for Teachers

It is the result of a work led by the Educational Innovation Office, from the Ministry of Education of Colombia. The document is intended to provide guidelines, criteria and parameters for those who design and implement training programs for teachers and practicing managers, and teachers willing to take on the challenge of developing and training on the educational use of ICT.

It has 3 stages of evolution, called Levels. Groups the indicators into 5 categories called Competencies: 1. Technological, 2. Pedagogical, 3. Communicative, 4. Management, 3. Investigative.

Table 7. ICT Competencies for the Professional Development for Teachers

Core Indicators

Indicators for each of the studied frameworks cover topics such as implementation, monitoring, plan design, policies and custom models, Monitor and Evaluate effective inclusion status, use and appropriation of ICT. Kozma, R. & Wagner, D. (2005) identify useful Core Indicators to be considered in any study of monitoring and evaluation of ICT for education. Based on this input the frameworks where analized according to how they conceived the evolution over time (Stages of Evolution), of the implementation of the framework. Shown in the following table.

Table 8. Stages of evolution of the Frameworks

The frameworks were correlated by the categories of indicators that each defines, identifying their membership into the Essential indicators groups, as it's shown in the following table.

Table 9. Indicators of the Frameworks

	CORE INDICATORS	CATEGORY OF INDICATORS	FRAMEWORKS' INDICATORS						
Inputs	1. Classroom ICT resources	1. ICT	UN-4	AF-1	NS-1	AU-1, AU-2, AU-3, AU-4, AU-5	4B-2	ME-20	CP-1
		2. Learning environments	UN-5	AF-3	NS-2		4B-3	N/A	CP-3, CP-4, CP-5
	2. Teacher training	3. Teacher Professional Learning/development	UN-6	AF-5	NS-1	AU-3	4B-1		CP-2, CP-3, CP-5
				AF-6	NS-5				
	3. Classroom pedagogy	4. Pedagogy	UN-3	AF-2	NS-3	AU-1	4B-1, 4B-3	ME-16	
Ouputs	4. Student knowledge of School subjects	5.Assessment	UN-2	AF-4	NS-3, NS-4	AU-1,AU-2	4B-1	N/A	CP-4
	5. Student attitudes			AF-2	NS-3, NS-4, NS-5	AU-1, AU-2, AU-5			CP-2, CP-3, CP-4
	6. Student skills				NS-3, NS-4	AU-1,AU-2			CP-4
	7. Systemic outcomes	6. Curriculum		AF-1	NS-3	AU-4	4B-3	ME-23	
	8. Teacher outcomes	N/A							
	9. Long-term outcomes	7. Educational Policies	UN-1	AF-5	NS-6	AU-4,AU-5	4B-1, 4B-2, 4B-3	ME-24	CP-4, CP-5
				AF-6					

Conclutions

The stages of evolution are the way to assess over time the development achieved in the implementation of a Framework. Thus, the indicators are different across each state to achieve an effective measurement.

The Indicators for each framework are clearly categorized clearly and effectively to help on assess the state of Inclusion, Use and Apropiation of the indicator category and the model.

The relevant indicators in different frameworks were identified to "build" an scheme of evaluation and monitoring of the state of inclusion, use and appropriation of ICT, suitable for public institutions of primary and secondary education at the municipality of Tunja.

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A systemic investigation and development of an operating model for a multi-stakeholder start-up

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Abstract

This 'work in-progress' action research (AR) aims to investigate an application of creating a start-up as a way of coping with environmental complexity. It explores forms of collaboration among partners and stakeholders in the early developmental stages, *inception and growth*, and addresses different types of complexities. The paper further addresses the development of an operating model for a start-up that is created in a multi-stakeholder environment.

For its practical evidence, this research will undertake a case study from Oman of the broadband industry. Workshops are conducted to investigate a governmental initiative that entails collaboration with different stakeholders, including operators, regulators, customers, utility providers, aiming to set up a new start-up responsible for operating and managing broadband infrastructure across the country. These workshops enabled the authors to build the sensory representation, and construct the problematic situation for this academic research, in addition to satisfy the business requirements of OBC

1. Introduction

Nowadays organisations face high complexity in their operating environment due to several factors, such as technological revolution, globalization, and market fragmentation (Gulati 1998; Hoverstadt 2008; Gulati 1995). Other factors include rapid economic change, increasing competition pressure, global interdependence, blurred boundaries between government and business, lack of perception of environmental risks, unsatisfactory legal processes for solving complex problems, and shrinking finance for social programmes (Taket and White 2000). These environmental pressures lead organisations to engage in a variety of alliances and relationships. Oliver (1990) reported six categories of environmental contingencies that motivate inter-organisational relations and collaborations: regulatory requirements, asymmetry, reciprocity, efficiency, stability, and legitimacy. Different forms of alliances emerge as outcomes of these collaborations. The relationships built help partner organisations strengthen their competitive position by enhancing market power, accessing different resources, learning new skills, entering new markets, and reducing risks (Prashant and Harbir 2009; Park and Ungson 1997; Yoshino and Rangan 1995).

Thus, organisations are seeking holistic models rather than traditional, bureaucratic and hierarchical ones, to deal with such environmental complexity and its rate of change, aiming to avoid a high rate of failures and risks in their strategic plans and projects (Hoverstadt 2008). Accordingly, a number of scholars have been concerned with the adaptation to complexity in the environment, and they have developed new models that enableorganisations to link their internal regulations, designs and structures to cope with the associated complexity in their corresponding environments (Taket and White 2000; Beer 1981; Espinosa et al. 2008; Espinosa and Walker 2011). These models consider collaboration

with other stakeholders as a key principle to cope with this complexity in order to gain appreciation of their interdependence, pool their insights, increase the variety of responses, and achieve high responsiveness, efficiency and stability among themselves (Taket and White 2000).

One way of coping with this environmental complexity is to create a new, start-up organisation that acts as a vehicle for multiple organisations to collaborate and work together and addresses different types of complexity (Hoverstadt 2010). It mainly considers those forms of collaboration among its partners and stakeholders in its early developmental stages, *inception and growth*,towards maturity when it becomes able to produce its own services and products. It aims to achieve two main objectives: a) to study the development of a new start-up created in multi-stakeholderenvironments during its evolutionary early stages of its lifecycle, *Inception and Growth*, and b) to develop an organisational design and performance framework for this start-up to achieve initial stability, using a range of system approaches which explorethe essential and deliberate inter-organisational parameters. This paper will focus on thedevelopment of an operating model for the creation of a start-up organisation in a multi-stakeholder environment.

2. Literature review

2.1 Organisationaldesign

Scott and Davis (2007) report three schools of thought about organisation studies: rational, natural and open systems. These three perspectives give different technical, managerial and institutional levels of analysis, respectively, and are supported by various theories leading to several methodologies, parameters and assumptions of application, and presenting some strengths of particular features of organisations (Scott and Davis 2007; Baligh et al. 1996; Suddaby 2010). Each of them is inadequate to solve complex problems in organisations because they addressdifferent levels of analysis, dealwith different contexts and natures of organisations, and were developed in different historical time periods that entailed different views on complexities. Therefore, scholars recommend combiningappropriatetheories and methods to avoid such limitations, and to best address particular problems of concern in organisations (Midgley 2000; Scott and Davis 2007).

Because the case study undertaken for this research demonstrates high complexity attached to the creation of a new start-up resulting from the engagement of different stakeholders, a holistic approach is required to handle this organisational complexity. In contrast, the classical,linear, deterministic and hierarchal models usually used to design organisations islimited in its ability to respond to the increased competition and cooperation among agents in complex environments(Hoverstadt 2008), where alliances emerge at many levels, in many different ways, and lead to emergent properties and unintended consequences(Battram 1998).

From a systems thinking approach, a powerful model for discussing organisational design and diagnosis is the Viable System Model (VSM), which was developed by Stafford Beer (Espinosa and Walker 2011; Beer 1981, 1985). Its concepts are grounded in Cybernetics:“the science of communication and control in animals and machines”(Beer 1994). It studies and models feedback mechanisms and information flows within an organisation, improving its

capability for self-regulation and control, aiming to maintain the viability and sustainability of organisations (Espinosa and Walker 2011).

The VSM is based on the dynamic interaction among three elements; Environment, Operation and Management withina hierarchal structure containing five subsystems. System one is responsible for the operating units, and refers to the primary activities producing goods or services (Beer 1985; Ríos 2012). System two is responsible for avoiding oscillations between these units, while system three supports these operating units to ensure that they self-regulated, and develop their synergies. System four is responsible for creating the future of the organisation bydevelopinginnovative options for adapting to new circumstances in the environment (Christopher 2011; Espinosa and Walker 2011). Finally, system five is responsible for the identity and closure of the organisation, represents all the stakeholders and is the ultimate authority (Beer 1981).

In addition, recursion is a fundamental feature of the VSM. Eachviable system is made up of viable systems embedded within it, and is embedded in other viable systems (Beer 1994). This design of systems and sub-systems is called a recursive structure that uses the same systemic laws and axioms and has common patterns and properties at each layer (Beer 1985; Hoverstadt 2008; Midgley 2000). However, recursions can be circular or 'self-referential', and they do not necessarily run from top to bottom, e.g., virtual corporations that link several organisations by information to share skills, costs and access to new markets (Schwaninger 2006). Recursion analysis is apowerful tool to assess the ability of organisations to build up their variety to cope with the complexity of their environment.

Nevertheless, two arguments have been raised related to the VSM's capabilities in start-ups and the intra-organisational domain. First, Asproth (2011) argued that VSM is limited to dealing with inter-organisational forms, as it was developed to deal with a single organisation with one identity.However, we can argue that an organisational network would develop its own identity and therefore might be seen as a viable system. Schwaninger (2006)explained that VSM, through the principles of recursionand cybernetics in the context of heterarchical networks and virtual organisations, can conceive of heterarchies as viable entities, which couldenable organisations to be more intelligent and to build autonomy. Second, Nechansky (2013) argued that start-ups begin with a simpler approach than is proposed by the VSM, and the need for VSM is valid only once the company matures. However, not all start-ups begin with a simpler approach as it is the case of the start-up organisational network we are investigating in this research. In this context, we attempt to provide practical evidence to investigate the capability of the VSM to design a non-trivial start-up heterarchical network type of organisation. Morever, in order to explore the relevance of the VSM to multi-organisation start-ups, we will consider how the performance of the start-up organisation can be measured (and thus managed).

2.2Performance management

Performance measurement systems (PMS) comprise the actual output or results of an organisation as measured against its goals and objectives. Researchers have suggested that organisations at different stages should be assessed by different models of organisational performance (Quinn and Cameron 1983). Accordingly different PMS, have been developed such as Performance Measurement Matrix (Keegan et al. 1989), Viable System Model (Beer 1981), Performance Pyramid System (Lynch and Cross 1995), Balanced Scorecard (Kaplan

and Norton 1996a), Integrated Performance Measurement System (Bititci et al. 1997), Performance Prism (Neely et al. 2002), etc. These models differ in their dimensions and areas of assessment.

Nevertheless, there are a large volume of published studies investigating PMSs in large organisations as compared to start-ups (McAdam 2000; Tennant and Tanoren 2005). This is because measuring the performance of start-up companies is difficult and the tools used should be different from those used in traditional measures (Van de Ven et al. 1984). These difficulties are attributed to uncertainty, innovation and evolution in start-ups (Garengo et al. 2005), in addition to their limited human and financial resources, unclear strategies and processes, and lack of supporting software (Rompho 2011). Moreover, Sommer et al. (2009) claim that start-ups face unforeseeable uncertainties or inabilities to recognize and articulate all relevant variables affecting performance, and their functional relationships.

Additionally, many investigations show several factors influence the success of start-ups at their early stages. Oe and Mitsuhashi (2013) discussed the prior experience of the founders in the same industry and its impact on start-ups success. Low and Abrahamson (1997) discuss the market opportunities and environmental constraints in three distinct contexts of industries: emerging, growth, and mature (Low and Abrahamson 1997). Van de Ven et al. (1984) investigated several indicators of the organisational performance of start-up companies from three perspectives; entrepreneurial, organisational, and ecological. Kim and Heshmati (2010) demonstrated that an efficient initial strategy is critical for a start-up's performance and it enhances its creditability and the confidence of the market. However, there is a scarcity of literature examining the relationship between alliance strategy and performance in a start-ups' context (Pangarkar and Wu 2013), and therefore start-ups might expose themselves to opportunism by their partners due to uncertainty and lack of prior experience (Pangarkar and Wu 2013; Davis and Cobb 2010).Together these studies provide important insights of start-up performance aspects. However, most of them investigated those start-ups created by actual and nascent entrepreneurs. Fewer investigations have been done on those created in the multi-agency environments, such as the case examined in this paper.

2.3 Pettigrew'smodel of organisational change

In addition, Pettigrew's model (1991; 1985, 1988) is one of the models used to study the strategic changes in organisations, using three dimensions; context, content and process. Its analysis takes into account the emerging events and action of people involved, considers a number of cultural, institutional, individual and technological aspects that could be realised in strategic changes, and understands how each one emerges and influences the situation. Therefore, Pettigrew's model is introduced into this researchto organise our understanding in the formation of the start-up at three levels of analysis: the start-up and its partners, the industry that it belongs to, and the global environment surrounding the whole.

There are three main features of holism in Pettigrew's model, elaborated inhis works (1991; 1985, 1988), that could be seen as a supplement to system approaches. First, it is obvious to us that Pettigrew's model views change as a continuous process occurring in a given context, rather than a simple rational episode operating on the assumption that there is a knowable end-state of this change (Collins 2005). Second, the model gives high consideration to the context, and acknowledges its complexity by focusing on multi-layers of

contextual analysis through consideration of different levels of individual, group, organisation, industry and the wide society. These analyses agree with recursive analysis in VSM. Third, it explores a number of linkages between its three dimensions through time, in which historical and real data are required over different levels of analysis, so context comes to be involved in the production of actions(Collins 2005). These concepts match several key principles addressed by Complex Adaptive System (CAS), such as coevolution and self-emergence (Vidgen and Wang 2009).

3. Conceptual model

The proposed conceptual model for this case study is based on selected theories of organisational design, performance systems and complexity that enable deep understanding of various realities related to actions promoting organisational learning and creating a new start-up. These actions could be analysed, understood and managed by using systemic approaches to maintain proper and efficient design of the start-up in its early stages.

In this case study, the inner context of Pettigrew's model refers to the development of an operating model, structure, roles and responsibilities, configuration of resources, and the emergence of the organisational culture. The outer context refers to the development of theorganisational identity and purpose, stakeholders' matrix, and those changes may occur in the whole industrystructure.Various system methods could be utilised to serve this dimension; for example, VSM will be used for designing and structuring activities associated to the creation and growth of this start-up. Soft System Methodology(SSM) could be seen as an appropriate model used for stakeholder identification and identity development. The content dimension includes the development of strategy, critical success factors, performance measures and evaluation of the new start-up, and how these aspects are interconnected to similar aspects in the whole industry or other industries. Lastly, the processes dimension, in which processes can be seen linear, directional, cumulative, as well as non-linear, radical and transformational (Sztompka 1993). Therefore, Complex Adaptive System (CAS) is suggested as a descriptive tool to reflect and explain how issues emerge, develop and change over timein business eco-systems, to extract regularities, processes and simple rules. Figure-1 shows the conceptual model suggested for this research.

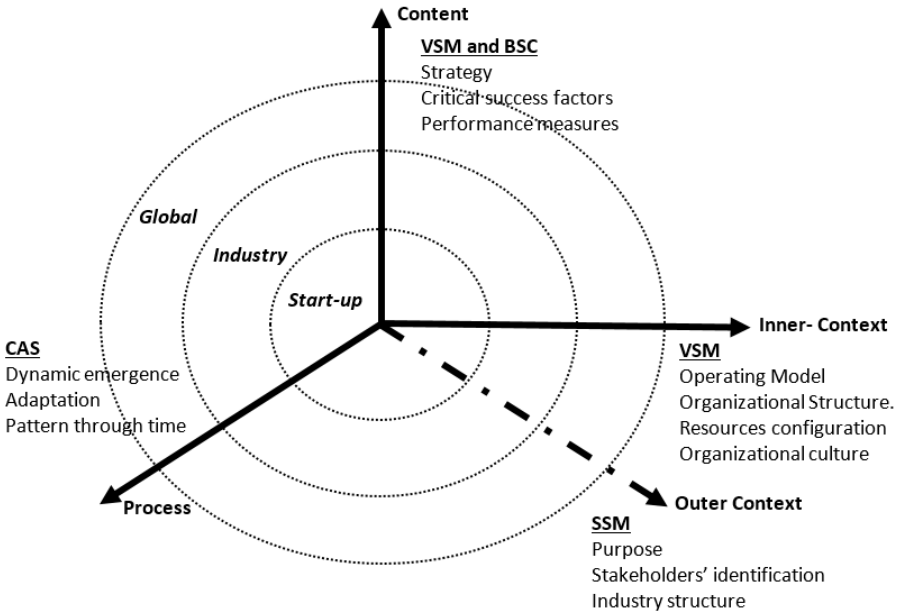

Figure-1: The Conceptual Model.

4. Research design

This Action Research (Davison et al. 2004) is framed in a Case Study, and grounded in the 'Inductive Top-Down Theorizing Model' developed by Shepherd and Sutcliffe (2011). This combination allows us to use knowledge from literature, in particular those theories related to the main areas of this research, in addition to knowledge gained through experiences and perception of the problem concerned. It gives us greater flexibility to explore different stakeholders' perspectives, by seeing the phenomenon of concern through multiple theoretical lenses compared to a single one (Midgley 2000). This engagement of stakeholders could enhance the understanding of numerous non-linear interactions and interconnections between multiple factors in the wider system that modify the boundary judgment, organise the associated relationships (Checkland and Poulter 2006), and produce the outcome or change (Burns 2013).

Figure-2 illustrates the diagnostic framework proposed for this research, consisting of five stages as explained below:Each of the following stages will be developed through workshops with representatives from the emerging organisational network at different stages. Next section summarises the prototyping stage and initial findings.

- Stage-1: Environmental scanning: this stage aims to scan the corresponding environments of various systems connected to broadband industry at different recursion levels. Bear (1994) emphasised that an organisation has to understand different economic, social and environmental systems that are encountered by its internal subsystems.

- Stage-2: Complexity Mapping and adaptation: 'Variety' is one of the key concepts in cybernetics that measures the complexity of a system. The system in focus has to build its capability to attenuate or amplify varieties to maintain its balance, and remain viable and self-regulated. A number of tools are suggested for variety engineering including VSM diagnosis (Espejo and Reyes 2011), and Team Syntegrity

(TS) (Beer 1994). The output of these two stages will help to design and understand the start-up'sstrategy and its operating model.

- Stage-3: Structural alignment: This stage aims to identify the structural linkages between the different recursive levels of strategy. It also identifies critical success and failure areas that should be controlled and monitored for a successful implementation of strategy and operating model developed in stages 1&2. Additionally, it differentiates primary activities from meta-systemic roles carried out by various sub-systems. We suggest using the VSM sub-systems analysis to design and diagnose the organisational structure at different points in time.

- Stage-4: Performance measurement: this stage aims to design the performance measures to monitor the growth of the start-up towards its objectives (content), and to realise the patterns through time of its coevolution in its lifecycle (process of design). We suggested to use the concepts of the three measures identified in VSM: actuality, capability and potentiality (Beer 1985, 1994), and we make sure that they cover the four dimensions of BSC: financial, customer, learning & growth, and internal business processes(Kaplan and Norton 1996b).

- Stage-5: Reflection and learning: this stage addresses the dynamic of the start-up in its changing environments and its potential for learning, re-configuring itself, and re-crafting its strategy, operating model, structure and performance indicators. We suggest to use CAS to reflect on the above stages and explain how issues emerge, develop and change over time and shape the features of the processes used.

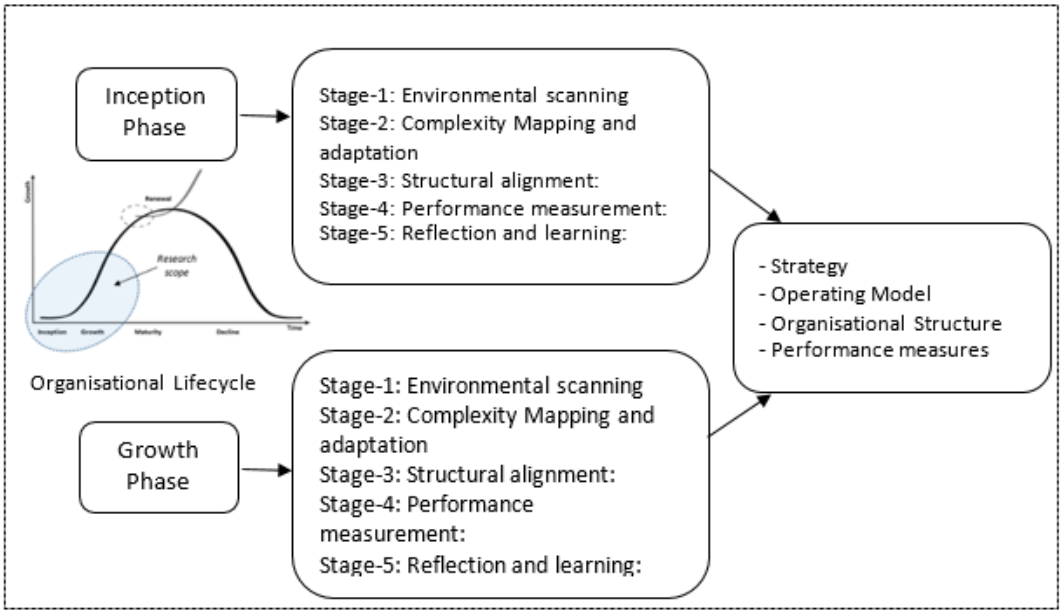

Figure-2: The Diagnostic Framework.

5. Case study and context

In the past, the national telecommunications networks and services in Oman were managed by the Ministry of Transport and Communications (MoTC), and operated by the General Telecommunications Organisation (GTO). In 2000, due to the Oman's commitments as a full

member in the World Trade Organisation (WTO), the government started the liberalisation of the telecoms market by implementing a liberal telecom regime, opening the market to competition and gaining access to leading-edge technology. In fact, the government expected that the ICT industry would play a key role in its economic plans and strategies based on reforming the structure and economy of the ICT sector. Accordingly, in 2002, the government introduced a new telecommunication act followed by the establishment of a specialized authority called the Telecommunication Regulatory Authority (TRA) responsible for implementing the telecommunications policies, regulating the telecoms market, and balancing the interests of various stakeholders based on principles of non-discrimination, transparency and technology neutrality(TRA 2012). In 2006, the government set up a new entity called the Information Technology Authority (ITA) to implement national IT infrastructure projects and supervise all projects related to implementation of the Digital Oman Strategy including e-government and e-payment services. Beside the above governmental bodies, the ICT sector is organised to be made up of a number of class-I, II and III operators who provide the main telecommunication services to their consumers, including fixed-lines telephones, mobile calls, internet services, and other special telecom products. Additionally, it also includes vendors, technology providers and system integrators who offer a range of technologies and technical systems demanded by operators as well as consumers. As a consequence of this setup and structure, the ICT industry has become more complex, particularly when it incorporates and collaborates with other industries. By understanding this structure and taking in consideration the structure of the National Five-Year Plans, we came with the following recursive analysis illustrated in Figure-3.

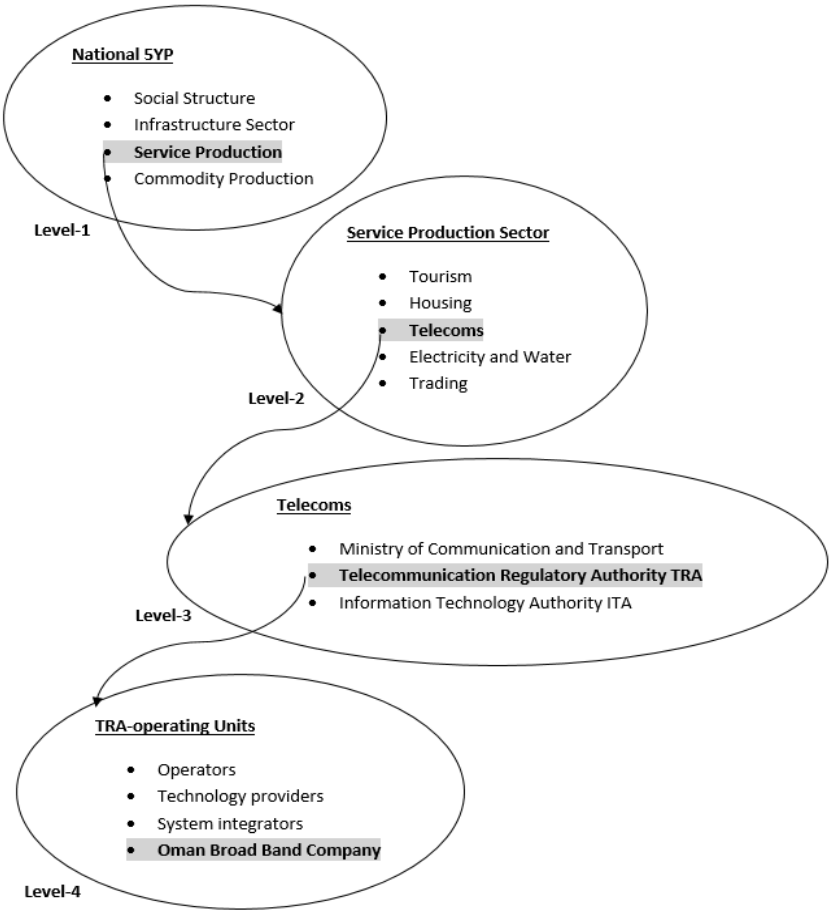

Figure-3: The recursive analysis of ICT sector.

5.1 Broadband industry:

Access to high-speed broadband networks is considered as one of the significant telecom services in the world. It is increasingly seen as a basic right of citizens, a key part of economic life, a critical factor in stimulating economic growth, and a means of increasing productivity across other sectors. As a result, many countries have taken serious initiatives to promote the spread of broadband and make it accessible to all segments of society. At present, the broadband industry in Oman is facing a number of obstacles that limits its growth, such as: 1) low percentage of fixed broadband take-up with slower growth, 2) various constraints for expansion of mobile broadband coverage including spectrum limitations, provision of backhaul connectivity and securing rights of way for new towers, 3) high cost of broadband compared to GDP per head benchmarked across the region and globally, 4) limited competition among broadband providers, and 5) high cost to reach rural areas, which represent 23% of the total population(MOTC 2013).

Given these obstacles, from 2011 to mid of 2013, the government set up a committee from different public and private organisations to develop the National Broadband Strategy (NBS). It discussed many technical options, technologies, timeframe, financial resources, risks, and opportunities related to the broadband industry. One of NBS's initiatives is creating a commercial entity called Oman Broadband Company (OBC), to be responsible for operating and managing broadband infrastructure across the country. Over the next three years, the expected size of this company is reach 200 employees and $500M capital.

6. Findings

In this section we present the initial findings that have helped us to structure the research problem. To date, one of the authors was invited to attend three workshops to participate in the initial discussions of the start-up initiation of OBC. These workshops are perceived as a pilot study assisting to build the sensory representation, and construct the problematic situation for this research. The organisers provided a number of documents showing historical data of the broadband industry, and details about various steps taken to initiate OBC. They enabled the authors to negotiate, discuss and reflect on the obtained data, and suggest future activities and actions to satisfy the academic objectives of this research as well as the business requirements of OBC. The following sections give more details about each activity and explain its finding.

6.1 First workshop: December 2013

This workshop aimed to hire an appropriate consultant for the consulting services requested by the MOTC to design OBC. It demanded several presentations, dialogues and debates fromthose consultancy firms who had submitted their bids for this project. It revealed a number of components considered as key elements for the OBC' design: the strategy, operating model and organisational structure, which are explained below.

- Strategy: explains how the organisation can achieve its goals within its corresponding environment. Literature showed many models for developing business-strategy, such as Miles and Snow's Strategy Topology (Miles et al. 1978), Porter's Competitive Advantages Model (Porter 2008), the Balanced Scorecard (Kaplan and Norton 1996b),

VSM (Hoverstadt 2008), etc. These models refer to different theories and address certain dimensions and contingencies that lead to organisational effectiveness.

- Operating model: describes how an organisation operates across processes, and technology domains to do and perform its businesses (de Vries et al. 2011). It breaks complexity into components to improve understanding and suggest opportunities for improvement. The operating model is well-connected to the choice of strategy that aims to navigate and scan the complexity of the environment and recognise its influence on organisational performance.

- Organisational structure: designates formal reporting relationships within the hierarchy and span of control of managers, identifies the grouping of individuals who do the same function, and ensures effective coordination and integration between departments across the organisation. It could be a functional, divisional, geographical or matrix structure, and its choice is linked with the organisational operating model and strategy(Daft et al. 2010).

6.2 Second workshop: April 2014

This workshop aimed to review the approved document of NBS, and re-develop a short, simple, readable strategy-format summary. It gavemassive historical data about the development of NBS,and the initial steps taken by the government to set up OBC. However, there was no clear strategy-model used in the development of NBS, therefore, for academic purpose, we used VSM reflectively to model the approved NBS showing its key sub-systems, main stakeholders, resources and information flows. This helped to understand the broadband system, and defined its market gabs. Two main findings were obtained:

- The NBS conducted a partial environment scan, which defined a number of complexities related to the technology and economy, regulations and politics, social and culture, etc. However, it is clear from Figure-4 that NBS concentrates only on three identified categories of customers in system-one and no consideration is taken for the future environment to addresslinkages with other businesses related to creation of local content or connections to the internet-cloud, etc. Addressing these future linkages may bring new opportunities, threats or issues related to supply and demand of broadband services.

- Creating a specialised company to deploy, manage and operate broadband networks is seen as a right approach to cope with the complexity of broadband. From VSM in Figure-4, two roles were identified for OBC within the broadband industry. First, it appears as a key player in system-one providing broadband infrastructure for three different categories of users, and collaborating with other operators and utility providers. Thus, OBC could organise its primary activities in terms of technology, geography and customers. This role was addressed by NBS and well-understood by key stakeholders and participants. The second role,is not addressed by NBS, which is to enhance the supply and demand of broadbandat industry levelas shown in system-four. For example, it could collaborate with Internet portal companies to use Oman as one of their global hubs for their data centres.

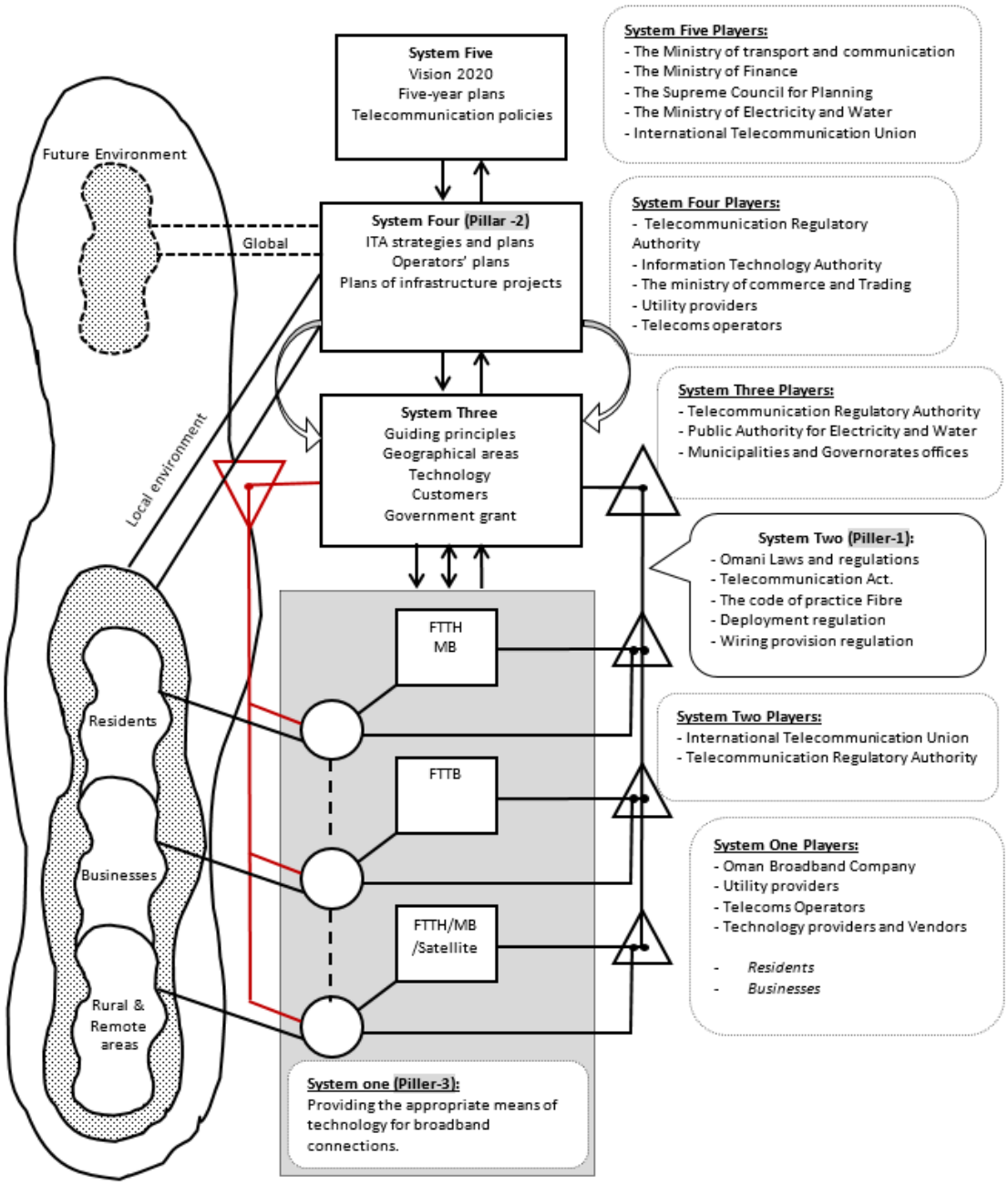

Figure-4: VSM Model for the National Broadband Strategy

6.3 Third workshop: August 2014

This workshop aimed to review the suggested operating model,which served three types of customers listed in NBS; residents, business and rural areas, through the use of different technologies; fibre, towers and satellite, serving three geographical regions; Muscat, urban cities and rural areas. Figure-5 illustrates the initial operating model for OBC.

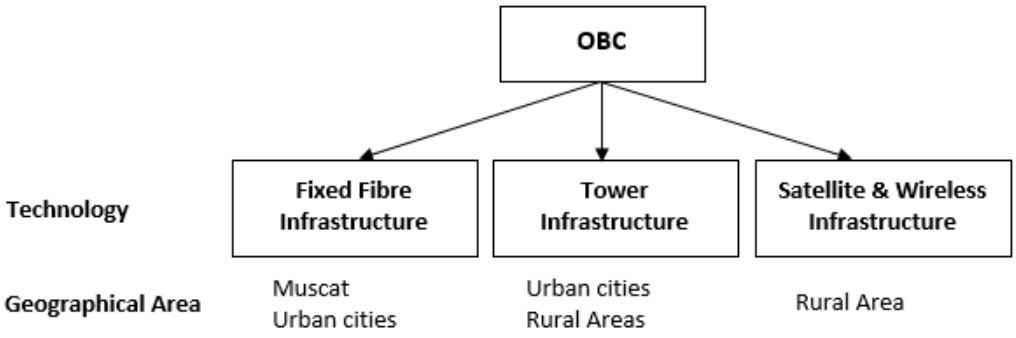

Figure-5: OBC's Business Model

The first unit is the fibre infrastructure, which can accommodate the existing fibresowned by current operators, utility companies and other organisations, as well as enable them to be shareholders in OBC.Additionally, it manages the new investments of new fibres roll-out in other geographical zones to avoid overlapping and duplication. As well, it makes use of underutilized national assets of fibre infrastructure, particularly those owned by electrical companies used for their SCADA systems. Similarly, the second unit, tower infrastructure, is going to manage the use and share of existing towers used for electrical networks and telecom mobile services, and drive the demand for new once. Such towers could be utilised by different stakeholders for suspending fibres, antennas, and other technical equipment. Lastly, the third operating unit is responsible for providing the wholesale satellite broadband service to rural and remote areas where any other infrastructure is not commercially justifiable. It also may play a key role in launching a future national satellite project. Consequently, this model will provide a single, unified and integrated broadband access network to enable fair access for telecoms operators, utility providers and others to gain substantial benefit in terms of operational and capital cost, and it willaccelerate the deployment of broadband across the country with minimum cost and time. Figure-6adds a fifth level to the recursive analysis presented in Figure-2.

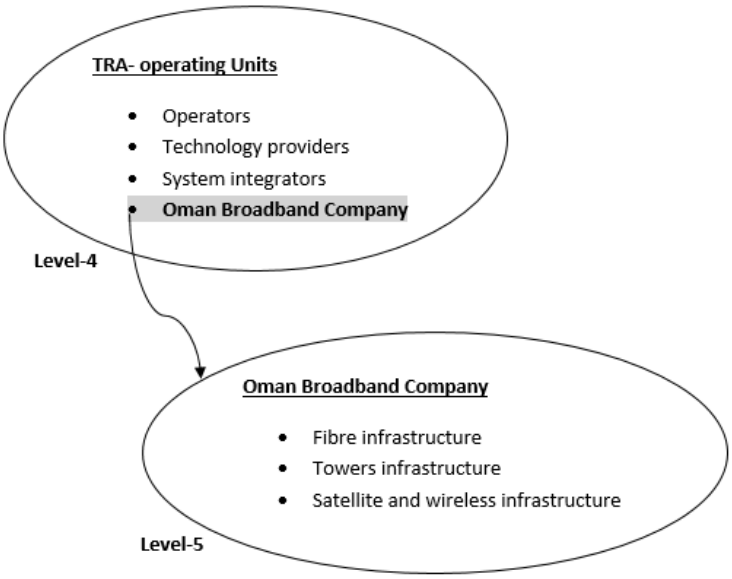

Figure-6: Fifth recursive levels of the Broadband System

7. Discussion

Schwaninger (2006) argues that the design of a business system may face challenges related to positioning the company in the market and increasing relations with potential customers. The three workshops revealed aspects of these challenges and constraints. For example, in the first workshop, many variances were identified between the consultancy firms in terms of their perceptions of this start-up, their entry form, and the degree of complexity perceived in their submitted offer. It providessupporting evidence that this project - creating a start-up in the inter-organisational domain - is complex, and its complexity is associated with the different interests and scope of the various stakeholders. This plurality of perspectives, boundaries, and the variety of components has to be addressed and identified in order to embed the start-up within the wider industry system.

Additionally, it was clear that OBC was working aggressively to adapt itself within the broadband system in Oman and considering an enormous number of varieties exhibited in its environment; varieties that are much larger than those being considered by OBC at this stage of its inception. OBC was able to handle this challenge and cope with this variety-imbalance by acquiring, generating, sharing and retaining knowledge from different sources, such as the extent of alignment with national strategies and plans, analyses of similar projects in Europe, Singapore and the Arab Gulf region and lessons learned, identifying past broadband projects carried out by other organisations, consideration of challenges attached to the technology, geography and cost, and a number of discussions and debates with key stakeholders and potential shareholders. All these engagements with different institutions and individuals assist OBC to define the primary activities that will constitute its identity.

Consequently, this knowledge has built its capability to design the appropriate filters and amplifiers to attenuate environmental varieties and amplify its own varieties respectively. Some of these filters are imposed by the broadband system, such as a) Telecoms Regulatory Act, b) national strategic plans and their budgeting and scopes, and c) telecom standards. OBC used the obtained knowledge to design its own filters, such as: a) hiring a consultancy firm with experience in telecom, business and legal, b) transferring a telecom unit from a utility company with an experience in fibre optic roll-out in Muscat, c) promoting initiatives to invite collaboration with utility providers, and d) complementing telecom operators rather than competing with them. Overall, this variety-engineering process assisted OBC to shape its operating model.

The suggested operating model identifies the meta-management functions assigned to the OBC-holding entity as perceived systems two to five. It also sets the primary activities of system one, which are assigned to the sub-entities; fibre roll-out, towers management and satellite services. It replaces the traditional hierarchical forms of designing organisations with a form of network, in which not all commands come from OBC-holding entity. This structure shows clearly the relationship between OBC and its three sub-entities, where each one will implement the strategic directions formulated by OBC, and be accountable for the alignment of its investments towards the strategy. In other words, each entity has the autonomy to define its boundary, customer groups, market, and enter new alliances or networks, as long as these activities are aligned with the wider strategy to enhance OBC viability, and synergy with other organisations.

Furthermore, this research seeks to use the concepts of performance methodology from the BSCand the VSM to develop performance measures start-ups at the early stages of their life-cycle. From a BSC perspective, the proposed operating model allows OBC to reduce the direct cost of its products and services in future, by integrating itself with other utility organisations, utilising their existing assets and sharing common resources. These financial themes provide a number of linkages across other dimensions of the BSC (Kaplan and Norton 1996b). Consequently, OBC could align its objectives with its key customers' objectives creating a number of integrated business processes and cross-functional activities. By doing so, OBC can increase its chance of business success through the expansion of their key customers' operations, incorporating measures related to time, quality and price. In addition, OBC has considered a number of strategic enablers to maintain its learning and growth by complying with international telecoms standards, aiming to initiate an academy training specialised in fibre termination, developing an appropriate HR policies for learning and knowledge transfer, and setting an advisory team with an international experience in its core function.

Additionally, from a VSM perspective, the proposed operating model outlines OBC's core business, develops communication channels with its key customers and potential shareholders, and complies with regulation and policies within its market. These are essential measures to maintain the fit between its primary activities and its corresponding environments. However, OBC takes into account those opportunities that might be seen as highly significant in future, and accordingly the capabilities it needs to develop or acquire. A good example of this is satellite services, which currently is limited compared to first and second primary activities. The diversification itself in its primary activities opens up room for building new capacities responding to future opportunities, and addressing strategic risks. This gives us evidence that OBC recognises the need to close a strategic gap between what is required now and what might be demanded in future.

8. Summary

To sum up, this case study disclosed a number of activities and actions that occurred in the inception phase of creating a start-up in a multi-stakeholder environment, particularly those that facilitate the development of its operating model. It also discussed how the start-up obtained the required knowledge to position itself in the market, identify its key customers and potential shareholders, and establish its primary activities. Furthermore, it identified a number of measures used to maintain growth and to achieve initial stability and viability.

The next phase of this project is to study how the start-up utilises its operating model to design its organisational structure and internal processes. Two more workshops using VSM analysis will be conducted for further exploration and investigation. Finally, all data obtained from these workshops will be used to develop a systemic framework, based on this application, to enhance a start-up's learning and adaptability within its environment, and to link a start-up's design with performance in its inception phase.

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Sharing business partner behavior

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Abstract

PURPOSE:

The purpose of the article is twofold: First, to provide a deeper, more holistic account of the business partner behavior sharing practice by simultaneously addressing/analyzing it from three different perspectives – technical/technological, legal and ethical/moral. Second, it aims to report the results and experiences from the real-life business partner behavior sharing experiment.

DESIGN/METHODOLOGY/APPROACH

For the purpose of the technical feasibility evaluation, a real-life experiment was conducted. A sharing agency was founded, offering behavior sharing services on the market. Its results and experiences were collected, summarized and reported in the article. For the purpose of legal evaluation, relevant legislation was analyzed. Ethicality/morality was assessed utilizing a standard applied-ethics approach. Two major normative moral theories – teleology and deontology – were selected for this purpose.

FINDINGS

Results show no significant technical obstacles for the systematic business partner behavior sharing being successfully implemented and performed in practice. Also, no major legal or ethical arguments against it were found, although some important conditions were identified that have to be met in order for the practice to be performed legally and to be qualified as ethical/moral.

RESEARCH LIMITATIONS/IMPLICATIONS

Analysis of legality was limited only to the EU and local Slovenian legislation. Ethicality of the practice was assessed only from the utilitarian and rights perspectives. Other possible normative ethical frameworks also exist that could be utilized for the purpose of the ethical evaluation of the business partner behavior sharing practice.

PRACTICAL IMPLICATIONS

Some important technical, legal and ethical insights into the practice of business partner behavior sharing are provided, useful for those considering entering into the practice either as a service provider (i.e. agency) or just as a behavioral data/information contributor (i.e. sharing company).

SOCAL IMPLICATIONS

Important positive effects on market efficiency and social welfare are identified and advocated in the paper, resulting mainly from the decreased information asymmetry on the market, thus reducing the costs of default/problematic commercial relationships due to the (1) improved risk management opportunities and (2) improved market participants' contractual discipline.

ORIGINALITY/VALUE

To our knowledge, this is the first time that the practice of business partner behavior sharing is addressed simultaneously from technical, legal and ethical perspectives, and so it is an important contribution to a more holistic account/insight of/into such a business practice. Also, to our knowledge, this is the first time the results and experiences of an actual real-life experiment involving such a practice are reported.

Keywords:
Business ecosystems, data sharing, business behavior, reputation, legal aspects, ethicality

1 Introduction

Business success relies on sound business decisions. These are based upon information on the company's internal state, processes and plans and the business environment. Business intelligence (BI) (Kpmg, 2011) is systematically focused on providing internal information, while external information is gathered with a combination of Customer Relations Management (CRM), external databases, specialized agencies, and informal information interchange. Building on the work by Leonard (2007), which enhances Beer's (1972) viable system model (VSM) with collaboration efforts, the need for sharing business partners' experiences emerges.

The main issue is that we do not know exactly how the business partners will behave in a real situation. We can only answer some basic operational questions: Will they deliver the goods in time? Will the quality of the delivered goods be up to our standards? How will they react on reclamations? How flexible will they adapt to changes? How fast will they inform us on the changes? Will they pay the issued invoices? Are we their strategic partner, or will they exchange us at the next opportunity? The required level of information can only be obtained by actually doing business with the partner.

In the paper, business partner data sharing mechanism implicates Luhmann's theory of social systems and communication(Luhmann, 1982), as elaborated by Klein (2012). In the proposed scenario, the data on partner behavior in actual business events is reported by the companies. In return, a reporting company is provided with the information originating from multiple sources, which can be used in making business decisions. The mechanism is based on a presumption that the value of complete partner behavior information is higher than the cost of reporting the data.

We propose a mechanism through which players actively and systematically upgrade the system by expressing and sharing their experiences and providing a higher level of organizational transparency, as proposed by Bula and Espejo (2012), with their proposal of inclusive democracy, and Espejo and Bendek (2011), with active citizenship. Since this is a disrupting concept, all important aspects need to be evaluated. In this paper, first, technical feasibility of providing a secure, effective and inexpensive sharing environment is examined. Next, the direct and indirect positive business implications are identified and assessed. Third, the legal aspects are examined to mark the sharing limitations. Last, but not least, ethicality of the proposed business practice is discussed.

The data sharing is actually a proven concept. The financial institutions already share their customers' data to avoid credit risk (Dierkes, Erner, Langer, & Norden, 2013; Kanaparti, Kumar, Tatekalva, & Padmavathamma, 2012; Sanders, Autry, & Gligor, 2011); the sellers in online marketplaces are rated by their customers; in the supply chains, the inventory information is often shared with the suppliers (Sanders, et al., 2011); and non-payment patterns are shared between companies (Dun&Bradstreet, 2014; Perko & Mlinaric, 2014). Nevertheless, for a typical company, especially for small and medium enterprises (SMEs), the effort to manage complex sharing mechanisms is too large to cope with (Ross, Beath, & Quaadgras, 2013). By using cloud secure services for data interchange and storing, the cost of data sharing can be significantly reduced, as discussed by Kanaparti, et al. (2012). The appropriateness of cloud and big data-related technologies for sharing purposes will be elaborated in this paper.

There are several positive business data sharing impacts; they include executing risk mitigation strategies, optimizing cooperation with suppliers and customers and obtaining new partners with the desired reputation. The direct impacts are revealed on the operational level, where every business decision that involves external business partners can be supported, and on the tactical level. However, the indirect effects can turn out to be even more important. If companies are aware that their performance is directly measured according to the critical operational points, related to the partners (e.g., the product quality, the delivery timing, the responsiveness to requests and reclamations and the payment strategies), they are encouraged to meet the expectance and prove their reputation. Thereby, instead of giving all the focus in providing the financial results, as requested by their owners, companies can directly focus on better performance, thus fulfilling their reason of existence in the business ecosystem.

Since legal aspects and the potential consequences of sharing business partners data are currently not adequately elaborated, the sharing is usually averted. However, we intend to elaborate the legal aspects of every sharing instance from multiple perspectives. We will place special focus on the status of the reporting entity and on the sharing purpose, the form and the scope of the data shared. We will rationalize what business information we can share. If a failure to comply with the agreed terms of business represents breaking a contract or agreed terms of cooperation, we will elaborate whether the information of breaking the obligations should be shared or not. We will also explore the authorization of sharing the positive experiences between business partners, which can play an important role in the business partner reputation.

Sharing such data might be technically feasible; it might also be legally acceptable. But is it ethical? This is the question we intend to address in the final part of our work. It has been already stated that sharing business partners behavior is a disrupting new concept. Consequently, strong opposition can be expected, including the argument that it is unethical to report negativities on one's business partners. A feeling of betrayal seems to us as the particularly probable reaction on reporting sensitive data, since a fear of being betrayed is proven to be one of the strongest heuristics determinants that individuals use when making ethical judgments (Sunstein, 2005). Because we firmly believe that only ethical business practices are to be pursued, we find it important also to shed light on the observed ideas from this perspective. Various normative theories exist that could provide a useful framework to analyze the ethicality of observed practice (Ronzoni, 2010). Literature review and analysis that enlighten the views of selected ethical theories will therefore be carried out to provide deeper insight into the ethicality of discussed business practice.

Some of the newly acquired insights can be used in designing business ecosystems, especially the business partner behavior sharing mechanisms. The themes addressed in the paper also provide multiple new business data sharing research opportunities, optimizing the ratio of business value added/sharing costs and finding new means to anticipate and manage business partner behavior in a timely manner.

2 Feasibility analysis

The business partners data sharing mechanism provides new insights into the existing available information for the business partners reputation assessment. The direct appraisals of services and products quality has proven to be one of most useable information sources in the decision-making process.

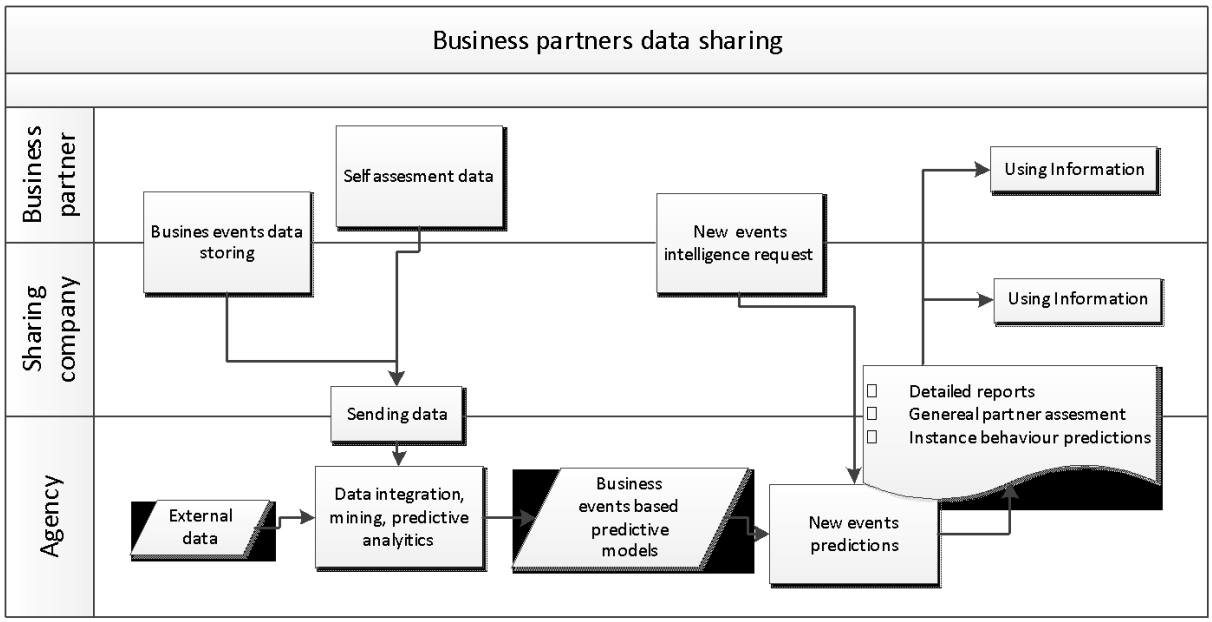
In business partners data sharing, three groups of participants are involved: the sharing companies, the sharing agency and the business partners. The sharing company goal is to reduce partner-related risks. They report behavioral data to the agency to optimally use the new information available. This involves reorganizing the partner-related risk management processes.

The business partners' role is passive, with their reputation dependent on the agency reports. Thus, their interests must be protected by involving quality controls mechanisms, delivering them detailed reports on the data reported upon them, and providing the opportunity to respond to them.

The agency acts in the interest of sharing companies. Its purpose is to provide services that are out of the scope of a single sharing company, to provide information with the highest value added and to minimize the data-sharing-related costs and risks by applying appropriate security standards. Major agency-related risk is connected with potential shared information misuse. Therefore, appropriate supervision mechanisms must be applied at all levels.

The process of sharing business partners information involves multiple steps, as depicted in Figure 1.

Figure 1 General data sharing process



Business events data is stored by standardized Enterprise Resource Planning (ERP) solutions. Financial related data is stored in standard structured formats (for instance the invoice data set) at a reasonably high quality level, whereas nonfinancial data, such as the quality of services and products and partner response attributes, needs to be systematically acquired from other sources.

The last step in ERP solutions development are cloud ERP solutions, where all of the data is physically stored in the same location (Helo, Suorsa, Hao, & Anussornnitisarn, 2014). Costs and security risks in the cloud environment can be minimized if the sharing is executed by the ERP provider. The only task and responsibility for the sharing company is to manage the data content quality.

The agency provides safe data storing, integrating data from multiple sharing companies and external sources, developing predictive models, and responding to intelligence requests by the sharing companies in the form of detailed reports, general assessment reports, and most importantly, business

partner behavior predictions. Agency can provide multiple results, but we assess the behavior predictions at the business event level that can provide the highest value added. These reports provide predictions on business partner behavior in the current situation based on the behavioral cumulative experiences from previous business events. For instance, questions like, "What is the possibility of invoice being paid in the next 30 days?" can be answered and directly used to successfully employ active risk mitigation strategies at all business levels.

The storing and analysis of large-volume fast-changing detailed business data present major challenges. The latest R&D achievements in cloud computing and big data technologies provide the capabilities to perform the services accordingly (Leeflang, Verhoef, Dahlstrom, & Freundt, 2014; Ross, et al., 2013). Big data technologies enable the integration of large-volume, fast-changing data and their advanced analysis, enabling real-time answers to the sharing companies' information requests.

The information usage by the employees can be sporadic and therefore ineffective. The information utilization performance would be leveraged by invoking BI reporting into the ERP production environment and employing via mobile devices. The BI results should proactively answer the issues emerging in the business process (Perko & Bobek, 2007). Mobile devices with their omnipresence and interactivity potentials should be considered as an appropriate communication channel to enrich the standard ERP solutions with advanced BI services (Verkooij & Spruit, 2013).

2.1 Expected effects

Sharing of business partner behavior can have positive effects for the sharing company's operational and tactical level management processes, to market transparency, reduce information asymmetry and influence the self-assessment and reputation building of the business partners reported upon. Most importantly, sharing business partner behavior clarifies in which steps of the business process the partner behavior must be monitored and, if possible, predicted. This improves the understanding of good partnership by operatives in the sharing company and in their business partners.

At the operational level, behavior predictions can help in selecting the appropriate partner, set appropriate business conditions and select insurance instruments or appropriate steps in the issues mitigation processes.

At the tactical level, detailed reports help selecting appropriate business partners to develop lasting relationships and to discuss the important factors needed for mutual success. By providing standards and demands in the form of KPIs, the sharing company can enfold its business strategies to the business partners and compel them to better cooperation.

At the market level, sharing reduces information asymmetry. It helps to disclose companies that address their partners' discriminatory behavior and to prevent the spreading of the depraved business behavior. Because of its low cost, direct measurement and high dynamics, this information is particularly appropriate for observing SMEs. It offers an alternative to expensive examinations to reveal the current behavior and instantly build reputation, while on the other hand, it can be used by the SMEs to anonymously report on their big business partners monopolizing practices.

Detailed partner behavior reports can provide an instant back loop and should form the pressure for the management to upgrade the business processes required to achieve sustainability. The shared KPIs can act as a counterweight to the financial KPIs and thereby contribute a customers' view in a balanced scorecard (Kaplan & Norton, 1992). The KPIs from the detailed partner report should be used to upgrade the internal business KPIs.

2.2 Defaults sharing experiment

To explore the feasibility of the sharing potential/opportunities, an experiment was conducted regarding sharing defaults[1] in 2012, in which multiple companies reported defaults on invoices issued to their business partners (Perko & Mlinaric, 2014). Companies sent daily reports on invoices defaulted by their business partners. During the experiment, the paying strategies from regular payments, trough payment delays, strategic defaults[2] to terminal non-performing invoices were observed.

The experiment involved the creation of a cloud data environment, providing services for sending invoices data and receiving non-payment partner reports. The experiment lasted for more than one year, with data gathered on a daily basis. The last data snapshot contains invoice data on 4.275 companies, resulting in 33.635 invoices with a total value 58.512.870,49€. On average, 7,9 invoices were reported per company; the average reported debt per company was 13.687,22€.

Default data sets were shared by companies using diverse ERP solutions, the data quality issues were not severe and were managed successfully. Since the companies' ERP solutions were stored on-site and not in the cloud, data uploading services were used to share default data with the agency. The direct data-sharing costs in the form of time and effort spent were reasonably low. The sharing costs could be lowered by actively including ERP providers in the sharing process.

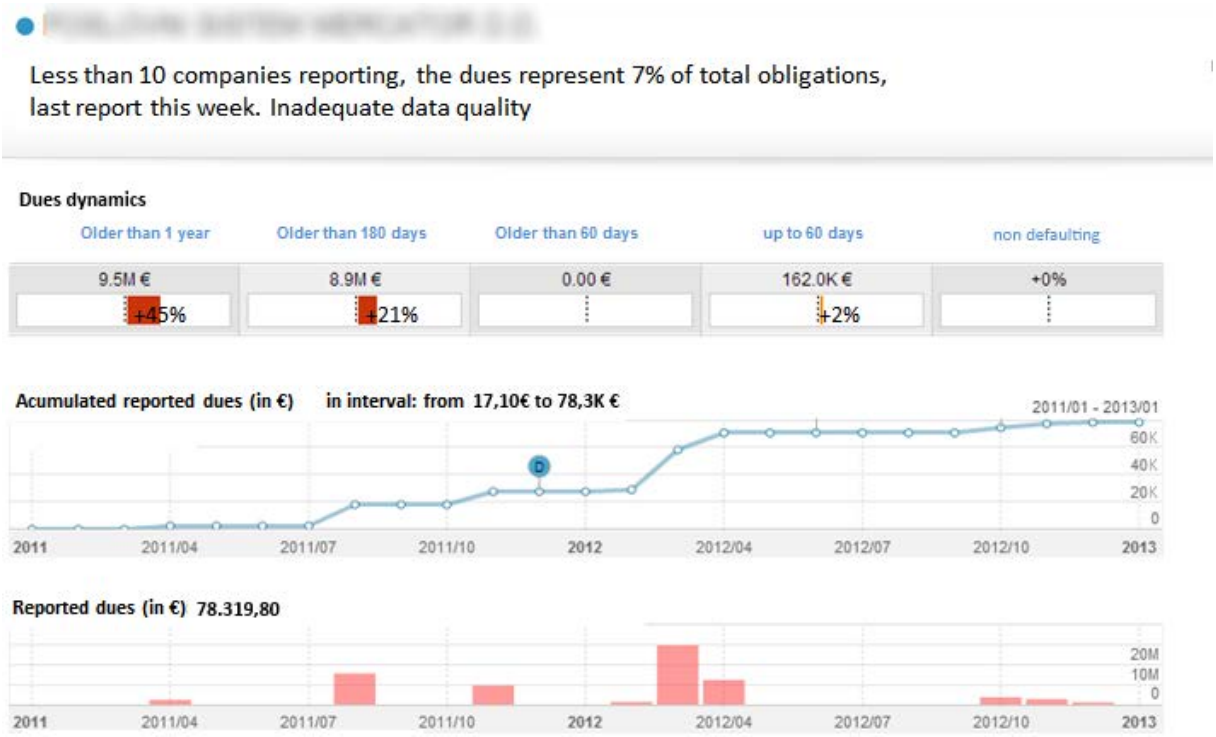
In the experiment, a limited number of records, narrow data structure, and daily data refreshing were used, and therefore the standard IT resources were sufficient to conduct the process of integration, summarization and predictive analytics for the creation of predictive models. In a real environment, a structured data set is supplemented with unstructured data in high volumes and is refreshed in real time. To provide appropriate scalability and security with big data, appropriate hardware and software technologies need to be used. The costs of scalable hardware applicable for big data management are affordable, with big data integration and prediction software providing the capability to securely integrate and analyze structured and unstructured data in real time (Chen, Chiang, & Storey, 2012).

In the experiment, a detailed report on partner defaults is created, including months of delay, sum of debt, and time dynamics. It is provided in the grid and interactive graph, allowing a credit portfolio overview, debtor analysis and comparison (Figure 2). This figure was created to show company data in one place, thus any comparative analysis can be easily executed without great loss in crucial data oversight. The graphical interface supports static and dynamic presentations of crucial thresholds: using the monthly thresholds, the data from multiple companies or groups can be compared, while the dynamic threshold clearly separates old debts (older than 1 year, 18 days, 60 days and less) from the more recent ones.

[1] Default: non-payment caused by the inability or unwillingness of the due party

[2] Strategic default: a default as a result of the unwillingness of the due party, despite its means to pay the invoice.

Figure 2 The defaults graphical representation



The interactive reports were published on a web site, while the experiment did not include the formal integration of reports in the business process, ERP solutions, or creation of mobile applications. Combining BI and ERP solutions could provide additional development-related costs for the sharing company.

Although the experiment provided the basic feasibility proof and can be used for assessing direct sharing costs for sharing companies and for the agency, it did not adequately answer the questions of full potential value added of the proposed sharing mechanism, including the instance behavior predictions and mobile integration with ERP systems. Additionally, the relations and responsibilities of all involved parties (i.e., the sharing companies, the agency and the business partners) must be thoroughly examined, since the sharing information can affect their relations.

The feasibility results show that business partner behavior data sharing would represent a major challenge for a single company and provide limited value added. Introducing a sharing agency would raise the value added considerably, based on the data integration from multiple sources. The feasibility study also shows that the combined use of the business data management technologies (e.g., ERP solutions, cloud services, big data storing and analysis potentials, proactive BI, and mobile devices) would enable the sharing in such a way that it would provide great value added in the operational and strategic business processes and reduce the operational costs and risks to an affordable level.

3 Legal aspects

A database on business entities, created, managed and maintained by a private company, would be a private sector activity and as such could be carried out on a contractual basis. Every participating business entity should give its express consent.[3] This means that the database management company

[3] These are the conclusions of Kenneally and Claffy (2009, p. 4 and 5), who established the basic principles in creating the Internet databases. These include, *inter alia*, transparency (algorithms should be made public but

(agency) would have to conclude relevant contracts with the participating companies, defining, in particular, the purpose of data collection, types of data, data processing modalities and the availability and transmission of collected data. Furthermore, the company should guarantee, in accordance with good business practice, to keep the collected data confidential, process it solely in line with its collection purpose and make only specific data from the database available to business entities. The data would be solely available to the contracting parties unless otherwise provided by law. Collection and disclosure minimization is an important principle in database management, which means that, for database searches, privacy-sensitive techniques should be used and that all or parts of sensitive data are deleted and anonymised, the size of databases is limited, etc. (Kenneally & Claffy, 2009).

3.1 Prohibitions

In terms of its contents, certain data is such that it is obvious to anyone that it should not be, *a priori*, collected, processed and transmitted to any third parties and that it does not belong to a database on business entities. This includes, e.g., the data **treated as classified in accordance with the Classified Information Act.**[4]

To update the list of the prohibited data, the wording of paragraph 1 of Article 6 of the Access to Public Information Act[5] may be used, specifying the cases in which a body denies the applicant access to public information; however, it may be used *mutatis mutandis*, which is also entirely appropriate in our case. In addition to classified and personal data as well as the information considered a trade secret (rather than an absolute prohibition, a relative prohibition or compliance with specific prohibitions is more appropriate for personal data and trade secrets as explained below), the following should also be included in the list:

- information the disclosure of which would constitute **an infringement of the tax procedure confidentiality or of tax secret** in accordance with the Act governing the tax procedure;
- **information acquired or drawn up for the purposes of criminal prosecution** or in relation to criminal prosecution or **misdemeanors procedure**, and the disclosure of which would prejudice the implementation of such procedure;
- information acquired or drawn up for the purposes of administrative procedure, civil, non-litigious civil procedure or other court proceedings, and the disclosure of which would prejudice the implementation of such procedure.

3.2 Restrictions

In addition to the prohibitions listed above, the creators of company databases should take particular account of the following legal restrictions:

1. The database should contain **no personal data**[6] (such as names, addresses of representatives, directors of business entities[7]), unless an individual gives personal consent to the processing of

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data or conclusions of the processed data protected), access limitations, purpose adherence, use specification and limitation.

[4] This includes the information "relating to public security, defence, foreign affairs or the intelligence and security activities of the state which, for reasons defined in this Act, must be protected against unauthorised persons and which has been defined and marked as confidential in accordance with this Act" (point 2, paragraph 1 of Article 2 of the Classified Information Act, Official Gazette RS, No. 87/2001, latest amendment published in the Official Gazette RS, No. 60/2011).

[5] Official Gazette RS, No. 24/2003, latest amendment published in the Official Gazette RS, No. 50/2014).

[6] Personal data is defined as any information relating to an individual (identified or identifiable natural person regardless of the form in which it is expressed (point a., paragraph 1 of Article 2 of the Directive and points 1

specific personal data and is informed of the purpose of its processing, since there is no specific legal basis for the collection of such data, at least not in the Republic of Slovenia.

The data relating to legal persons (governed by public or private law) is not regarded as personal data, since personal data relates to an individual (a natural person). In running their operations, legal entities cannot avoid possessing personal data, as they are artificial persons, whereas those responsible for a company's operations are actually natural persons (representatives, employees). Furthermore, a business entity (private sector) may also act as a "manager" of personal data, which is not prohibited as such, provided it has a legal basis for it or the data subject's consent.[8]

In the private sector, personal data may be processed if the processing of personal data and the personal data to be processed are **specified by law or if the data subject's consent is given for the processing of specific personal data.**

Furthermore, these two conditions are indicated in the Directive 95/46/EC of the European Parliament and the Council on the protection of individuals with regard to the processing of personal data and on the free movement of such data,[9] as two of the criteria are laid down to ensure the legitimacy of personal data processing.[10]

2. Information considered a **trade secret**

The notion of trade secrets is subject to the regulations in a number of areas (statutory, labour, competition, criminal and intellectual property law) mainly dealing with legal protection, whereas under Slovenian law, the notion of trade secrets is defined in corporate law; i.e. the Companies Act.[11] In view of the fact that the object of a trade secret constitutes a competitive advantage for a company, its inclusion in the corporate law (Primec, 2006) is justifiable. Two conditions must be met to define the notion of trade secrets:

- confidentiality (secrecy) of information, and
- its specificity in terms of norms (which means that the information complies with the legal requirements related to the definition of a trade secret or that it is defined as a trade secret at the discretion of its holder, who is also obliged to respect the legal provisions).

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and 2, paragraph 1 of Article 6 of the Personal Data Protection Act, Official Gazette RS, No. 86/2004, latest amendment published in the Official Gazette RS, No. 94/07 – official consolidated text; hereinafter: the ZVOP-1).

[7] In this respect, an interesting decision of the Inspectorate for Personal Data Protection (No. 751-02-36/2004-01 (0106) of 31 August 2005, p. 8) was issued, by which it ordered a private company based in Ljubljana to prevent, through modifications of a computer program, the users and any other persons having access to the data in the GV IN Pajek module or database, from acquiring any data on business entities in which a particular person, specified by name and/or surname, is a representative, a member of the board of directors, a founder or a supervisory board member, by keying in the name and/or surname or by clicking the personal name of a representative, a member of the board directors, a founder or a supervisory board member or in any other way (the decision was confirmed by a judgment of the Administrative Court of the Republic of Slovenia, Ref. No. U2477/2005-48 of 10 October 2007).

[8] For more details see Article 9 of the ZVOP-1.

[9] Official Journal of the European Union, L No. 281 of 23 November 1995.

[10] For more details see Article 7 of the Directive.

[11] Official Gazette RS, No. 42/2006, latest amendment published in the Official Gazette RS, No. 82/2013, hereinafter: the ZGD-1.

Persons outside a company shall also be obliged to protect data constituting a trade secret of the company if they knew or, given the nature of the data, should have known that it was a trade secret.[12]

The information treated as a trade secret of a business entity could be part of the database if other major circumstances regarding the operations of business entities could be established on its basis. In this context, it is important to point out that the information refers to the trade secrets of the holders who have consented to enter their confidential data into the database and regulated their mutual relationships through an appropriate contract; in no case, however, it is allowed to enter the trade secrets of other entities having no contractual relationship with the management company[13].

The notion of trade secrets has not been regulated so far at the EU level. The Member States have regulated it in very different ways in their national legislations, which is why the Draft Directive of the European Parliament and the Council on the protection of undisclosed know-how and business information (trade secrets) against their unlawful acquisition, use and disclosure (Council_of_the_European_Union, 2013), hereafter, the Draft Directive is all the more welcome in order to finally harmonize this area.

3. Information which may affect the market position of a business entity is not, in itself, the data that should not be contained in the database unless the purpose of its entering into the database would be contrary to good business practice. The legislation relating to unfair competition specifically prohibits so-called "tarnishing" (Zabel, 1999, p. 448), which refers to disclosing the information on another company if such information damages or may damage the reputation and operations of another company.[14] Tarnishing takes place when a business entity makes a statement, disseminates information or submits data on other business entities.[15] A further condition that has to be met is that, by disseminating the information, the **damage is or may be caused** to the business entity, either material (it is detrimental to the company's **operations**) or non-material (the company's **reputation** is affected). It should be stressed, however, that causing damage to a business entity does not imply an unfair practice. If sharing information is carried out in accordance with honest practices in industrial or commercial matters, i.e. in the spirit of fair and equitable rules for market behavior, such selection among the companies does not cause unlawful (unfair) competition. Or, as pointed out in legal theory, the opportunity for information is also restricted by two conditions: the data should be communicated as confidential and either the person giving or the person receiving the information should demonstrate a valid interest in information sharing (Zabel, 1999, p. 450).

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[12] Paragraph 2 of Article 40 of the ZGD-1.

[13] For ease of comprehension, an example is indicated in which company A, having a contractual relationship with the management company, issues an invoice to company B. This invoice is considered a trade secret for company A as it contains an indication of the discount rate, the price etc.; i.e. the information that company A wishes to keep confidential. Nevertheless, company A sends the invoice to the management company so as to determine on the basis of it the behaviour of company B (ability to pay, payment due date etc.). Given that, as a consequence, the management company will obtain the information on company B, also registered as a private company operating in the market, the collection of such information, its processing (in accordance with the purpose indicated in the contract) and communication (to a limited number of entities: the business entities having a contractual relationship with the management company and entitled to have access to the data in the database) are legitimate. If, however, company A concluded a nondisclosure agreement with company B on their commercial relationship, company A would breach the rules for the protection of trade secrets by communicating the information to the management company.

[14] The third indent of paragraph 3 of Article 13 (Official Gazette RS, No. 18/1993, latest amendment published in No. 110/2002), hereinafter: the ZVK.

[15] The third indent of paragraph 3 of Article 13 of the Protection of Competition Act (Official Gazette RS, No. 18/1993, latest amendment published in No. 110/2002), hereinafter: the ZVK.

In conclusion, it should be noted that private databases on business entities have become a reality and that their importance in the business world is increasing rapidly. There is no legal framework available for establishing such databases other than some rules relating to the protection of specific types of data. Therefore, this area should be regulated in greater detail and more comprehensively. Such a situation does not exist only in the Republic of Slovenia but also in other EU Member States; e.g., in the United Kingdom.[16]

4 Ethical considerations

There are three main reasons we find it important to address ethical considerations regarding this issue. First (1), the practice discussed is not benign for those about whom are being reported. Negative consequences in the form of reputation lost can be expected, and, combined with the fact of their involuntary participation (at least for some of them), we find this reason enough to ask ourselves whether any ethical/moral principles exist that could be violated by supporting such a practice (i.e. participating in it). Second (2), after a detailed literature review, we were able to find only a few articles (Mellert, 1982; Morris & Roberts, 1982) addressing the practice of business partner behavior sharing from an ethical/moral perspective, clearly indicating the need for a deeper ethical/moral analysis before reaching a final conclusion to that question. Third (3), we firmly believe that no holistic account of any practice involving relationships can be made without also addressing the ethical/moral dimension of it.

Since various normative ethical/moral theories exist that can provide a useful framework/approach to the analysis of ethicality/morality of a certain practice, selection had to be made as to which to choose for the purpose of our analysis. Teleological and deontological evaluation were selected as two of most frequently cited/utilized approaches in business ethics (Beauchamp, Norman, & Denis, 2008; Brady, 1999; DeGeorge, 1996; Donaldson & Werhane, 2008; Hunt & Vitell, 1986; Kaptein & Wampe, 2002; Reidenbach & Robin, 1990; Ünal, Warren, & Chao, 2012; Yoon, 2011). Accordingly, our analysis is also structured along this line of normative ethical/moral theories division.

4.1 Teleological evaluation

Teleology is the first of the two major normative moral theories/approaches to be utilized in our analysis of the ethicality/morality of the business partner behavior sharing practice. Its defining distinction as a normative theory is that the ethicality/morality of a certain behavior is judged exclusively on the bases of the overall aggregate (non-moral) consequences of it (i.e. utility, happiness, pleasure, etc.) for all either directly or indirectly, actively or passively involved stakeholders.[17] The greatest good of/for the greatest number (i.e. classical utilitarianism) (Bentham, 1789; Mill, 1863) is a frequently applied explanation of such a principle, under which a certain behavior is deemed ethical/moral if and only if the overall/aggregate positive consequences (i.e. "the good") of it exceed the overall/aggregate negative consequences (i.e. "the bad"). Teleologists differ in their definitions of what exactly is "the good" (the desirable end; the value) which is to be maximized,

[16] Thomas & Walport (2008) point out that, due to non-comprehensive and unsystematic regulations in this area, practitioners deciding whether or not to share information often make decisions based on what feels right to them as professionals, albeit with concerns that their approach may not accord exactly with the law. Their report, however, deals primarily with personal data, with their handling being the most legally regulated. It can be assumed how inconsistently regulated other databases remain.

[17] This is the so-called "agent-neural" (or utilitarian) conception of teleology, which is not the only one possible. Wider conceptions without such an "agent-neutral" restriction also exist, including "agent-centered" theories such as ethical egoism and similar. For more on that subject, see for example Frankena (1973), Vallentyne (1987) or Sinnott-Armstrong (2014).

but one frequently utilized conception is the conception of it as a social welfare we are also going to use in our analysis. What we have to do, therefore, is evaluate what aggregate effects on the social welfare can be expected by supporting (i.e. participating) the sharing practice in question. If the aggregate social welfare is expected to increase, than the practice can be deemed ethical/moral; if it is expected to decrease, than it should be deemed unethical/immoral.

Since it can be argued convincingly, we think, that, in our case, such an effect depends directly and mostly on the economic consequences for the market participants involved, what follows is just such an economic evaluation. Six individual effects listed below have been identified as covering the majority of the overall/aggregate social welfare effect expected:

1. decrease in costs of default/problematic business relationships due to the improved risk management opportunities/information; **a positive effect for all actively participating market participants**;

2. decrease in the costs of default/problematic business relationships due to the improved market participants' contractual discipline (including quality of their products and services); **a positive effect for all either actively or passively participating market participants**;

3. increase in market opportunities and potential for growth due to improved trust and reputation; **a positive effect for all market participants with <u>good</u> behavioral records;**

4. decrease in market opportunities and potential for growth due to deteriorated trust and reputation; **a negative effect for all market participants with <u>bad</u> behavioral records;**

5. improved general business conditions (better payment arrangements, easier financing, lower costs of financing, etc.) due to improved trust and reputation; **a positive effect for all participants with <u>good</u> behavioral records; and**

6. worsened general business conditions (more strict payment terms, prepayment and additional warranties demands, higher costs of financing, etc.) due to deteriorated trust and reputation; **a negative effect for all participants with <u>bad</u> behavioral records.**

Upon aggregating the identified effects, one can quickly notice that effects 3 and 4 are essentially of the same kind but just the opposite directions (depending on the behavioral records of individual market participant). For the purpose of aggregation, it can therefore be safely assumed that they annul themselves. We believe the same can be assumed for effects 5 and 6. The remaining are the two clearly positive effects of cost reduction (namely 1 and 2), which means that it can be convincingly concluded that the overall aggregate effect of the practice of business partner behavior sharing on social welfare is positive. The practice can therefore, at least from the teleological perspective, be qualified as ethical/moral.

4.2 Deontological evaluation

Deontology is the second of the two major normative moral theories/approaches to be utilized in our analysis of the ethicality/morality of the sharing business partner behavior practice. Its defining characteristic as a normative theory is the belief that certain general moral rules/norms/duties exist independent of the actual (non-moral) consequences they bring about, and that these rules/norms/duties are only relevant when judging the ethicality/morality of a certain action/activity. Or, put differently, deontologists believe that the rightness or wrongness of certain actions lies not in the (good or bad) consequences they bring about, but rather or even exclusively (depending on what

strand of deontology we are talking about) in themselves being in accordance with certain general moral rules/norms/duties (Alexander & Moore, 2014; Fieser, 2014; White, 2014). As such, deontology is basically a negation of teleological approaches, where ethicality/morality of an action is decided entirely on its non-moral consequences.

Various deontological theories exist. The most traditional mode of taxonomizing them is to divide them between agent-centered and victim-centered (or "patient-centered") theories (Alexander & Moore, 2014; Kamm, 2007; Scheffler, 1988). Victim-centered versions differ from agent-centered in their rights-based rather than rules-based orientation, meaning that they are premised on people's rights (Alexander & Moore, 2014). People's rights are therefore the primary basis/source (i.e. are foundational) of moral agents' duties, their central moral duty therefore being the respect for such rights, to the extent that one is ready to accept the idea of business entities also as rightful bearers of moral rights (for some contrasting views on this subject, see (Malcolm, 1994; Ozar, 1985). One possible way to deontologically investigate the morality/ethicality of an activity in question is also to investigate whether any such rights exist that would be violated with the performance of it. If such rights do exist, then the activity in question could be judged unethical/immoral and one should, at least *prima facie*, refrain from it.

Since sharing business partner behavior is in essence an information exchange activity, the right to the confidentiality/privacy of shared data/information seems to us as the most logical to investigate, since it can be reasonably expected that the majority of the objections (assuming there will be any) would be formulated on that base. Because the evaluation we are about to do is of the ethical/moral kind, only moral rights are of concern. Since grounded on a moral reason, this essentially means that, for someone's interest/claim to confidentiality/privacy to be morally recognized, a convincing moral/ethical argument to it must be provided.

In the proposed sharing process figure, two distinct information exchange flows can be identified, one related to the information input and one of the information output. At the output, only synthesized data/information on someone´s past behavior (aggregate performance statistics, summary evaluations etc.) and predictions of his/her future behavior are shared with the agency´s end users. Evaluating such information from the right to confidentiality/privacy perspective, we can find no elements necessary for it to qualify as proprietary/confidential (i.e. a business/trade secret). Consisting only of information on one´s performance/reliability as a commercial partner (e.g. information on one´s paying discipline, information on one´s delivery reliability, information on one´s respect for agreements, etc.), no intellectual property or any other ownership claim to prevent such information from disclosure to interested users seems possible or justified to us. On the contrary, it seems morally highly counterintuitive even to think about qualifying as confidential the information for which apparently no other plausible reason to do so can be imagined but to prevent the prospective commercial partners from realizing someone's true commercial self. Which, at least as we see it, equals the unethical intent of hiding important and possibly unpleasant/damaging truths from those considering to do business with us and so denying them an opportunity of a free choice (meaning also free from incomplete information and disinformation). Since apparently no commercial or other morality standards have been found for information discussed to be regarded confidential, it is our conclusion that no legitimate ethical/moral reasons exist for sharing it to be qualified as unethical/immoral. Consequently, the practice of sharing business partner behavior can be qualified as perfectly ethical/moral from this perspective.

But what about the information/data that is being shared (fed into the system) at the input phase of the process? Can the same ethical/moral conclusions about no confidentiality issues be drawn also for

these? As we see it, while it can be argued as perfectly ethical/moral to share synthesized information on someone's commercial behavior, this does not necessarily apply also to the detailed transaction-level data/information at the input of the same process. Consequently, to be able to make conclusions about the ethicality/morality of the proposed sharing practice as a whole, the issue of confidentiality has to be addressed also for the input phase of the process.

Much more analytical in nature, transaction-level (accounting) data, if too detailed, when combined with information from other sources, could provide insights into one´s business operations much more deeply than the average business person would normally be ready to accept. So deep, in fact, that most if not all would argue that it should be regarded as a business secret and be therefore confidential. For example, most if not all of the business organizations consider their business/accounting records to be confidential and would never disclose them to someone else unless absolutely necessary. But when a commercial partner of ours shares detailed data about, for example, his/her accounts receivable (quite a common practice on the credit markets), this is exactly what happens. A substantial portion of our accounting records is also being disclosed/shared with a third party without our consent. Can such a practice be deemed ethical/moral? The answer, again, depends mainly on how convincing a moral argument one is able to make to qualify such data/information as a business secret (i.e. proprietary) and therefore confidential.

The protection of one´s intellectual property/trade secrets seems to us as the only potentially plausible moral argument to hold/qualify certain business data/information confidential. As we see it, the strength of such an argument depends directly on the level of susceptibility (sensitivity, usefulness) of the data/information, to be misused for the purposes of industrial espionage or other immoral/illegal purposes damaging to someone´s legitimate business interests. The degree of insight into someone´s internal functioning (operations/processes) seems to us as the most logical criteria for such an evaluation. Substantial differences on that regard between different types of transaction-level commercial data can be identified. While, for example, we see no great danger for someone´s intellectual property to be misappropriated with accounts receivables shared, the detailed accounting data on business partners' individual orders/purchases consisting of analytical information on items and quantities being ordered/delivered is quite another story. Although by legal standards such information probably does not qualify as a trade secret (or perhaps it does; it depends on the court and jurisdiction), when combined with information from other sources, it could provide insight into business operations deep enough also to reveal some of those aspects/elements of them that could legitimately be considered as someone´s intellectual property and therefore confidential. For that reason, it is our ethical/moral judgment that detailed/analytical information on commercial partners´ individual procurements (i.e. "physical/material" data on items and quantities delivered) should not be shared. Since the importance of such data for the evaluation of business partners' commercial reliability and trustworthiness is low, no real negative effects to the purposes of the sharing practice as proposed in this article can be expected from such an exclusion. It is also our judgment that no similar "trade secret" reasons can be argued for the exclusion of other transaction-level data, important for the purpose of business partners' reliability and trustworthiness evaluation[18].

5.3 Conclusion on the ethicality/morality of the business partners behavior sharing practice

In order to evaluate ethicality/morality of the practice of business partners behavior sharing two competing normative ethical/moral approaches were utilized. Since neither teleological nor

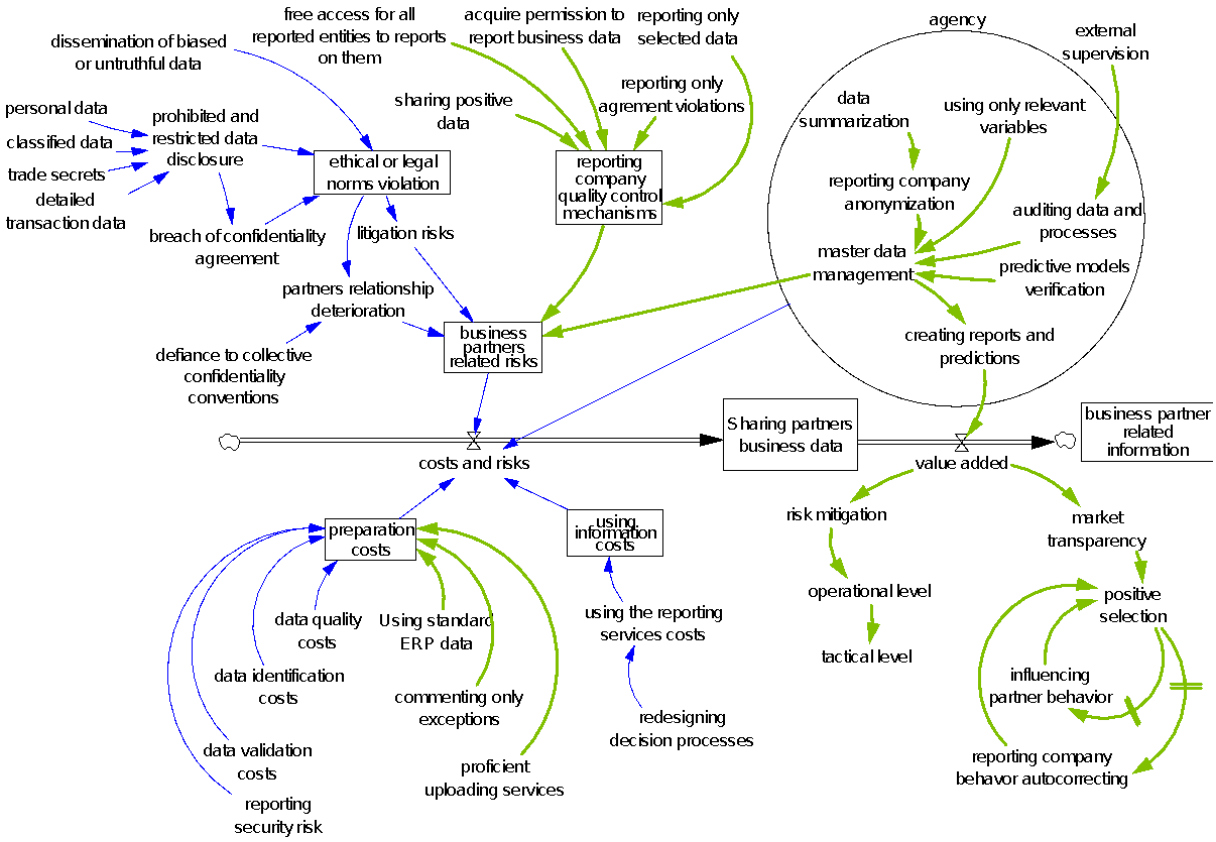
[18] Accounts receivable (including information on payment delays), delivery time records (including information on delivery delays), goods and services reclamation/return records, etc.

deontological evaluation produced any convincing moral argument against such a practice, it is our conclusion that no *a priori* moral reason exists for it to be considered as unethical/immoral, and consequently that the sharing of one's experiences and data on his/her business partners' commercial behavior can be judged as ethically/morally perfectly acceptable/permissible. That is, of course, as long as no personal data and legitimate business secrets are disclosed and as long as general moral principles of truth-telling, equal treatment and good faith are observed.

5 Sharing implications

The negative and positive business partner behavior sharing practices are joined in Figure 3. The costs and risks, predominantly found on the left side, can be generally divided into business-partner-related risks and data preparation and using information costs; they can be mitigated using various quality mechanisms. The positive effect generates value added for the reporting company and eventually the whole market.

Figure 3 Business data sharing SD diagram



The most important variable: business-partner-related risks, is dependable on partners' relationship deterioration or indirectly on defiance to collective confidentiality conventions and on litigation risks. The confidentiality conventions reside in local environments but can be changed in time. The litigation risks reside from violating ethical or legal norms violation, such as dissemination of biased or untruthful data, prohibited and restricted data disclosure (personal data, classified data, trade secrets, detailed transaction data), or breach of confidentiality agreement.

The business-partner-related risks can be mitigated by the sharing company by employing quality control mechanisms, such as free access for all reported entities to report on them, acquire permission to report business data, share only selected data, share positive data and share only agreement

violations. Some of the mitigation strategies may be controversial (e.g., share only positive data) and don't contribute to expected results.

The agency plays an important role in mitigating business-partner-related risks. By imposing master data management procedures, such as using only relevant data and verified predictive models, by anonymizating sharing companies, auditing data and processes and complying with external supervision, they lessen the risks of unethical reporting. Since they possess the knowledge of correct sharing, they must consult and control sharing companies on quality control mechanisms implementation.

The costs of sharing business data are inventible, but as argued in the paper, with implication of agency and ICT, reasonably low. For the sharing company, costs occur by sharing data and by using the newly acquired information. Data identification, validation and quality costs can be managed by sharing automation from ERP systems, while the use of proficient uploading services can mitigate sharing security risks.

It is interesting that the costs can occur by using the newly acquired information. The existing organizational, ICT-supported business processes need to be redesigned, which can temporarily lead to suboptimal process execution. By employing modular ERP solutions and new user communication channels, as for instance mobile apps, the costs can be lowered considerably.

Sharing agency related costs, executing data management processes, creating reports and predictions, are arguably lower than when applied by a single company. The big data technologies and cloud services limit the agency costs to an affordable level.

The sharing positive effects are double sided. The shared information can be used by the sharing companies for risk mitigation and improves partner communication at the operational and tactic levels. More importantly, it positively affects the market transparency, and through clearer posted market requirements, positive selection is achieved. Companies that recognize their business partners' demands adapt their behavior to comply. Lastly, by sharing and observing business partner behavior, the sharing companies recognize the important aspects and can adapt their behavioral patterns.

6 Summary

Trying to get insight into other members in the system is as natural as hiding individual weaknesses. In developed systems, multiple actual and virtual barriers have arisen to defend their privacy and also intrude on others' defenses. The stronger the barriers, the more energy is needed for their erection and intrusion, and the less viable is the system as whole.

In this paper, sharing of business partner behavior is proposed as one of the solutions for downgrading the barriers in the business ecosystem. Since systemic changes usually cause strong reactions, we examined the proposal from three perspectives: first the feasibility of the proposed change, secondly we examined the legal barriers, and lastly, the ethicality of the proposal was examined.

The feasibility analysis revealed three major players: the sharing companies, the intermediate agency, and the companies reported upon. To lessen business-partner-related risks, a set of mechanisms is proposed, protecting all involved players. Information technology plays an important role in cost reduction as well in providing the greatest possible positive impact in the form of clearly exposing company features, important for their partners and predicting their future behavior.

The legal and ethical research results reminded us that sharing must apply to a purpose: a fair disclosure of behavior patterns and no more. We answered not only the dilemma of whether to share or not to share, but also what (not) to share, and how to share, to maximize the positive sharing effect.

The positive impacts are both instant and postponed: Knowing your business partner reputation and anticipating their future behavior can be directly used in negotiation process and in issue resolving procedures. But even more important is the higher level of market transparency that positively influences the business partners' selection and consequently affects the behavior of companies willing to adapt to new business requests.

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Performance for viability: complexity and variety management

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Abstract

It is natural for actors constituting an organisational system and environmental agents to experience complexity asymmetries. In this contribution I discuss the balancing of these complexities at a level of performance that not only maintains the organisation’s viability but also the health of its ecosystem. Ashby (1964) proposed variety, or the number of possible states of a situation, as a measure of complexity and the Law of Requisite Variety as an ontology and heuristic for complexity management strategies. Following these propositions Beer’s variety engineering (Beer, 1979) is a construct to design these strategies. This paper offers epistemological and methodological considerations to discuss the viability and performance of organisational systems (Espejo and Reyes, 2011).

Introduction: Actors, agents and Requisite Variety

It is not until social *agents* coalesce around shared purposes (tacit or explicit) that they constitute themselves as *actors* of organisational system. These systems emerge from processes of self-organisation and self-regulation in which relationships between actors and agents constitute value co-production processes between them. Hopefully neither the values of one nor of the other will dominate these relationships. The aim is increasing mutual influence and transparency in their interactions.

It is natural to experience complexity asymmetries between actors and agents. For particular purposes it is natural for one to have more complexity than the other. If agents are citizens in need of social services, it is natural that the complexity of their requirements will be much larger than the complexity of the supplied services. Individual citizens need unique services and social services

need managing their limited resources by offering different categories or types of services. The challenge is managing these asymmetries achieving a good performance. Requisite variety is a construct to assess this performance (Ashby, 1964). Variety, or the number of possible states of a situation, is a measure of complexity. The more demanding is the required performance the more challenging is likely to be achieving a satisfactory balance in the relationship between agents and actors. Ashby’s Law, tells us that “only variety absorbs variety”. In other words “the variety of a regulator has to be as large as the variety of the regulated”. Since in general the variety of the regulator is less than that of the regulated, in practice often requisite variety is achieved by killing the variety of the regulated. Hierarchical, unilateral, oppressive regulation achieves control but at a high cost to people and organisations. In this contribution I want discuss more palatable strategies for complexity management. Strategies that allow organisational systems achieve requisite variety for desirable outcomes in which agents and actors learn from each other and co-create value through recurrent communications. Balancing organisational and environmental varieties at a level that maintains desirable levels of performance between actors and agents in a sustainable ecosystem is at the core of creating and producing desirable policies (Espejo, 2014a).

Variety Engineering

Figure 1 offers a template for complexity management strategies. It shows an organisational system in interaction with its environment aiming at requisite variety to achieve desirable performance, like viability in a challenging environment. It makes apparent that self-organisation and self-regulation are key strategies for agents and actors. It is only when environmental agents succeed absorbing among themselves much of their own variety that unabsorbed residual variety has a better chance to be matched, at a desirable level of performance, by the smaller variety of the organisational system. It is not only until these actors learn to achieve more with less that they will be able to match a larger environmental residual variety and improve their performance.

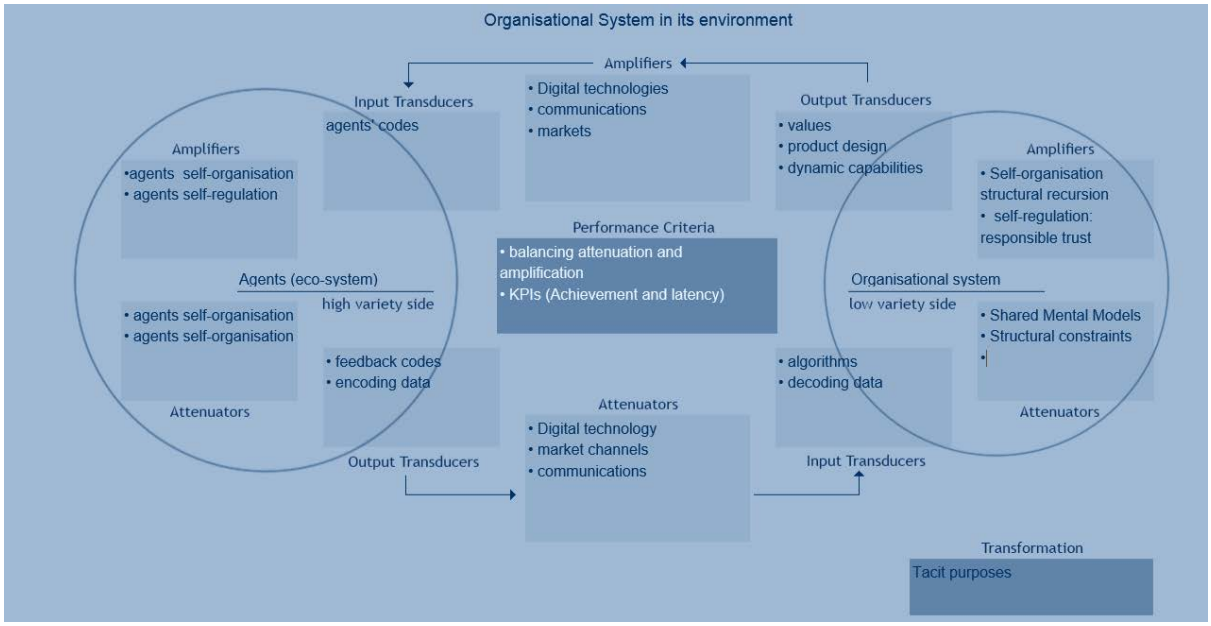


Figure 1: Strategies to balance actors’ and agents’ varieties

This figure illustrates:

1) That actors need to find better ways to reducing agents’ variety than ‘killing’ it. For this they need fostering policies that increase the agents’ self-organisation and self-regulation. This strategy has the potential of decreasing the residual variety they need to deal with at the same time of increasing performance, that is, at the same time of increasing the environmental variety matched by the organisational system.

2) That actors need to do more with less through effective organisation structures (Espejo et al, 1996). The Viable System Model (Beer, 1979, 1981, 1985) is precisely a construct to guide self-organisation and self-regulation within the organisational system. It provides heuristics to enable structural recursion, adaptation, autonomy and cohesion within the organisational system. Implementing the VSM is a strategy to increase organisational complexity in relation to agents. Indeed, current digital technologies are helping to do this (Pentland, 2014).

3) That actors and agents communicate with each other through complex enabling and/or obstructing contexts. For instance markets play that role and they are regulated even in the most lassie faire situations (Chang, 2010). This complexity needs management as well. The more effective are the contextual amplifiers and attenuators the more effective will be the absorption of residual variety and performance of actors and agents. Digital

and communication technologies play this role (Tapscott, 2009). Examples such as Google, Amazon, Alibaba and many others are expressions of this digital society.

4) That communications between agents and actors need transducers. Transducers are media that transforms signals from one expression into another expression that is more appropriate to the receiver. They are necessary every time that signals cross a boundary; they change one ontology into another making signals more meaningful to receivers. A decoder alters the input code into internally meaningful code and an encoder alters the output code into externally meaningful code (Beer, 1985).

Figure 1 is a *variety engineering* model relevant to organisational systems (Beer, 1985, Espejo and Reyes, 2011).

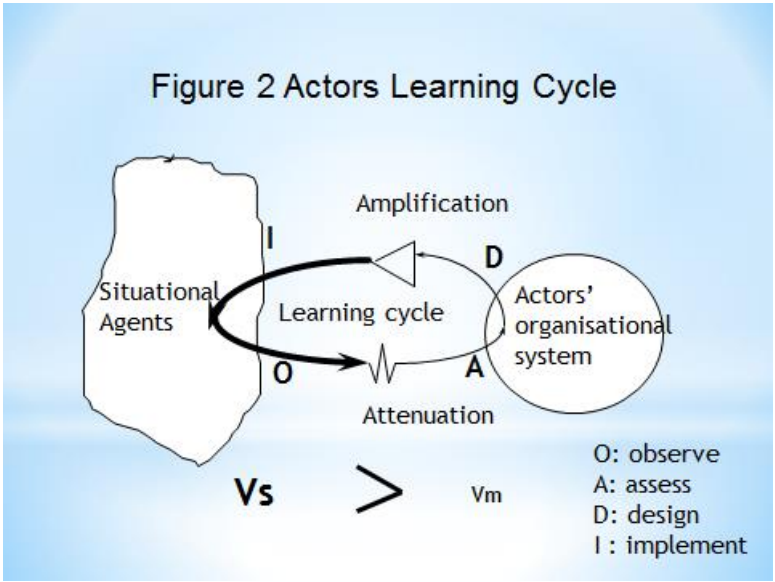
To check whether the variety engineering model is adequate it is necessary to assess whether the complexity management strategies are balanced regarding amplification and attenuation of variety. For instance, a company’s marketing policies may increase customers’ awareness of its services. However, as it triggers agents’ demand, its market residual variety may be too big and show that it does not have response capacity. In response, to improve the situation, the company may develop tools for customers to produce part of the services by themselves in the environment. But, if after these responses the enterprise’s performance is not satisfactorily its viability may be threatened; they did not pay enough attention to balancing amplification and attenuation. They are failing to develop their capabilities to match agents’ demand. Figure 1 is one of myriad of templates for any organisational system. *These templates are learning models* and therefore need to be in constant evolution supported by appropriate variety amplifiers and attenuators.

A consequence of the new technologies is enabling connectivity at all structural levels. It makes sense not to operate in isolated niches. New technologies are increasing actors’ holistic appreciation of their environment (Johnson 2012). In this sense technologies are changing the *nature* of organisations; innovative systems are necessary in their quests for effectiveness. Dealing with these challenges requires effective communications.

Individual and organisational learning

Figure 2 illustrates a well-known learning cycle between actors and agents (Kim 1993). In fact it is consistent with Figure 1. Actors observe (O) situational agents and their ecosystem, assess (A) these observations, design (D) actions and implement (I) them (OADI model). I want to highlight two aspects of this learning model;

1. First, as actors constitute a system with closure there is an organisational cognitive domain where observations and actions are not individual but organisational. Collectively, actors produce a “shared mental model” (SMM) and constitute the organisational system’s cognitive processes. These are structurally recursive processes.
2. Second, these learning processes are reflexive. Actors’ actions are affected by, and affect their own actions as well as those of environmental agents. These actions may change who these agents and actors are, something that changes the boundaries of co-created situations. For instance globalization decisions may make unexpected distant immigrants part of a country’s economic system and change its boundaries.



Organisational system double loop learning

Strategies to manage complexity and the OADI-SMM learning process can now be integrated in a methodological approach to support organisational learning. This approach is illustrated in Figure 3.

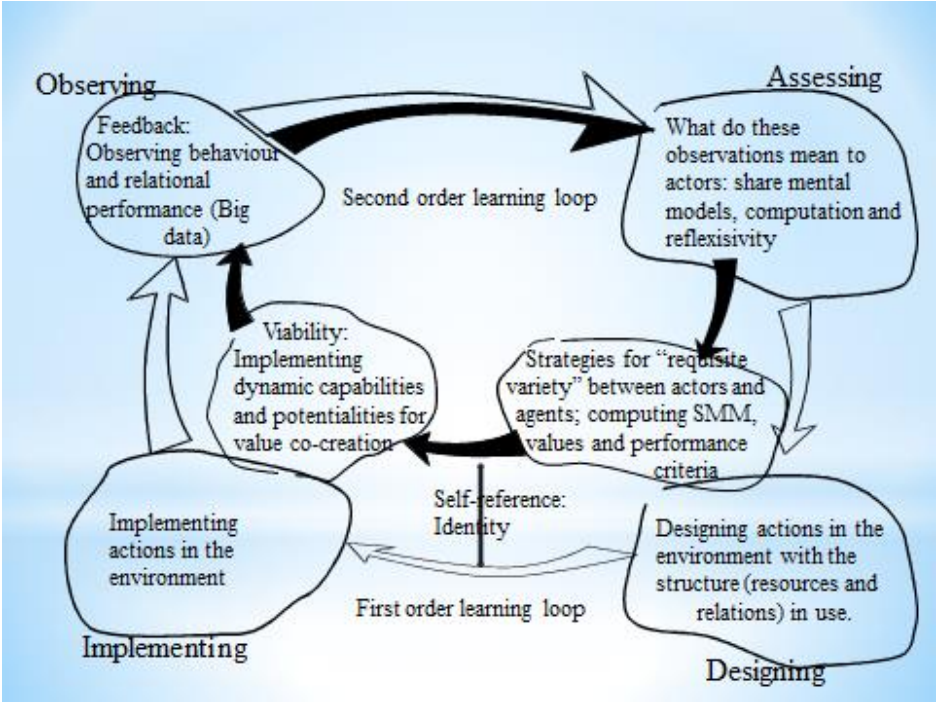


Figure 3 Organisational System Double loop learning

The first order learning is a feedback loop from the environment in which actors observe, assess, design and implement the actions triggering the feedback (white loop in Figure 3). Through this loop actors observe agents’ behaviours and relational performance. From these behaviours, actors’ resources and relations-in-use produce shared mental models (SMMs) and meanings that are used to design and implement actions. Though this first order learning loop, as explained so far, may support learning, it is questionable whether it will be aligned with the actors’ explicit purposes and values. Often actors’ actions are

fragmented (Figure 4) and though they may espouse shared purposes and values, in practice they are not integrated in the expected organisational system.

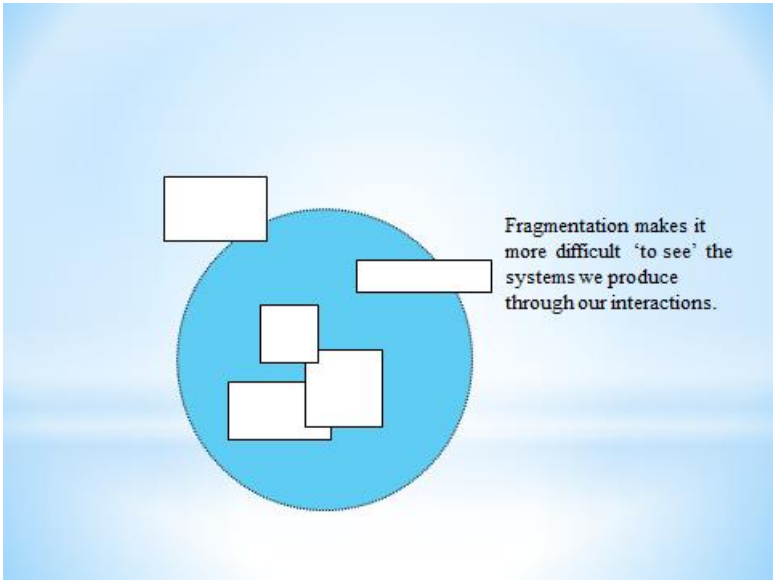


Figure 4 Fragmentation of resources and Organisational System

Much guided self-organisation (Ay, et al 2012) is necessary to produce a learning organisation. For as long as the loop’s complexity management strategies are inadequate and the actors’ explicit purposes and values are not embodied in their organisational identity (Espejo, 2003) this learning may help improving current doing, but may not be adaptive to a changing and reflexive environment. This more demanding learning is referred here as “second order learning” (black loop in Figure 3). It is necessary to highlight the following aspects:

1. Actors need visualising and implementing strategies to achieve requisite variety with environmental agents at a performance that secures both their viability and a sustainable environment. These strategies where discussed in the first part of this paper. In addition to enabling agents’ self-organisation and self-regulation actors need to guide their own self-organisation supported by conceptual tools such as the VSM (Figure 5) and digital technologies like communication and coordination tools.

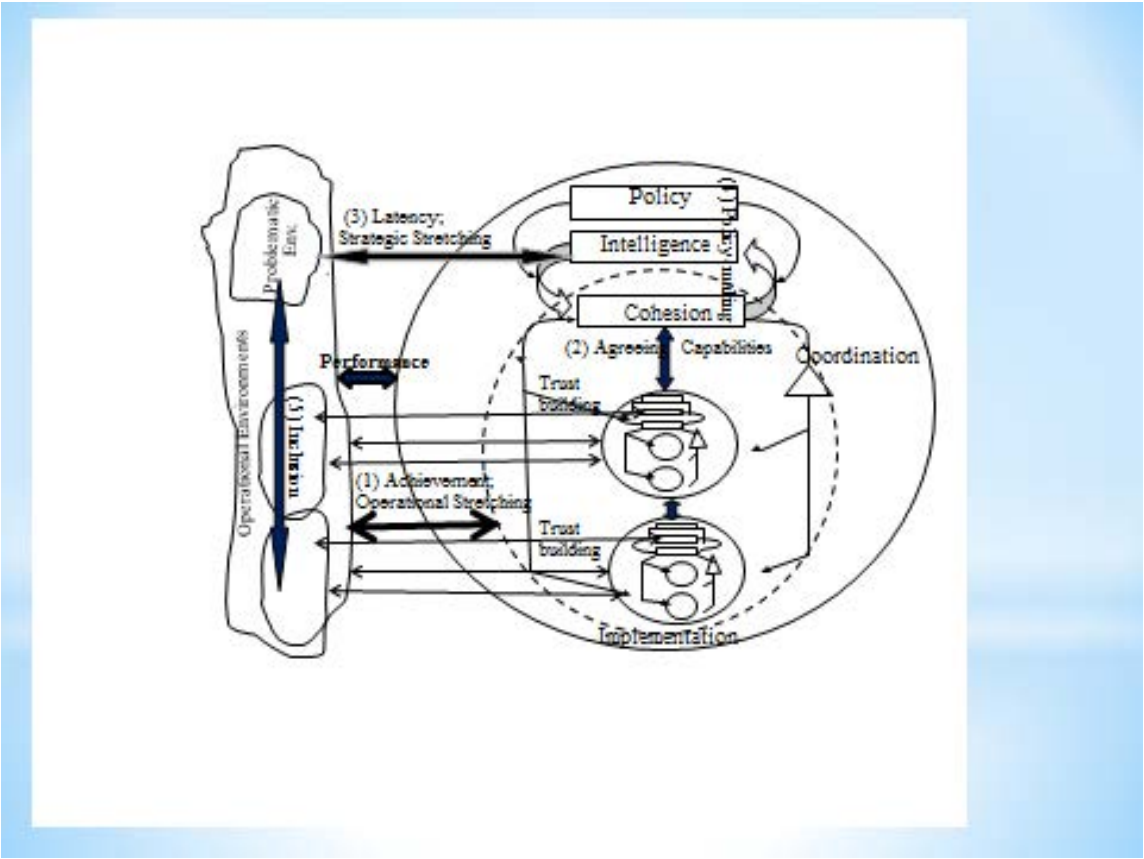


Figure 5 Recursive Performance of an Organisational System

2. An organisational system with organisational closure is structure determined (Maturana, 2002) and therefore is not responding but absorbing environmental buffeting with reference to its own identity; it is self-referential. Organisational closure and self-reference are critical concepts to all this argument. Self-reference offers a platform to develop awareness of the organisational system’s on-going assessment and design of the values it is co-creating in its interactions with agents. As actors in the organisational system observe the consequences of implementing their designs they are creating shared meanings with agents. They are not offering “objective” products and services; they are co-creating them. In the traditional market economy producers offer products as designed by them, with limited attention to value co-creation. Their products are accepted tacitly or not by agents in general. The framework of this paper suggests a “new market economy”, one where actors are aware that often they are managing a “surrogate world” (Beer, 1973) that needs to get closer and closer to a “constructed world” by actors and agents in *real-*

time. This implies for actors to move away from observing an objective world to observing the observers (von Foerster, 1984) co-constructing an emerging world from the collective observations and actions of actors and agents. Actors’ buffeted by disturbances and supported by affordances are learning more and more about agents’ values and creating shared values with them. These systems are organisationally and operationally closed. Their learning and performance relates to the organisation’s dynamic capabilities to deal with disturbances and affordances.

3. This framework is a platform for the system’s cognition and value co-creation with agents. Actors compute environmental feedback with reference to a model of what they are (organisation-in-use) and a model of they want to be (say, an organisation with effective complexity management strategies for shared purposes). Their actions follow from reflexion, self-reference and operational closure: this is the second order learning loop. First and second order learning loops are dependent on each other (the arrow between the two loops).
4. The VSM offers a wide range of interrelated strategies to balance varieties for viability. Its relational epistemology for value co-creation and balancing variety operators (amplifiers and attenuators) offers an approach to measure the relational complexities between agents and actors.
5. Observing imbalances between “variety operators” is a first heuristic for improving performance (see Figure 1). Complexity imbalances allow first to seize opportunities to reconfigure organisational resources and develop its dynamic capabilities (Teece, 2008, Eisenhardt and Martin, 2000) and second to work out through conversations with old and new agents its potentialities. For the total organisation performance indicators are methodological tools to work out holistic complexity imbalances (cf. Ralf Wilden, et al., 2013). Dynamic capabilities are the outcome of processes that enable organisational systems to performance better over time. These capabilities are recursive.
6. Reconfiguring resources is closely related to the ideas of variety management. Devolving problem solving and decision capacity to small teams in an organisation implies amplifying its complexity through autonomous units as far as possible. All this is enabled, among others, by digital technologies. Some products are more likely than others to unfold their complexity. For instance, in technological terms the production of

plastics sheets is likely to be less flexible than the provision, for instance, of consultancy services. It would appear unavoidable to have large machinery to produce plastic sheets, but would it? On the other hand it is natural to have small management consultancy teams. This would suggest that structural amplification of complexity is more restricted in the manufacturing example than in a consultancy firm. Of course, technology and ingenuity can overcome –to a degree- these restrictions. Ingenuity can create for large machinery multifunctional teams with capabilities to create, regulate and produce product lines for particular markets (Espejo et al, 1996, Chapter 5). With current technology, it is possible to have resource centralisation of specialised expensive resources, and functional decentralisation for service delivery. This is a case where technology permits centralising product creation and regulation, thus gaining the advantage of scarce expert resources, at the same time of decentralising less specialised resources for service delivery (cf. Christensen et al. 2009 illustrate this situation for health services). What makes this situation consistent with the heuristic of pushing down complexity unfolding is that structurally and technologically it is possible to link specialised central resources with service delivery by bringing them together into virtual autonomous teams (Espejo and Reyes, 2011, Chapter 8).

7. Second order learning is enabled by digital and communication technologies. What is of particular relevance today is that these forms of collaboration are supported by technologies that few years back where unavailable (Avril & Zumello, 2013, Johnson, S., 2012, Christensen, C. et al, 2009, Tapscott, D., 2009, Teece, J.D., 2008). Standards for collaboration are evolving constantly, making possible routine exchanges and communications between enterprises as if they were parts of the same organisational system. The first and second order learning *loops* are about building structures for effective conversations; the first order learning loop is about improving the organisation’s use of its resources. The second order loop aims both at observing the observer and at better appreciation of the organisation’s operational and problematic environments in a changing technological world; the world of big data (Pentland, 2014).

Conclusion

In the early 1970s I was part of the Cybersyn Project (Figure 6), a creation of Stafford Beer for the Chilean Government (Espejo, 2014b).

Figure 6. Photo of the Chilean Operations Room (1972-73)

Beer´s Liberty Machine (Eden 2011) was an ambitious vision ahead of its time. My hope is that this paper will open further explorations of current digital and communication technologies as enablers of complexity management strategies to achieve a *fairer* value co-creation balance between agents (e.g. “customers”) and actors (e.g. enterprises, economies). Indeed, today we have the conceptual and technological tools to go beyond the invisible hand of the market economy.

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Proposing a Basic Methodology for Developing Balanced Scorecard with System Dynamics Approach

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Abstract

Successful future has inspired organizations to measure long-term and non-financial measurements and KPIs (key performance indicators). Kaplan and Norton proposed Balanced Scorecard for this issue and have extended it to one of the most preferred strategic management system's tools. However, available tools like BSC (balanced score card) have some limitations, like dependency to the developer, and also weakness in showing time delays, mathematical relationships between lead and lag indicators, and planning. In this paper, we would present a new methodology for developing BSCs, which has been able to overcome these limitations. This new methodology is a composition of original BSC development methodology and system dynamics. This methodology consists of six different steps (Developing a system for organization, Selecting vision, Identifying organization's objectives and their KPIs for different BSC aspects, developing strategy map, Targeting, and Selecting initiatives and policies). Furthermore, an assumed organization has been used for showing methodology's capability and procedure.

Keywords: Balanced Scorecard, System Dynamics, Developing BSC, BSC Developing Methodology.

Introduction

In the competitive economy of the day, companies have to achieve their financial targets; moreover, they must have loyal customers, introduce new innovative products, improve employee skills, and also invest on their infrastructures. Financial measures may only tell a fraction of a company's behavior. Therefore, the financial accounting tools must be expanded to incorporate the company's intangible and intellectual assets that satisfy customers and employees (Kaplan & Atkinson, 1998). Kaplan and Norton proposed a new tool for managing organizations and assessing their performance; which is named BSC (Kaplan & Norton, 1992). They developed BSC and transformed it to a strategic management system (the BSC literature would be described later in this paper). However, BSC has some limitations. BSC is completely dependent on the developer and different BSC developers create different BSCs for the same organization. Moreover, mathematical, non-linear relationships, and also the time delays between

the objectives and KPIs are still unknown. Furthermore, targeting for objectives and initiatives settings are so primitive and essential. By employing Systems Thinking, entrepreneurs can establish accountability mechanisms, ensure equity for all stakeholders, and facilitate system sustainability (Dzombak, et al., 2013). Therefore, we have applied system dynamics for developing BSC to overcome these limitations and gained respectable results. Generally, BSCs and their complementary tool, strategy maps, have some limitations which described in the proceeds of this section.

Hudson et al. have pointed out BSC has not a mechanism for defining relevance measures (Hudson, et al., 2001), and as a result relevance objectives. This would results in different BSC for a company with a special vision, which have comprised of developer. Applying system dynamics for developing BSC and designing a standard mechanism would be concluded in a unique BSC for a unique company with a unique vision.

BSC border depends on developers, most of whom consider internal factors. Neely et al. have criticized BSC for not considering important interest groups, such as suppliers (Neely, et al., 2002). Furthermore, Mooraj et al. have argued that BSC does not consider the company's extended value chain (Mooraj, et al., 1999). For developing a system, a border must be considered. Selecting an appropriate border, results in considering different interest groups. In this article's proposed methodology for developing BSC, borders are beyond internal environment and would consider almost all important interest groups.

Some researchers criticize BSC for its weakness in describing interrelationships between measures (Lawrie & Cobbold, 2004). As a result, relationships between objectives are not clear and targeting for them is depending on developer. BSC can't properly describe causality between objectives as mentioned by Nørreklit in 2000. In addition, she has mentioned that causal connections between objects are not as shown in strategy maps, and also, has noted that BSC is a static model and wouldn't consider time factors (Nørreklit, 2000). This weakness can cause some problems for the organization. Kaplan and Norton have eliminated some problems, aroused from the gap between measures and objectives, by strategy maps (Kaplan & Norton, 2004). But some problems still remain. For example, without considering time delays between measures, organization’s decision-making process would have lots of complexities. Causal loops and system thinking are tools, which can be applied for solving problems like time delay consideration. Kunc in 2008 has applied system thinking in developing causal loops for BSC, and he has achieved considerable results (Kunc, 2008). Barnabe and Busco have added some discussions to Kunc’s research works. They have identified system dynamics contributions to the BSC. As it can be seen in Kunc’s research works, they have proposed applying causal loops and linkages. Furthermore, they have offered using loop’s polarity and variable formalizing for a better representation of causal loops. Also, causal loops can explicitly describe feedbacks in the organization’s strategy map. Mental model and using organization’s knowledge for strategic planning by BSC is another advantage of system dynamics approach to BSC (Barnabe & Busco, 2012). This problem could be solved with system dynamics abilities for describing causality between objectives. In addition time consideration is one of the other capabilities of system dynamics, which can be applied for developing better targets.

Another BSC weakness is its limitations for time delays interpretation. Well known BSC developing approaches are taken into account in differentiating between lagging and leading

indicators and have no explicit representation or formalization for time delays. This problem would be solved by using system dynamics modeling, which is mathematically formalized in computer models according to their typology. Furthermore, non- linearity would be analyzed when an organization has applied system dynamics for its BSC. Also, organizations, which have benefited from system dynamics, can analyze their strategic scenarios and choose the best scenario by system dynamics mathematical model (Barnabe & Busco, 2012). Also, Morecroft believes in system dynamics ability for a better linkage between strategy and operations in organizations. He has also recommended policy analysis with system dynamics; which can be applied for identifying resources and operational flows in the organization (Morecroft, 2007).

In 2008, Nielsen and Nielsen have constructed a dynamic model, inspired by a case study based on an international company. Theoretically, they have described one of the main difficulties of balanced scorecard (BSC), which is to foresee the time lag dimension of different types of indicators and their combined dynamic effects. Therefore, they have applied system dynamics for an international company's BSC and analyzed three different strategic policies for the company. These policies have been compared by their effects on a main target (return on capital). Their results have shown that a minimal change in one of the base variables (skills, customer base or work in process) may have a major influence on profit and other indicators and its prediction might be impossible without using a dynamic model (Nielsen & Nielsen, 2008).

One of the most comprehensive studies on applying system dynamics in strategic management system has been presented by Barnabe in 2010. He aimed to focus on the development of a "dynamic Balanced Scorecard" and demonstrated that matching the traditional Balanced Scorecard (BSC) architecture with system dynamics principles offers a better support for strategic management decisions. Therefore, he developed a comprehensive dynamic model for a company and then applied flight simulator to it. He suggested that this dynamic Balance Scorecard has overcame some limitations of the original BSC and also helped companies on applying BSC architecture and system dynamics principles simultaneously (Barnabe, 2011).

These research works have helped us for developing our methodology. Kunc's research has shown the ability of causal loops for demonstrating strategy maps, which have been applied in our research work for developing strategy maps. The research papers by Barnabe and Busco in 2012 show the highest capability of system dynamics in strategic management system, and have been applied in our methodology. Morecroft has mentioned that a dynamic model can be used for linking strategic and operational approaches, and we used his results after changing some targets and setting initiatives for BSC. Nielsen and Nielsen have introduced good aspects of applying system dynamics for BSC. Selecting most important objective of the organization and analyzing different policies for organization's success are the lessons to learn from them. These lessons with some modification would be applied in the second, fifth and sixth steps of our methodology, which would be described later in this paper. Also, Barnabe in 2010 has introduced dynamic Balanced Scorecard, which is the synthesis tool for strategic management system. This tool is a system dynamics model based on BSC concepts. We use the capabilities of

system dynamics and after improving some aspects and adding new features; we make a BSC with system dynamics abilities[1], and not a system dynamics model with BSC abilities[2].

In the next two subsections of this section, BSC and System Dynamics concepts would be presented.

System Dynamics

System dynamics is a methodology for studying and managing complex feedback systems, which one finds in business and other social systems. In fact, it has been used to practically address every sort of feedback system (Hajiheydari & Zarei, 2013). While the best known models are linear with beginning and end points, system dynamics sees the world as it is, with non-linear and interacting parts that influence and feedback to one another. It uses basic concepts like "stocks" (levels of quantities that change overtime and need to be tracked) and "flows" (the rates of changes). System dynamics modeling is a tool to address the complexity and incorporates feedback loops in systems, and the results of system dynamics models have shown to be valuable in identifying factors that affect outcomes of processes, programs, and decisions (Sterman, 2001). System Dynamics is also a rigorous modeling method that enables us to build formal computer simulations of complex systems and use them to design more effective policies and organizations. We can experience the long-term side effects of decisions and speed learning, develop our understanding of complex systems, and design structures and strategies for greater success" (Sterman, 2000). Systems become increasingly complex and this leads to a more difficult process of conceptual design for their behavioral model. Therefore, the concept of using "Micro-world" is developed to analyze some of the pre-defined variables in order to understand system behavior. Creation, modification and manipulation of "Micro-world" increase our knowledge about the systems we live in, work or stop working with (Woodside, 2006).

Applying system dynamics in business has following advantages (Thurbly & Chang, 1995):

- System dynamics analyzes not only the company's processes, but also its policies.
- System dynamics applies system-thinking approach to study the entire business system rather than studying only problematic processes.
- System dynamics helps in establishing business control metrics and quantifying.

Forrester in 1958 applied system dynamics in different applications for the first time (Forrester, 1958). Since then, system dynamics has been developed and used in several problems like engineering, strategy and policy analysis, environmental issues and so on, ex. the unanticipated impact of low cost housing programs which results in increasing unemployment (Forrester, 1969).

System dynamics, related to systems thinking, is defined as the principle and technique of feedback control systems for modeling, analyzing and understanding the dynamic behavior of complex systems. System dynamics coupled with system modeling and computer-based

1 A BSC developed with a system dynamics approach which has dynamics features; therefore it could be applied for designing and analysis of policies for the company.
2 A system dynamics model comprised of a BSC, which is applied for policy analysis in the company.

simulation is a valuable aid for gaining insights into the complex feedback systems and making appropriate decisions (Barnabe, 2011).

Sterman in his widely-recognized book, 'Business Dynamics: System Thinking and Modeling for a Complex World' claims that "formalizing qualitative models and testing them via simulation often leads to radical changes in the way we understand reality." Simulation speeds up and strengthens learning feedbacks. Discrepancies between formal and mental models result in improvements in both, which includes changes in basic assumptions such as model boundary, time horizon, and dynamic hypotheses (Sterman, 2000). Also, mental models are integral in order to focus on the openness needed to unearth the shortcomings in perceptions (Senge, 1990). System dynamics can use dynamics and feedback to assist decision makers in understanding the structure and characteristics of a complex system (Yang & Yeh, 2013).

Nevertheless, building a model is not an easy task. It implies an iterative process, in which the model could be rebuilt several times. There is no best recipe for developing a successful model and no optimal procedure that could guarantee a useful model, although a few main steps should be included in any modeling process (Barnabe, 2011):

1. Articulate the problem that needs to be addressed;
2. Formulate a dynamic hypothesis or theory about the causes of the problem;
3. Build a simulation model to test the dynamic hypothesis;
4. Test the model;
5. Design and evaluate policies.

Balanced Scorecard

Organizations have used tools and systems consisting of a mix of financial and non-financial measures to track progress for quite some time. Balanced Scorecard is one of these tools, which has been proposed by Kaplan and Norton in the early 1990s. The BSC includes four different perspectives: the financial perspective, the customer perspective, the internal perspective, and the learning and growth perspective. The BSC was developed to address the shortcomings of traditional management accounting by including three new perspectives in addition to the financial perspective: a customer, an internal process and a learning, and growth perspective (Kaplan & Norton, 1992). Kaplan and Norton paper was a popular success, and was quickly followed by a second in 1993. In this second paper, they have shown BSC in practice (Kaplan & Norton, 1993). In 1996, they published a book "Balanced Scorecard: Translating Strategy into Action"; which presents their ideas about assessing organization's long- term success. They have demonstrated that one of the most important objectives of BSC is the feedback related to learning and improvements for employees, the communication, information, and learning for executives (Kaplan & Norton, 1996). Moreover, in the same year, they have published another article about applying BSC as a strategic management system (Kaplan & Norton, 1996). Kaplan and Norton have introduced the strategic maps, which links the key performance measures together in a causal chain. They specify how to translate strategy into tangible and operational terms. The strategy is defined through specific objectives that can be linked in cause-and-effect relationships across the four perspectives (Kaplan & Norton, 2004). In 2006, Kaplan and Norton described the alignment process of all organizational strategic business units (SBU) to the

strategy and, thereby, introduced an enterprise strategy map and a BSC that clarified corporate priorities (Kaplan & Norton, 2006).
In Execution Premium, Kaplan and Norton proposed a strategic management system with BSC; which can be seen in Figure 1. The steps of this cycle are described later in this paper. We would apply this cycle for developing our dynamic strategic management system.
The six steps of Kaplan and Norton's strategic management system are:

1. **Develop the Strategy**: Organizations must be able to state exactly what business is, identify the key issues face, and determine how good to compete. Developing the strategy uses an array of strategy tools such as mission, values, and vision statements; external competitive, economic, and environmental analyses; methodologies such as Michael Porter's five forces and competitive positioning framework, the resource-based view of strategy, and blue ocean strategies, as well as scenario planning, dynamic simulations, and war-gaming.
2. **Translate the Strategy**: Organizations must be willing to develop strategic objectives, measures, targets, initiatives, and budgets that will ultimately guide action and resource allocation. For this purpose, organizations need to be able to describe their strategy, measure their plan, identify plans of action, figure out how to fund their initiatives, and decide who will lead the strategy execution process. Translating the strategy uses such tools as strategy maps and Balanced Scorecards, along with targets and strategic initiatives.
3. **Align the Organization**: Organizations must be able to link company strategy to the strategies of individual business units while both aligning and motivating employees to optimize strategy execution. Organizations align with the strategy by cascading strategy maps and Balanced Scorecards to all organizational units, by aligning employees through a formal communication process, and by linking employees' personal objectives and incentives to strategic objectives.

Figure 1: Kaplan and Norton's strategic management system (Kaplan & Norton, 2008).

4. **Plan Operations**: Organizations must link long-term strategy with day-to-day operations, align strategy with operating plans and budgets while focusing on those process improvements that are most critical to the strategy. Planning operations uses tools such as quality and process management, reengineering, process dashboards, rolling forecasts, activity-based costing, resource capacity planning, and dynamic budgeting.
5. **Monitor and Learn**: Organizations must be committed to monitoring performance results once a strategy has been developed, planned and implemented, enabling you to determine if the strategy is being properly executed. It requires monitoring and learning about problems, barriers, and challenges. This process integrates information about operations and strategy into a carefully designed structure of management review meetings.
6. **Test and Adapt**: Organizations must also test fundamental strategic assumptions to determine if they have certainly found the right strategy. This involves testing and adapting the strategy, using internal operational data and new external environmental and competitive data, and thus launching a new cycle of integrated strategy planning and operational execution.

Pluralization

In the following paragraphs, we would introduce our methodology for developing BSC with system dynamics approach. In this section, an assumed organization would be used for showing methodology's capabilities. And finally, we would demonstrate methodology's contributions and capabilities, advantages and future research frontiers.

Proposed Methodology

As we know, developing BSC is highly dependent on its developer. In this section, we demonstrate a new BSC developing methodology, which leads to standard BSCs. Furthermore, this methodology can improve BSC. Like strategy maps, BSCs and its complementary tools have some limitations like:

1. Objective selection is dependent on analysis of developer and if different developers develop BSC for an organization, their results would be different.
2. The relationship between objectives in strategy maps is also dependent on developer thoughts. This can be results in unrealistic causal relationships because of developer's point of view and his/her bounded rationality.
3. Targeting for objective cannot be perfectly done, because of static estimation.
4. Since the relationship between the objectives is not mathematical, sensitivity analysis[1] cannot be done, and therefore, managers have some difficulties for selecting appropriate initiatives and policies.

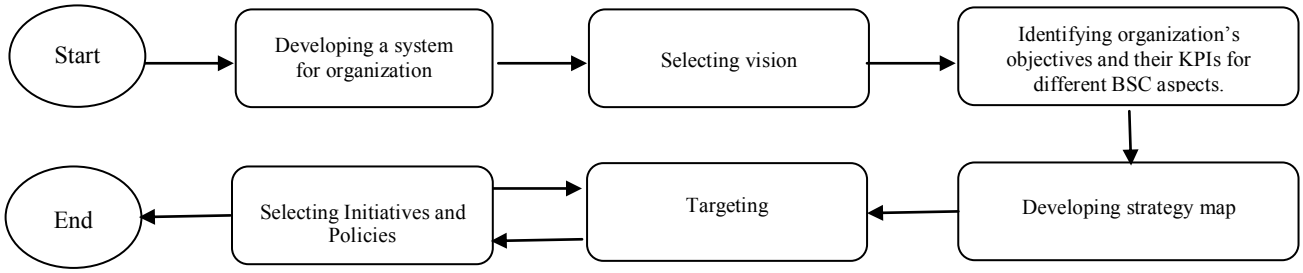
[1] Sensitivity analysis is the study of how the uncertainty in the output of a mathematical model or system (numerical or otherwise) can be apportioned to different sources of uncertainty in its inputs (Saltelli, et al., 2008)

These limitations have guided us to a new methodology. This new methodology is a combination of system dynamics and strategic management system. Procedures of this methodology consist of the following six steps:

1. Developing a system for organization: this step is a system dynamics step for developing a system for an organization, and is based on Barnabe's introduced methodology.
2. Selecting vision: this step is based on the first step of Kaplan and Norton's strategic management system.
3. Identifying organization's objectives and their KPIs for different BSC aspects (Financial, Customers, Internal Process and Learning and Growth): this is a compound step which is composed of the first and second steps of Kaplan and Norton's strategic management system with system dynamics sensitivity analysis.
4. Developing strategy map: this step is also a compound step, composed of the second step of Kaplan and Norton's strategic management system and causality loops of system dynamics.
5. Targeting: this step is a system dynamics step, in which the target of objectives would be selected.
6. Selecting Initiatives and Policies: this step is a facilitator for Kaplan and Norton's management system, in which generality of initiatives and policies for rotating the cycle would be analyzed.

Steps 5 and 6 are iterative steps and iterate in anticipation of complete accordance. The methodology has been shown in Figure 2.

Figure 2: The procedure of the proposed methodology.



In the following paragraphs, we have explained the steps that have been followed by an example. This example is a simplification of a production organization which sells directly to consumers. This organization produces agricultural machines. This example is only for better methodology instruction and simplification would be applied in the proceeds of this article. We will refer to this organization, as "A".

Step One: Developing a system for organization

This step is a base for this methodology. In this step, we develop a complete system for the organization (for example A). In developing this methodology, environmental and internal aspects of the organization must be considered. This can be done by well-known methods like

PESTEL[1] analysis (Yüksel, 2012) for macro environment and Porter five force[2] analysis (Porter, 2008) for micro environment. In addition, value chain (Porter, 1985) and McKinsey 7S framework (Waterman, et al., n.d.) could be applied for organization's internal analysis. Therefore, important factors have been identified for the organization and its environment. These factors must be applied for developing a qualitative system for the organization.

Preceding this step, the system would be transformed to a quantitative dynamic system. Therefore, variables would be created directly or indirectly from factors. If a factor needs to be better explained, then some variables would be created indirectly from it, otherwise, the variable is made directly. In summary, a system dynamics model would be developed for the organization, as explained in the system dynamics literature. For example, Figure 3 demonstrates a quantitative dynamic model for "A". In this figure, for simplicity we have considered a part of organization's internal analysis, and assumed that A is in an isolated environment and the "word of mouth" is the only effects of environment on it, which can affect the customer gain rate. This dynamic model would be used later in this paper.

In this model, we can see A's manager can change: his employees' ability by training, production line by structure cost, quality of products by R&D[3], marketing by price and marketing costs (like promotion, advertisement, events and so on), combination and number of employees and also employees salary. In conclusion, these are the lead factors[4] in an organization and managers can change them by initiatives or policies, for organization's success.

Step two: Selecting vision

This step is highly dependent on organization's stakeholders; also, it can form the organization's BSC and strategy map. Each organization has its unique vision. For example, one company has a target for creating the most possible revenue and another has the target for uprising its brand. Therefore, this step has been placed in the methodology for consideration of organizations differences.

A's vision is to be achieving higher profit margin from about 6 to 18 percent.

Step three: Identifying organization's objectives and their KPIs for different BSC aspects

This step is the most important step in this methodology. In this step, developer must change the independent variables (lead variables) and study other dependent variables (lag variables); especially organization's primary target or vision. Most sensitive[5] variables must be identified and used for creating objectives from them, then allotted to one of the four BSC aspects. These

[1] Political, Economic, Social, Technological, Environmental and Legal

[2] Threat of new entrants, Threat of substitute products or services, Bargaining power of customers or buyers, Bargaining power of suppliers, and Intensity of competitive rivalry.

[3] Research and Development

[4] A lead factor can modify lag factors (like financial factors) and could be changed by company and its managers.

[5] When independent or leading variables change, some of dependent or lagging variables change more rapidly, compared with the others, therefore they are sensitive variables. Moreover some of leading variables respectably change the whole system, subsequently they are also sensitive variables.

most sensitive variables are objective's components for a company[1]; which must be monitored by BSC. On the other hand, these components are key performance indicators (KPIs) of the organization's objectives. In summary, this step helps identify the organization's objectives for developing its BSC.

As an example, in Figure 3 we have simulated a model for A. The most sensitive variables are:

1. Price
2. Marketing Cost (like promotion cost)
3. R&D Cost
4. Training Cost
5. Orders
6. Customer Rate
7. Revenue
8. Cost
9. Structure Cost
10. Production Cost

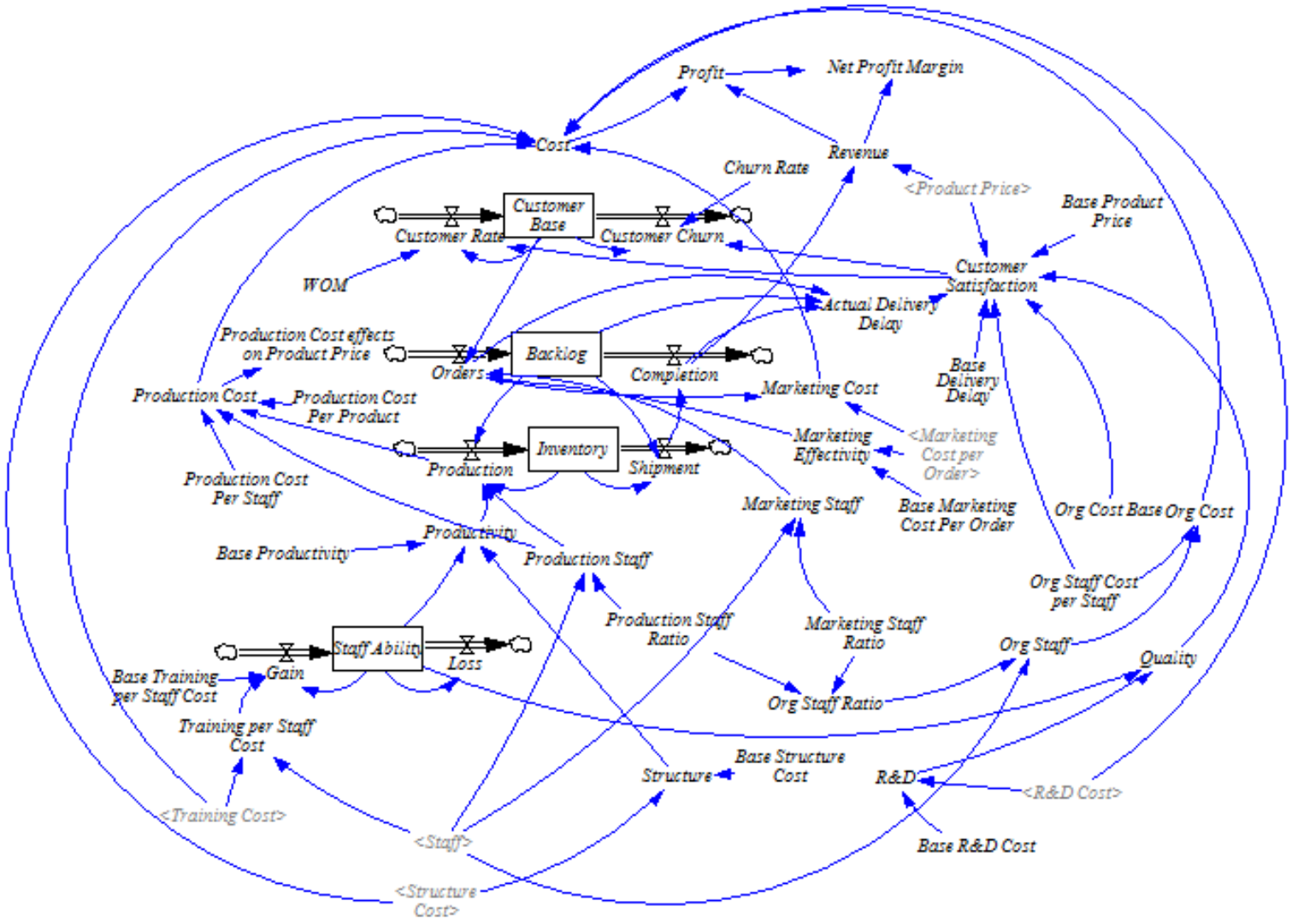
These variables have been applied for creating A's objectives. Furthermore, they are the KPIs of the objectives too. A's objectives and their corresponding KPI(s) and BSC aspects are shown in Table 1.

Table 1: A's objectives and their corresponding BSC aspect and KPI(s).

Corresponding BSC aspect	Objective	Corresponding KPI
Financial	Increase Income	Revenue
	Decrease Cost	Cost
Customer	Customer Stabilization	Customer Rate
	Increase Customer Orders	Orders
Internal Process	Optimize Marketing Mix Policies	Price
		Marketing Cost
	Improve Production Process Efficiency	Production Cost
Learning and Growth	Improve Knowledge of Employers	Training Cost
	Investment on Product's Quality	R&D Cost
	Investment on Production Facility	Structure Cost

[1] Because these variables could change more respectable than the other variables, therefore they must controlled, which controlling them, results in controlling the whole system's health.

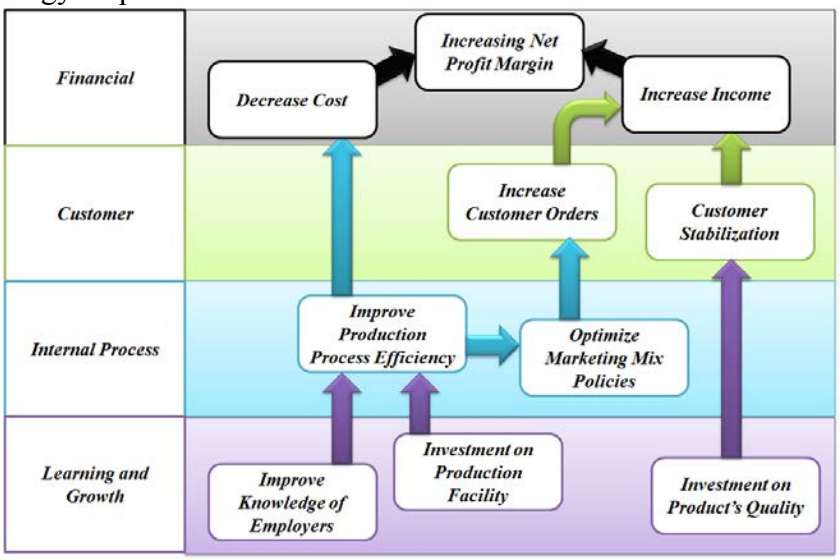
Figure 3: A's quantitative dynamics model.



Step four: Developing the strategy map

System thinking and causal relationship between the variables in a system dynamics model would be applied for developing strategy maps. As mentioned in the introduction, this procedure has been performed by studying cause and effect relationship in system dynamics model. It must be noted that for creating comprehensible strategy map, some of causal relationships must be excluded from original system. For example, A has a strategy map, as shown in Figure 4. The relationships between objectives in this figure are concluded from qualitative (has not been shown in this paper) and quantitative (Figure 3) dynamic models for this organization.

Figure 4: A's strategy map.



Steps five and six: Targeting and selecting initiative and policies

Targeting and selecting initiatives are iterative steps in this methodology. In the targeting step, BSC developer would analyze changeable variables and their effects on the most important objective(s) or vision of the organization. Therefore, the developer must consider planning limitations like budgeting boundaries (strategy budget or STRATEX usually must be lower than 10 percent of the total budgets of the organization), time limitation, etc.

These two steps are aimed to create a system dynamics game and change the leading variables until the most important objective(s) of organization has (have) been satisfied. When the most important objectives, targets and also initiative limitations are modified using the values of the KPIs, they would be the targets for the objectives of the organization. Otherwise, limitations and boundaries adjust their values until all of them and also organization's most important objective(s) are satisfied.

For example, "A" can achieve its vision by Table 2 initiatives. In this table, time and cost of initiatives (project or action) are shown, while the detail could not be covered in this paper. Figure 5 illustrates the effects of initiatives on Net Profit Margin. Furthermore, we have identified the target for each of A's KPIs. This can be seen in Table 3.

Table 2: A's initiatives and policies.

Initiative	Value	Time (number of month in plan)
Uprising Training Cost	10 percent	1st month
Uprising Marketing Cost	0.5 percent each month	From the 1st month
Uprising Training Cost	0.3 percent each month	From the 6th month
Uprising R&D Cost	10 percent	6th month
Uprising R&D Cost	0.3 percent each month	From the 12th month
Holding an exhibition (Uprising Marketing Cost)	7 percent	28th month
Uprising Price	5 percent	30th month
Uprising Price	3 percent every 6 months	From the 46th month
Holding an exhibition (Uprising Marketing Cost)	7 percent	50th month
Investment on Production Facility	5000	From the 50th to 60th month

Figure 5: A's Net Profit Margin behavior during 60 months of planning.

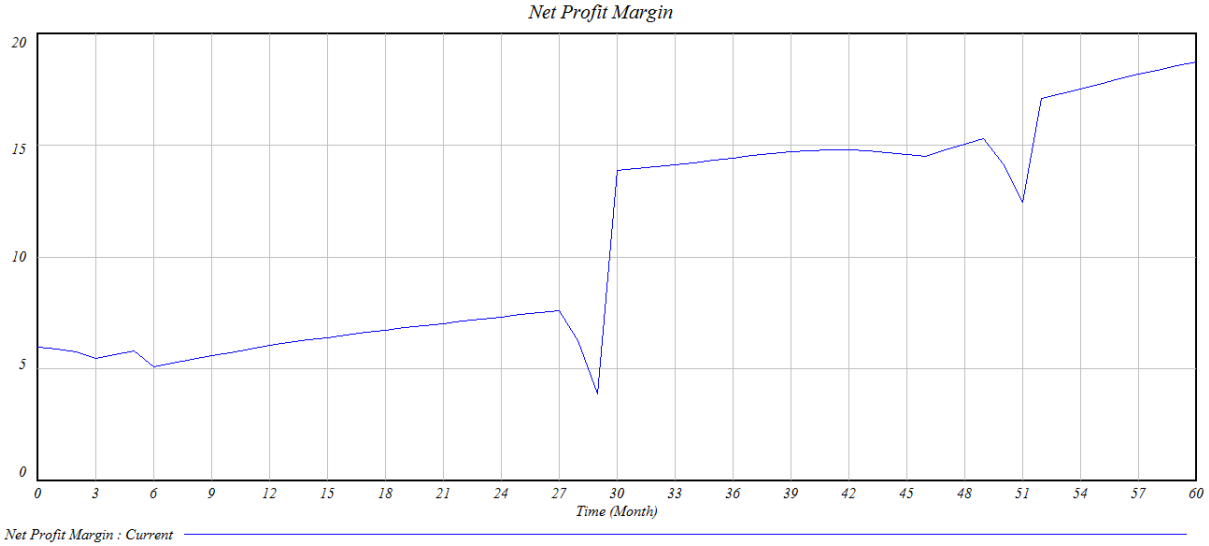


Table 3: A's KPIs target.

KPI	Base Year	First year	Second year	Third year	Fourth year	Fifth year
Net profit Margin	5.96	6.04	7.31	14.43	15.03	18.73
Revenue	10.9	113.88	119.96	141.1	143.38	153.38
Cost	102.5	107	111.2	120.75	121.83	124.65
Customer Rate	33	33	33	33	29	26
Orders	218	230	242	271	271	271
Price	0.5	0.5	0.5	0.525	0.53	0.56
Marketing Cost	10.9	12.12	13.49	16.86	17.56	19.49
Production Cost	264	261	258	252	252	251
Training Cost	1	1.12	1.15	1.19	1.23	1.26
R&D Cost	10	11	11.36	11.72	12.08	12.44
Structure Cost	20	20	20	20	20	25

Complete BSC for "A"

Table 4 demonstrates complete BSCs for A.

Table 4: complete BSCs for A.

Corresponding BSC aspect	Objective	Corresponding KPI	Base Value	Target Value	Initiative
Financial	Increasing Net Profit Margin	Net profit Margin	5.96	18.73	
	Increasing Income	Revenue	10.9	153.38	
	Decreasing Cost	Cost	102.5	124.65	
Customer	Customer Stabilization	Customer Rate	33	26	
	Increase Customer Orders	Orders	218	271	
Internal Process	Optimizing Marketing Mix Policies	Price	0.5	0.56	Uprising Product Price by 5 percent in the 30th month
					Uprising Product Price by 3 percent every six months from the 46th month
		Marketing Cost	10.9	19.49	Uprising Marketing Cost by 0.5 percent each month from the first month
					Holding an exhibition (Uprising Marketing Cost) by 7 percent of total Marketing Cost in 28th month
					Holding an exhibition (Uprising Marketing Cost) by 7 percent of total Marketing Cost in the 50th month
	Improving Production Process Efficiency	Production Cost	264	251	
Learning and Growth	Improve Knowledge of Employers	Training Cost	1	1.26	Uprising Training Cost by 10 percent in first month
					Uprising Training Cost by 0.3 percent each month from 6th month
	Investment on Product's Quality	R&D Cost	10	12.44	Uprising R&D Cost by 10 percent in the 6th month
					Uprising R&D Cost by 0.3 percent each month from the 12th month
	Investment on Production Facility	Structure Cost	20	25	Investment on Production Facility by 5000, from the 50th to 60th month

Conclusion

During the last two decades, the necessity for developing and implementing multidimensional performance measurement systems and strategic management systems has become clear in management science (Kaplan & Norton, 2008). Long-term success is a critical issue for modern organizations. They have understood successful long-term performance, not necessarily related to financial performance. Therefore, Kaplan and Norton proposed Balanced Scorecard (BSC) to respond to this critical need (Kaplan & Norton, 1992). In addition, they have improved BSC as a strategic management tool (Kaplan & Norton, 1996). However, BSC has some limitations. Dependency of an organization's BSC to its developer, vague relationships between objectives, weakness of targeting and setting initiatives are some weaknesses of the original methodology in developing BSCs. Therefore, we proposed a new methodology for developing BSCs with system dynamics, to overcome these limitations. This methodology consists of six steps: Developing a system for organization, Selecting stakeholders' most important objectives and their target (vision), Identifying organization's objectives and their KPIs for different BSC aspects (Financial, Customers, Internal Process and Learning and Growth), Developing strategy map, Targeting, and Selecting Initiatives. The methodology has been described with a presumed exemplary organization in previous sections of this paper.

In brief, the proposed a methodology, contributed in science for composing system dynamics concepts, capabilities and methodology with strategic management system proposed by Kaplan and Norton, who had developed a dynamic strategic management system. Furthermore, it can be used for several applications, in addition to developing BSCs; which can be a subject of further research works. The organization's vision would be analyzed by the BSCs, which have been developed by this methodology and a rational achievable vision could be selected. Moreover, managers of the organizations, who have applied these BSCs, can analyze their strategies and policies and select the one, which is the most appropriate for governing their organizations. Furthermore, change management can be applied with these BSCs for planning changes by strategic objectives' targeting. These applications could be applied in organizations for strategic planning (vision) so that the best strategic policies could be made.

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Organizing for Lean: Recursion, Autonomy and Cohesion

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1. Introduction

The concepts or Lean Production, presented originally in (Womak, Jones, & Roos, 1991) have revolutionized manufacturing, and are expanding its influence throughout Health Services (Toussaint & Gerard, 2010) (Kenagy, 2009), Construction (Ballard & Howell, 1998) and IT systems development (Poppiendeck & Poppliendeck, 2006), leading in all these fields to higher productivity, increased responsiveness to the customer and new levels of worker engagement. However, and despite all this success and the multitude of examples, the route that an enterprise needs to follow in the adoption of Lean appears as difficult and full of obstacles, misunderstandings and dead-ends. Of course that Lean as a continuous improvement approach is never finished, but it is nonetheless surprising how Lean implementation efforts stumble and even get abandoned before the expected benefits fully materialize.

In what follows we introduce a model of the enterprise which, even though arising from a different source, sheds an important light on the nature of Lean practices and on what is needed organizationally so that transformative Lean initiatives can succeed and take root. The model has its roots in the work of Stafford Beer (Beer, 1985) and it has been further elaborated by Raul Espejo; for a comprehensive discussion of the overall approach see (Espejo & Reyes, 2011). In the following sections we will touch on some of its key themes; Sections 2 to 5 present the concepts of recursion, autonomy and cohesion and how those are actually embedded in Lean processes and practices, as well as what the implications are for the successful deployment of Lean in an organization. Section 6 provides a brief summary.

2. Recursion, and the recursive character of Lean practices

It is probably in Computer Sciences where Recursion has been most clearly characterized and applied. In that field we say that a procedure is *recursive* if its execution involves executing smaller versions of itself. An example may help visualize what this entails; the procedure in Figure 1, for instance, is set up to determine how many files are stored within a folder in a computer (including all its subfolders).

```
GetNumFiles(Folder)
    TotFiles = 0
    For each Object in Folder,
        if Object is a file, then TotFiles = TotFiles + 1
                (if it is a file, we count it)
        if Object is a folder, then TotFiles = TotFiles + GetNumFiles(Object)
                (if it is a folder, we go count the files within it and add that to the total)
    Return Result = TotFiles
End
```

Figure 1: A recursive procedure

We see that executing GetNumFiles involves calling the process itself for looking within smaller subfolders. Recursive calls do not go on forever, though; the key aspect of recursion lies precisely in that it allows for *splitting a potentially difficult problem* (finding the total number of files in a large folder) *into smaller and progressively more manageable problems* (finding the total number of files in a smaller subfolder). At some point the process reaches some end folders that hold only plain files and no more subfolders, and the results are returned, added up and presented to the user.

The question may arise of why going through all this effort, instead of just directly counting the individual files within the original folder. What happens is that each folder only has information on its direct members (only 'communicates' at that level) and has no information on (does not 'understand') what lies underneath that top level.

Many of the Lean techniques have also a recursive nature. This gives them their systemic value, but it also explains some of the difficulties of its implementation: just like the procedure in

Figure 1 needs to get to the smaller folders to count all files, so do the Lean procedures need to get to all the levels of an organization – it is not enough for them to be implemented or promoted only at a managerial level, or only as generic exhortations. For a value stream to be able to provide product at the pull of the customer, for instance, it is necessary that pull production[1] be implemented between each of its blocks or "loops", and in turn this demands that work be pulled between each of the activities within the loop (or flowed, which in itself includes an elementary version of pull). A thorough implementation of pull would thus need to proceed recursively down to the smallest units, and then integrate up to the full value stream. Even the humble 5S [2] needs to be implemented recursively – the only way to implement 5S at, say, a factory level, is to implement it in all its areas and, further down, at each of the workstations.

Recursivity becomes particularly important when considering the overall process of implementing Lean in an organization. Lean implementation, and its continuous sustenance, can be seen as an ongoing process of improvement, and two Lean practices specifically address the overall management of improvement: Hoshin Kanri – also known as Hoshin Planning, or Policy Deployment – and the Improvement and Coaching Kata, IC Kata. Both are recursive in nature, and in what follows we take a look into their recursive character and its implications.

Hoshin Kanri (Cowley & Domb, 1997; Dennis, 2006) borrows heavily from Management by Objectives – the rolling down of company strategies throughout the organization by translating them into narrower and narrower objectives – with two added features. One is the possibility, or rather the mandate, that the objectives of each unit be negotiated with the levels directly below and above it to assure coherence, to validate that while being enough of a stretch they are indeed achievable, and to make sure that they align with the established strategic priority or Hoshin. This recursive alignment process is figuratively described by stating that each unit plays "catchball" with the units above and below it. The second addition to Management by Objectives is the establishment of periodic cycles of reflection and learning, where not only are

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[1] Pull production: a method for production management in which downstream operations ('customers') signal their needs to upstream operations ('suppliers'), and nothing is produced until such signals are received. Often contrasted with production to schedule, or to forecast. For details on this and other Lean tools discussed here, see for instance (Dennis, 2007)

[2] A process for organizing the physical workplace and for keeping it organized.

results tracked, but root causes for deviations are discussed, and countermeasures devised in pursuit of the desired results. Just as objectives were discussed and rolled down the organization, lessons learned and countermeasures are now recursively rolled up, level by level.

The *IC Kata* (Rother, 2010) has at its center a performance improvement routine[3], the Improvement Kata, to be executed in weekly or even daily cycles by personnel all the way from upper management to the shop floor. The process starts with each leader working with his or her direct supervisor to single out a performance *challenge* to be met. From this challenge, and from a proper understanding of the *current condition*, agreement is reached on pursuing a *target condition* that can represent an incremental step in the direction of meeting the challenge. Progress towards the target condition is achieved by executing a sequence of actions (*experiments*), by reflecting on what is learned from each of these, and by devising or adjusting future experiments until the target condition is achieved and a new one needs to be defined.

The Improvement Kata is meant to be recursively deployed, with the setting of challenges starting at the highest level – the key performance challenges for the organization. From there down the target conditions set at each level act, recursively, as a driver for identifying the challenges to be addressed by each unit at the next level down.

The other piece of the IC Kata, the Coaching Kata, also has a recursive nature, whereby those working on the Improvement Kata are coached through it by their direct supervisors, who are themselves being coached by their supervisors one level up, and so on. Supervisors participate in coming to an initial agreement on the challenge to be addressed, and then support the coachees, in weekly or daily sessions, throughout the analysis of the current situation, the identification of a target condition, the selection of experiments to conduct and the reflection on their results. The development of the enterprise's coaching capabilities also proceeds recursively, starting at the highest level, to assure that supervisors acquire the experience needed to help their direct reports in setting their own target conditions, experiments, etc., until eventually everyone involved becomes a coachee of their supervisor and, if appropriate, a coach of their direct reports.

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[3] A kata is a form, or sequence of movements, intended to be practiced repetitively in martial arts training.

Lean deployment implications: Recognize the need to take a recursive, and not merely a top-down, bottom-up or shotgun approach to Lean implementation. Start by establishing a clear direction and challenging high-level goals from the leadership of the organization.

3. Autonomy and the Recursive Organization

We now want to look into the question of what kind of organizational structures may allow, and facilitate, the deployment of recursive Lean processes such as those described above. It is clear that, since recursion progresses down and up through different organizational levels, such levels need to exist for recursion to be possible. The following levels, for instance, are used as an example in the discussion of the IC Kata (Rother, 2014):

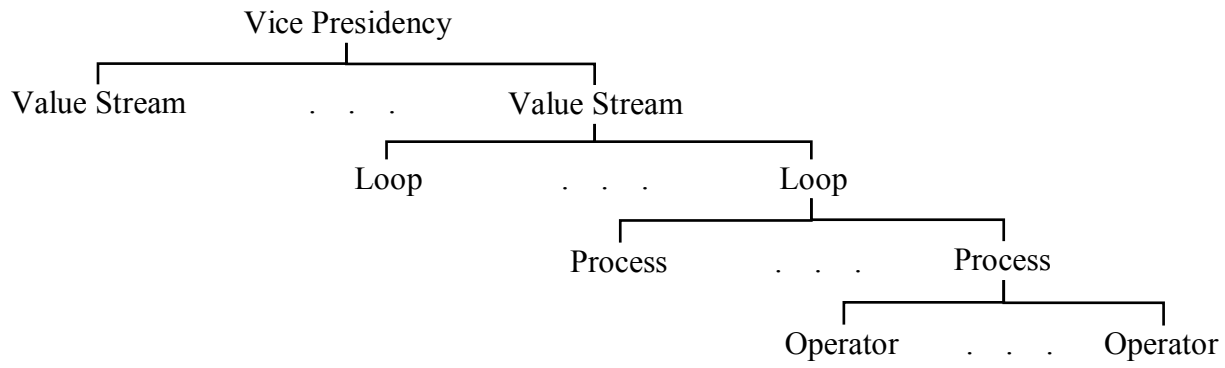

Figure 2: Organizational Layers

This tree-like structure is not enough, though. Hoshin Kanri, for instance, in its use of catchball, assumes that each unit has a capability for understanding and challenging the goals that are being proposed for it. For such a discussion to be valuable each unit has to be aware of the environment in which its operations take place, of the demands of its customers, of the actual and potential capabilities of its suppliers and of its own capabilities. Moreover, if the unit is to be made responsible for attaining the agreed results it also needs to be able to command or to call upon the resources needed to attain those results.

The Improvement Kata presupposes all this as well, and also that each unit can modify and redefine its own internal processes – the way they do their work – and that this can be done fast enough as to enable quick cycles of experimentation and learning.

It is this combination of smarts, empowerment and capabilities that we denote as *Autonomy*: the ability of a unit to manage the whole of the processes for which it is held accountable (Espejo & Reyes, 2011)[4].

In summary, to support these recursive Lean processes the organization not just needs to be layered; it needs to be composed of autonomous units or, more precisely, of "autonomous units within autonomous units" (Beer, 1985). An organization thus structured is what we call a *Recursive Organization*.[5]

We use an oval around the name of a unit to indicate that the unit is autonomous in the sense described. With this notation, the diagram of Figure 1 turns into that of Figure 2[6]:

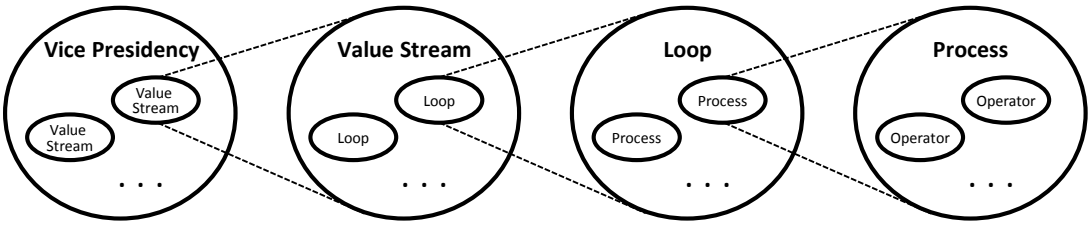

Figure 3: The Recursive Organization: Autonomous Units within Autonomous Units

Structures such as shown in Figure 3 tend to naturally arise in all large human organizations as a way to respond to the complexities in the organization's environment and to the resulting complexity of internal interactions. Good portions of it are often informal, however, and they develop as some units and their leaders manage to carve an autonomous space of their own, or when alliances are built that operate as semiautonomous units in their own right, and so on, with the result that some units may be left with less than the autonomy they would require to properly execute critical tasks while others end up enjoying a level of autonomy that may in

[4] This notion of autonomy is somewhat related, and implied, by the Lean concept of "zone control" (ref).

[5] A recursive organization is, thus, one capable of supporting recursive processes of the nature that we have described.

[6] We could say that in this recursive organization diagram, ovals are shown to remind the leaders at each level that they are managing autonomous units, and need to lead them as such!

fact result detrimental to the effective execution of work. When this happens then the actual, acting structure does not necessarily appear as aligned with the overall organizational purpose nor, as a matter of fact, conducive to an effective Lean implementation.

> Lean deployment implications: When deploying Lean through an organization, make sure to strictly follow a "catchball" process that acknowledges the autonomy at each level, and to have each level tracking progress only at the level immediately below it, and not beyond – which would infringe into the autonomy.

4. The effective allocation of Autonomy

The main driver that leads organizations to structure in collections of (more or less) autonomous units is the need to properly *manage complexity.* A big enterprise is, after all, set up to address challenges that are too big for one person or a few people to address. Not only are the tasks complex; the environment in which these tasks are to be accomplished is also complex, comprising myriads of customers, suppliers, regulators, etc. If the enterprise is to remain viable, management needs to *manage* that complexity, that is, it needs to devise appropriate answers to the challenges arising from all these fronts, in a manner that allows the enterprise to still achieve its purpose and goals (Espejo & Reyes, 2011). This would seem an impossible task since managers, being human, have themselves a limited capacity to deal all this complexity. Having autonomous units, each addressing a piece of the overall complexity, allows management to limit its considerations to the much smaller *residual complexity* that the autonomous units and their interactions cannot handle. An ideal organization would maximize at each level the complexity handled by the component units and minimize the residual complexity that management has to work with, while assuring that management maintains the capacity to assure that organizational goals are met and that the organization remains viable. For this to happen each organizational unit has to match a corresponding "chunk" of environmental and task complexity, and have the capability to autonomously address it. The challenge is thus to find an appropriate "chunking" or decomposition of the environmental and

task complexity, and then leverage this decomposition to guide the recursive structuring of the organization into autonomous units.

(Espejo & Reyes, 2011) propose the following approach when considering how to decompose complexity:

a) Identify the organization's purpose: what is its role, what are the key products and services that the clients are willing to pay for? In Lean terms: how is it adding value?
b) Identify the main *drivers of complexity* for the organization by mapping the products and services delivered and their main production processes, as well as market segments, geographic spread of activities, etc .
c) Assess how those different drivers can be used to "chunk" the complexity into progressively more granular areas that can conceptually be autonomously managed.[7]

The purpose of this analysis is to end up with an appropriate cascading down or *unfolding* of the complexity that needs to be managed by the organization, in the manner of the high-level unfolding shown in the example on Figure 4. Ideally the recursive structure of the organization itself would map to this complexity unfolding, down to the levels illustrated on Figure 3.

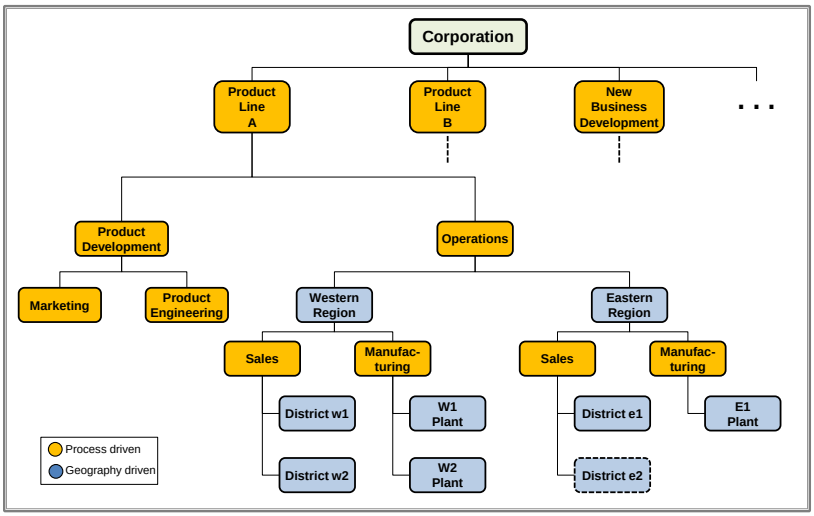

Figure 4: Unfolding of complexity

[7] It is worth noting that this process parallels the one indicated in (Rother & Shook, 1999) for Value Stream Mapping: (a) identify product families and customer demand; (b) map the process for the chosen product families; (c) identify "loops" and use them to structure improvement efforts.

This unfolding can then provide a guide for recursively structuring the organization's *primary activities* – those that transform inputs into the goods or services supplied to customers – as autonomous units within autonomous units.

When driving a process of change, it is frequently the case that the existing organization may not provide a good fit to this unfolding of complexity. In such cases, it is useful to think of an organization as a *pattern of recurrent interactions* among those involved (ref?). This includes the formal meetings, the informal conversations, the requests posed (and the way they are phrased), the responses given, the considerations presented, the kind of arguments deemed valid, and so on, well beyond the formalities of an organizational chart. If this is indeed the case, then the way to influence the organization is by setting up *new patterns of recurrent interactions.* [8] How this can be done is exemplified by the Lean practice of value stream mapping: mapping the current state creates a shared understanding of the (technical) dimensions of the complexity that needs to be addressed and the future state map describes, in its blocks or loops, the individual autonomous units that can match this complexity, and the conditions that can allow the whole value stream to work as an autonomous unit composed of autonomous units. Most importantly, through the value stream mapping workshop itself the conversations and *interactions* are shifted towards considerations of performance, of functional support to the value stream, etc., effectively conceptualizing it as an autonomous unit. What becomes critical is what happens next, whether those valuable interactions become *recurrent* or not. Does the workshop lead to structured long-term objectives at each level (Hoshin Kanri style) that allow for an IC Kata to develop recursively on the value stream, and are the value stream and its objectives revised periodically to reach ever higher goals and to sustain the IC Kata process? If this is a case, then these efforts do in fact create the recursive organization that can effectively execute and sustain the changes. On the other hand, if the workshop leads only to a to-do or nice-to-have list, then the improvement spirit and the resulting interactions would appear as ephemeral, lasting only until the excitement of the initial workshop wears off. Similarly, structuring the Lean deployment and its improvement activities along the lines of the

[8] This is indeed the point of the IC Kata – the enactment of recurrent interaction routines, or katas, to influence and transform the basis of the organization.

overall complexity unfolding of the organization, and sustaining those improvement activities through recurrent interactions (coaching such as in IC Kata, periodic reviews as in Hoshin Kanri, and so on) allow for the creation of the recursive organizational support needed for an effective deployment. [9]

As for the *support functions*, those that maintain the life of the corporation rather than generate its products (human resources, finance, supply chain, etc.) they need to be deployed so they can optimally support the work and the autonomy of the primary activities. The relation of these support functions to the different levels of the primary activities – their degree of centralization or de-centralization – can be represented in a primary activity-function table such as the one shown in Figure 5. In principle a support function would best be de-centralized to a specific level if it constitutes a critical success factor for the units at that level, if it assumes a specific differential form when applied to each of those units, and if there are enough resources and demand as to make such a de-centralization viable (Espejo & Reyes, 2011).

Support Functions / Primary Activities	Purchasing	Contracts	Logistics	Maintenance	Planning	Internal Control	Budget and Finance	Safety	Salary Management	Training	Hiring / Firing
Corporation	•	•			•	•	•	•	•	•	•
Product Line A		•			•	•	•		•		•
Product Development					•	•	•		•		•
Marketing					•	•	•		•	•	•
Product Engineering					•	•	•		•	•	•
Operations		•	•	•	•	•	•	•	•	•	•
Western Region			•		•	•	•	•	•		•
Sales					•	•	•		•	•	•
Districts					•	•	•				•
Manufacturing	•	•			•	•	•	•	•	•	•
Plants	•		•	•	•	•	•	•		•	•

Figure 5: Primary Activity – Function table

> Lean deployment implications: Work to gain a thorough understanding of the main drivers of the complexity that the organization needs to manage and to develop an appropriate unfolding of that complexity. Deploy the high-level organizational goals in the spirit of Hoshin Kanri, along the lines of this unfolding

[9] In fact Hoshin Kanri allows for deploying strategies either through the formal structure or through cross-functional teams, depending on the nature of the strategy and the formal structure. When following the route of functional teams, it creates in fact its own deployment support structure.

of complexity; avoid including support function objectives as part of this deployment, as the improvements needed in their performance should be uncovered through the work of the corresponding primary activity teams at each level.

Drive progress recursively from the top, in the spirit of the IC Kata, in order to create de facto the organizational underpinnings – the recurrent interactions – needed to sustain the deployment and to promote the eventual evolution of the formal organization itself.

5. Maintaining organizational Cohesion

Just as important as assuring autonomy so that each unit has the flexibility needed to address the challenges presented by the chunk of complexity that it has to manage, is to assure *cohesion* so the actions undertaken by each autonomous unit are aligned with the interests of the overall organization. (Espejo & Reyes, 2011), following (Beer, 1985), consider three components that need to be in place at each organizational level to allow for the recursive implementation of cohesion:

- *Negotiation* of the goals and programs to be undertaken by the embedded units and of the level of resources that these units can have available in order to meet those goals and execute those programs; and then tracking the progress of the agreed goals and programs and the utilization of the resources.
- *Monitoring*, sporadically, the activities taking place at the component unit level, so as to gain some degree of first-hand understanding of their context, capabilities, concerns, operational and environmental pressures, and so on. Only with this knowledge can an effective negotiation of goals and resources be undertaken.
- C*oordination* among the component units themselves so as to create synergies and most importantly to reduce inconsistencies and conflicts of behavior and impact. Effective coordination among the component units also mitigates the residual complexity that needs to be addressed at the higher level and assures that issues are resolved at the levels that have the best understanding of how and when they arise.

> Conversely, lack of coordination at a given level forces the higher levels to arbitrate matters for which they do not have the necessary intimate knowledge, nor much of an interest either.

It is through Negotiation, Monitoring and Coordination that the cohesion at each level is maintained, and that recursively the overall cohesion is assured.

Many of the Lean tools and practices are oriented precisely towards maintaining cohesion, and can be interpreted as instances of negotiation, monitoring or coordination; we look at this detail below. Understanding how Lean practices contribute to organizational cohesion while preserving the autonomy of the individual units can provide a foundation for integrative Lean implementations that go beyond the mere introduction of individual tools.

Negotiation. It is interesting to see that not just the process, but the spirit itself of using negotiation to ascribe goals and distribute resources is embedded in both Hoshin Kanri and in the IC Kata. The *catchball* of Hoshin Kanri is the primary example, which is also mirrored by the identification of challenges and target conditions in IC Kata. These are key tasks, since without such tools for recursively assigning transformative goals and for tracing all efforts to enterprise objectives, a Lean deployment will necessarily lack in cohesion and long-term viability.

At a more operational level, it is *Standard Work* that constitutes a clear specification of what is expected, subject to a continuous review in a *negotiated* process that includes the workforce itself looking for the best way to accomplish each task. *Takt Time*, and a clear visual display of whether production is getting behind or ahead of Takt, provide the same clarity of goals at a higher level, as well as a basis for allocating resources to cells and loops to make sure that they can indeed meet Takt.

Monitoring. In the positive sense meant here of a direct presence to help understand operational issues, concerns and opportunities, monitoring is one of the core principles of Lean, as exemplified in the frequent exhortation to *go to gemba* [10] and on Ohno's demand for *standing in the circle* [11]. In Lean, the richness of this interaction at gemba is enhanced with the

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[10] Gemba: the place where the work is being performed.

[11] Observing the operation for hours at a time, and interacting with operators to understand issues and identify and test improvements. Often suggested by Taiichi Ohno, the Toyota plan manager credited as the primary architect of Lean.

use of *Visual Controls* and the prominent display of *Standard Work*. The *Coaching Kata*, on its part, with its demand for the supervisor to support the coachee in striving for challenging goals and in identifying and addressing obstacles, provides an even more structured means for leadership to gain an intimate knowledge and a first person view of operational issues.

Coordination. This is probably the hallmark of Lean: finding ways for operations to coordinate among themselves rather than being coordinated from above. *Kanban*, or the usage of direct signals to coordinate processes by communicating the need to deliver a supply or manufacture an intermediate product, was for some time considered to be Ohno's signature improvement and synonymous with his revamping of manufacturing production systems (Japan Management Association, 1986). Current efforts to extend Lean practices beyond manufacturing have also placed particular emphasis on direct coordination: Lean Health Care with joint patient rounds and *Collaborative Care* (Toussaint & Gerard, 2010), Lean Construction *Last Planner* for the joint planning, commitment[12] and tracking of activities by the different specialties (Ballard & Howell, 1998), *Kanban board* for coordinating computer coding (Anderson, 2010), and so on.

All these are instances of *Pull*, where sequential activities coordinate among themselves, famously resulting in manufacturing on the need for only a single point of scheduling per value stream, with the rest of the value stream just responding to the "pull" of the downstream operations (Rother & Shook, 1999). Work-in-progress inventory between operations is diminished, both as a result of the improved coordination and as a means to enhance that coordination through visual tools such as *supermarkets* and kanbans. For operations that can be more tightly integrated, *flow* can replace pull, with activities so coordinated as to be fused on a common rhythm. Indeed in Lean coordination is not seen as a separate, episodic activity: through "pull" and "flow" it becomes deeply embedded in the operation itself.

Many continuous improvement efforts in Lean are also geared towards enhancing coordination. *Value Stream Mapping*, and the development of a Future State map, for instance, contribute to building a future of closer coordination through flow and pull (Rother & Shook, 1999). *Kaizen events* bring different stakeholders together to redesign processes and enhance

[12] With its use of Fernando Flores' Conversations for Action (Flores, 2013) to solidify commitments (Macomber & Howell, 2003).

coordination, and practices such as *Improvement Kata*, *A3* or *PDSA*, when conducted at a supervisory level or higher, often center on improving coordination among different units.

Process stability, another cornerstone of Lean, is geared precisely to assure that commitments can be met and that coordination is simplified. In fact, coordination among primary activities, and of them with the necessary support functions, can be exceedingly time-consuming when work is inconsistent, impeding 'just in time' delivery and thus wreaking havoc in pull and flow systems, forcing rescheduling, demanding emergency meetings, and so on. Inconsistency breeds internal complexity, which stresses the always limited resources of the organization. It can also lead to internal conflict and thus for the intervention of higher organizational levels, thus hindering autonomy. Several Lean tools and activities seek to reduce this internal complexity and increase the reliability of work: *Standardized Work*, for one, but also *Total Productive Maintenance*, *5S*, *Mistake-proofing* and *Jidoka*[13], as well as improvement activities leading to reducing defects and variability. It is this enhanced reliability that allows for collaboration to be successful to the point of becoming almost transparent.

> Lean deployment implications: Focus on strengthening organizational cohesion towards achieving customer satisfaction and waste reduction. Articulate Lean tools and practices so the three key aspects of cohesion are supported – negotiation, coordination and monitoring – rather than attempting to implement each tool on its own.

6. Conclusion

Lean, in summary, aims at maximizing organizational cohesion towards the goals of satisfying customer requirements and minimizing waste (work that does not contribute to the satisfaction of customer requirements). With waste being so prevalent and taking so many forms, Lean structures the fight against waste through tools and practices meant to be utilized by autonomous units addressing the specifics of work at each level.

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[13] Stopping a process when a defect is detected, to quickly identify root causes and prevent the defect from recurring.

Effective implementations proceed recursively, promoting a structure of “autonomous units within autonomous units” that can address the complexity that the organization is facing, and strive to enhance organizational cohesion while respecting this autonomy.

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Diagnosis and organizational design through a systemic and cybernetic intervention of an enterprise of sanitation. Case: EPS SEDAM Huancayo S.A. - Perú

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1. Introduction

The situation of the sanitation sector in Peru is still deficient from an institutional, management and financial point of view; so if you want to face it, is necessary to consider such a situation as complex and systemic. This is widespread in Service Provider Entities Sanitation at the national level within which is SEDAM HUANCAYO S.A.

Moreover, organizational diagnosis and design by systemic and cybernetics has been studied and discussed by several authors who have supplemented studies organizational cybernetics Stafford Beer. Some of these studies are extensive and nourish how to intervene in complex-systemic problematic of the organizations.

So then, the sanitation sector to which the organization SEDAM HUANCAYO S.A. belongs with systemic feature, in this case study is confronted by a systemic-cybernetic approach described by means three stages: 1 Identification and analysis of the actual organization, 2 Organizational Diagnosis and 3 Organizational Design.

2. The methodological framework of organizational diagnosis and design through a systemic and cybernetic intervention.

Stage of identification and analysis

In the stage of identification and analysis of the situation under study, the location and definition of the system under study is performed by determining the actual situation of the organization carrying out the following activities:

- Determine the relevant system to be studied, this is called "focused or reference System."
- Identify the purpose of the reference system.
- Specify which system belongs the reference system.
- Specify the components of the reference systems that are responsible for "producing the goods or providing the service."
- Identify the organizational ataxias and organizational systems archetypes.
- Identify and describe primary and regulatory activities of the organization considering purpose, definition, metrics, questioning, and its current operating deficiencies.
- Perform the analysis respect to the five viability systemic functions.

Stage of organizational diagnosis

During the phase of organizational diagnosis shows the meaning and purpose of the organization under study in a systemic definition of the company, through the following activities:

- Declare the systemic definition of each perspective of the organization and some candidate measurements for self-regulation.
- Unfolding the organizational complexity according to the criteria in use recursion.
- Diagnostic of systemic functions through the diagnosis of: autonomy and operation, coordination and stability, cohesion, auditing and monitoring, adaptation and intelligence, identity and ethos.
- Develop and display the viable system model diagnostic mode of the current organizational system.
- Describe centralization and decentralization by supplementing the analysis of systemic functions versus current regulatory functions of the organization.
- Declare the cybernetic organizational archetypes and organizational pathologies (functional and structural).

Stage of organizational design

The stage of organizational design demonstrates a framework of organizational cybernetics and processes, a design of the organizational structure (autonomy, internal balance, balance with the

environment, and political identity mechanism), the viable system model idealized mode, systemic functions that contain macro processes, processes and sub processes, and complementary the map of business processes. All this through the following activities:

- Design the operation and autonomy.
- Designing the internal balance.
- Designing the mechanism of balance with the environment.
- Designing the mechanism of identity and ethos.
- Develop and describe the idealized model mode viable system of the organization.
- Design decentralization and centralization.
- Expand systemic functions versus regulatory activities.
- Define macro processes and processes according to the systemic functions of viability (Mission, Cohesion, Stabilization and synchronization, auditing and monitoring, adaptation and intelligence, and identity politics).
- Develop process map of the organization.

3. Case Study: EPS SEDAM Huancayo SA-Perú

The water supply and sanitation in Peru is regulated by the General Water Law of 1969 and the General Sanitation Services Law of 1994. The regulator and supervisory agency of the services of potable water is the "Superintendencia Nacional de Servicios de Saneamiento" (SUNASS). The service providers of potable water in the country are: SEDAPAL and Companies Providing Municipal Services (EPS) under their jurisdiction to 62% of the total population; Communal Organizations that have responsibility from 29% of the population settled mostly in rural areas; and Small municipalities (490) harboring to 9% of the total population.

In the city of Huancayo the Enterprise Sanitation Services Provider is SEDAM HUANCAYO S.A., owned by the Municipality of Huancayo and the District Municipalities of El Tambo, Chilca, Huancán, Viques and Huacrapuquio; with legal personality under public law, own equity functional autonomy, economic, technical, financial and administrative. The scope of action of SEDAM HUANCAYO SA is comprised in the jurisdiction of the province of Huancayo, the districts of: El Tambo, Huancayo, Chilca, San Agustin de Cajas, Huancán, Viques, Huacrapuquio and the Concepción province concerning Orcotuna district.

In the reports statistical situation management before the systemic-cybernetic intervention SEDAM HUANCAYOS.A. was: Insufficient coverage of water services, sanitation and wastewater treatment. Poor quality of the provision of services puts you at risk the health of the population. Deficient sustainability of built of operations systems. Tariffs do not cover the costs of investment, operation and maintenance of services (delayed tariff).The size of the markets under responsibility of the EPS does not guarantee good management and not allow economies of scale and financial viability. Weak institutional and financial and human resources in excess, low-skilled and high turnover.

The above-described situation motivates a systemic-cybernetic organizational intervention to make immediately effective innovations for analysis, diagnostics and organizational design of the enterprise that is narrated below.

Identification and analysis of SEDAM HUANCAYO S.A.

Focused or reference system is the enterprise SEDAM HUANCAYO SA whose purpose is the sanitation services.

On the other hand, an EPS is an enterprise provider sanitation services dedicated to providing quality of life to the population through the water services and sewerage. There are 50 recorded in the SUNASS regulatory agency located all over the Peru. Are categorized into SEPADAL, EPS large, EPS Medium and EPS small.

It is so, in the systemic definition of SEDAM HUANCAYO SA, is considered as purpose in use: "Provide basic sanitation services with good quality, using water resources rationally and to contribute expanding coverage and improve the quality of life of the population". It addition notes that the General Meeting of Shareholders and the Board are those who direct or organize, the Technical Management and Commercial Management are the nominees mission processes; in the same way the following actors are identified: Manager, Technical Specialist, Workers, Employees, Analyst, Chief, President and Personal confidence.

In the environment of SEDAM HUANCAYO S.A. is on the right SUNASS regulators and also the beneficiaries of which are divided into users and institutions, while the left you will find, providers SEDAM HUANCAYO SA in this case public and private businesses. Figure 1.

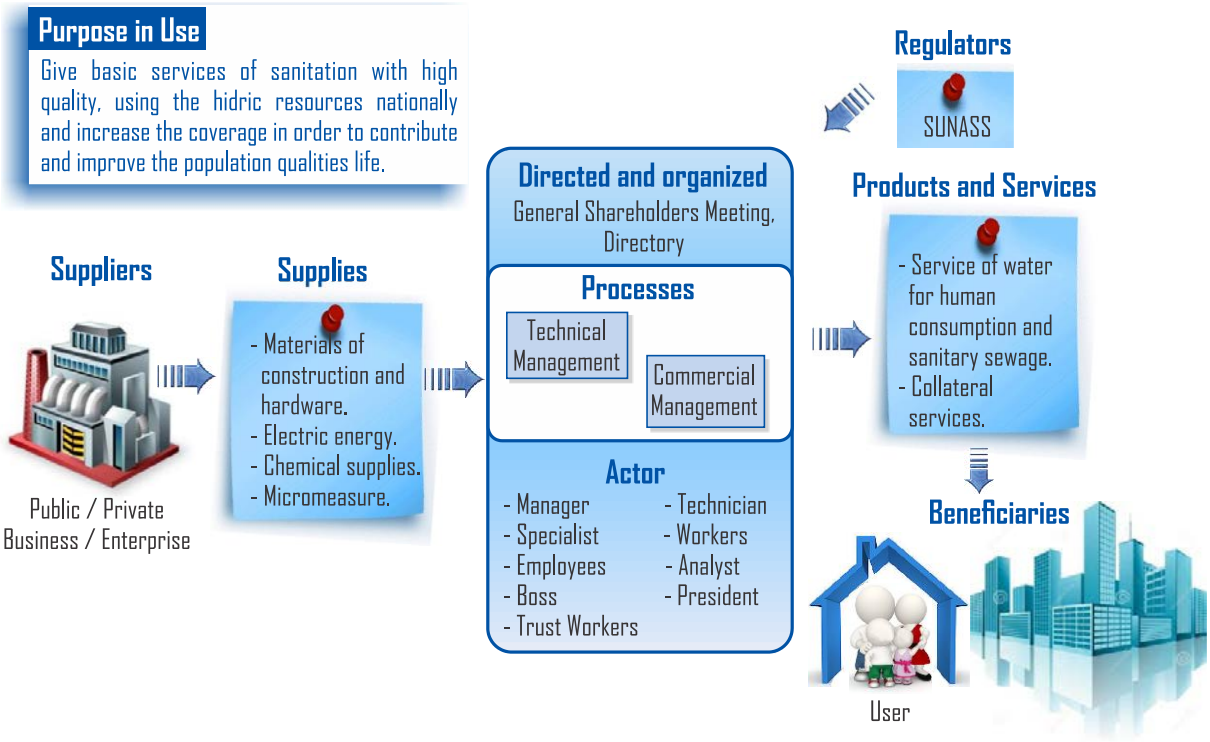

Figure 1. Initial Systemic definition of SEDAM HUANCAYO S.A.

The next, described the different ways to represent to the organization, these are the structural models. Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6.

Figure 2. Disposition of residual waters of SEDAM HUANCAYO S.A.

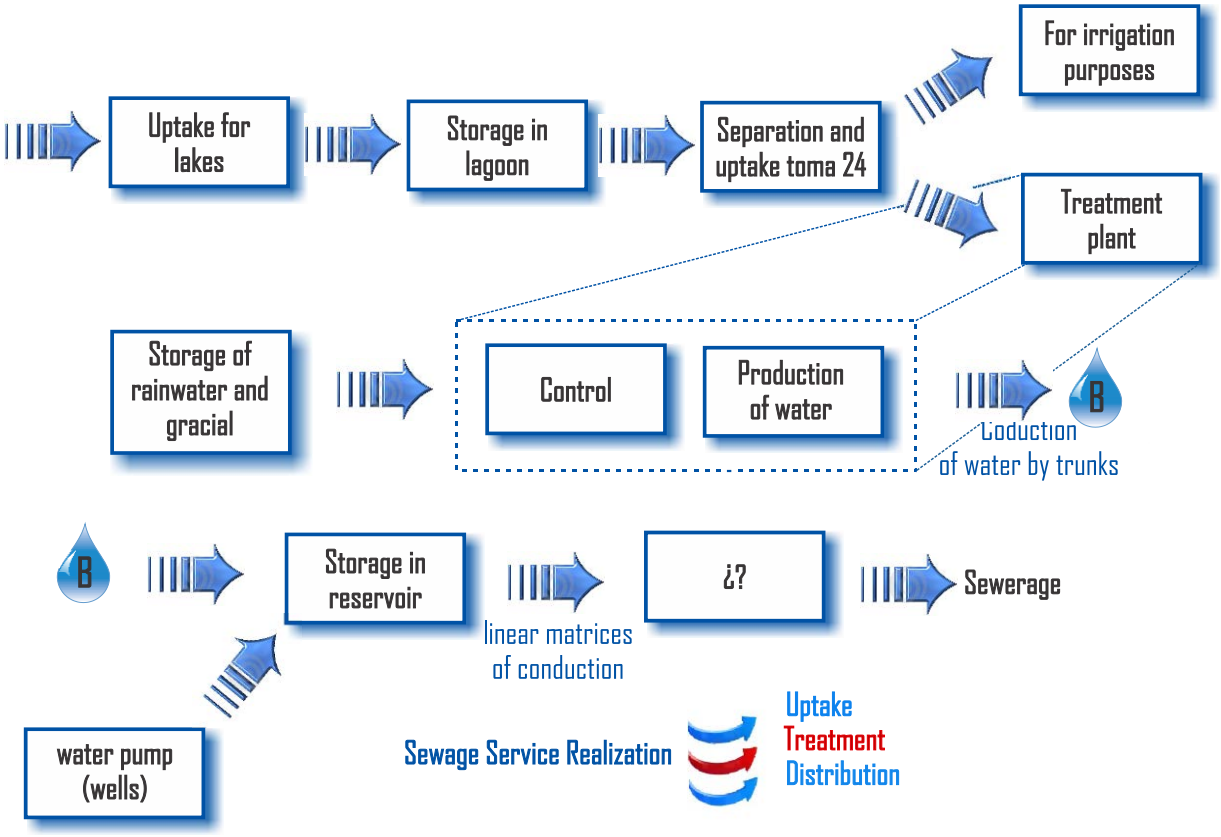

Figure 3. Service of water for human consumption of SEDAM HUANCAYO S.A.

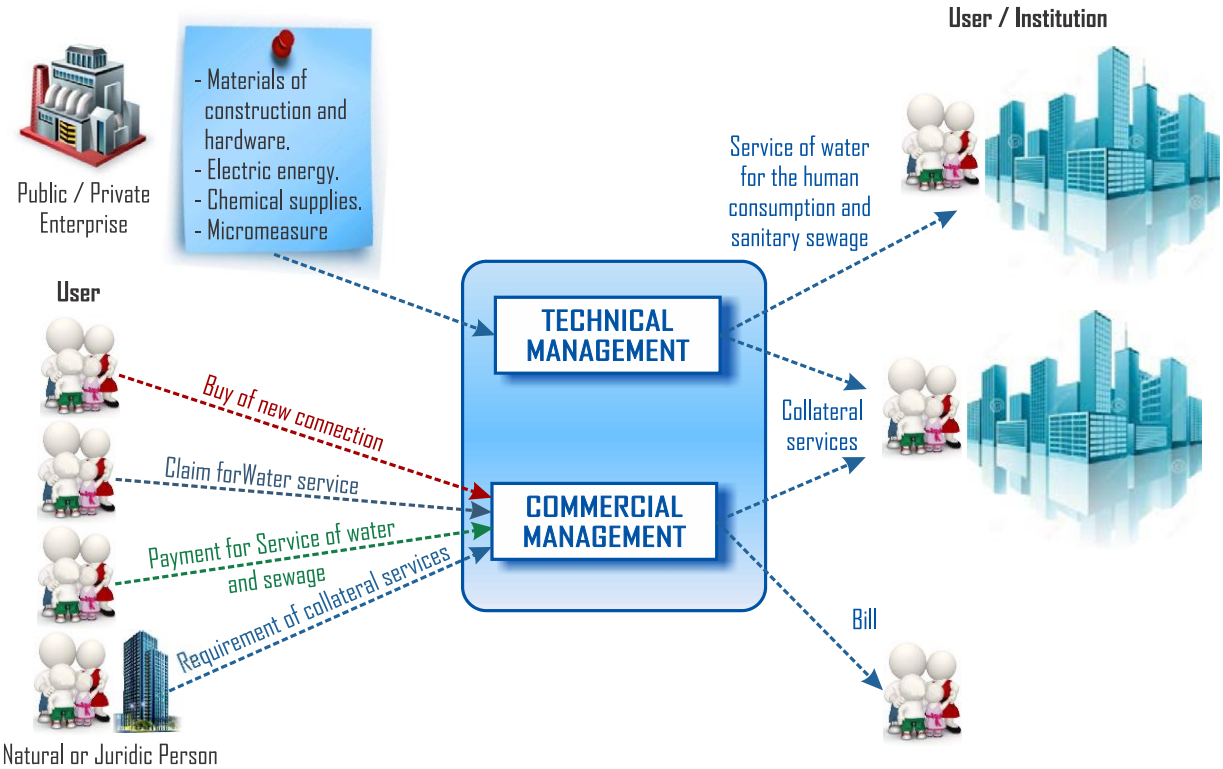

Figure 4. Segmentation model of SEDAM HUANCAYO S.A.

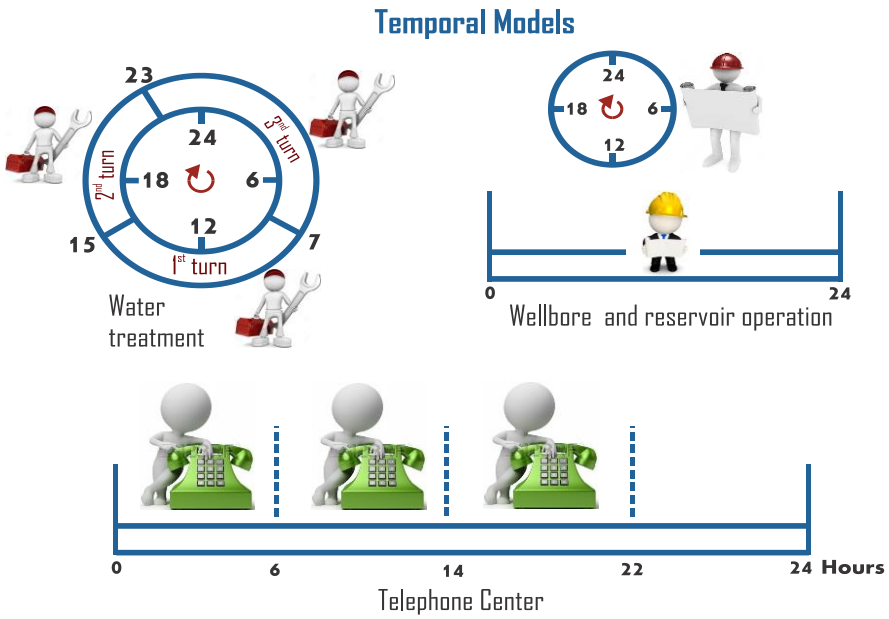

Figure 5. Time model of SEDAM HUANCAYO S.A.

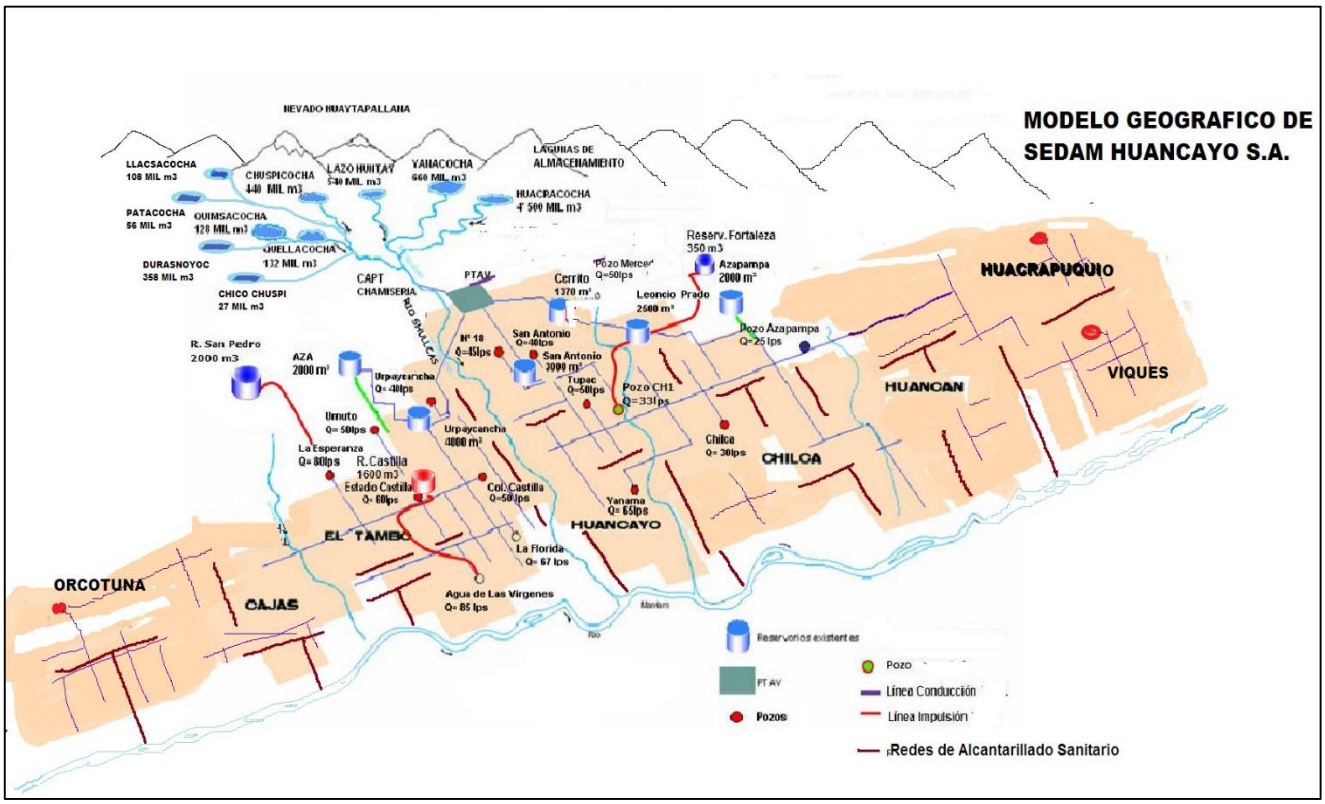

Figure 6. Geographic Model of SEDAM HUANCAYO S.A.

The organizational ataxias identified in the enterprise, considered as the upheavals in the organization and generate the reduced ability of coordinating inside and outside of the organization, they are follows:

- Personnel management, the number of employees and workers reincorporated for injunctive has been increased from the year 2009 to 2010; likewise, evidenced the positions of trust that remain constant during the years 2009 and 2010.
- The information systems were developed in an isolated manner for each area or department.
- The organizational climate, reflects the dependence of the upper levels, poor cohesion between coworkers, being a constant and low individualistic culture of teamwork attitude, there 4 groups classified by their political backgrounds which generate some filtering of information with diverse objectives, areas that receive greater work pressure are human resources, logistics, accounting and legal advice. There is little arrangement of support of chiefs areas, the policies of recognition of good performance are absent, although in some cases the workers have noted that delegated some officials trainings were given as stimuli by the absence of other incentives, there socialized thoughts like "if something increases should be for everyone". There is little arrangement of support of chiefs areas, the policies of recognition of good performance are absent, although in some cases the workers have noted that delegated some officials trainings were given as stimuli by the absence of other incentives, there socialized thoughts like "if something increases should be for everyone", there is no management policies that encourage a culture of innovation and the activities are performed conservatively, a conformist attitude of the workers is noted against the training plans, training and research, it because there are few opportunities, spaces and forms for personal development of employees, realizes personality types who seek to problematize things in public change of mood, are very selfish and comment much about the lives of others. Only 40% of the staff is committed to a greater magnitude making only its core functions, there is a culture of working so unplanned and without goals or objectives, communication is formal and sometimes cumbersome "paper commands", there is a lack of training for handling a possible intranet system, regarding the interpersonal informal communication in some cases the chiefs do not have the appropriate authority, which indicated the missing by his followers on demand for its lack of technical management or few management skills.
- The organizational structure for 100% of workers recognize that it is deficient, obsolete, outdated and inoperative. The management instruments do not help the adequate performance of the organization. The staff for an indefinite period is not well located and the staff is fixed term without specific functions. The areas of logistics and accounting there are several workers who do not meet the profile required for the job.

The organizational systems archetypes understood as natural configurations, original patterns that control events, constitute generic organizational structures and are recurrent, as those blood vessels and nervous at some point in its path return to their place of origin, operant in the enterprise are:

- **Success to the successful**, was evidenced in the areas of Micrometering and Cadastre, for what Micrometering can do its job requested helps to Cadastre, what causes inattention in the work of Cadastre. Also, this archetype was evident in the areas of Invoicing and “Cuts and Reopening” area, the workers of Invoicing area request support of “Cuts and Reopening”, due to shortages of personnel to cover the established routes, what causes inattention to the work of Cuts and Reopening.
- **Fixes that fail**, the information systems, which are implemented according to the requirements of each isolated area, for some time things improve, but after more dependence is generated by the information technologies.
- **Shifting the burden**, in the reinstatement by court order, when the employees with a view to its replacement suing the enterprise; also, this archetype operates in management documents, when it faces an administrative deficiency resorts to management documents, whom belong to another context in space and time. Finally, this archetype was evident in the formulation and implementation of the "Initial Opening Budget" and "Analytical Personal Budget", which are made with historical data, so causes it modify in the course of its execution.
- **Eroding goals**, the position of trust, officials enter achieve their goals, but not continuous with previous work but rather work under their own criteria, the achievement of the initial goals are evidenced partially, this causes that the official is removed from their functions and another person is placed, which reinforces the erosion of goals. The archetype is also evident in the area of

Collections, not where you get to collect 100% of the billed, the strategies of “Cuts and Reopening”, and awards to punctual customers, do not work in the expected way.

- **Limits to growth**, the consumption of hydric resource by the enterprise in its field of operation.
- **Tragedy of the commons**, the consumption of hydric resources between SEDAM HUANCAYO SA and the irrigators in the area.
- **Escalation**, the organizational climate, where current labor relations of the company integrate to the employee into different groups, all this is done to strengthen the power of one group over the other, which causes that the individual targets prevail in all respects.

The primary activities express the “reason of being” of the organization; in SEDAM HUANCAYO S.A. it was shown that the following organizational units are responsible for the primary activities: Technical Management, Area of Engineering, Maintenance Area, Area Operations, Unit works supervision and studies, Laboratory Unit and Quality Control, Commercial Management, Invoicing and Collection Area, Cadastre and Measurement.

The regulatory activities ensure that the operational units work together in an integrated and harmonious way, that it is working as a unit. It was shown that processes of coordination, control and monitoring of the following dependencies: General Office of Legal Advice, General Management, Administration and Finance, Area of Human Resources and Industrial Relations, Area General Accounting, Area Logistics, Institutional Control Body, General Office Informatics and Computation. As processes of Organization, Policy and Adaptation: General Meeting of Shareholders, Directory, General Office of Planning and Budget, Secretary General Office and Institutional Image.

Organizational Diagnostic of SEDAM HUANCAYO S.A.

At the beginning, it declares each organization’s perspective through systemic definition and some candidate measures for its self-regulation of the enterprise. Perspective are as fallow:

- Perspective 1: Sanitation services provider. Figure 7.
- Perspective 2: Attention to the environment. Figure 8.
- Perspective 3: Profits and profitable generator. Figure 9.
- Perspective 4: Costumer of hydric resources. Figure 10.
- Perspective 5: Regulation and normative. Figure 11.

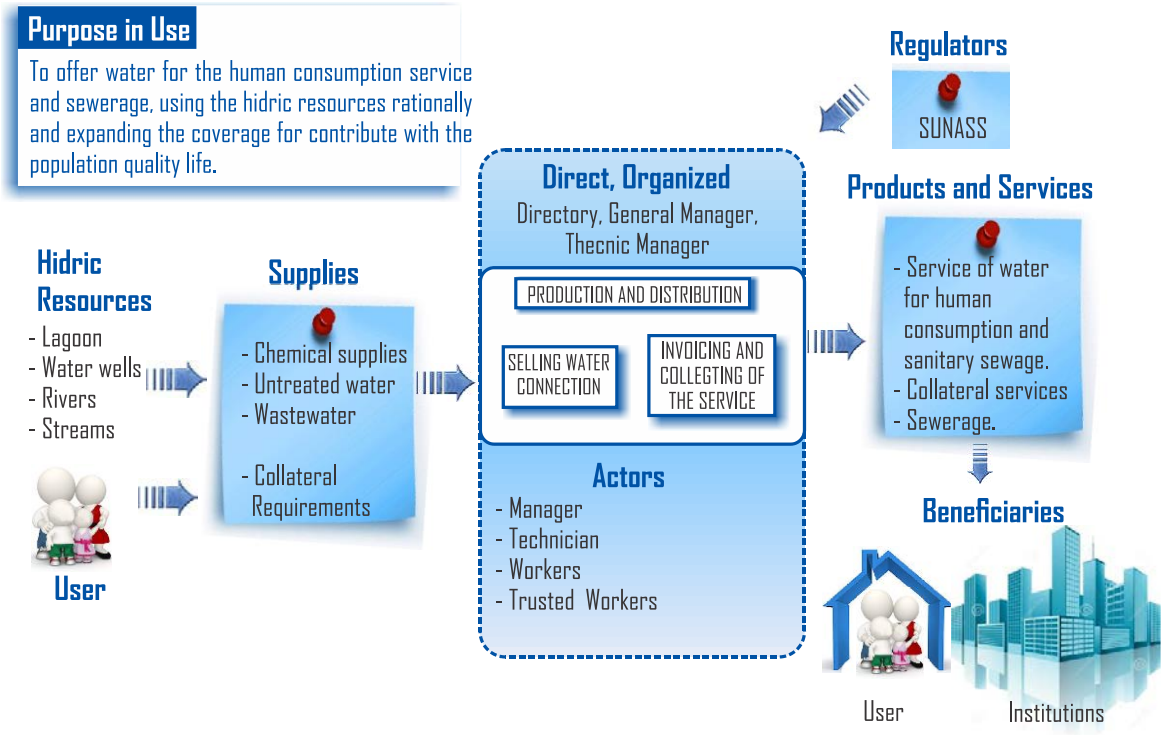

Figure 7. SEDAM HUANCAYO S.A. as provider of water, sewerage and collateral services.

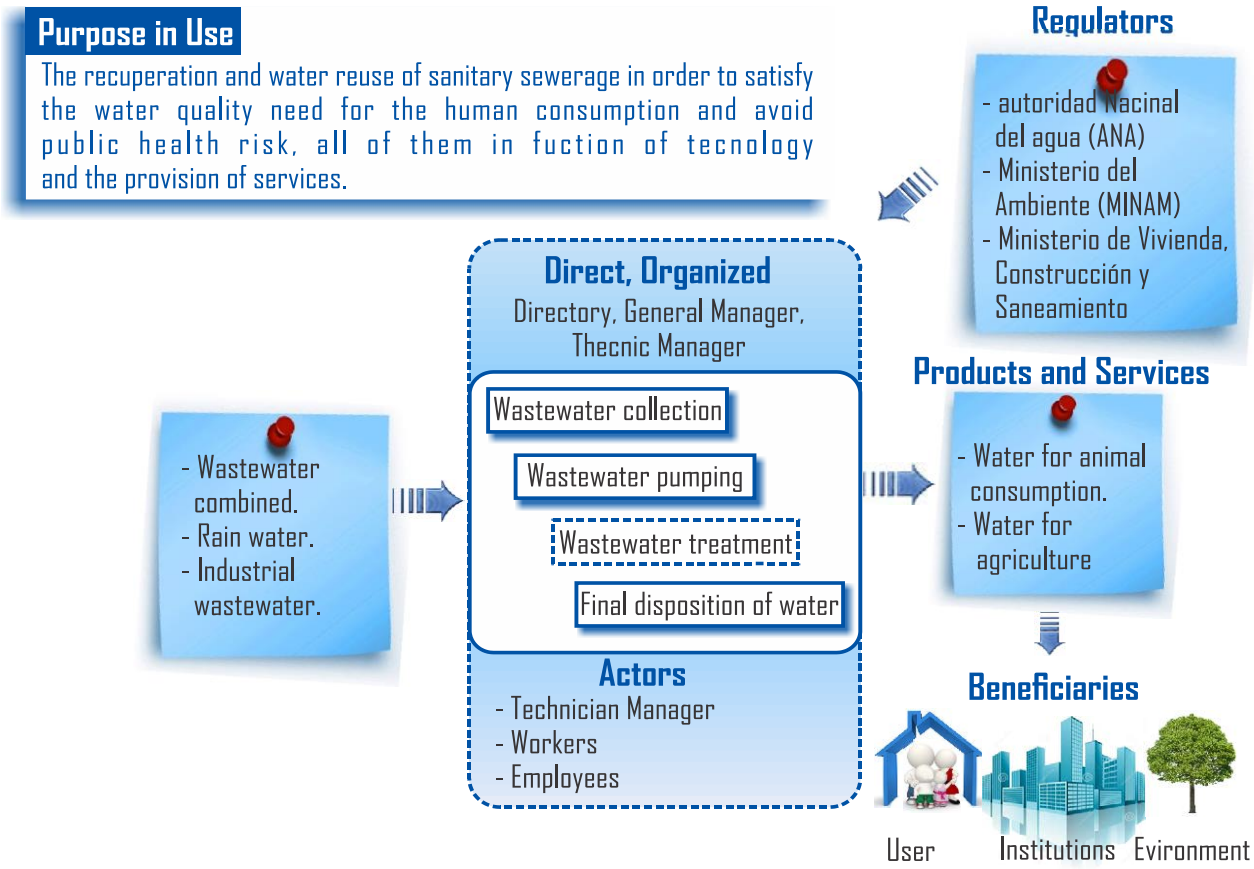

Figure 8. SEDAM HUANCAYO S.A. in the context of the environment.

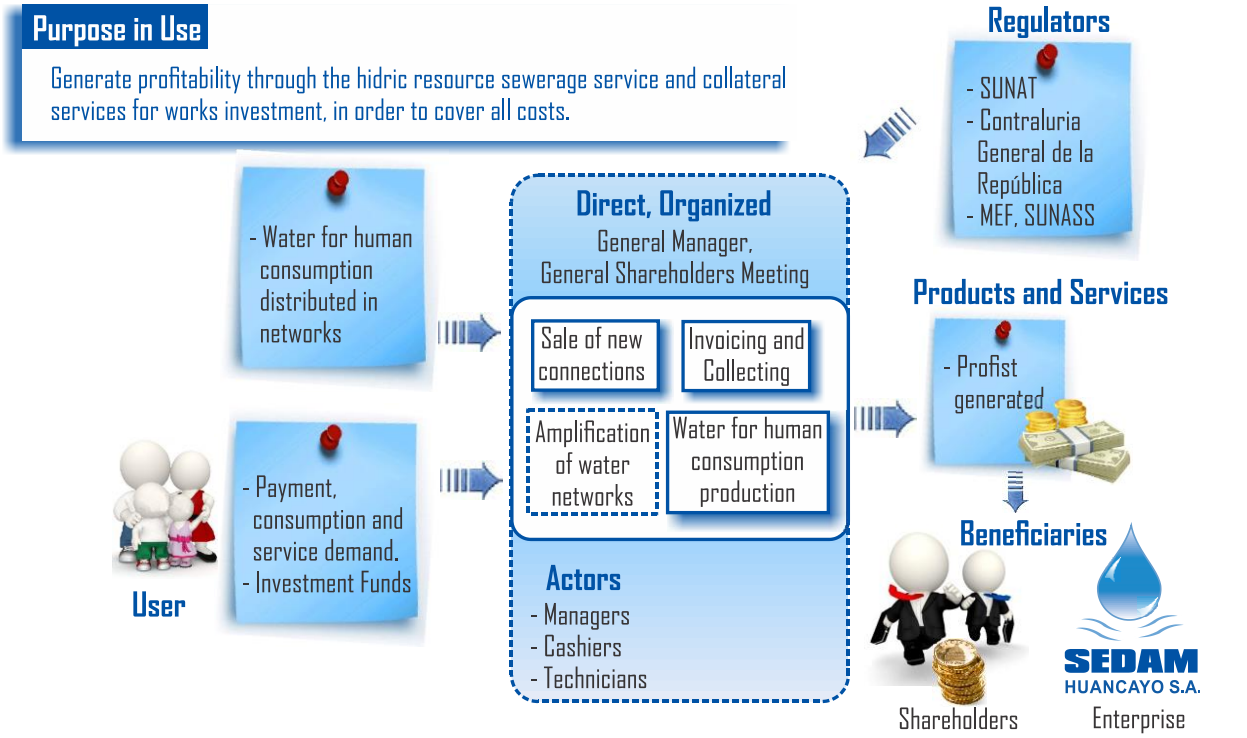

Figure 9. SEDAM HUANCAYO S.A. as profits and profitable generator.

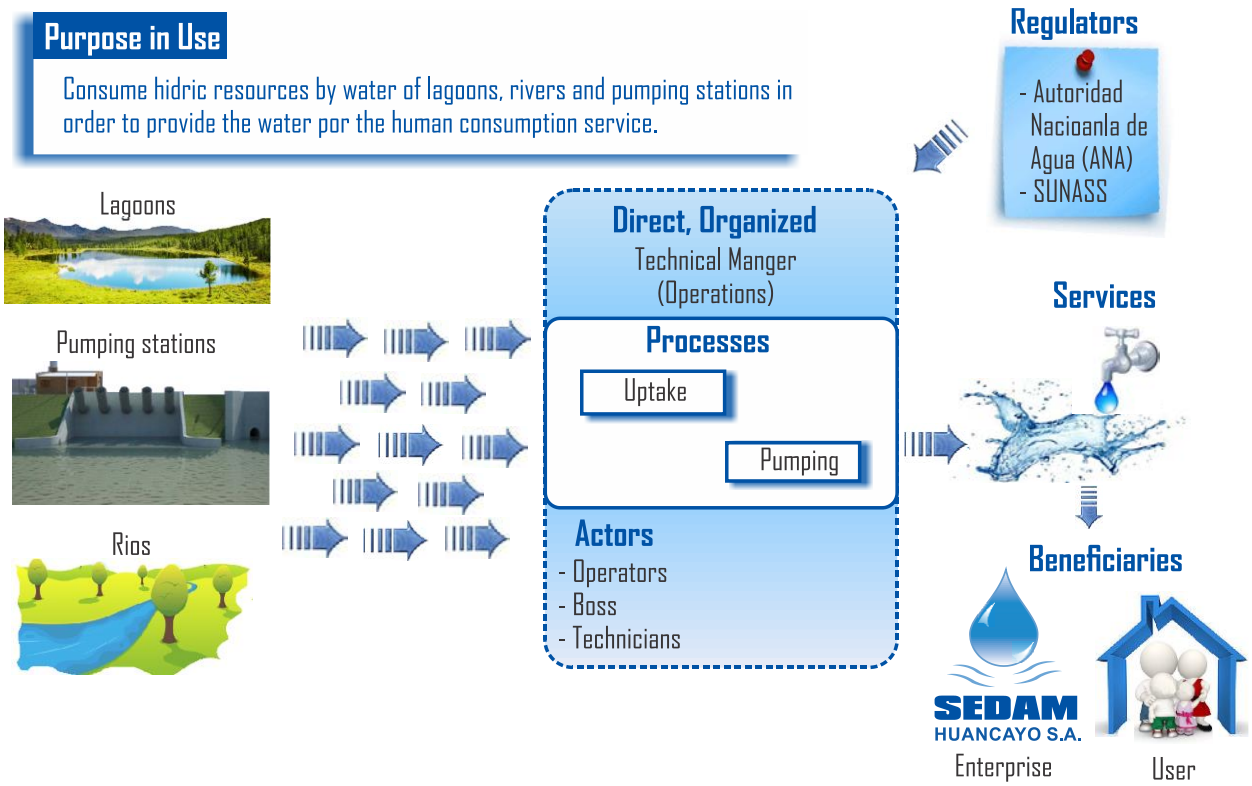

Figure 10. SEDAM HUANCAYO S.A. as costumer of hydric resources.

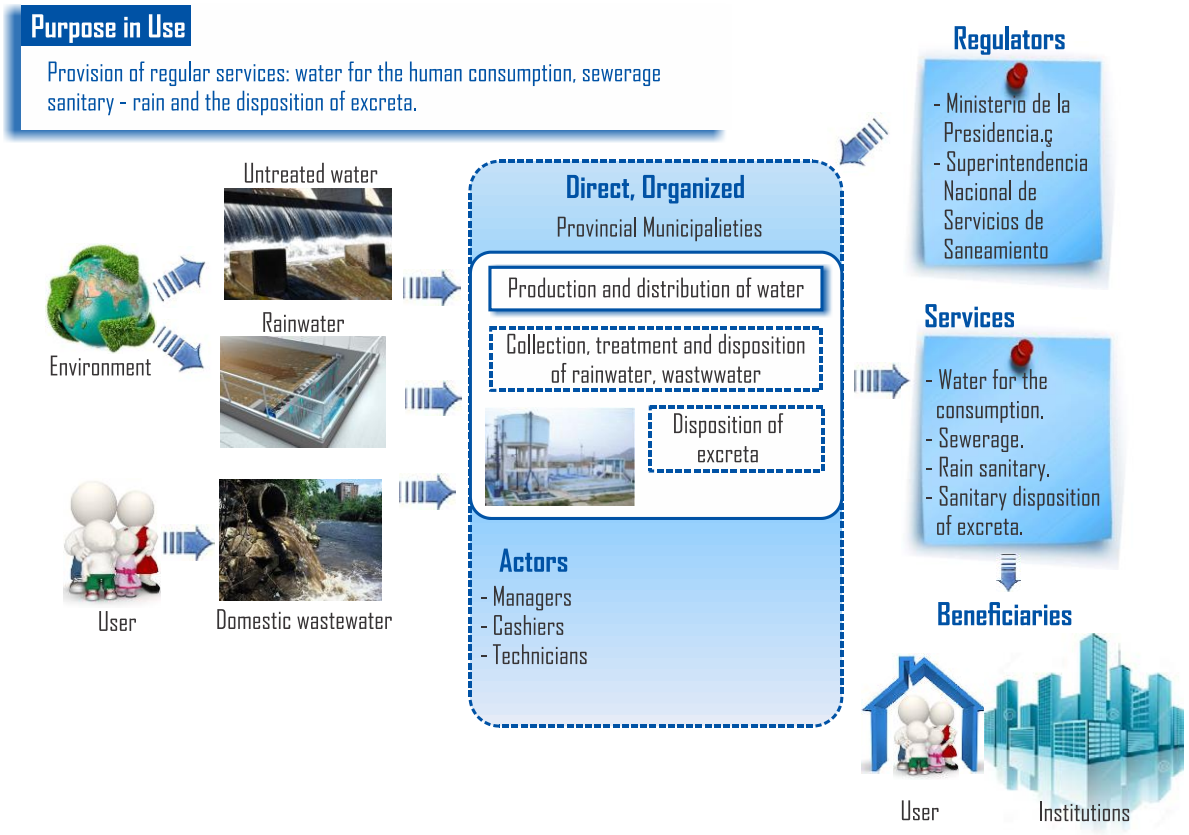

Figure 11. SEDAM HUANCAYO S.A. from the regulation and normative.

The self-regulation organizational, which let measure and describe what the actual situational state of the enterprise is, it was possible to rich it by considering some of the organization's perspective mentioned before, and those are as fallow:

- "Sanitation services and water provider", it considers the sanitation demand considering the population and its projection.
- "Costumer of hydric resources", it expressed by efficient and sanitation service quality.
- "Attention to the environment", by the residual water volume for the final disposition.
- "Profits and profitable generator", expressed by operational inputs, operational costs, and net profits.

The initial unfolding of complexity of the enterprise evidences that together with other enterprises "provider services" it belong to the sanitation sector, and its operational units are Commercial Management and Technical Management, Figure 12.

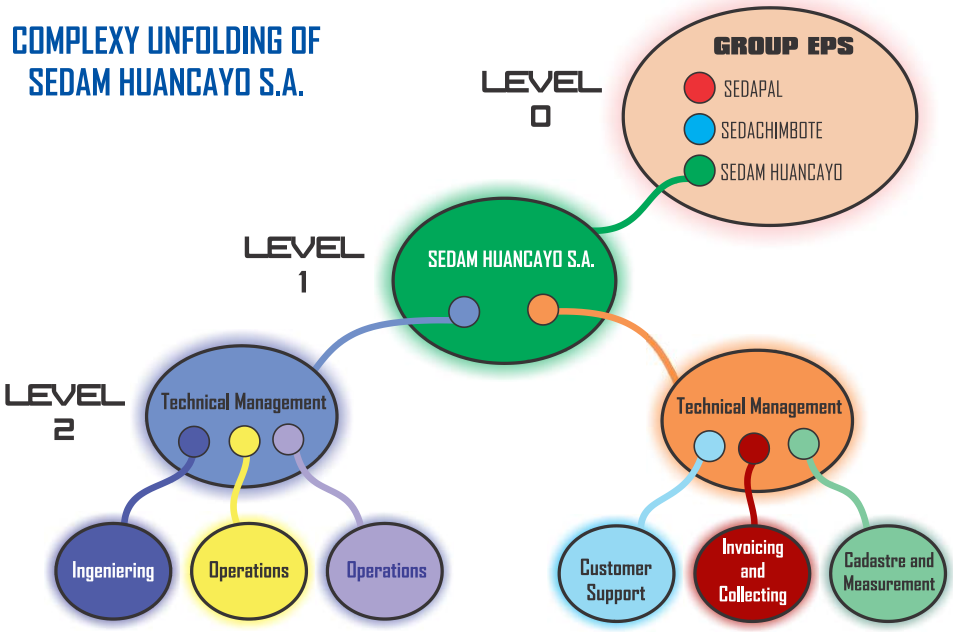

Figure 12. Unfolding of complexity of SEDAM HUANCAYO S.A.

The diagnostic of the enterprise's systemic function, it begin with autonomy and operation diagnostic, then with coordination and stabilization, fallow by cohesion, audit and monitoring, and before finish adaptation and intelligence, and finally identity and ethos.

The enterprise's autonomy in diagnostic terms spreads an autonomy analysis, coordination, cohesion, monitoring and tracing**,** intelligence and adaptation, identity and politics of each operational units of the enterprise; that is, Commercial Management and Technical Management without avoiding its environment.

The coordination diagnostic show up communication among operational units: commercial management and technical management, it happen by using the telephone center and the integrated system of information (SIGA). Coordination by SIGA permit to keep informed between the two operational processes about pending gap which each one have.

As well as, committee management allow coordinate among the operational units and general management, this is sporadically requests by one of the management office (technical or commercial) and almost with the participation of the office interested, which generate difficulties getting coordination among system one's stakeholders of the enterprise. Other committees: committee multi-sectorial, committee bagged and committee duty, they are little operative and some deficient.

Cohesion diagnostic show up that general management is responsible of supervising achievement of goals establish for each year, for this used the management reports, which are delivered quarterly by mission processes, which are compared to the goals set in the Optimized Master Plan (PMO). General management translates the global policies into operational plans, deriving and conducting tracing for compliance with those policies in whole the enterprise. Admin and finance management comprised by:

human resources, logistics, accounting and finance. General accounting exercises control through three processes: the patrimonial control, budget control, accounting management, by means of that make a control of tax issues (Concerning providers) and payment vouchers (are attached to purchase orders and services), likewise the control is done through the analysis of ledger accounts. The general office of secretary general and institutional image communicates the decisions taken at boards of shareholders, directorate and managerial committees to the offices or areas of Commercial management or Technical management to which benefits and impacts these agreements or policies for later follow up on the implementation of these directives or agreements. The diagnosis of monitoring and tracing proves that there is an internal control structure dependent on an external government institution and not inside the company. Audits are scheduled for each year, so that areas know on what date it will be audited.

The diagnosis of intelligence and adaptation make evident the processes that cooperating with projection of the company towards its future are: planning and budget. The formulation and programming of the institutional budget for opening and budget allocation to each organic unit, it based on the documents of expenditure (sent by the organic units) and income (sent by commercial management) to project the amount of financial resources needed for a year; the budget allocation is based on historical dates and sometimes groping. Planning and budgeting receive internal information (management reports, investment program report, earnings report, execution of expenditures, budget availability); but does not perceive external information about environment variables.

A joint form to understand the diagnosis of the enterprise is represent it in a viable system model of diagnostic mode. The figure 13, the notation ¿? States that "The aspect in identification and analysis is not met. There is a circumstantial component that prevent verify the achievement of the purposes set forth. Exist good intentions that not achieve to materialize".

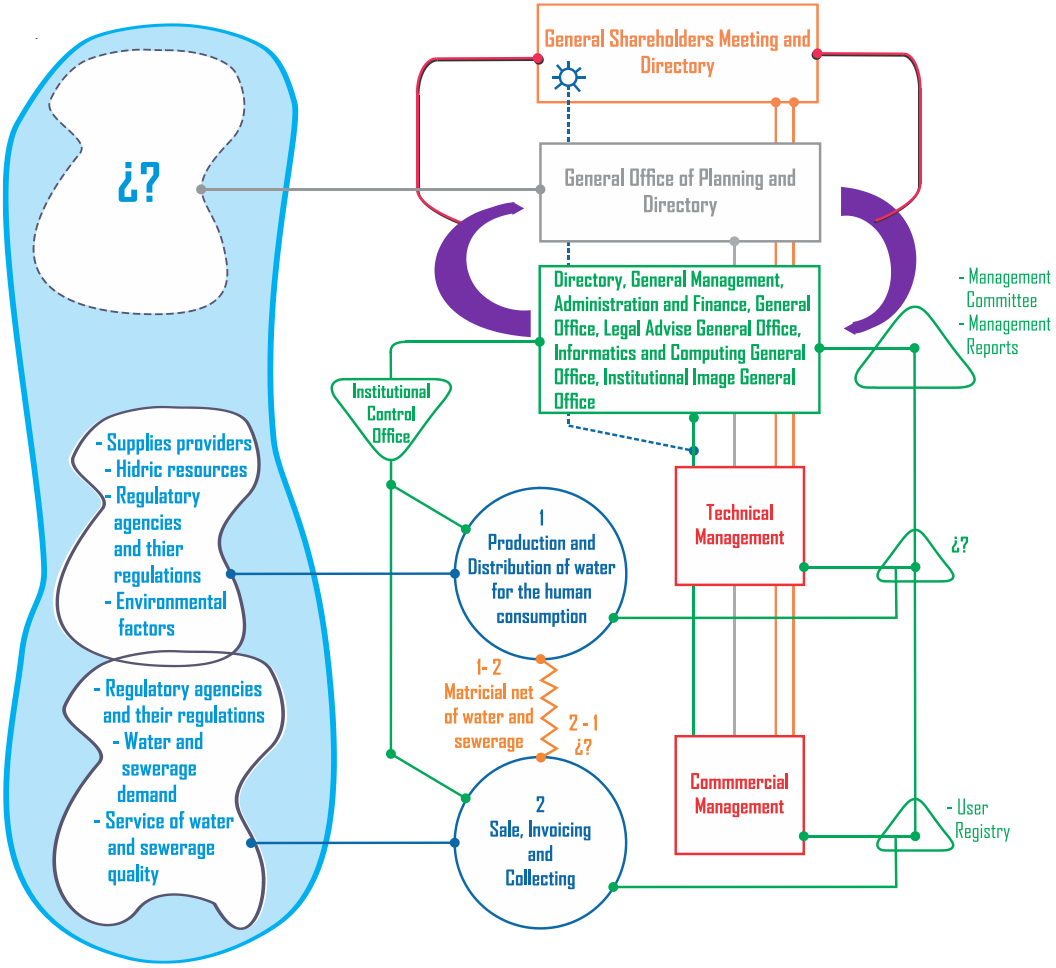

GRAFICO 13. Viable system model of the enterprise in diagnostic mode.

The centralized and decentralized analysis in order to diagnose the enterprise is described in Table 1

Table 1. Matrix of discretion.

	General shareholders Meeting	Directory	General Management	Management committees	Management and Finances	Human Resources	Accounting	Treasury	Logistics	Acquisitions	General service	Warehouse	Planning and Budget	Rationalization and statistics	Budget	Planning	Investment projects	Informatics and Computation	Secretary General and Institutional Image	Legal Advice	Institutional Control Body	Laboratory Unit and Quality Control	supervision and studies
SEDAM HUANCAYO S.A.	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Commercial Management			o	o									o	o	o	o			o				
Invoicing and Collection														o		o			o	o			
Cadastre and Measurement														o		o		o	o				
Attention to customer														o		o			o				
New connections														o		o			o				
Technical Management													o	o	o	o			o				
Operations			o	o							o			o		o		o	o			o	
Maintenance														o		o			o				
Engineering			o			o	o		o	o				o	o	o			o	o			o

The analysis of systemic -regulation functions of the enterprise shows that systemic function perform each supporting role, likewise, that systemic function is not performed by neither of the support functions. Table 2

Table 2. Matrix systemic functions and regulation functions.

	General shareholders Meeting	Directory	General Management	Management committees	Management and Finances	Human Resources	Accounting	Treasury	Logistics	Acquisitions	General service	Warehouse	Planning and Budget	Rationalization and statistics	Budget	Planning	Investment projects	Informatics and Computation	Secretary General and Institutional Image	Legal Advice	Institutional Control Body	Laboratory Unit and Quality Control	supervision and studies
SEDAM HUANCAYO S.A.	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Politic and identity																							
Intelligence and adapting																							
Corporative intervention	o	o	o											o		o							
Resource bargain					o	o	o	o	o	o	o		o	o	o		o	o					
Monitoring and tracking																					o	o	o
Coordination				o									o					o					

As final activity of diagnostic was identified the "pathologies and organizational archetypes". The organizational pathologies are structural and functional dysfunctions understanding each term in a context of cybernetics organizational; that is to say about roles, resources and enterprise processes. In the case study were identified the following:

- Vertical unfolding absence: the enterprise intends to cover a field of action disproportionate and unique level environment that is presented, therefore it result that the activities are impossible or incomplete. Because of the pathology is poor relationship with customers of water and sewerage service.
- Pathology of intermediate levels: there are relevant areas to the enterprise, though, they are not addressed by any specific intermediate structure, as in the case of Invoicing and Collection

The organizational archetypes are related to situations and common cases that describes a set of features and problems associated with communication and control, in the case of the enterprise SEDAM HUANCAYO S.A. are the follows:

- Liquid Identity: the shortage of water resources because of environmental changes, pollution, population growth habitat, water purification technology and economic activities in the valley; they are generating a confused identity on the company. If it only focuses on a single factor, the enterprise identity also leaves aside the other factors, which are pushing more and more. This results on the company addiction on just performing the service of potable water, omitting the other pressures or environmental constraints. This means that the enterprise wants to keep itself safe and have a fear of facing environmental constraints.
- Weak primary activity: the allocation of resources across the enterprise is centralized to the decision and action of the Logistic area that involves more of a reliance on all areas of the enterprise promptly Technical Management. This also happens the same in staff recruitment for direct execution of works (location service) involving the Logistics area.
- Identity: according to the purpose of SEDAM HUANCAYO SA, technical and commercial management are aligned to the purpose, but also participates Administration and Finance, which it means an administrative part is participating in the activities according to the purpose, as evidenced in the current organizational structure of the enterprise. Furthermore, water purification is being done at the expense of sewer service.
- Negative Synergy: In the organizational climate, it is evident that employees work to achieve private ends aligned to the group they belong to (syndicates and managements), the above described prevents cohesion and achieving business objectives.
- Hierarchical: the Directory**,** with purposes of implementing a policy or directive uses the General Management. Then general managements devolves these functions to managers through a document and in managements happen the same. This is an inefficient and hierarchical bureaucracy.
- Politicking (Politicians archetype): The agenda discussed by the Directory clarifies more local problems, as in the case of balance sheet, human resources, infrastructure and engineering; generating and affects local decisions. The factors causing this might be policy decisions and individual interests.
- Unsupported self-organization: the actual enterprise structure is currently not facing a specific demand of the environment that has Technical Management and Business Management. In addition, there is an increase in the demand for extension of water networks and sewage by the population in need of water. Areas of Operations and Maintenance cater this demand, given that the areas do not have the trained personnel of the Engineering Area requested, it generates the gap in updating the cadastre.
- No monitoring: from what it is achieved or supposedly achieved in the Technical and Commercial managements as reported by the "management reports" with a quarterly frequency to Planning and Budget area, who perform the consolidated statement. While they are elevated to General Manager and this is sent to the Board - directory, all of this is done out of habit and obligation without interesting to vary the content and frequency.
- Centralization and organizational decentralization: Logistics, Planning and Budget have centralized resources management in the enterprise causing delay in the delivery of resources outside the required time. This prompts the beneficiary resort areas to justify the failure of their goals that differ from the dependence of the requested resource.

- Weak Adaptability: the sharp changes of the enterprise environment makes policy processes emerge so responsible for making the planning are involved in primary activities of the enterprise, which let them understand their limitations operational processes and thus undermine the requirements of adaptation to its environment.
- International standardization: the plurality of sources and distribution nets of water resources is evident that brings attention that is not standardized.
- Organizational belonging: expresses the enterprise belongs to the EPS and as well to public local government.

Organizational design and processes of SEDAM HUANCAYO S.A.

The organizational design of the enterprise is oriented to the implementation of the purpose: "Provide water service and sanitation in their area, in balance with the ecosystem".

The beginning of the organizational design is the design of the operation and autonomy of the enterprise considering the following components: Production of water for the human consumption, Commercialization of Sanitation Services and finally, Sewerage and wastewater treatment. Figure 14, Figure 15 and Figure 16.

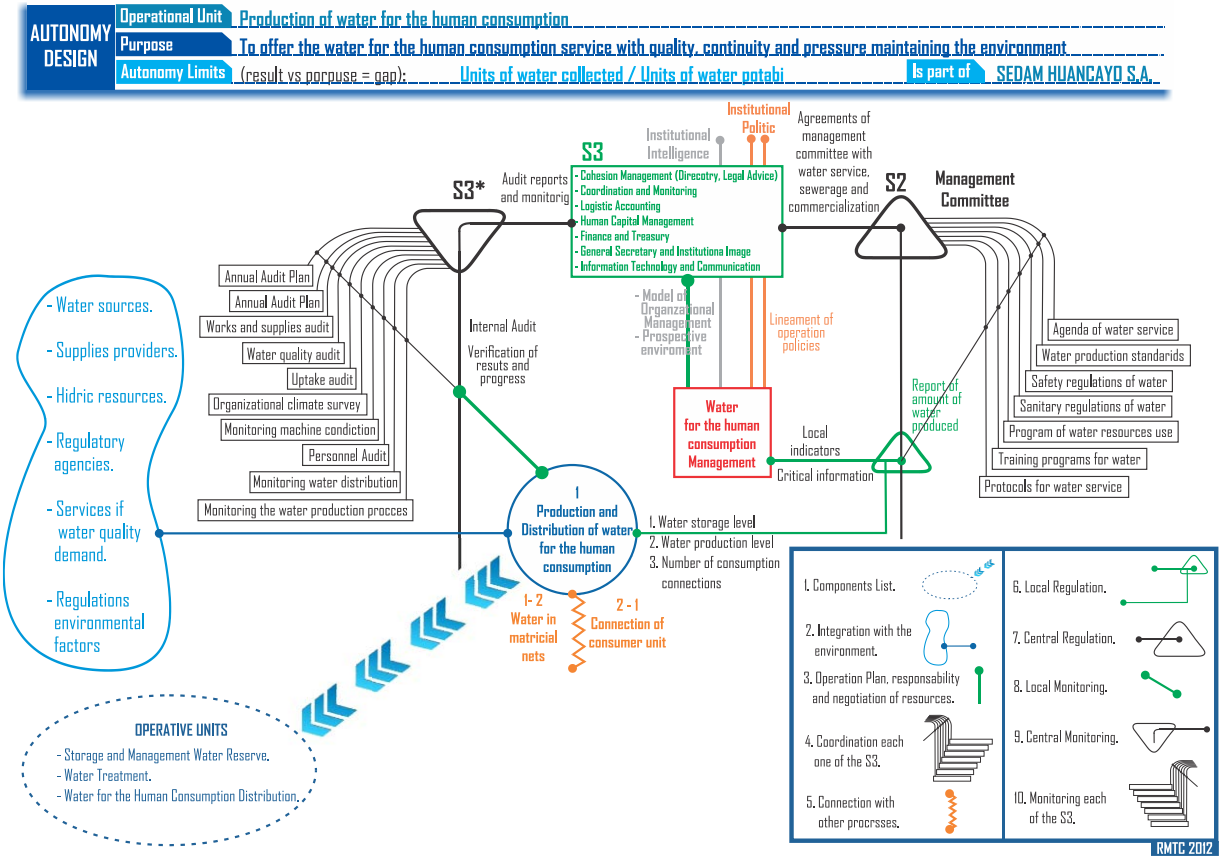

Figure 14. Autonomy design of Production of water for the human consumption.

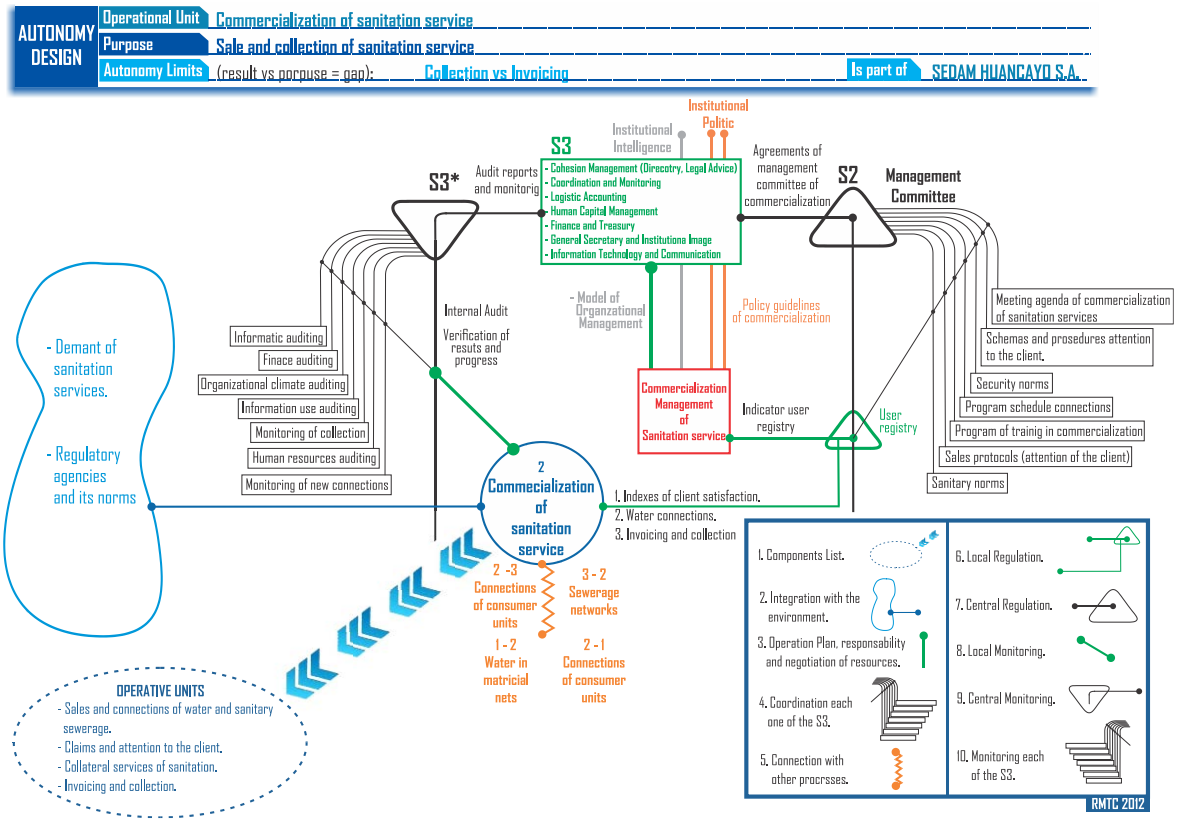

Figure 15. Autonomy design of Commercialization of Sanitation Services and finally.

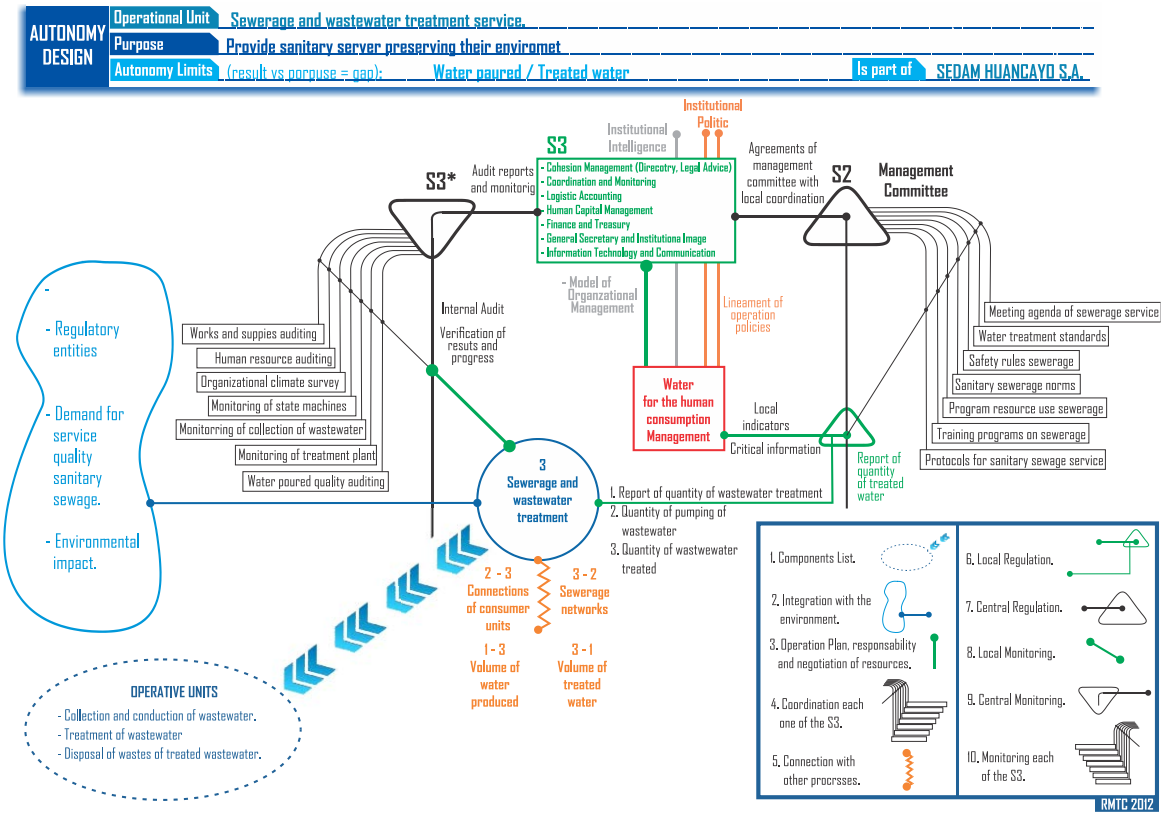

Figure 16. Autonomy design of Sewerage and wastewater treatment.

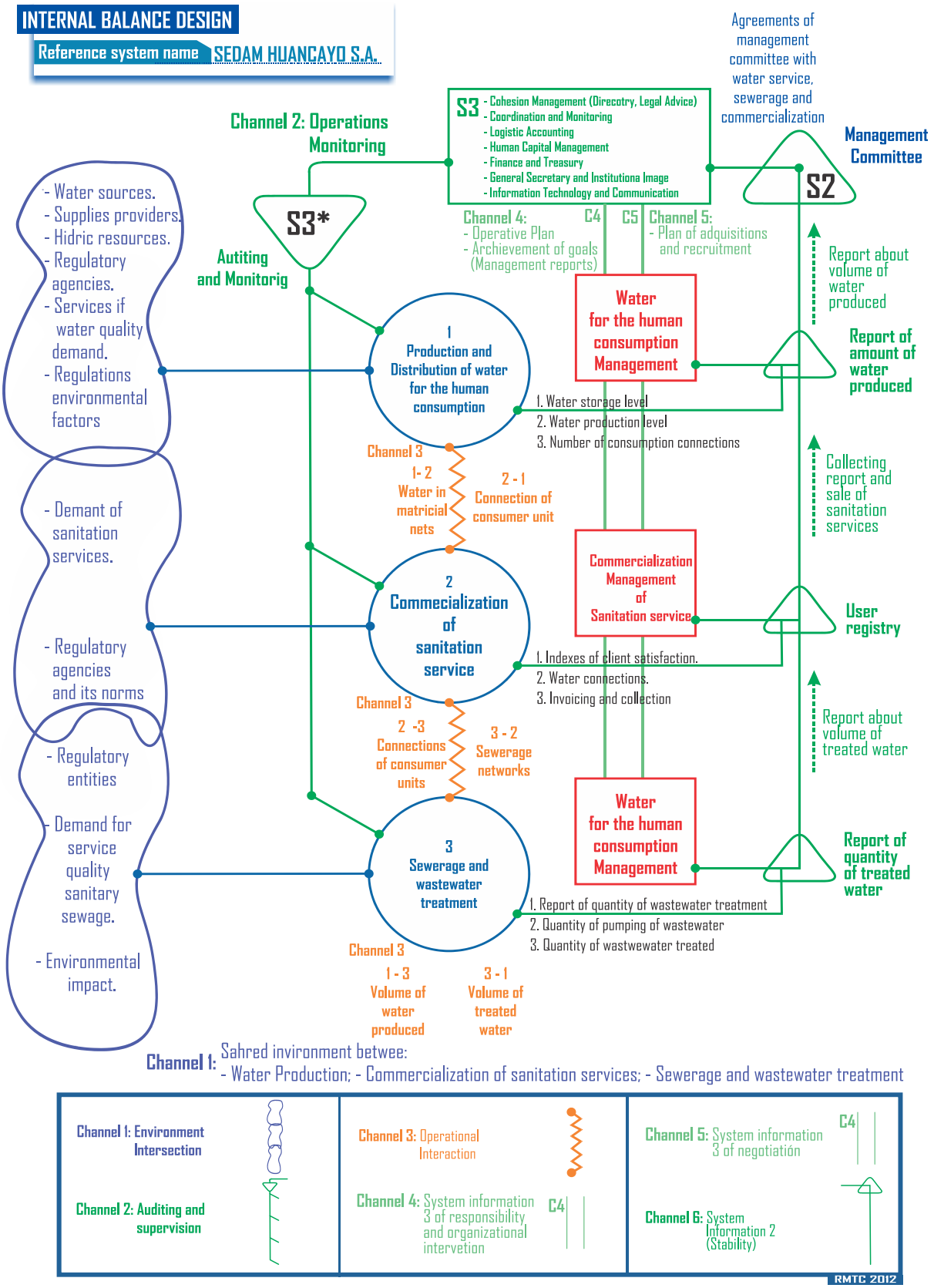

Figure 17. Internal balance design of SEDAM HUANCAYO S.A.

Immediately is make the design of the internal balance of the enterprise (Figure 17) with the idea of describing the interaction of the mission or operational units, as much as possible and increase the capacity of cohesion and coordination to strengthen their negotiation skills. In addition, the elements of the internal balance, "The here and now" (Implementation, Coordination and Monitoring Cohesion) of SEDAM HUANCAYO S.A. are:

- Implementation: Production of water for the human consumption, Commercialization of Sanitation Services, Treatment and disposal of wastewater.
- Coordination: Management Committees
- Cohesion: Logistics, Management of Human Capital, Accounting and Finance, Management of Information Technologies Services, Legal Advice, General Secretary and Institutional Image, Management Cohesion (Directory, Cohesion Management and Sub Cohesion Manager.
- Operations monitoring: is done by auditing and monitoring, which includes specific information according to the Missional Process.

Then continues to design the mechanism of balance with the environment of the enterprise, that is design the adaptation and intelligence processes, this mechanism is also called "The outside and then". The processes of “Planning and Foresight”, also “Organization and Institutional Improvements” are responsible of the balance mechanism with the environment. Figure 18.

After designing the mechanism of identity, ethos and politics; this mechanism is responsible for General Shareholders Meeting, three managers, one for each unit missional, and President of the Directory. Figure 19.

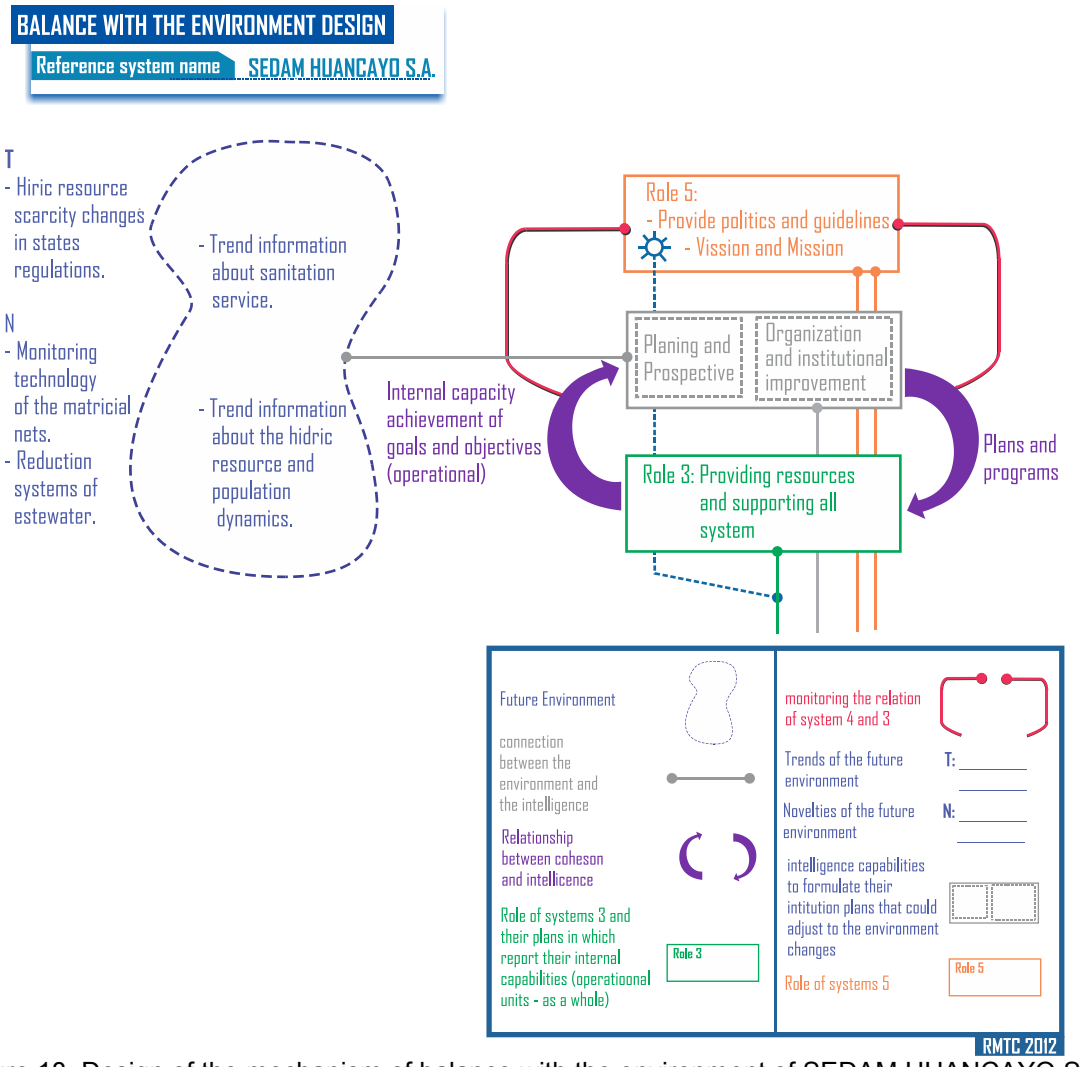

Figure 18. Design of the mechanism of balance with the environment of SEDAM HUANCAYO S.A.

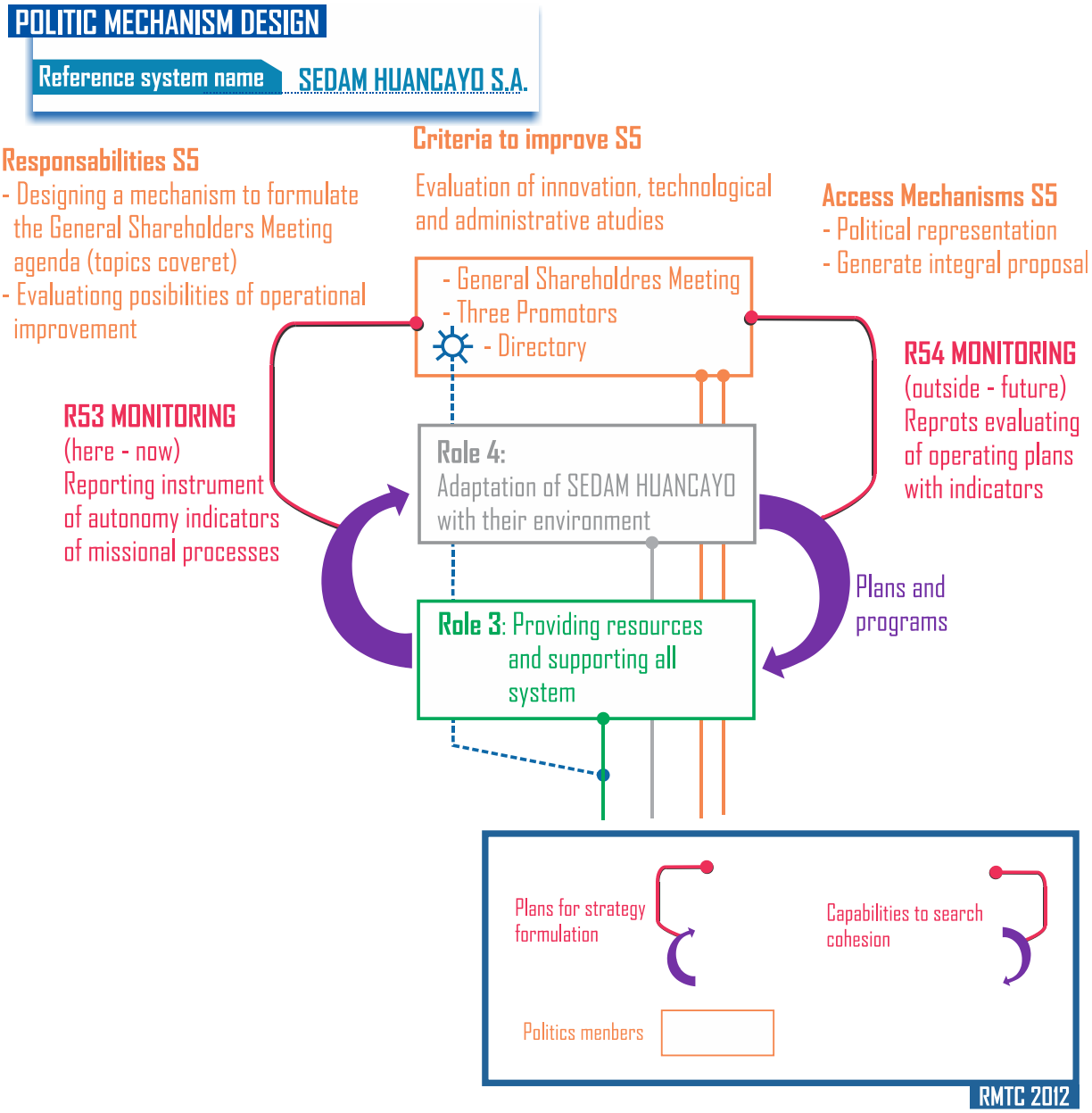

Figure 19. Design of the mechanism of identity, ethos and politics of SEDAM HUANCAYO S.A.

With the purpose of integrate the organizational design is developed the viable system model of the enterprise, that allows to represent and synthesize the systemic functions in the enterprise. Figure 20.

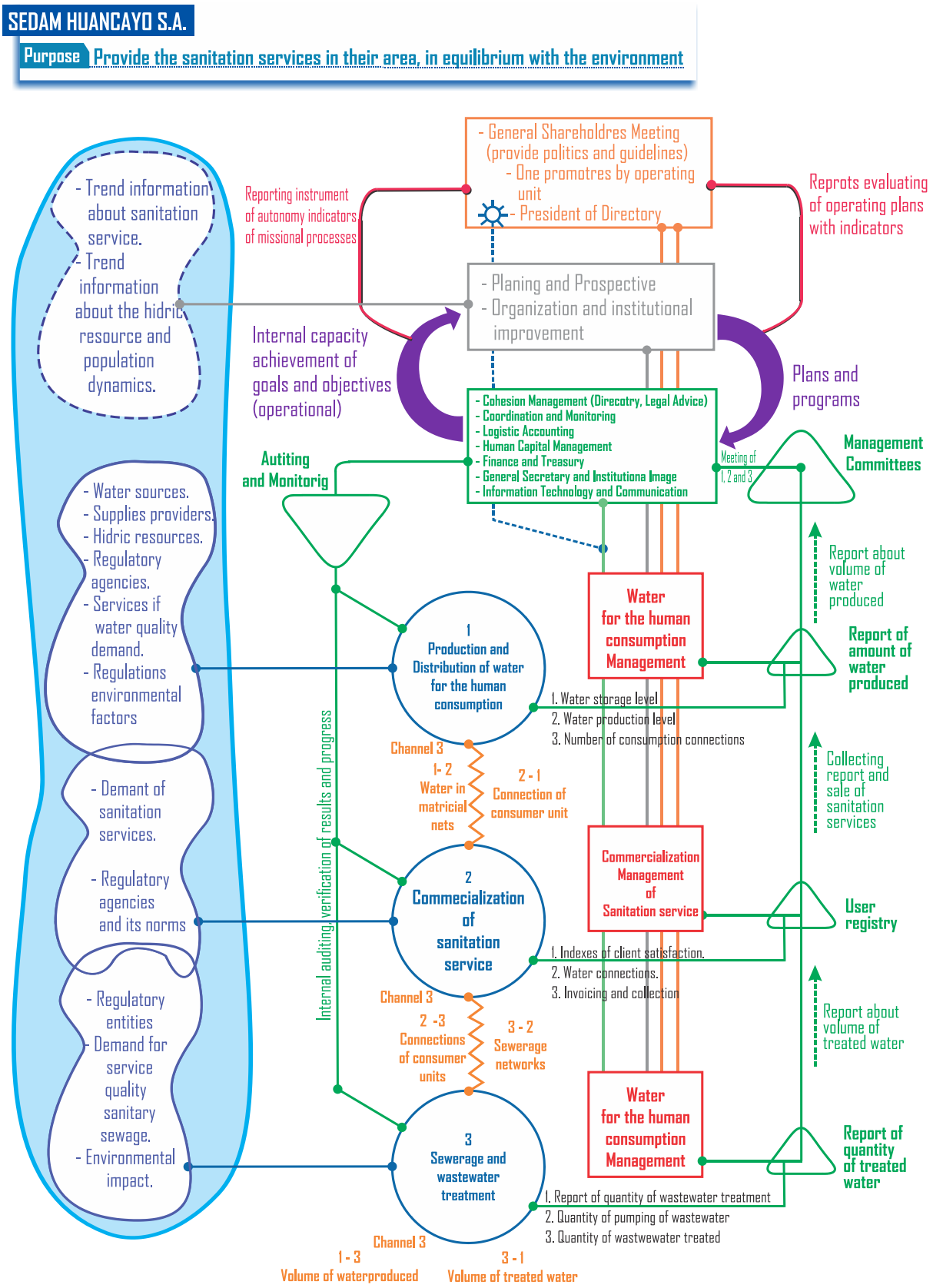

Figure 20. Viable system model of SEDAM HUANCAYO S.A.

During the organizational design is necessary to declare the discretion in the processes that is described in Table 3.

Table 3. Analysis of discretion

	Cohesion Management	Human Capital	Accounting	Finance and Treasury	Information Technology Services	Legal Advice	General Secretary and Institutional Image	Logistics	Monitoring and Auditing	Discussion of reports	Build consensus agreements
SEDAM HUANCAYO S.A.	o	o	o	o	o	o	o	o	o	o	o
Production of water for the human consumption	o						o	o		o	o
Storage and management of water reserves							o	o			
Treatment of water					o		o	o			
Distribution of water for the human consumption							o	o			
Commercialization of Sanitation Service	o						o	o		o	o
Sales and connections of "water and sanitary sewerage"							o				
Claims and attention to the client							o				
Collateral services of sanitation							o				
Invoicing and collection					o		o				
Sewerage and Wastewater Treatment	o						o	o		o	o
Collection and conduction of wastewater							o	o			
Treatment of wastewater					o		o	o			
Disposal of wastes of treated wastewater							o	o			

Deploying the systemic functions versus the regulation activities confirm the operation of the viability systemic function, there are: politics and identity, intelligence and adaptability, corporate intervention, resources negotiation, responsibility, monitoring and follow up, stabilization and synchronization. Table 4.

Before completing, the organizational design is defining the macro processes and the processes according to the feasibility systemic functions and then displays the process map of the organization. The macro process of SEDAM HUANCAYO S.A. feasible given as follows:

- It has as purpose: "Provide sanitation services in their area, in equilibrium with the environment"
- To fulfill this purpose there must be six macro processes: Misional, Stabilization and Synchronization, Cohesion, Monitoring and Auditing, Adaptation and Intelligence, Identity and Politics.
- The Missional Macro process is made up: Production of water for the human consumption, Commercialization of Sanitation Service, Sewerage and Wastewater Treatment; which is responsible for carrying out the processes to fulfill the purpose of the institution.
- The Stabilization and Synchronization Macro process consists of Discussing Missional Reports, Consensus Missional Agreements and it is responsible for maintaining effective communication between Missional Processes.
- The Cohesion Macro process whose members are: Cohesion Management, Logistics, Human Capital, Accounting, Finance and Treasury, Legal Advice, General Secretary and Institutional Image, Information Technology Services; he is responsible for the negotiation

of resources that the missional process required and are the responsible of requiring responsibilities reports, and also have the function of Corporate Intervention.

- The Monitoring and Auditing Macro process is integrated by the processes: Evaluate the performance of missional processes, providing recommendations to optimize the integration of missional processes; is responsible for conducting audits and monitoring frequently and unscheduled, in addition to informing the formal ways in order to make recommendations to integrate processes.
- The Adaptation and Intelligence Macro process is integrated by Planning and Prospective, Organization and Institutional Improvement; is the is responsible for ensuring the future environment and the organization improvement, is concerned with maintaining a hemostat within the system along with the Cohesion Macro process.
- The Identity and Politics Macro process is integrated by the processes: Evaluation Study of Technological Innovation, Evaluation of possibilities Organizational Improvement. This Macro process is responsible for providing policy guideline to the whole institution, also has the faculty to intervene in the Missional Macro process, as long as it fails to comply with the policies and guidelines of the institution and consequently it could not satisfy the purpose for which it was created and designed the institution.

Table 4. Analysis of Systemic functions – regulations

	Evaluation Study of Technological Innovation	Evaluation of Improvement possibilities	Generate integral proposals	Planning and Prospective	Organization and Institutional Improvement	Cohesion Management	Human Capital	Accounting and Finance	Information Technology Services	Legal Advice	General Secretary and Institutional Image	Logistics	Monitoring and Auditing	Discussion of reports	Build consensus agreements
SEDAM HUANCAYO S.A.	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
IDENTITY AND POLITICS	o	o	o												
ADAPTATION AND INTELLIGENCE				o	o										
CORPORATIVE INTERVENTION						o									
RESOURCE BARGAIN						o	o	o	o	o	o	o			
OPERATIONAL ACCOUNTABILITY						o									
MONITORING AND AUDITING													o		
STABILIZATION AND SYNCHRONIZATION														o	o

As, the Process Map Figure 21, is the result of the integration of the identification, diagnosis and design stages, with the participation of each one of the enterprise members; the interpretation is of the next manner.

- Lecture of the purpose, what is understand as the DNA of the enterprise? their essence and should answer to the question, how for exists the enterprise?
- In order to achieve, the enterprise purpose, it should fulfill the three Missional Process: Production of water for the human consumption Process (1), Commercialization of Sanitation Services Process (2), Sewerage and Wastewater Treatment Process (3). The result of the Missional Macro process are the services of water and sewerage; so also the water for the agricultural and stockbreeder consumption, considering the user satisfaction and maintaining the equilibrium with the environment.

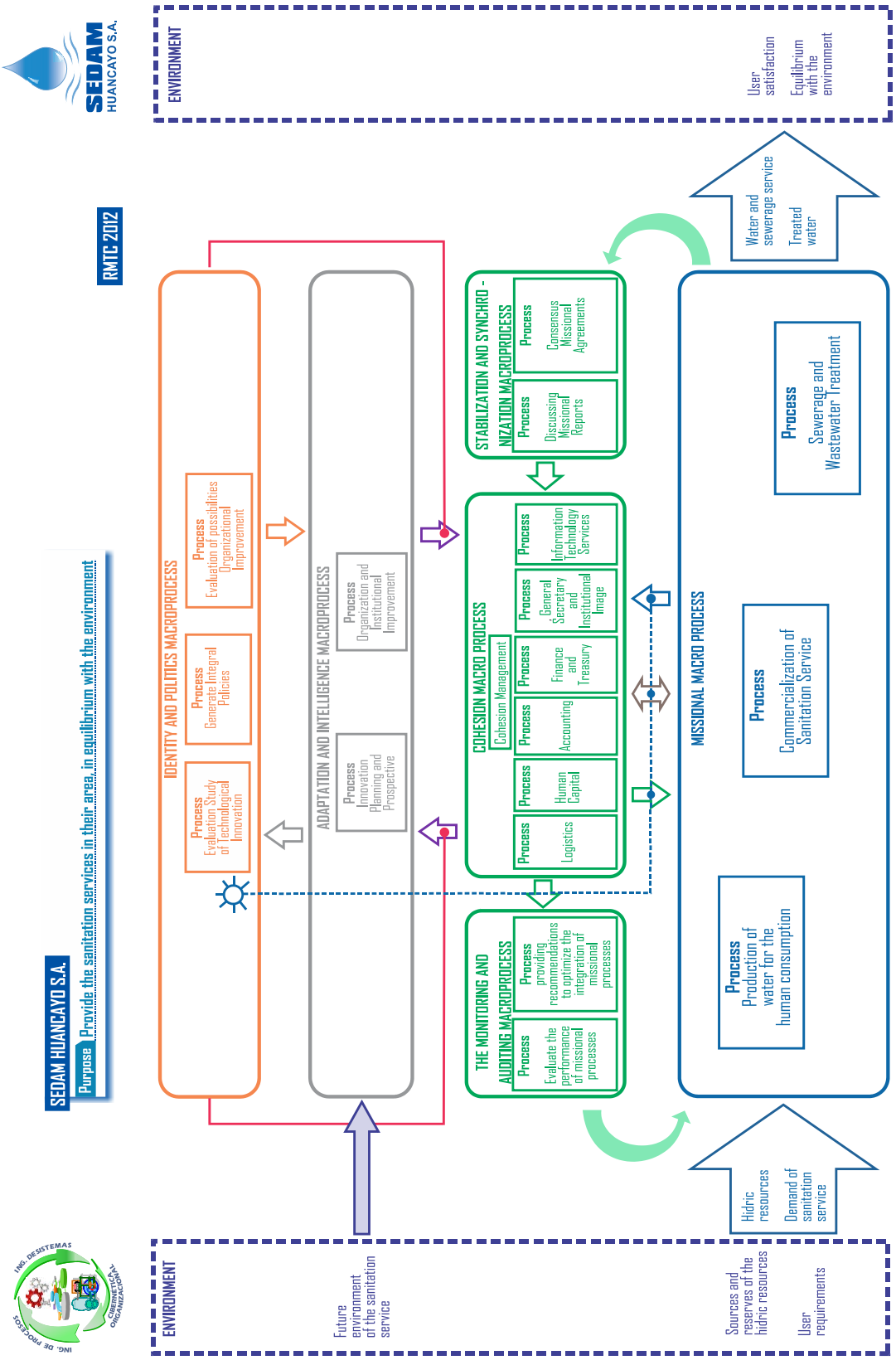

Figure 21. Process map of SEDAM HUANCAYO S.A.

4. Conclusions

- The case of study contributes to improve a particular process of systemic and organizational cybernetic application in the context of public service of local sanitation.
- The diagnostic and organizational designs that apply systemic and cybernetic intervention propose a manner on how the enterprise should function in their environment, that allow obtain the flexibility that need for survive in changeable and complex ecosystems.

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Evaluation of trust in a domain of business entities and people by employing data source provenance information

Abstract

The Semantic Web offers a compelling vision in integration of data, yet it also raises many difficult challenges. One of the key challenges is the problem of trust as a method of dealing with uncertainty. This aspect is especially significant when dealing with online personal information. There are several online data sources that include information about business entities and people. With that kind of data we often deal with the problem of semantic inconsistencies. While performing integration of data sources including trust management would greatly improve the success rate in relations discovery among entities. The vast majorities of current approaches that deal with semantic integration of information from several data sources omit or don't fully address the aspect of trust. We will discuss semantic integration of personal and business information from various data sources coupled with trust layer. Our approach employs provenance information about data sources which enables users more intuitive definition of trust and furthermore delegation and employment of provenance information. It has been widely accepted that this kind of information is vital for evaluating quality and trustworthiness of information on the Web (Golbeck, 2008). While incorporating trust for single entity and also for data source the resulting system has higher and more defined solidity.

Our contribution is related to the preliminary study (Lavbič et. al., 2013) and it improves the definition of trust by employing provenance information. As the results showed, the system had higher and more defined solidity while trust for single entity and also for data source was defined, while we will focus on employment of provenance information. The user can, with high adaptability, define the level of trust and customize the trust management. We employ W3C PROV-O vocabulary (Belhajjame et. al., 2012) for provenance information specification and RDF language that is a standard model for data interchange on the Web. The PROV-O is targeted at data owners who will publish provenance along with their data. But we argue that third parties can also publish provenance information about data and our approach supports and it is compliant with this option.

Trust management used throughout the extended abstract introduces three levels of trust and trust T of entity e is comprised of: (i) provenance trust $T_{PROV}(e)$, (ii) data source trust $T_{DS}(e)$ and (iii) entity trust $T_E(e)$, which further consists of (iii.i) schema level entity trust $T_E^{TBox}(e)$ and (iii.ii) instance level entity trust $T_E^{ABox}(e)$. Provenance trust $T_{PROV}(e)$ defines inferred level of confidence that takes into consideration provenance information of data from various data sources with details of its origin, agents, activities etc. Data source trust $T_{DS}(e)$ defines the level of confidence of data source and is common for all information that is derived from selected data source (e.g. user provided information, collected online, have lower level of confidence than information acquired from official databases from public administration sector). Entity trust $T_E(e)$ is defined for every ontological entity and defines

the atomic level of confidence for selected entities. Trust T of entity e has range $T(e) \in [-1,1]$, where the meaning of values is defined by interval boundaries. A trust value of 1 defines absolute belief in the information, while -1 defines absolute disbelief. A trust value of 0 represents absolute uncertainty. If trust value of entity is omitted in our approach, the default value of 1 for absolute belief is considered. The trust is defined as follows $T(e) = a\ T_{PROV}(e) + (1\text{-}a)\ T_E(e)$. Parameter $a \in [0,1]$ defines the weight of importance in calculation of trust regarding the consideration of provenance trust $T_{PROV}(e)$ and entity trust $T_E(e)$.

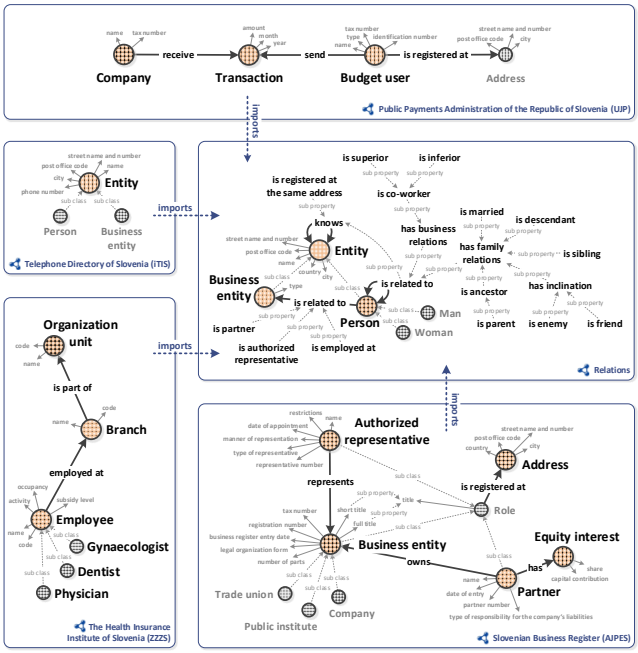

Figure 1: Set of data source ontologies

The case study of SocioLeaks, which we introduce, focuses on integration of personal information from data sources mainly maintained by government authorities, which have higher trustability than information from social networks. There is information about entities from Telephone Directory of Slovenia (iTIS), The Health Insurance Institute of Slovenia (ZZZS), Slovenian Business Register (AJPES), Public Payments Administration (UJP), Facebook, etc. (see figure 1). To support main functionalities of SocioLeaks system, several external data sources were integrated to enable users cross data source search and pattern discovery to find hidden relations between business entities and people. Every data source in our system has defined data source trust, entity trust and provenance trust for each comprising entity. All external data sources are extended by relations' ontology, which is also the user entry point to SocioLeaks system.

Currently SocioLeaks system holds almost 11M triples from several data sources. Its main purpose is to enable users' traversal and relation discovery among business entities and people employing Semantic Web technologies. This process is supported by information system where users can search for entities; while results are displayed in graph based manner to enable them the traversal and further relation discovery (see figure 2).

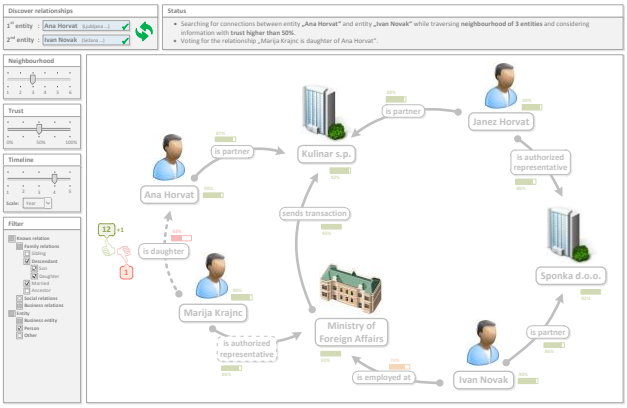

Figure 2: User front end of SocioLeaks system

Users can either enter one selected entity and display all related associations to some level or enter two entities by finding all existing routes between those two entities and all other that are part of the path. User has the ability to set the filtering with selection of considered entities (business entity, person etc.) and selection of knows relations (son, daughter, married, employed etc.). There is also additional feature of timeline filtering with selection of timeframes for information we are interested in (e.g. display all relations that were present between selected company and its legal representative during some period of time).

The novelty of our approach is the ability to incorporate trust in visualizing relations between people and business entities and employment of provenance information for trust calculation. We enable users to select the acceptable level of trust that is then considered in searching the relations and displaying them in a graph based manner. Every entity is accompanied by indicator (value of trust displayed as progress bar and percentage value) acommpanies every entity. By including the trust information users have more complete information about displayed relations among entities and can make more educated decisions.

Keywords

data integration, provenance, semantic web, trust

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Virtual situation room as distributed cognition and control system

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Abstract

As it is well known, the first cybernetic system of the government of the state was carried out by Stafford Beer in Chile. Cybersyn really used the opportunities of information and communication technologies. The project has absolutely anticipated its time and made it possible to govern the state in real-time mode. It was something new and different from capitalism or communism, the major political systems of the XXth century.

The Cybersyn system consisted of four subsystems:
- Cybernet – network that transmitted and received information with the government and enterprises.
- Cyberstride – information system that monitored production indicators in real time and fed the statistical modeling software.
- Checho – economic simulation software that the government used to forecast the possible outcome of economic decisions.
- Operation Room – centre where administrators saw relevant data, formulate desisions, and transmit advice and directives to enterprises and factories in alarm situations.

In our research team we develop two directions: the simulation modelling of complex systems and building the situation rooms (decision support systems).
As far as situation centres are in common use to control current activities, we focused our work systems for designing the future – cognitive centres.

The paper describes the concept of Cognitive Centres and its realisation in digital ecosystem, designed by Systeco Group in the Keldysh Institute of Applied Mathematics Russian Academy of Sciences. The Institute operated as a system integrator for the Russian Academy of Sciences in major research and development projects during the years of the USSR, in aspects such as space exploration, nuclear weapons and information technologies. Later the Institute's Director Sergey Pavlovich Kurdyumov established the first Russian Synergetics scientific school. Our group is a part of Kurdyumov-Malinetsky scientific school, which investigates interdisciplinary complexity problems, non-linear dynamics and applied computational modelling in a wide range of fields such as history, management, economics, medicine, psychology, physics of protein, forecast of earthquakes and others.

Introduction

The key idea of our group is that management in multi-agent systems turns to effective communication support.

There is a view that there is not one world the same for all but there are many different worlds and everyone lives in his own world. For example a man who spent his entire life inside the submarine is superior sailor but does not know anything about the sea. He lives in his own closed world of submarine's devices, sensors and buttons (Maturana, H.F. Varela, 1980). Likewise each of us lives in his own model of the world – Umwelt (Uexküll, J. von, 1982).

Such models (further Umwelt) constantly changes during the communication. Easier to communicate for people with similar Umwelts. Otherwise they cannot understand each other. For example, for mathematician it is difficult to understand what businessman thinks about and for businessman it is difficult to understand what mathematician thinks about (Grigori Perelman, for example). These people belong to different communication systems, have different meanings and interests, different language and timescale. They live in different worlds, although in the same place and time.

Cyberneticians, consultants and system thinkers connects two different worlds of science and practice, which are operationally closed and self-organized systems. They are like the interpreters between two languages.

Incoming information changes the volume and the structure of knowledge, thesaurus or Umwelt. New information is not simply added to the old, and it integrates into a new system. In this case, the ability to perceive new information depends on the Umwelt of receiver, which in this case plays the role of meta-information with respect to the information received (Shreider, 1974).

Communication and Umwelt are always utilitarian; each living system uses them for their activities. Uexküll wrote "Everything that comes in contact with the Umwelt is changed and transformed until it turns into a useful meaning; otherwise it is completely ignored". Every living system uses a model of the world – Umwelt, which is dictated by the vital functions. For example, the ant's theory of grass radically differs from cow's theory of grass. (Sharov, 1998, 2001)

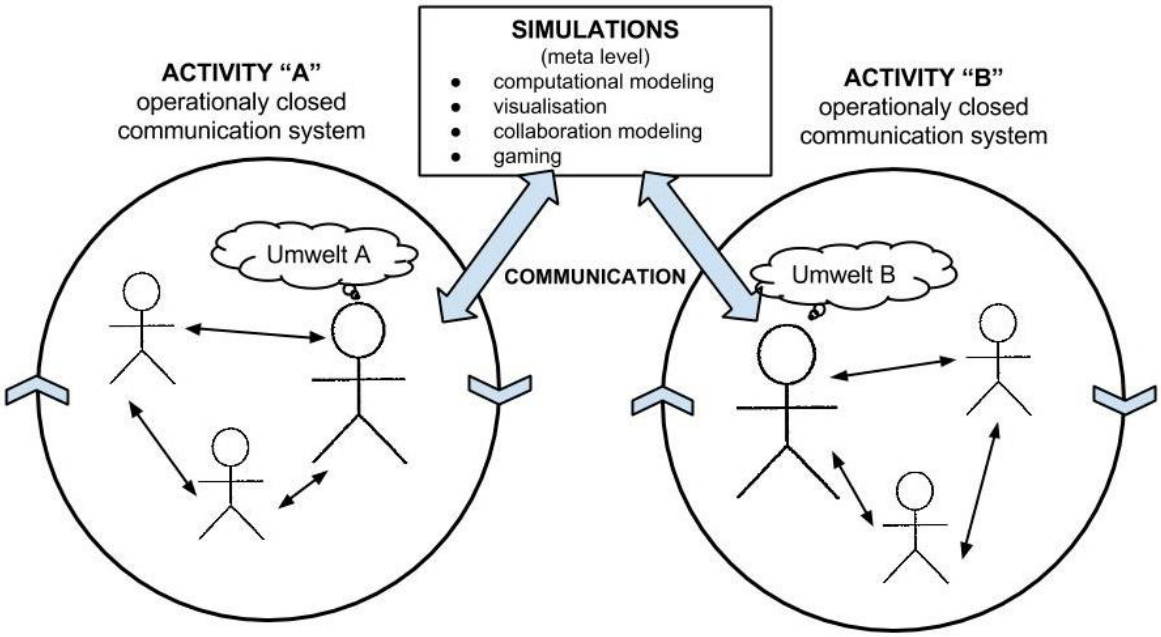

Figure 1. Communication using simulations as a media.

To proceed we should review the key points of the theory of communication systems:

- Communication (exchange of knowledge or functional information) requires the compatibility of interpretators (media, languages, Umwelts, models, interests, etc);
- The communication is based on the mutual benefit of the transmitter and the recipient;
- Communication system is a carrier of the sense. Meaning is determined by a communication system which is similar to the reference point or coordinate system in physics.

Knowledge carried by a communication system is not available to everyone and is not universal. But this does not mean that the communication systems are absolutely isolated. Different levels of hierarchy often have their own Umwelts, which leads to a plurality of communication systems in the same organization.

Algedonic alerts – an example of a universal language understood by the agents from different communication systems. Such algedonic communication can be two-way. From the bottom signal is "pleasure and pain" and from the top – "carrot and stick".

Methodology

A traditional cybernetic view of management involves a system (object) and a controller (subject). This model can be useful for mechanical, biological and similar systems, as well as for some social systems, such as companies, if they have a strict hierarchical

management structure. However, for nets of enterprises, industries, for regions and states this traditional management model may not be applicable. Social and ecological systems, using Ackoff's system classification (Ackoff, 1972), include multiple active authorities which control signals can be easily blocked by others. However, these systems also need control in the sense of maintaining homeostasis. Effective communication support is the core management method for such systems. In Subject-Subject management model one subject cannot determinate targets for the whole system but can provide effective communication between other subjects and can generate and support autopoiesis processes (Maturana and Varela, 1980). We visualise that approach as a gardener who looks after trees, assures their growth but does not direct their development.

On the one hand the management aims to maintain homeostasis. On the other hand, management should initiate and implement changes. These are two sides of the same coin, as in a sense, conservation and change are identical opposites. Today in a rapidly changing world we cannot forget about the management of a change. It is not enough just to respond to external disturbances of the environment, it is important to create the future.

The idea of cognitive centres is to provide a tool for understanding the changes and building a vision of the future for many subjects at the same time, the subjects of the different communication systems of different levels. We provide effective communication between the subjects relating to their activities to change the situation.

The Subject-Subject management approach is applicable and useful for industries, regions, states, large corporations, nets of any multi-agent systems with several independent subjects.

The product of situation room is decision. The product of cognitive centre is understanding. In addition, due to the construction of effective communication between different actors cognitive centre is the generator of communication systems.

During strategic session the authorities form harmonized images of future and generate communication systems within region or industry.

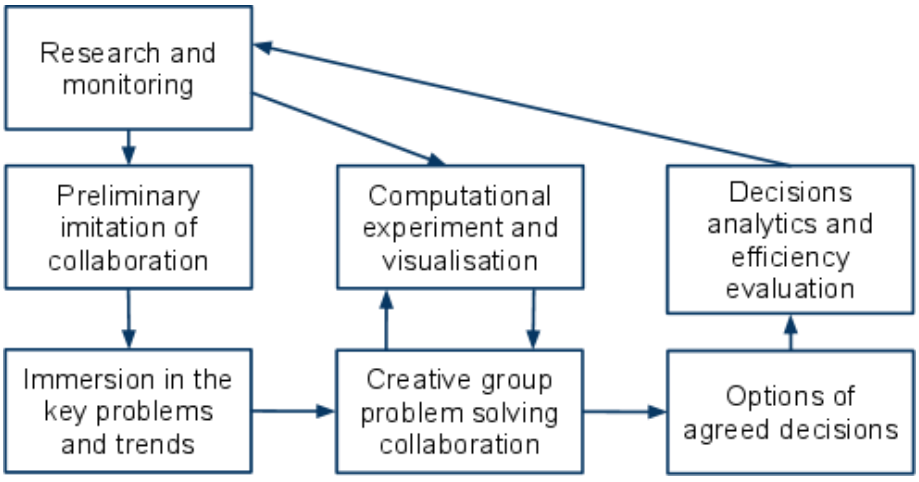

Figure 2. Cognitive Centre main processes (Ototsky, Manenkov, 2011).

The process is as follows (see Figure 1):

- Research and monitoring. Building a base of experts to build up complex models of situation or system; sample cases for an imitation of collaboration; in further cycles - monitoring the evolution of the situation through the comparison of reality and models.
- Preliminary imitation of collaboration. Training authorities to collaborate on sample cases in the creative group problem solving procedure. Transition from a set of subjective contexts to a systemic vision of situation via model by considering sample cases and metasystemic transitions of the authorities towards their formal roles.
- Immersion in the key problems and trends. Using the experience of collaboration with sample cases, the group is focused on actual real problems, trends, internal and external factors of decision making.
- Creative group problem solving collaboration (discussions, brainstorming, etc.) supported by computational experiments and the creation of visualisations in a dialog mode. The group is asked to formulate alternative future scenarios and decision options. This group can be temporary amplified by remote experts in specific knowledge domains. On the one hand group members and remote experts give closure to the models providing their views of trends for the future. On the other, modelling acts as an environment for communication of authorities and experts.
- Decision options may be evaluated by surveying "focus groups" or via other methods.

The procedure means an on-going activity because it supports system learning. Scheme of group collaboration is based on Cybernetic (Viplan) Methodology which is used to aid conversations about change in organisation, making explicit differences of viewpoint and interpretations between individuals (Espejo, 1989, 1993, 2011). The result of this procedure, based in cognitive centres, is more than agreed visions for the future and evaluated decision options; it is the design of communication systems for authorities, experts and administrators through which they can influence, with their own purposes, timescales, visions and activities, policy discussions and selection of options.

Design

Today we are moving cognitive centre tools into the digital environment by developing the Virtual Cognitive Centre (VCC) as a cloud service. The VCC integrates Cognitive Centre's conception of management in multi-agent systems and Digital Business Ecosystem's usage of information technologies.

Cognitive centre is the instrument for understanding and forming the concerted vision of the future and ensure the effective communication between authorities that is the core of making decisions process.

The Cognitive centre consists of the following modules:

- Organizational procedures of managing strategic sessions;
- Communication platform;

● Visualization system;
● The tree of mathematical (dynamic, agent-based, soft models etc.);
● Evolving knowledge-base;
● The system of managing interdisciplinary expert sessions;
● Education (simulations and game-based training)

The Virtual Cognitive Centre (VCC) — is a communication system for the nets of situation rooms that provides:
● Remote access to the situation rooms resources and tools;
● Effective teamwork of territorially distributed decision-makers and experts;
● Controlled integration of IT environment and data of situation rooms;
● Unification of models and structures of knowledge warehouse used in situation rooms.

The key functions of VCC tools:
● Communication (working with information) – teamwork with texts, schemes, tables, patterns, external video-, audio- information, collective creation of own materials and etc;
● Knowledge base (accumulation of knowledge) – is a convenient tool for saving information (both: structured and unstructured);
● Project management (progress and entirety);
● Integration (import and export) – coordinated connection of exterior services for project tasks with translation and date integration of these services into the project.

The user interface should be practical and simplified to the limit. So the users may focus on what they are doing, not on the instrument. The communication should be hold in real-time mode. Nothing should be lost.
Key requirements to VCC:

- The user interface should synthesize three key functions of VCC into one process: **COMMUNICATION = WORK WITH INFORMATION = PROGRESS AND ENTIRETY**

  or in other words:
  COMMUNICATION SYSTEM = EVOLABLE KNOWLEDGE BASE = WORK ON SPECIFIC PROJECTS

- The focus of attention should be on content.
- Nothing should be lost.
- User should feel the progress and gaps.

Conclusion

The practice of our research, development and deployment on private and package solutions for cognitive centres of headquarters support reveals the necessity of creating the new generation of centres – virtual cognitive centres (VCC) and shows their principle demands. The world experience of VSM deployment and the modern information and communication technologies make it possible. Cybernetic Methodology and complexity management foundations give tools.

The solutions of difficult problems often seem to be obvious when they are already found. The thing is that difficult questions are unresolvable in original coordinates, in the system of concepts the problem were put into.
Their solution is construction the new augmented system of categories. This cognitive process is extremely complex. In the world that changes every day the recipes that worked well yesterday are not useful today. Administrators have to work consciously and contemplate not only subsystems, but meta-system either and think interdisciplinary.

Has the meaning of control changed in a multi-agent systems and organizations with a network structure? What tools are needed? What is the challenge and role of science and cybernetics to a new post-capitalist world?

The historical context of our message is the world in situation of disunity, conflicts and controlled chaos. We believe that in such a difficult time is vital for looking for solutions conquering new complexity. We believe that an alternative system of disunity and conflict economic, political and geopolitical is virtual personal situations room – communication network of cognitive centres, connecting theoretical scientists and practitioners from the whole world and creating a global cognitive infrastructure for creating future.

We offer one of the variants of the solution to the science and common society with a hope of discussion.

Keywords
complexity, communication systems, cognition, management, future development, cognitive centre

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Operational Processes Modelling and Information Flows in the Laboratory of Metrology

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Abstract

This project was made at the University of Cauca in collaboration with the Metrology Laboratory of the Popayan city, focusing on the structural and dynamic modelling of its operational processes. In order to develop this project, it was took a large number of theoretical concepts about information managing, business processes and business modelling, looking forward to obtain the structure and processes classifying most suitable for the current state of the laboratory. Once established the required structure for the laboratory processes is, it was proceed to fully document the various techniques and tools that can be found to perform both dynamic and structural models to define the most appropriate for the project implementation. Once chosen the tools structuring processes identified from the records kept of the laboratory and applying the theory of Porter Value Chain for a separation between production and management processes to define the scope of the project is done. The business process modelling is done from IDEF0 for the structural approach which further data content of exchanged information in business processes and laboratory dynamic modelling is performed with WFNets also allows for the use defined resources for the execution of tasks modeled obtaining results in the generation of roles and actors in the process.

Keywords: Metrology Laboratory, Business Processes, Business Modelling, IDEF0, WF-Nets.

INTRODUCTION

Companies looking tobe atthe forefront of technology-shoulduse existing toolson the market, in order to make better useof their resourcesand avoidresult indata that-slows the processofintegration, becausemanagementand staffoperationalneedto havereal-timedetailed informationof all the elementsthat affect the processand thusbetter controlofthe effectiveness and efficiencyof their processes andproducts, whichdefinesprofit marginsand rationaleof a company.Butthe lack of integrationof business functions, generatescalls"islands ofinformation" [1], corresponding to the presence ofcomponents technologysoftware, hardwareandhuman talenteffortsof the company,preventinga flowconsistentand continuousinformationbetween departments.

The appropriateuse of informationfor decision making, improves aspects such ascustomercare, reduce paperwork andofficeactivities, taskseliminates manuals, reduce tedioustasks, time and resources; for this reason, it is important to have toolsthat get betterprocessesinformation exchange.Beforeany implementation,building modelsthat yield anapproximation for theanalysis of the processes thatare taking place intheorganization and thusdocumenting, validating, and proposestrategies for improvementin the development ofimportantactivities associated with the business, as modelstohelp showhowfuturechangesmay affecttheexisting organizational structureand what recommendationscan be madeto improveprocesses.

In this articlethe results of themodelling ofbusiness processesMetrology Laboratoryof the Popayan city,for this projectwasinitiallymade a process bystudying thedocumentation providedby the companyperformedalong with aprocess-views conductedbetweenoperators, afteran investigationofthisacquisition istoolsandmodelssideof this information, creating a frameworkfrom whichthe most appropriate toolfor the realization ofbusiness processesmodellinglaboratoryis selected; to finally getresults instructural and dynamicmodellingof flowsof information inthe metrology laboratoryandconclusions the respectiveproject.

1. CONCEPTS

1.1. Business integration

Business integration is a concept that seeks to break down organizational barriers within a company, to optimize the synergy (I work together to achieve greater effectiveness) both internally and in its relationship with other companies to do this, it uses the enterprise modelling which allows externalize the knowledge of the company, adding value and sharing it as needed; is to create models of the structure, behaviour and organization of the company[2][3]. Thus, the enterprise integration points to the importance of good information management, so that is provided correctly in the form, place and proper time.

The business internally, integration includes horizontal and vertical integration. The first refers to the physical integration of equipment and process logic, from the stage of product demand, through production and finishing in the same shipment. The second refers to the integration between the different administrative levels in terms of decision making, so that information flow type "orders" downward den, and "reports" up [3].
The inter-enterprise integration requires every company to have modelled their processes, because these, in part or in whole, will be interacting with other companies[3].In business process integration is essential to find the best approach the complexity of the company, identifying the key elements that allow the modelling of the same[3].

1.2. Information Management

To Ponjuán[4]the information management is the process by which they are obtained, display or use basic resources financial, physical, human and material type, to manage information within and for the society it serves. Its basic element management lifecycle of the resource and occurs in any organization.
Organizational environments are directly related to existing hierarchical levels in an organization and on the other hand, affect both the source, such as maintenance and disposal of information flows, the dynamics crosses all sectors of the organization. Organizational environment is defined as the areas of interaction between people, technology and information-oriented company goals, spaces of action responsible for the daily organizational dynamics. Informational environments are therefore a result of organizational environments, aimed at information[5].

1.3. Business Processes

The definition of business process varies according to the author and the time in which is due to the prevailing business technology, where the main focus has always been the different aspects of production.
Davenport and Short [6], define business process as "a set of logically related within a defined space and time, which are performed to achieve a result of the business process for a particular client tasks". While Saven in your modelling business process article: review and structure defines it as "the combination of a set of activities within a company with a structure describing their logical order and dependence that aims to produce a desired result" [7]. Who also mentions that the modelling of business processes provides an overall understanding of the activities of an organization and also a firm can be analysed and integrated through its business processes, hence the importance of correct modelling of the same [7].As clearly the authors emphasize the concept in the process activities which relate the results of the business process with an applicant or customer of the product.
Importantly, any activity that is part of a business process, takes time, incurs a cost and delivers a quality product or service. An activity that is part of a process, has implied systemic concept, consisting of an input, a process and an output, which in turn is related to others with which it interacts, thus forming a set of interrelated parts[8].

1.4. Value Chain

Michael Porter proposed the value chain as a tool of analysis for strategic business planning, basically, facilitating the identification of competitive advantage within the organization[9]and the concept behind this tool is that any organization can be analysed under the value contribution generated by each one of its main activities and the emerging of the interrelationships between them.
Given that the Porter value chain is modelled for the manufacturing sector, and the process modelling as the final product is the provision of a service, it is necessary to obtain the value chain for services proposed in Article Marketing Services: Reinterpreting the value chain [9].Where provided for each of its activities with the final product value is highlighted. For a more clear definition of the services value chain to define the concepts of value and service is performed.

> **Value:** customer perception about a set of tangible and intangible benefits that meet the needs of timely, effective and efficient customer, with the subjective value to the customer.
> **Service:** a set of activities to meet the needs of a client, developed with the idea of setting an expectation in their outcome. Also considered the non-material equivalent of a good.

1.5. *Enterprise modelling*

Organizations need to continuously adapt to changes in the market, to be competitive. The main challenges of the current organization are global competition, fluctuations in demand, short product life also customer expectations in terms of product quality and delivery time. To meet these needs requires knowledge of the organization in all its aspects, hence the importance of role models, because these are an external representation and an explicit part of reality, they can be used to understand, modify, manage and control part of that reality. [10]

Modelling the organization helps represent flows, trends, embedded features, and processes of individual monitoring. Modelling is a technique for representing and understanding the structure and organizational behaviour, analysis of business processes and support process reengineering. Currently there are several tools available for modelling a system, they are able to model many different aspects of a system at various levels of detail, and these

can be classified into two types of structural and dynamic modelling.

1.5.1. Structural Modelling

Structural or static models usually depict possible objects flow paths through a system. This information is very useful to determine what elements are involved in the process and the functions performed by the system-das [11].Static models represent structures that do not provide the time factor. This includes modelling organizational structures of the companies information such as forms or modelling of relationships between business objects [12]. Some of the structural modelling tools studied for possible use in the execution of this project were IDEFØ, UML, BPMN and GANTT chart.

1.5.2. Dynamic Model

Dynamic Representations systems attempt to capture and describe the system behaviour over time under various operating conditions. Dynamic models can be used iteratively to study the behaviour of the system under different operating conditions[11].In addition, provide the analysis of alternative process scenarios through simulation by providing quantitative process metrics such as cost , the cycle time, service and resource utilization. These metrics are the basis for evaluating alternatives and selecting the most promising scenario for implementation[13]. All types of models that represent a process flow (such as event-driven, process chains or value chain diagrams) are types of dynamic models [12]. Some of the dynamic modelling tools studied for possible use in the execution of this project were IDEF 3 RAD, Petri Nets and Petri Nets Petri Net Workflow or WF Net.

2. METODOLOGY

For a proper development of the project and considering that is mainly based on the development of business process modelling metrology lab, you must have a methodology that will facilitate implementation of the target. This methodology consists in the knowledge of the case study, the collection and analysis of information later to make the modelling, then made the process is described in detail.

2.1. Study case

Metrology is involved in many areas of daily living, although for many people this is not noticeable, it becomes really important when the measurement process is vital in any type of business transaction in military applied-in the field of health , in the production of medicines or food, and particularly, in the quality testing, etc. Without metrology, would be impossible to verify the quality of products or processes, defined in international standards. Hence the importance of this and the studies being done about it. Some of these studies are related-dos with the design of laboratories to provide service calibration and measurement equipment meet the requirements to be accredited internationally [14]. Others describe the requirements you must meet in order to be an accredited laboratory[15], the current state of the metrology in different countries and international corporations that govern them[16].

2.1.1. C.E.O. MetrologyLab

The Metrology Laboratory is an organization dedicated to provide services to electricity meter calibration, belongs to management control and energy, specifically the leadership of innovation and development of the company. They are currently seeking accreditation by the Colombian technical standard NTC-ISO / IEC 17025 General requirements for the competence of testing laboratories and calibration[17]; why this project seeks to strengthen the laboratory through the modelling business processes, operational processes on time; I supplemented with other degree work focused on management processes work up a final diagnostic laboratory business processes, not as a result because evidence is not part of the scope of this project.

2.2. Data collecting

For modelling is essential to carry out a process of data collection in a planned manner and with clear objectives on the level and depth of information to be collected. Therefore it is necessary to know the techniques and existing information collection that is best suited to the project.

Taking into account the information needs PUE-den make three closely related activities: the first refers to the selection of the measuring instruments and / or data collection techniques; the second relates to the implementation of these instruments and the third concerns the preparation or encoding of information obtained in search of easier analysis [18].With this can set the types of information that exist and the data collection instruments that have.

2.2.1. Primary data

Primary data is data that the researcher collected directly through immediate contact with its object of analysis[18].This type of information has different collection instruments such as the questionnaire survey, signing, testing, observation and the interview. For this work the interview and observations were implemented, the first by its flexibility that allows to capture a wide spectrum of issues and the interaction between the interviewer and interviewee. And the observations in order to ensure that the information gained from the interview match the procedure performed in the modelling process.

2.2.2. Secondary data

Secondary data is data that the researcher collected from research done previously with different purposes, is acquired from existing documentation. For this case was obtained from standards, processes, procedures, instructions, manuals, records and formats provided by the laboratory, this was the biggest source of information with which a general framework of the operation of the laboratory was performed to structure the interviews and properly address each form.

2.2.3. Data collecting process at the Lab

In order to succeed in gathering information and taking into account the type of information, techniques of data collection and arrangement of the metrology laboratory of the company, a first process corresponding to the reading and analysis was performed documentation provided by the laboratory, this being the basis for understanding the structure, dynamics and functioning of the laboratory. Departing from prior knowledge, interviews raised for more information on the process because these allow you to have firsthand information, in addition to resolving doubts or questions that have not been included in previously raised. The data collection scheme can be seen in figure 1

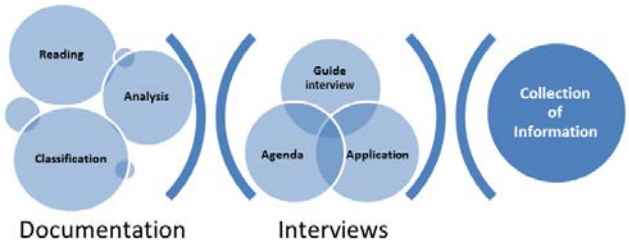

Fig.1. Collecting process at the company lab Scheme

A scheme of general and specific questions according to each process was raised for interviewing employees about the activities undertaken by them after this people interviewed were defined and the respective time used to it; interviewees were chosen such that they were the people who had more knowledge and management process executed by them, so that their contribution was the most complete and reliable. Each interview was executed personally and independently (charges) as registration tool using audio recordings. Furthermore, the observation of the process in the laboratory was carried out simultaneously with the interviews to ensure the accuracy of the information given by the operators regarding the procedure performed by the same.

The information obtained is collected in formats that were structured by the order of execution of the activities where the receiving and sending of information and objects with their respective vendor and customer is emphasized, along with the resources necessary to perform the function. Table 1 shows the format used for the collection of information, confidentiality clauses can't be displayed for this work the information in the format.

Table1. Data collecting format

Charge	Activities	Sending data	Client	Collected data	provider	Resources
Observations:						

2.3. Data Analysis

Once done the documentation process in the metrology laboratory of the company, proceeded to define and identify different business processes that interact with each other to meet the goals of the laboratory and which differ from management processes through development of the value chain adopted for the laboratory, allowing thus limiting processes modelling for this studycase.

2.3.1. Value chain in the Laboratory of the company

Given that the activity performed by the metrology laboratory is providing the calibration service energy meters and has a production process in which the final product is the calibration report, integration of activities is sought and / or attributes of two value chains so as to satisfy the needs and represent the behavior and nature of the laboratory, the value chain for manufacturing Porter primary links and links in support of the value chain of services is selected [9], resulting in figure 2.

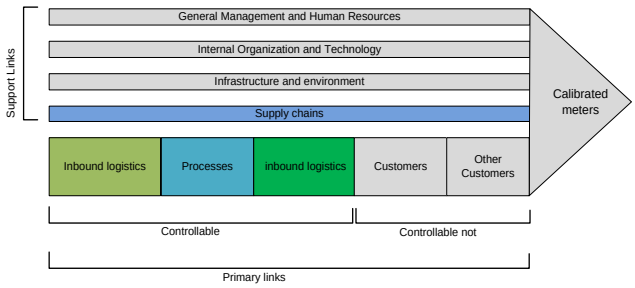

Fig.2. Value chain of the Laboratory

For the laboratory value chain applied to operational processes, supply chains, inbound logistics, outbound logistics processes and the value chain adapted in Figure 2 were taken, others are outside the scope of the project. Each of the selected link was assigned the laboratory processes corresponding to it, the result being chain of Figure 3; supply links and inbound logistics activities is receiving processes in the link processes are processes for external verification and initial commissioning, calibration and sealing internal verification, and issuance of certificates, finally the link inbound logistics activities have clearance process.

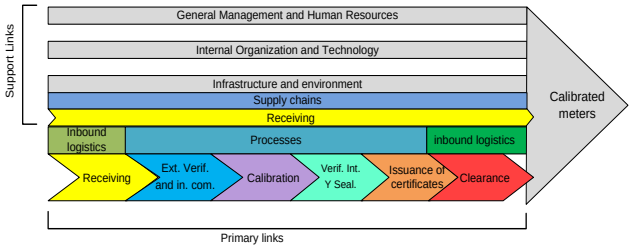

Fig.3. Value chain of the Laboratory

Table 2. Characteristics of modelling tools

Goals and objectives of modelling	**Modelling techniques Requirement**
Human understanding support and communication	Comprehensibility and communicability
Processimprovementsupport	Reusability, measurement, comparability, selection and incorporation of technological support, support changing processes
Processmanagingsupport	Reasoning, prediction, measurement, monitoring, management and coordination
Processdevelopmentsupport	Integration with development environments, support for process documentation, reusability
Execution of processsupport	Automation of process tasks, automation of performance measures

The major changes undergone by the tool in its adaptation for use in utilities, lie in the organization of the primary links, which appear absolutely redefined while showing an additional classification in relation to its controllability.

The links of support are modified with respect to the original proposal, hold function contribute to the assembly stage which will take place in the service, ensuring the establishment of the best possible conditions.

2.4. Selection of modelling tools

By a conceptual review of the existing tools for the project execution modelling the large number of options are for modelling business processes evident; with knowledge of its characteristics can be identified that differ in their scope and capacity of representation. Also there is no definitive solution or a universal tool that meets all of the features required in modelling. The purpose of the selection is not to find the ultimate tool, but the most appropriate for the needs of modelling case study.Given that business process models can be used to perform diagnostics on the current state of the organization, supporting decision making towards improving the same, perform engineering and / or process engineering, design and development information systems; the purpose for which the modelling is performed significantly affects requirements or specifications to be met modelling.

Based on the corresponding requirements to common objectives modelling Curtis [19] that can be seen in Table 2, and the study of the most important features of modelling tools as the goal of modelling, criteria were defined selection, which are described below.

If an analysis of each of the requirements modelling techniques according to the goal modelling with the most relevant features of each tool, the following criteria for the selection of modelling techniques were identified:

- *Human understanding support:*
  - **Standardization (1):** defines the strictly graphical language used in the modelling process. The phases of analysis and graphic symbols make the modelling process is standard andconcise.
  - **Representation (2):** simple and intuitive graphical representation, easy to understand.
  - **Support for documentation (3):**this criteria refers to the ability to record the relevant intraining formula two models in formats for the transmission of in-formation and storage of the same.

- *Processimprovementsupport*:
  - **Expressivity(4):**ability to modelthe complexity ofbusiness processesbothin behaviourand inallocatingresources, determining roles, disjoint parallel execution activities, among others.
  - **Information (5):** Allows represent the interaction between the processes by information flows.

- *Process management Support:*
  - **Roles (6):** Allows representation of the roles involved in the process.
  - **Hierarchy (7):** Allows hierarchical models which can analyse a global process, thread and activities.
  - **Specifications of resources (8):** clearly states the use of resources within the modelled business processes and their states, the representation of roles and assignments.

- *Processdevelopmentsupport*:

- **Evolution (9**): View the evolution of the process over time.
- **Software (10):** There is different software for modelling with the tool.

- *Execution of processsupport*
  - **Sequence (11):**Patterns of activation tasks after the execution of a previous work, in the same process.

2.4.1. Assessment criteria and choice of modelling tools

Based on the definition of the evaluation criteria of modelling tools and knowledge of the characteristics of these Table 3, which describes a checklist of compliance to a greater or lesser degree the criteria for each of the tools set and thereby taking:
The "X" represents the performance in greater criteria from one of the tools, the absence of "X", that is, the blank represents compliance lesser extent or no criteria by a tools.

Table 3.Characteristics of modelling tools**.**

Tool	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*
Dynamicmodelling											
WF-Net	*X*	*X*	*X*	*X*		*X*	*X*		*X*	*X*	*X*
UML	*X*		*X*	*X*		*X*	*X*	*X*	*X*	*X*	*X*
RAD		*X*		*X*		*X*				*X*	
IDEF 3	*X*	*X*		*X*			*X*	*X*		*X*	*X*
Structuralmodelling											
BPMN	*X*	*X*								*X*	*X*
IDEF 0	*X*	*X*	*X*		*X*		*X*	*X*		*X*	
UML	*X*		*X*	*X*		*X*	*X*	*X*	*X*	*X*	*X*
D. GANTT		*X*		*X*					*X*	*X*	*X*

Table 3. Shows a summary of the advantages of each modelling languages both structural and dynamic and can rule quickly tools that meet less selection criteria. With this WF-Net and UML and IDEF0 are for dynamic structural modelling and UML modelling. Given that the most important criteria for this project are representation (2), information (5) and roles (6) the selection of tools is concluded because UML does not meet two of these criteria as IDEF0 and WF-Net to meet the three complemented.

Therefore selected for modelling business processes in the Metrology Laboratory Company IDEF0 modelling tools are structural and WF-Net for dynamic modelling. WF-Net also has advantages such as the ability to analyze business processes through simulation, validation and verification of the models[20]. Also, both IDEF0 as WF-Net have a simple but precise language, allowing a strategic view of a process, facilitating analysis for the identification of areas or improving processes and complemented for dynamic modelling and structural modelling, among others.The following describes in greater detail each.

3. RESULTS

Taking all the information gathered and organized lab proceeded to perform the modelling of business processes, which are divided into structural and dynamic modelling, to identify these different characteristics of the process and are below.

3.1. *Structuralmodelling*

3.1.1. Chosen Structural modelling technique: IDEFØ

IDEFØ is a modelling technique to represent hierarchically structured and the activities that make up a system or company and the objects or data supporting the interaction of these activities. This modelling is a series of hierarchical diagrams with texts and cross references between them which are represented by rectangles or a series of boxes and arrows. One of the most important aspects is that as IDEFØ modelling concept is gradually introducing more and more levels of detail through the model structure[21]. Thus, communication occurs giving the reader a well-defined amount of detailed information available to deepen the model with such a degree of abstraction that allows the analysis of the system for re-structuring and re-engineering subject.

3.1.2. Layout and components IDEFØ

Modelling IDEFØ diagrammed through boxes and arows, each box contains a function or activity and each arrow indicates a control mechanism, an input or output activity, Figure 4.

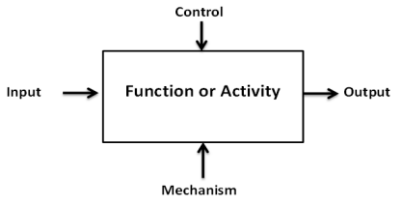

Fig.4. Representation of an activity

With the information obtained from the interviews it was possible to identify the input and output of each process, with which structural models that allow a global view of the process is performed, the figure show Diagram A-0, this is see the input, output, and controls the mechanisms that influence business process metrology laboratory of the company.
In structural modelling lab can identify the correspondence of information that enters the overall process and the information you need each of the processes involved. The red lines represent a control input and a mechanism

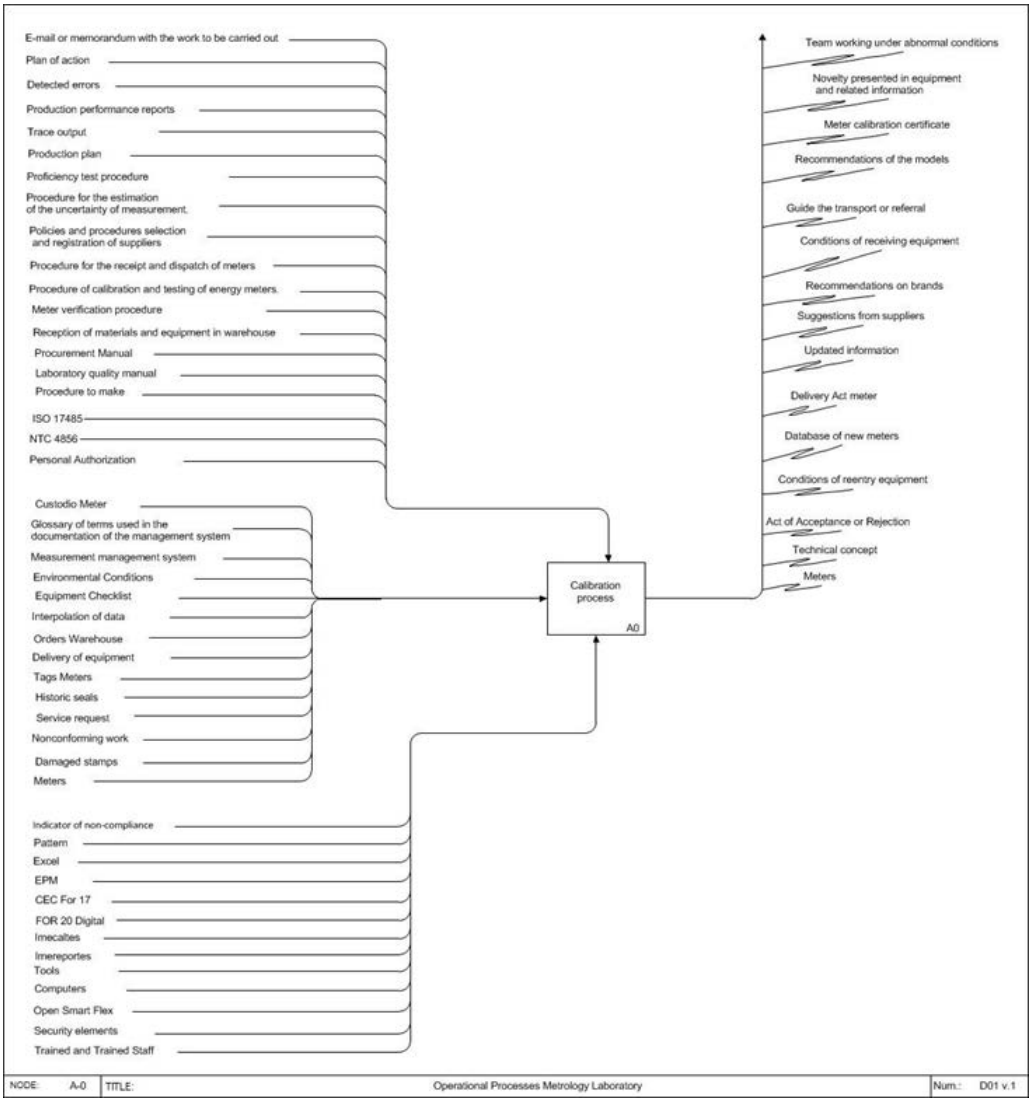

Fig.5. Metrology Lab Diagram in IDEF A-0

which can be seen in Figure 5 hence the importance of structural modelling, which will allow the laboratory to identify if you have redundant information or information that is not needed in the process. Also you can see the relationship of input to each process of laboratory activities that take place there.

Identifying information generated in each workstation, which allows the performance of the models and the identification of roles: as a result of structural modelling of business processes of the company Lab-test two important raps that are found and actors involved in each of these. And the identification of the data content of the exchanged information that helps identify more and less relevant data in the process; define these data exchanged improve the response time of the process is avoided because lead to information and unnecessary information is removed.

3.2. Dynamic modelling

3.2.1. Chosen dynamic modelling technique: WorkFlow Nets

Petri Nets are a modelling tool that allows the study of systems with a mathematical representation. Analysis of the Petri net can then reveal important information about the structure and dynamic behaviour of the modelled system. This information can be used to evaluate the modelled system and suggest improvements or changes. Therefore, the development of a theory of Petri nets is based on the application of Petri nets in modelling and systems design.

A Petri net modelling a Workflow process definition is called a WorkFlow net (WF-Net), it satisfies two requirements: firstly, the WF-Net is a place of entry that corresponds to a case that needs to be managed and a place corresponding to a case that has already been run

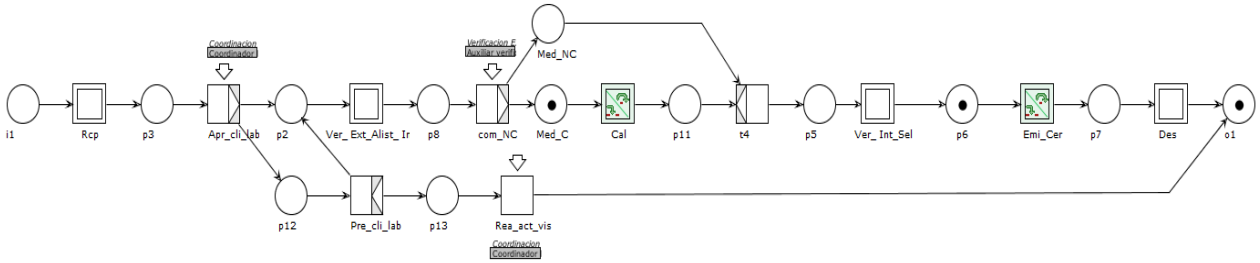

Fig.6. WF-Net of the process at the company Lab

out. Therefore, each of the transitions of the network must be located in a path from place to place. Secondly, the following requirement corresponds to a strong relatioship if you are related via an additional transition (transition feedback).

Definition of WF-Net: A nets of Petri $PN = (P,T,F)$ is a WF-Net, yes or yes:

- PN has two special places: $i$and$o$. The place i is a source place: $\bullet i = \emptyset$ and the place $o$is an outcome place: $o \bullet = \emptyset$
- If we add a transition $t*$ a PN that connects place o with i it means, $t* \bullet = \{i\}$), then the Petri nets resulting is strongly related.

At WF-Net the places in the P Set, correspond to the conditions and transitions in the set T correspond to the tasks that make up the case of the WorkFlow. Flagging a WF-Net is responsible for representing the state of WorkFlow a simple case, in which the state contains the information for each case.

Dynamic modelling was performed in WOPED (WorkFlow Petri Net Designer), open source software developed under the LGPL license, it's a simple modelling tool that allows you to use modelling Workflow Petri Nets[22], it is necessary to develop this project characteristics.
IDEF0 models with information flows identified WF-Net now allows the evolution of the process, potential "bottlenecks" and activities that can stop the process. In Figure 8, the overall process is shown in the laboratory and as is the trend over time, the circles are the conditions which identifies what state the process, the activated tokens processes and activities, for example the token in the activated condition P6 Med_C and the process of Cal and April respectively (figure 6), also indicates that the process finished before finally the token indicates that o1 has completed the calibration process for one or more meters. It is the same figure can be viewed each of the processes carried out for calibration of meters, each related to its structural modelling, these processes are welcome (Rcp), external verification and initial enlistment (Ver_Ext_Alist_Ini), calibration (cal) verification and sealing internal (Ver_int_sel) Issuance of certificates (Emi_Cer) and clearance (Des). There are also activities related to the client's presence in the laboratory, which are performed by the lab coordinator.

The hierarchy of the WF-Net modelling allows you to view each process as a set of activities and tasks, this feature allows you to reach the basic tasks of each process and thus break down the process to discuss possible improvements activity by activity. In Figure 7 the activities of the certificate generation and actors who perform are shown, which in this case is the auxiliary emission.
In the generation of certificates involved the participant named as Assistant certificate issuance, it performs tasks such as check notifications (Rev_not), which involves reviewing the notification mails arriving from other areas to report an error in the process.
As a result of the dynamic modelling of business processes of the company Laboratory found an important contribution is the definition of roles and actors in the operational process of the laboratory, human talent being the most important resource of the organization to develop its business value it is necessary to know how to administer adequately. Each role defines the various potential competencies that exist in a system. Are defined independent

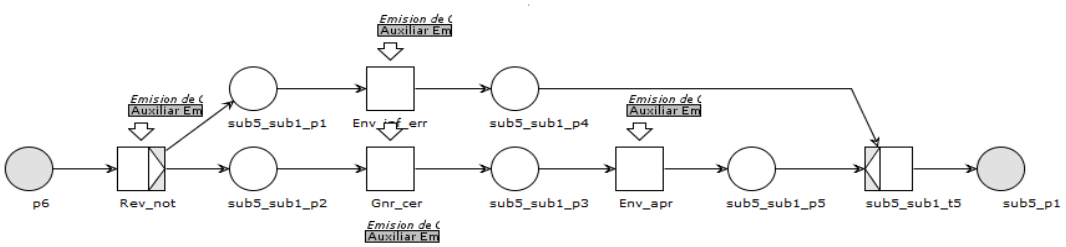

Fig.7. WF-Net certificates generation of metrology laboratory of the company.

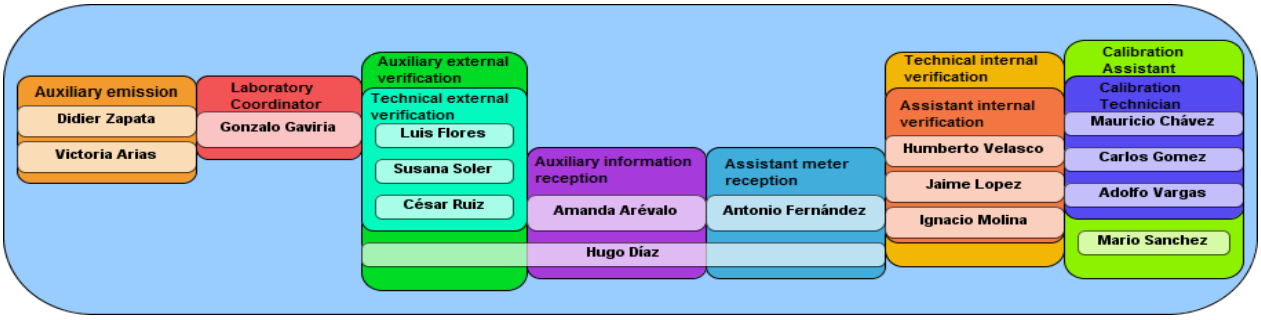

Fig.8. Rolsand participants in business processes Metrology Laboratory of the company.

ly of individuals to whom they are going to allocate those roles. A person can have more than one role, a role being a set of characteristics of an actor. For people actors, a role can refer to specific skills, responsibilities or authority it possesses.[23]

One of the advantages offered by the modelling is to see the condition and operation of a system and identifying the resources needed to develop their activities and tasks, thereby defining the roles based on dynamic modelling activities. The roles identified for the metrology laboratory in the area of operational processes are shown in Figure 8.

4. CONCLUSIONS

- The metrology laboratory of the company provides a service meter calibration consisting of manufacturing operations to generate an intangible product, which is necessary to adequately represent their processes, an adaptation of the manufacturing value chain proposed by Porter and services value chain, resulting in a new value chain for the lab.
- There exists a large number of tools and dynamic structural modelling, that the objective and modelling features required fit, so they are useful for modelling any type of system, but it should make an assessment of criteria to select the best suited and provide considerable advantages in modelling performed.
- Structural and dynamic models in the laboratory show different aspects of the process, while the structural modelling laboratory sample making, dynamic displays as it does, so complement to have a clearer picture of the activities performed and the current situation in which is located. This helps to get a better perspective of the processing performed within the organization and thus identify potential process improvements.
- The structural modelling helps to identify information flows in the laboratory which help in decision-making at the time of any change in the processes performed, because they helped identify the contents of data relevant to the laboratory.
- Dynamic modelling contributes to the definition of roles within the organization because it activities at every stage of the process is displayed and thus grouping is possible to generate a specific role to set the tasks to be fulfilled by every actor, providing support for proposed improvement plans and the incorporation of new personnel, among others.
- The data collection process is important to identify timely, vital for decision-making, as in the case of tools used in the exchange of laboratory information obtained from the interview process.

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Learning Curves for Small Hydropower in Colombia

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Abstract

Small hydro has played a role in the Colombian electric sector since 1900.Hydropower is a mature technology, and further cost reductions are expected to be less significant that some other REs. Even so, small hydro presents opportunities to make projects technically feasible in a wider range of locations and to improve the technical performance of new and existing projects (IEA, 2013). A proper analysis of different drivers for small hydro in Colombia is needed (learning, economies of scale, R&D, incentives, etc.). In particular, it is relevant given the growing interest for new investments in the country, and the attraction of the technology to supply electricity to non-connected (and very poor) areas. In this paper we investigate the prospects for small hydropower (SHP) in Colombia, based on a cost analysis of past activities for the deployment of this technology. A cost analysis based on economies of scale and learning curves is presented, and resulting polices for investment in new capacities are recommended.

Information about the installed plants since 1900 to present was gathered in order to analyze the evolution of SHP. We have adopted the definition of Colombian Mining and Energy Planning Unit (UPME), which considers an Installed Capacity (IC) less than or equal to 20 MW (UPME, 2005); moreover, we have classified the SHP into three further categories according to the size of the installed capacity, as Micro centrals (IC<0,1MW), Mini centrals (0,1< IC≤1MW), and Small centrals (1< IC≤20MW).

We have built the database for the analysis of the evolution of SHP. Different sources were consulted, such as historical files of governmental SHP programs, history of private electricity generator companies, thesis, technical reports for expansion planning of the power sector, interviews with experts, and other studies about SHPs in Colombia. The built data base SHPs, contains information about construction year, installed capacity, location and current state. Furthermore, information about investment costs for different SHP since 1900 to 2013 was also collected into the data base. With the

yearly Installed Capacity (IC), a Cumulative Capacity (CC) curve was built by adding the capacity of new plants to the value of the previous year.

Typically, the investment costs for SHP in developing countries vary between 1000 and 8000 USD/kW; however, given specific conditions of each plant, it is common to find values outside of that range (IRENA, 2012). For Colombia, all the gathered data varies in this expected interval (900 – 9400 USD/kW), with very few outliers for non-connected areas. The data was discriminated into: *Total Costs, Equipment Costs, Infrastructure Costs, and Other Costs.* The analysis included Economies-of-Scale (EOS) and Learning-by-Doing (LBD). With the data characterization, we were able to observe some tendencies with the magnitude of installed capacity. For this reason, EOS effects were corrected before the LBD analysis, since costs reductions over time could result on EOS, instead of LBD. Other costs were excluded from the analysis given that we assume that the elements considered as *other* does not present neither learning nor are affected by EOS.

For the EOS correction, a scale parameter was calculated based on collected data and other studies. On one hand, this correction showed that it is not possible to exploring EOS and LBD in total, as these can aggregate information. On the other hand, the corrected infrastructure costs remained constant over time, which suggests that costs reductions on infrastructure are related to EOS, rather than learning. Thus, LBD analysis was performed only for equipment costs.

With the cumulative capacities and the corrected costs for each capacity category, an estimation of a learning rate (LR) was carried out using standard OLS method. Additionally, a sensitivity analysis for the scale parameter was performed. The results for these estimations show that, for all capacities, a LR between 13% – 18% was observed, however, the R^2 was lower than 0.3; thus, the existence of learning for SHP in general cannot be confirmed for the Colombian case. Still, an analysis by categories was performed. Learning curves for mini and small plants were obtained with a reasonable adjustment (R^2>0.7) and learning rates of 21±0.5% and 24±3% respectively. Although SHPs are a mature technology, which has existed for more than 100 years in Colombia, the results suggest that, so far, there is a learning phenomenon. This learning has produced a reduction about 21-24% in installation costs, when doubled the IC. For micro plants, the CC is still too small, and the data points are very close in the log-log scale, that it was not possible to build a statistically significant learning curve.

Even though extrapolation into the future is uncertain, a future costs reduction can be expected in the short term, as a result of innovation in the design of turbines, control systems, etc. This results are similar to the LR reported by other renewable energy studies, with typical findings around 20% for most technologies (IEA/OECD, 2000; Lindman & Söderholm, 2012; McDonald & Schrattenholzer, 2001; Schoots et al, 2010); however, our results differ from the large hydro rates, with reported values around 4% (Jamasb & Köhler, 2007). The sensitivity analysis performed for the scale parameter showed no significant changes in the R^2, and small variations in learning rates. In this sense, the assumed value for the scale parameter does not affect the final conclusion about the existence of a learning phenomenon.

Our findings suggest that both private sector and the government should focus on investing mini and small plants, because they can take advantage of EOS, and costs are expected to decrease in the future, as a result of a learning process. Installation of micro centrals started after 1980. Most of these plants were built by the IPSE for electrification of non-connected areas. The rest of the micro plants are individual installations for supplying small farms, hotels, etc. On one hand, owners should join with their neighbors to exploit the EOS, and investing in larger plants that can electrify, for example,

a group of farms. On the other hand, for the electrification of non-connected areas, government should focus on bigger scales.

Keywords

Hydropower, Investment Costs, Learning Curves, Renewable Energy, Climate Policy.

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Complexity, Sustainability and Self-Organisation

Asset Transfer Pricing Models and their role: A Decision Framework from Complexity Economics and Systems Theory

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Asset Transfer Pricing Models ("ATPMs") are the discrete processes that presage the acquisition of assets comprising: a comparative model valuing current and prospective assets accompanied by a "due-diligence" process that sources the data and the influences surrounding the target investment for the model parameters. Criticism of the embedded models within ATPMs and a lack of proper governance structures were blamed for what is now termed "the Credit Crisis 2008" ("2008"), an economic "bubble" of unprecedented size. Though Rogoff (Reinhart and Rogoff 2009) shows such "bubbles" are more frequent than priced for in traditional ATPMs and the collective effects of ATPMs can even be seen in Mandeville's 1723 "Private Vices-Public Virtues" it is only post 2008 that the fragility of an intensely networked and global capital structure was exposed. Grounded in a Newtonian framework of universal laws and time current ATPMs are shown to be unresponsive to rapid changes in market activity and regulatory influences that affect the initial commercial strategies and their expected financial outcomes. It is also shown that, whereas "the Enlightenment" spawned a deterministic "Newtonian" commercial framework following the rapid social changes post the UK's "Glorious Revolution (1688)" and the 1787 establishment of the US Constitution with its Commerce Clause, the reaction to its universal laws and time in the Romantic Period developed a more probabilistic and recursive framework. By shifting the underlying conceptual framework to a Complexity approach, as defined by W Brian Arthur(Arthur 2013), it is believed that the current collective mispricing may be overcome by taking into account the dynamic structure of a relativistic recursive commercial eco-system. Such a framework offers a dynamic commercial state-space wherein a changing network topology continuously alters the structural and temporal properties of

financial models. To accompany such a framework an enhanced “due-diligence” process is required to capture the additional data. Drawing upon General System and Complexity Theories a dynamic recursive commercial structure is derived whose changing strategic and temporal properties can be included within existing Key Performance Indicators (“KPIs”) themselves derived from standard financial metrics. Stafford Beer’s Viable System Model (“VSM”) offered the most developed set of alternate commercial models and performance metrics using a recursive heterarchical governance structure. Its typology of roles, use of a Gödelian governance language and Information Theory offered a dynamic commercial state-space where user-defined KPIs can be analysed probabilistically. The VSM also provided a method to test for critical endogenous governance failures within commercial structures that did not meet its full rigour but were successful nonetheless. However whilst the VSM accounted for adaption to exogenous events it did not offer an anticipatory method. To accommodate this Systems Dynamics, Network Theory and Agent-Based Models are used to analyse: the embedded processes and communication networks; the changing internal and external topologies; and possible behaviour of agents. To evidence the VSM’s commercial application in a recursive commercial eco-system two examples of Beer’s own development from cybernetic first principles and practical application were selected: a national infrastructure and a US Global Bank. A Gedankenexperiment, Thought Experiment (“TE”), was then designed to integrate the above into a heuristic model labeled GHOST: General Heuristic On Systems and Time. GHOST can be considered a *meta*-ATPM embodying existing financial models modified to produce a dynamic commercial state-space with relative timeframes for each system yet sensitive to the same commercial strategic objectives including their ethical/religious considerations. GHOST employs an expanded “due-diligence” process to construct the appropriate recursive governance/influence structure and acquire the necessary data. To explore GHOST more extensively a cross-case analysis is performed comparing four possible applications of a Standby Capital product designed to use GHOST’s strategic asset pricing approach. GHOST prices the potential transfer of assets by first outlining the criteria required: a network of cooperating or competing commercial agents (“Agents”) connected by a set of operational parameters; a benchmark of the

viability structure for the agent to its VSM ideal; the position of the Agent in a recursive influence framework; and how the structural and temporal dynamics of the resultant commercial eco-system may affect the strategic direction and financial outcomes. This asset pricing process develops an expected value that is then dynamically monitored to anticipate strategic changes in individual and portfolio asset prices as well as highlighting breakdowns in the recursive structure. The latter considered important in their ability to amplify acceptable localised commercial "bubbles" and may indicate a potential systemic collapse. Individual expectations are established relative to, and the collective affects of ATPMs are captured within, the layers of a recursive commercial eco-system. The advantages and disadvantages of GHOST were discussed highlighting the need to move from a deterministic framework to a probabilistic commercial state-space that would require a capital cost. Though current analytical tools are available in all the fields employed and on-going research by others shows promise in understanding how changing properties of commercial networks modify financial parameters more work needs to be done to show how these integrate with the agent-based models that determine possible behaviourial trends. Like all TEs empirical testing is necessary and the recursive frameworks will be required in order to establish the influence network. Though this has begun through Beer's initial work there is a need to highlight the benefits of variety management within commercial institutions. Upon reflection GHOST highlighted the importance of correctly framing: the governance system to accommodate the unknown by setting principle-based rather than rule-based languages; models in a relative temporal rather than deterministic framework; and that performance is as much about structural governance and variety management as a cost/benefit analysis. The boundary between Network Theory, Agent-Based Models and ATPMs is very fluid in terms of developing research and may overtake GHOST however the application of state-change and temporal effects on financial KPI's is not in the practical domain and GHOST offers a vector in research to provide them.

Complex Learning, Leadership, and Flow.

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Abstract

This paper focused on describing an educational and leadership system, as the complex system on terms of balance between change and order. In this context, we explored how the interaction is in the teaching-learning process in a particular context, which results in more complex dynamics. The elements that can be promoted for complex learning and leadership are the student-oriented scope, teachers as facilitators, heterarchical topologies and communication skills. The useful of these elements are manifold and they could obtain better results when the flow state is reached. This approach tries to find some alternative paradigms in education and an advance in overcoming the traditional scientific reductionism.

Keywords

Educational Systems, Teaching-Learning Process, Human development, Emergence, Self-organization, Flow Theory.

Introduction

Educational and leadership systems are determined by the interactions and interdependence of their elements which partly define the future of the system. In such a complex system, the isolated study of the components is not sufficient to describe the system's dynamics (Gershenson & Fernández 2012). Its complexity is the result of the balance between its creative emergence (adaptability) and self-organization (stability). The system's scope for self-determination or autonomy can be estimated by comparing its internal complexity with that of its environment (Fernández et al. 2014).

In the education sector, particularly in universities, education has become technically more sophisticated. That means that the amount of data, technical and scientific information have the most important role, as opposed to building personal skills for individual and social development. The result is only instruction, not formation. In this sense, education does not promote the balance between technical contents and human development. As a consequence, we are observing a crisis of values and principles. There are many university graduates concerned only with their success which is based on money and pleasure, lacking values. The social crisis is expressed in unhappiness. Even when people achieve success they do not feel complete happiness, because people always want more. This is in part caused by our instructional models which do not promote the equilibrium, the flow, the gratification, and the spirituality in students.

Teachers as leaders must have a high complexity to build a more appropriate formation and attend students with diverse cognitive conditions (Gershenson 2014). In consequence, the introduction of changes for improving the knowledge and pedagogical skills in teachers promote an effective formation, which are welcome. Related issues are: pair learning, teachers as facilitators, and the promotion of balances such as cognitive-emotional, rational-emotional, cognitive-formative, skills-knowledge and individual-civic education, decision-action, personal-social interests, and guidance-autonomy.

The aim of this work is to present a complex system approach for educational and leadership systems. We inspected the processes that generate the adequate balance to achieve a more efficient learning and leadership. First we hypothesize that learning will be more efficient when there is a high complexity, resulting from the balance between skills and challenges. At the same time, leaders will become more efficient when there is a balance between the emotional and the rational parts of the brain. Our hypothesis is related with Flow Theory (Csikszentmihalyi, 1997), which can be measured in terms of information as proposed by Fernández et al. (2014) and Gershenson & Fernández (2012), offering alternative paradigms for education.

In the next section, we describe an educational and leadership system from the complex approach. Section two presents the elements of complexity, flow and leadership as balance. Section three discusses the elements for the promotion of the above elements. Section four mentions some learning lessons. Finally some remarks conclude the paper.

1. Educational and Leadership Systems (ELS) from Complexity Approach

1.2. ELS as Complex Systems

We can describe an Educational and Leadership Systems (ELS) as a complex system because they are highly interconnected and determined by the interactions and interdependence of their elements. Besides teachers and students, there are other structural and interacting components learning-teaching processes such as: (i) the diversity and differential abilities and attitudes of the students; (ii) the leadership of the teacher and how they promote it the students: (iii) the instructional factors and methods of learning-teaching; and (iv) the context, among others.

Relevant interactions between the mentioned elements generate novel information that partly determine the future of the system and its complex behaviour. Novel information limits predictability since it is not included in initial or boundary conditions. For example, the predictability for one or another instructional strategy can be limited. The interactions among elements of ELS, as the result of the implementation of the strategy produces new properties-experiences for the students- that derived in more or less students' engagement. This new emergent properties are not in the components but determine new conditions in the system. If students and teachers enjoy the new experience, they are intrinsically rewarding and seek to replicate it. These conditions introduce a selective mechanism into psychological functioning that changes the initial conditions of the ELS.

Also, interactions could be used by components to self-organize. If the interactions among students are promoted, the processes of learning will be more distributed. Thus, the process of learning could take place among school partners; teachers work as facilitators, and the control of the instructional will be shared. Opposite to the standard linear instruction and the teacher-controlled learning. By this way, we could observe the production of different global patterns from the local dynamics.

ELS have the possibility of showing states of extreme change (high emergence) or extreme order (high self-organization). However, the balance between change (chaos) and order (stability) provide to ELS of complexity. Complexity has been defined as a balance between emergence and self-organization and can be measured in terms of information. In this sense, chaotic ELS are more emergent and provide more information. On the other hand, stable ELS are more self-organized and produce less information.

As proposed by Gershenson & Fernández (2012) and Fernández et al. (2014), emergence, self-organization, and complexity could be measured in terms of information.

1.3. Characterization of ELS as Agent Network

Since ELS are highly interconnected systems, we can define them as a network of agents (Fernández, Aguilar, Gershenson, et al. 2012; Fernández, Aguilar & Terán 2012). This network has a structure $S = \{Ag, R\}$, where Ag is the agents and R their relations. Agents correspond to teachers, students, councillors, parents, friends, fans, followers and anyone that is involved in the teaching-learning activity. Relations correspond wiht the reasons of the connectedness among agents like friendship, collaboration, sharing of information and membership.

S defines the topology of the ELS network, and the interactions in the network (who is connected with whom) represented by links that could have directions, weights or signs.

Dynamics concerns with how the state of agents and their relationships changes in time, by which network expresses a particular behaviour. This conduct involves how the individual actions of some agents have consequences for the state and the outcomes of every agent in ELS. It implicates how some conditions, i.e. incentives, guide agents to achieve their goals or good outcomes.

According to Easley & Kleinberg (2010), there are other important characteristics in social networks like diversity, homophile, socialization, social influence, and positive and negative relationships. Thus, ELS being social networks contain these characteristics.

In some ELS their particular conditions like location, scholar planning and model, may influence the composition and diversity of the agents. As a consequence of the dynamics and the behaviour, it is possible that the *homophile principle* starts at any point of the dynamics. When ELS have the greatest similarities among agents, agents tend to be similar to each other. Homophile is based on the selection which operates into the schools because agents are immerse in the same social environment.

In addition, there are two processes: socialization and social influences. In the socialization, individual's attributes (behaviours, activities, interests, beliefs, and opinions) drive the formation of agents' relationships (inverse selection). In the social influence, existing relationships help to shape agents' characteristics (mutation).

As a result of the positive and negative relationships, structural balance in the network is produced. It means that the balance among friendship, partnership and hostile relations (controversy, disagreement, bullying and outright conflict), emerge from both positive and negative relationships in the ELS.

1.4. Elements for ELS description as Complex Network

Agents' diversity could be measured directly as the number of different types of agents, based on characteristics like race, gender, education, discipline or any particular competence taken into account.

In addition, a model that describes another aspect of the agents' diversity is the Margalef index (d) (Margalef 1958). For ELS d is estimated by the following formula:

$$d = \frac{Ag-1}{ln\ N}$$

Where Ag is the number of different agents, according to the characteristic selected. N is the total number of Ag in ELS. The subtraction of 1 is a correction factor that allows d to be equal to zero.

In socialization and social influence, ELS could be characterized depending on the individual attributes of Ag. In this sense, González-Avella et al. (2005) and Gonzalez-Avella et al. (2006) considered two premises about cultural similarity that emerges from the agents' interactions: (i) the probability of the interactions among individuals which is proportional to the number of the cultural attributes they share (a mechanism of homophile generation). (ii): The interactions that increase the cultural similarity. The increasing is due to the adaptation of the agents to the social influence.

On the previous base, an agent can be described in terms of its cultural attributes. Thus, a cultural vector for each agent (Cv_i) is defined as:

$$Cv_i = (\sigma_{i1}, \sigma_{i2}, \ldots, \sigma_{if,\ldots,}\sigma_{iF})$$

Hence:

F = Number of cultural attributes
q = Characteristics of attributes
$\sigma_{i1} \in \{0, \ldots, q-1\}$
q^F = Number of equivalent states

An example for F=3 and q=2 is presented in table 1.

Table 1 Example of Agents' Cultural Attributes and its Binary State

F	Binary State 0	Binary State 1
Phone's operative system	IOS	Android
Abilities	Intuition	Analytics
Precedence	Capital	Province

The possible combination for the above characteristics is $q^F = 2^3 = 8$ of different cultural binary states as it is presented in the table 2.

Table 2 Cultural Binary States for Agent Attributes Representation based on González-Avella et al. (2005); Gonzalez-Avella et al. (2006)

Cv_i	q	Colour Code
1	000	
2	001	
3	010	
4	100	
5	110	
6	101	
7	011	
8	111	

Then, we calculate the interaction probability among agents (Pi) as the number of the common characteristics among agents which are divided by the number of the total attributes comparing (F). This is:

$$Pi = \frac{Ca}{F}$$

Also, an agent i could adopt a non-shared trait of another agent. This is named *local convergence* which is derived from social influence. Despite the fact its convergence, the results are the emergence of the new way of thinking in ELS.

2. Complexity, Flow and Leadership as Balance

2.2. Complexity as Balance

In the science complex systems, there are a high number of discussions about this question: ¿What does complexity mean? Since complexity comes from the Latin *plexus* (interwoven), a complex system is something difficult to separate. This occurs by the components interdependence. In a systemic way, we can say that interactions maintain the systems as a whole. For that reason, the

reductionist approach which studies the parts segregated but is not sufficient to describe the dynamics of systems.

Following Lopez-Ruiz et al. (1995), we can define complexity as the balance between change (chaos) and stability (order). Change can be represented by emergence, and order by self-organization. Emergence refers to properties of a phenomenon that is presented at one scale and is not at another scale. In terms of information, emergence is the new information that comes from the transformation of the old information. This way, emergence is expressed as Shannon information. On the other hand, self-organization is related with an increase in order meaning an entropy reduction.

As we can see emergence and self-organization are anti-correlated and the balance between both results in complexity. More information about these properties can be found Gershenson & Fernández (2012) and Fernández et al. (2014).

2.3. Flow as Balance

In nature and human development there are different kinds of balance, like cognition and flow. In general, flow is a mental state of absorptive operation in an activity. People performing the activity are fully immersed, motivated and enjoying. In this state, individuals perceive their performance as pleasure and success, as reported by creative artists and scholars when they are engaged at their best work (Csikszentmihalyi 1997).

The flowing condition in scholar environments rises as an energized state when the students focus on solving some challenges based on their skills but a balance between challenges and skills are needed. According to Csíkszentmihályi (2004), more difficult challenges could be face on progressively when the skills are enhanced from the previous challenge.

In schools, the conditions that promote the engagement and flow (Shernoff et al. 2003) are: (i) balance between the perceived challenge of the task and students skills; (ii) Relevant instruction concerned with academic work that involves meaningful inquiries to find applied solutions; and (iii) learning activities under the control of the students. It means that the instructional format should be beyond a lecture recitation and the teacher-controlled scope. For these reasons, learning activity should be addressed by student-participation.

Based on these previous conditions the attention, the interest, the motivation, and the enjoyment of learning in students arises from the flowing process. This conditions may improve the overall performance in colleges and lower the high rates of boredom, alienation, and disconnection with schooling (Csikszentmihalyi 1997).

2.4. Leadership as Balance

We consider a leader as a person who influences, empowers, guides and maximizes, in a positive way, the efforts of other people towards the achievement of a goal. An inspired person who can make a vision real and promotes self-organization.

Traditional qualities associated to a leader are. Intelligence, toughness, determination and vision. Leaders are distinguished for having a high degree of emotional intelligence, expressed in self -awareness, self -regulation, motivation, empathy, and social skills (Goleman & Sutherland 1996). Also, rationality in a leader is required. Reasoning activities give to the leader the capacity of acting independent of his emotions, feelings and instincts. The logical processes are used to establish and verify the facts based on new or existing data. The balance between the emotional and the rational parts of the brain helps others to take appropriate actions according to social rules.

As has been argued by Covey (Covey 1991; Covey 2004), internal and external development is reached when seven habits are cultured and practiced. These habits give more balance to life. Applying the first three habits an internal victory is gained. They are: (i) be proactive (no reactive, you are in charge); (ii) begin with an end in mind (focus, define a mental creation) and (iii) put the most important things first (prioritize, materialize the mental creation in a physical creation). Habits four and five are about the improvement and promotion of external interactions and collaborations for mutual benefits. Certainly, the habit four is "think win-win" and sees life as a cooperative arena with mutual benefits in all human interactions, not a competitive one. Habit five advices to inquire "first to understand, and then to be understood", which improves the communications as the most important skill in life. Listening carefully to others, helps you not to miss details from people's conversations. Habit six is "synergize" and promotes the creative cooperation by means of an open-mindedness teamwork, in order to find creative solutions to problems. Habit seven is "sharpen the saw" and seeks out for a balance program for self-renew in physical, social/emotional, mental and spiritual areas of life. This is possible by doing activities that preserve and enhance the six habits.

An internal and external balance in the leadership may transform the personal capabilities and the institution, as well.

3. Elements for Complexity, Leadership and Flow Promotion in ELS.

3.1. The New Generation and the Complexity Package

Considering the student component in ELS, we argue that a new student generation has the complexity package preinstalled. These students have more capacity for reading the context than adults, including the teachers. The new generation is naturally in connection with others, mainly because they are reflected on the present technological world. Their thinking is nonlinear, and their visual scope is higher. It is very interesting to observe, how the new generation has an increasing networking scheme and how they are interested in giving more and faster solutions for humanity. As dolphins or bats that release waves to their environment, the new generation releases messages to the context which others detect, then a synergistic and stigmergistic networking dynamics starts. In this way, the new generation conforms large communities as twitter and follows more groups with similar interests, than to specific leaders. This is the result of their perception, context interpretation and networking approach, where the feedback of a multiple vision is shared. In the environment, they practice the hetero and auto-referentiation (autopoiesis mechanism).

The social responsibility of the new generation is "to see and feel the other", a new solution to social problems. When they see and feel the other, corruption does not work, especially because they are conscious about their actions which may hurt others. They understand all causes and effects of their behaviour. This vision contrast with the existing view that only promotes the self. If politics could feel the other, its policies would be more social. If humanity could feel the other, all wars could end.

However, the benefits of the interactions for complexity promotion have some constraints. Due to high level of interaction and changes of the context, people can be more unstable and jump to one and another community. In this sense, the new generation needs to be guided in a self-organization by people from the previous generation who have the complexity approach. An example of an inspirational leader with the complex approach is the Colombian ex-presidential candidate Antanas Mockus. He recommended some basic social agreements in order to affront the illegality which is the main obstacle for a social and economic development in the country. Corruption and violence are the expressions of this illegality. All is based on the premise that "the goal justifies the media", "in order to win everything is possible". To face the illegality and violence, Mockus proposed to practice social respect, citizens' participation, citizens' culture and the development of a society that *plays clean* and *works together*. The answer to his proposal by people of the new generation was interesting, because Mockus' message got into them.

3.3. Teachers as Facilitators

Based on the above considerations, teachers of the present generation need to have more complexity to face the challenge of guiding the new student generation. They also need to avoid the teacher-controlled mode. The teacher role should be as a facilitator.

In ELS, linearity applies when the role of the person who is teaching is speaking, and the role of person who is learning is only hearing. This speaking-hearing is the traditional relationship between a teacher-student that gives limited solutions when trying to resolve crises and new challenges. The

reduction of the linearity in ELS can be reached when the role and the relationship gradually promote more interactions due to their as presented in Table 3.

Table 3 Evolution of the role and relations based on interaction increasing (Based on Iafrancesco 2011*)*

	Role		**Relationship**	
	Who Teaches	**Who Learns**	**Teaching**	**Learning**
Interaction Increasing	Speak	Listen	Teacher	Alumni
	Explain	Understand	Master	Student
	Demonstrate	Learn	Scholastic	Learner
	Build	Learn significantly	Educator	Educating
	Transform	Emancipate Undertake	Mediator Facilitator	Transformational Leader

The teacher as a facilitator is a professional with formation in the field of science, technology and humanistic, combined with a profound level of human maturity. On this base, facilitator is connected with others, to transmit his knowledge and to motivate human and personal grow. A comparison of the characteristics between teacher role and facilitator role is presented in the table 4.

Table 4 Comparative Roles of Teacher and Facilitator

Paradigm of the teacher Role	**Facilitator Role**
Instructional	To facilitate the learning
Evaluative	Assessment
Power of knowledge-based	Power in group-delegated
Dependence generation	Autonomy generation
Central Control	Guided Self-organization
Generic transcripts follow up	Research and innovation
Concepts explanation	Give methods and tools for the knowledge construction
Emotional and rational aisle	Trainer and counsellor

As facilitators, teachers should be promoting the development of the competences beyond knowledge of "how to do". They should include in students the knowledge of "how to be" and the knowledge of "how to balance". Additionally, there are a great number of responsibilities with learning and with human development that are combined in the role of a facilitator. Each one corresponds to a particular state of the personal development in the student's progress. Also, the form in which these roles are combined promotes and supports the flow, while students face the challenges and develop their skills. Figure 1 depicts the progress of the role based on human

development and learning responsibilities. Notice that the role with the highest level is co-creator partner, means teachers and students are transforming themselves in the highest performance team.

Figure 1 Facilitator Roles Between Learning and Human Development

3.4. Hierarchical vs Heterachical Topologies.

As Mezza (In prep.) and Mezza et al. (In press) have been arguing that most human systems are strongly centralized. It could be seen in their tree topologies and their decision processes which sometimes resemble the computational mechanisms of a Turing machine. The result of this arrangements is often inflexibly rule-based, encapsulated, and sequential, with pre-specified halting conditions, centrally coordinated with other processes and controlled in a top-down manner.

In ELS, the hierarchical structures come from the teacher-oriented mode and they are related with a task-oriented scope in the whole institution. Evaluation (no assessment) of student's performance focused in their technical competences and their use of the logic and time. Teachers are the principal actors and captures all the attention in the teaching-learning process. In the same way of this orderly system, teachers are highly orderly, organized and inspire students with their careful planning. The result is a kind of learning and leadership highly self-organized but with a lower complexity or adaptability.

In the mentioned task-oriented scope, teachers base their behaviour in their technical background or expertise and in their personal charisma. Frequently, this can result in a narcissistic and a populist teacher. Some of them put their personal interest before the interest of their educational institution and their students; they are unbalanced leaders.

On the other hand, heterarchical topologies in ELS come from a networking scope and orientation. Assessment (no evaluation) of the student performance focused on their creative capacity to solve problems on the base of their self-regulation, adaptation and autonomy. Students are the principal actors of the instructional process and have all the attention. Teachers with this networking scope are more adaptable, inspirational and create a harmonious atmosphere for teamwork (Lewis 2006). They are people-oriented loquacious inter-relators and often complete the human emotionally transactions because they focused in human development.

3.4. Interactions and Communicative Processes

When the communicative process is carried out in the teaching-learning process, there is an emotional connexion by the identification of the other in the affective, intellectual, and social fields. The emotional connexion is possible, because the human brain does not work in the aisle way. Brain works on the base of the social feedback from the other people combining a direct feedback and environment feedback (stigmergy). The brain and the social connexion, conform a unified system of neural dynamics in which complex properties emerge. This is the base of the mutual recognition among people that starts from an emotional connexion. Recent approaches claim that the social interactions there are no limited to the mechanisms of social cognition. Indeed, the interactions also realize cognitive work and interactions dynamics guide the social cognition (Froese et al. 2014). In this way, to feel the other as part of yourself is possible.

Based on the emotional connexion the interaction in ELS is reached. However is important to notice that the communication dependence also of the task division of the listening habits of the people. According to Lewis (2006), diverse listening practices capture different percentage of the attention. For example, in Spain-Latin cultures, the listening for information and watching the person is around 66% (41 % for listening and 21% for watching). The remaining 34% is for waiting for imaginative question (17%) and thinking in other things (18%). This means that we need catch the attention by means of an assertive speech and an adequate corporal language. This way, graphics elements could improve the interaction.

On the other hand, in English cultures around 53% of the listening practice is spent in listening politely, occasionally interrupts for clarification, while smiles and nods. The remain 47% is for a lot of task like prepares for debate, makes mental notes, gives useful feedback, expects humor, wants little key, and needs context. In this case, the interaction with the person is more reflexive, intense and active than the Spain case that have a declamatory found. This is an important issue to take into account in case of monocultural or intercultural interactions by communication way.

4. Learning Lessons from Latin American Workshop on Complex Systems 2013

In Colombia in the 70s, a socio-critical model was proposed. This model promoted the emancipation and criticism, where the teacher was considered a researcher in the classroom. Nowadays, schools are looking for a way to transform students in transformational leaders,

formed by a mediator (Iafrancesco 2011). However, currently we need a theory, some concepts and some methodologies to achieve it. Meanwhile the traditional education continuous to be linear and teacher-oriented.

Recent results from the Latin American Workshop on Complex Systems (http://unitwin.csregistry.org/tiki-index.php?page=TallerLatino) inspire some solutions for the Latin American educational context. For example, Klauz Jaffe professor at Universidad Simón Bolivar suggested the use of different methods of analysis for bringing fields like in social and natural sciences. Mauricio Huertas from IDConsulting Co., based on his previous experiences in the private field; he introduces the concept of the teacher as facilitator who has practical skills. Enver Oruro at Nucleus of Cognition and Complex Systems at Center for Mathematics, Computation and Cognition UFABC,Brazil, recommended for the study of human behaviour in educational environments, the integration between social psychology with the multilevel scales (collective-individual). Oruro also proposed a model of the social context from the development of self-concept building, from the student cooperation in the classroom. Ragnar Behncke from Centro de Investigación Avanzada en Educación at Universidad de Chile confirmed the peer-learning among students. Observing some contradictions between media teaching and learning goals, Behncke asked himself the question about: How the social dynamics can be studied in the classroom? but from the view of the participants (students). Using google glasses and a facial recognition software, Behncke's group capture the micro-expressions and the attention periods of the students in a public school. From mathematical graphs analysis, the results showed a significant percentage of interactions among pupils (93%) and a little percentage between pupils-teacher (3%).

It seems that the learning among pupils comes more from their interactions between them than the interactions teacher-student. Regularly, the learning among pupils is based on an intrinsic mechanism of sharing and learning with others which generates positive emotions (flow). This allows the pupils co-adaptation, interaction, synchrony and cooperation. As observed in some groups of primates when they are play, this networking learning could result in emergent properties like fitness interdependence, flexibility and adaptive variability of their social behaviour (Behncke, In prep.).

5. Final Remarks

We proposed the description of ELS as complex systems. Some of the characteristics that are taken into account are related to the instructional scope, the context, teachers and students. For example, we could mention the promotion of them like: (i) the interconnectedness and identification of relevant interactions; (ii) the heterarchical organization and student-guided instructional plan; (ii) the autonomy of the students from the increasing of their complexity to respond to new challenges oriented by the teacher; (iv) the reduction of teacher-controlled instructional scheme and promotion of complexity in teachers in terms of adaptability.

As we can see the interactions promote positive mental states in the students. For instance, the flowing state can be reached when academic challenges involve them in the process of meaningful

inquiry to solve real life problems beyond the classroom. Challenge carries the flow promotion when students try to solve real problems which increase their creativity.

ELS as complex systems have inherent and irreducible complexity. Even if we had such perfect knowledge, nonlinear and noisy interactions between parts of the system and its relation to the environment would thwart to attempt to guide its adaptability.

Despite the fact that ELS have a historical trend of being closely connected with the organizational structure of society, complexity approach gives us a shift change in cultural habits.

Now days, education should be restructured and redesigned for humanization, for diversity, for globalization and should be adjusted for real context and for technological challenges. The teaching should be designed for learning to learn. All of the mentioned aspects characterize the complex thinking approach.

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The Study of Viability and the Management of Knowledge in Community Enterprises

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Abstract

This paper is related to the viability and management of knowledge of community enterprises (CE) in Thailand. Although CEs provide several advantages, they may cause various problems to communities. These problems arise from weaknesses in knowledge, thinking and learning, which affect the viability of CEs. Therefore, knowledge management (KM) is adopted to this study because it involves the management of knowledge and learning while the viable system model (VSM) is considered because it is a theoretical framework that explains organisational viability and sustainability. VSM can also strengthen KM implementation by making KM more effective. For these reasons, the combination of KM and VSM is applied to study the survival problem of CEs in Thailand. This study aims to explore useful ways to improve viability of CEs using KM. To achieve the research aim, an interpretivism research paradigm and a qualitative approach were employed. Data was collected through semi-structured interviews and participant observation in eight CEs from four regions of Thailand which were chosen as case studies. In order to enhance the transparency of data analysis process, NVivo which is the computer-aided qualitative data analysis software was employed. The findings from this study can contribute to both theoretical and practical contribution. That is knowledge in complementing KM with VSM to study the viability of small organisations as CEs will be extended. Moreover, the findings of this study can be used to improve viability and to reduce problems in CEs.

Keywords

community enterprise, knowledge management, viability, viable system model

1. Introduction

Community enterprise (CE) is a term that represents a range of business activities which are founded and operated by local people in order to strengthen economic development in a community. CEs not only promote economic aspects but also contribute to encourage community's learning and social development. In the cultural aspect, CEs also help to preserve indigenous knowledge and culture by adopting and adapting local wisdom or folk wisdom to create and develop their products. Moreover, CEs play a vital role in promoting people cooperation to solve their own problems. This is the basis of developing a strong community where members play an important role in managing their ways of life and creating a self-reliant community which can unite and develop solutions when facing problems or changes in this complex world.

CE has been rising in Thailand over the past ten years. This may be because a serious economic crisis in 1997 that forced a number of companies to close and resulted in a large number of unemployed people. A government policy called 'One Tambon One Product (OTOP)' launched in 2001 and the Community Enterprise Act 2005 are the other key factors supporting the growth of CEs in Thailand. In 2014, there are 73,774 CEs registered with the Secretariat Office of Community Enterprise Promotion Board (SCEB) (Secretariat Office of Community Enterprise Promotion Board, 2014).

Although, there are thousands of CEs in Thailand, only some of them have succeeded and survived to this day. An important cause of CEs' failure is their problem in the way of thinking and learning (Konthaiban, 2007). Lacking of thinking and learning ability leads to other problems such as financial problem, over supply problem and environmental problem (RISE-AT, 2003; GSCI, 2005; Hoawteerakul, 2010). Since viability of CEs is affected by shortcomings in knowledge, thinking and learning, knowledge management (KM) is brought to consider. This is because KM involves the management of knowledge (McAdam & McCreedy, 2000), relates with learning (Hislop, 2005) and has an effect on organisational viability (Yolles, 2000). Viable system model (VSM) is employed as a structure to study the management of knowledge in CEs because it is the systems approach that mentions all crucial and necessary factors for organisational viability (Leonard, 2000), and it has been demonstrated also to be appropriate to explore KM needs in businesses (Yolles, 2000).

This study is part of ongoing doctoral research that aims to explore useful ways to improve viability of CEs using KM. This aim leads to three research questions; 1) What kinds of knowledge do CEs need for remaining viable?; 2) How to generate, to share, to retain and to apply such knowledge in CEs?; 3) What kind of KM model is effective for improving viability of CEs?. To achieve the research aim, a qualitative approach is adopted through a case study strategy. Semi-structured interview and participant observation are the chosen methods for data collection.

This paper is organised as follow: the next section presents a review of CE, KM and VSM. The following section is research methodology. Then the findings and data analysis are discussed. The final section provides some preliminary conclusions.

2. Review of Community Enterprise, Knowledge Management and Viable System Model

This section summarised reviews of literature on community enterprise (CE), knowledge management (KM), and applying KM to study the small organisations as CEs. Then the viable system model (VSM) and the complementary of VSM and KM are reviewed. The last one of this section is a conceptual framework using in this study.

2.1 Community Enterprise (CE)

A community enterprise is a business owned and managed by members of the community (Community Business Scotland, 1991 cited in Pearce, 1993; 2005). It is independent and non-for-profit organisation. It works for sustainable regeneration in the community by combining economic, environmental, cultural and social activities (Development Trusts Association, 2000). Although it seeks to become financially self-sustaining and make profit to reinvest, it also aims to strengthen the local economy by creating job opportunities and generating income to members. Furthermore, CEs

contribute to the preservation of indigenous knowledge and culture by adapting local wisdom in producing their products. Most CEs have less hierarchy of command, use simple operational systems and have limited financial assets (Jonjoubsong, 2008). Moreover, they normally run business through casual employment and relationship rather than formal contracts (ILO, 2002). In addition to the term 'community enterprise', this kind of organisation may be called community business, community development corporation, community co-operative, community benefit corporation and community trading organisation (Pearce, 1993).

2.2 Knowledge Management (KM)

Davenport and Prusak (1998, p.5) state that "knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, practices, and norms". Knowledge can be classified into two dimensions, namely tacit and explicit knowledge. The former is highly personal because it is rooted in individuals experience while the latter is more formal and systematic because it is presented in symbolic form such as manual (Nonaka, 1994; Small & Sage, 2006). Most authors define KM by mentioning KM processes. KM is a process to create and use knowledge of organisations (Civi, 2000). Such process may include various activities which are identifying, capturing, creating, storing, distributing and applying knowledge (Krogh, 1998; O'Deli & Grayson, 1998; Chowa, Choya, Leea, & Chan, 2005). Although several activities will be mentioned in KM process, there are four basic activities or processes of KM. They are knowledge generation, knowledge sharing, knowledge retention and knowledge application (Achterbergh & Vriens, 2002). Knowledge generation is acquiring knowledge both from inside and outside an organisation. Knowledge sharing means the dissemination of knowledge within the organisation; or between the organisation and outsiders. Knowledge retention is storing knowledge to be ready for retrieving while knowledge application is using stored knowledge in working. The reason KM is implemented widely in a number of organisations may be its positive effects on organisations. KM encourages continuous learning and collaborating in organisations (Civi, 2000; Duffy, 2000; Lee & Hong, 2002). It also helps organisations in saving costs, generating income, and increasing customer acceptance (Edwards, Ababneh, Hall, & Shaw, 2009). Furthermore, innovation, intelligence, organisational competitiveness and sustainability can be improved by KM (Kogut & Zander, 1992; Davenport & Prusak, 1998; Hackbarth,1998; Zack, 1999; Achterbergh & Vriens, 2002).

2.3 Knowledge Management in Community Enterprises

Most studies about KM pay attention on large organisations rather than small ones. This may because large organisations have a large amount of knowledge to be managed; they comprise of various business units; they can afford resources in terms of budget, manpower and time to implement KM. (McAdam & Reid, 2001; Durst & Edvardsson, 2012). However, small and medium organisations should not ignore KM as a tool to develop themselves (Gharakhani & Mousakhani, 2012). In small and medium enterprises (SMEs) sector, the studies about KM in this context can be found. Durst and Edvardsson (2012) conclude from reviewing articles about KM in SMEs that the body of knowledge on KM in SMEs is still limited. KM implementation, KM perception and knowledge transfer are three areas of KM that seem to be well researched while knowledge identification, knowledge storage/retention and knowledge utilisation are less. Reviewing literature allowed the researcher to discover that it is relatively rare to see an application of a system approach with KM although several authors identify a close relationship between system approaches and KM. Some of these authors also

agree that system thinking can make KM work more effectively (Rubenstein-Montano et al., 2001; Gao, Li, & Nakamori, 2002; Cegarra-Navarro & Martinez-Conesa, 2007). There are few studies about KM in CEs. Some of these studies pay attention on the production process (Kar, 2012) while some focus on one process of KM processes (Tinnaluck, 2005). Reviewing literature about KM in CEs allows the researcher realise that the use of system approach with KM to improve viability of CEs is limited. The following is about viable system model (VSM) which is one of system approach brought to complement KM.

2.4 Viable System Model (VSM)

Stafford Beer's viable system model (VSM) presents basic and sufficient conditions for systems to be viable (Beer, 1981). There are three elements and five systems in VSM. Espinosa and Walker (2011) explain that three elements are the Operation (O), the Meta-system (M) and the Environment (E). O is the basic activities of a system, M is a part that support O to work well while E refers to everything outside and may have an effect to the system. They further describe that there are five interacting systems in O and M. System 1 (S1) or O perform the basic activities to achieve the system's objective while System 2 (S2) takes responsibility in managing conflicts between S1. The key jobs of System 3 (S3) is to encourage synergy in S1 and monitor S1's performance. Sometimes System3* (S3*) is required as an informal way to gather data directly from S1. System 4 (S4)'s tasks are monitoring the external environment, considering what may be threats or opportunities for the system and preparing the strategic plan to cope with such changing environment. The last one, System 5 (S5) is responsible for providing the ultimate authority to ensure the viability of the whole system. Although VSM is a concept that can be applied in several kinds and sizes of organisation (Jackson, 2003), most of organisations that have been reported implementing VSM are large organisations (Burgess & Wake, 2013). There are few studies employ VSM to SMEs context while implementing VSM in CEs is very rare. Examples of adopting VSM to study SMEs come from studies by Beckford (1992), and Burgess and Wake (2013). The first one employs VSM to study a family business. This study reveals that VSM is suitable for analysing the whole organisation and for determining each section's requirements. The second study discovers that VSM is a suitable tool for understanding operations and evaluating viability of SMEs.

2.5 Viable System Model and Knowledge Management

As mentioned previously that complementing KM with system thinking helps to enhance KM potential, VSM is one of system approach that has been employed to complement KM. Examples of accompanying KM with VSM are as follows. Leonard (2000) mentions that KM will not be fully effective if the organisation is not recognised as a whole. Then she suggests to apply VSM structure as a framework to consider organisational knowledge. Achterbergh and Vriens (2002) explore the relation about organisational knowledge and organisational viability by applying the idea of VSM to KM. Yang and Yen (2007) adopt the VSM framework to study with KM and present a viable system framework for KM to be used in considering the potential role of KM in organisations.

It may be concluded that KM enables organisational viability. Moreover, KM will be more effective if it is complemented by VSM. Reviewing literature allows the researcher to find research gaps. One gap is in applying KM to study viability of CEs; also adopting VSM to study CEs is very rare; and finally, we have not found any studies complementing KM with VSM for CEs. Therefore, the VSM is applied in this study in order to study the viability and the management of knowledge in CEs. More specifically,

it is used to study how by combining an effective structure and proper management of knowledge in CEs we can improve their viability.

2.6 Conceptual Framework

Based on the literature review, the conceptual framework for this study is generated as presented in Figure 1.

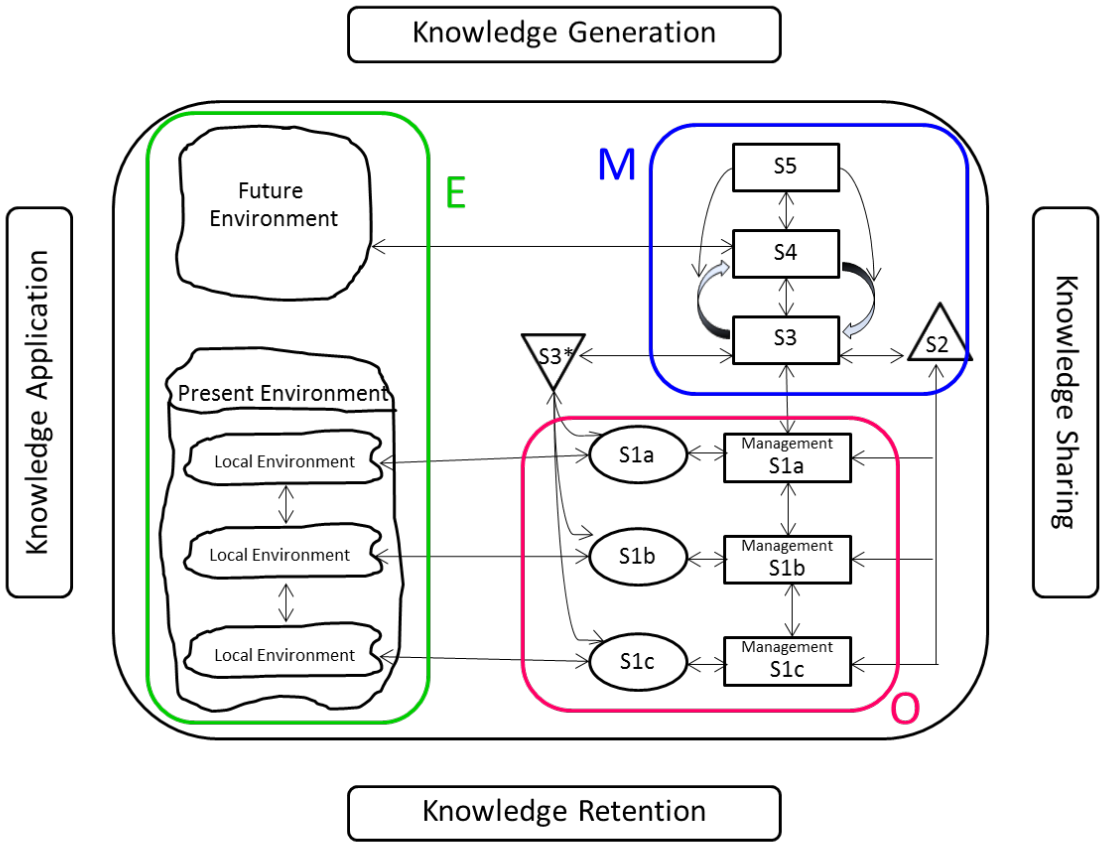

Figure1: Conceptual Framework

In this conceptual framework, VSM which consists of necessary conditions for viability is applied. VSM is used to be a structure to explore knowledge types which are essential for being viable in each system, namely System 1-System5. Then four key steps of KM process are employed to consider the ways CEs manage their knowledge. These four steps are knowledge generation, knowledge sharing, knowledge retention, and knowledge application.

3. Research Methodology

To reach the research aim and answer the research questions, an interpretivism research paradigm and a qualitative approach were adopted. The information required from the CEs study is in-depth

and detailed and cannot be measured by only using numbers or quantitative data (Bryman & Bell, 2003). Case study was chosen as a research strategy because it allows the researcher to explore deeply (Zikmund, 2003) and obtain a rich understanding of the selected CEs (Morris & Wood, 1991). Methods to collect data were semi-structured interviews and participant observation. Semi-structured interview was used to collect data from leaders and members of each CE. Questions were listed to ask informants. However, additional questions were added when the research want to get more information from interviewees. Participant observation was also adopted to collect data in each CE in order to allow data collection from the fieldwork to be more comprehensive and accurate. To analyse data collected, such data was grouped according to research questions. NVivo which is the computer-aided qualitative data analysis software was employed to strengthen the transparency of data analysis process.

Regarding case studies, eight CEs from four regions of Thailand were selected. They were categorised into two groups, namely average CE (CEa) and best practice CE (CEb). CEb is a community enterprise that has good attributes which are continuous learning, the ability in administration and management, initiative, economic stability, self-reliance, and viability. This group of CE is a good role model for other CEs. To compare and contrast with four CEb, four CEa are selected by the following criteria. Firstly, each CEa is located in the same district with CEb in each region in order to reduce the variances of race, religion, language, culture and geography. Secondly, these CEa are similar to other CEs in general and simple enough to be representative of most CEs which are common. Then they can be called average or typical cases (Yin, 2009). All case studies are presented in Table 1.

Table 1: Eight Case Studies

Group / Region	Average CE (CEa)	Best practice CE (CEb)
Northern Thailand	Tha Nao CE (CEa1)	Nam Kian CE (CEb1)
North-eastern Thailand	Mueang Khong CE (CEa2)	Oom Saeng CE (CEb2)
Central Thailand	Tha Ton Chan CE (CEa3)	Lad Bua Khao CE (CEb3)
Southern Thailand	Nopphitam CE (CEa4)	Karoh CE (CEb4)

In northern Thailand, one CEa and one CEb in Phu Phiang District of Nan Province were selected as case studies. The selected CEa is Tha Nao community Enterprise (CEa1). It is located in Tha Nao Sub-district. Fermented pork or sour pork which is a fermented food developed as a way to preserve pork is a product of this CE. The best practice CE in this region is Nam Kian community Enterprise (CEb1). It is located in Nam Kian Sub-district. This CE produces herbal personal cleaning products such as shampoo, conditioner, soap, cream bath and lotion.

Case studies in north-eastern Thailand are located in Rasi Salai District, Si Sa Ket Province. Mueang Khong Community Enterprise (CEa2) was selected as CEa. It is located in Mueang Khong Sub-district. They produce plastic basketry from plastic ribbons. Oom Saeng community Enterprise (CEb2) was selected as a best practice CE. It is located in Oom Saeng Village, Du Sub-district. This CEb commercialises several kinds of organic rice. Their job includes encouraging and supporting farmers who are members of this CE to do organic farming.

In central Thailand, Tha Ton Chan Community Enterprise (CEa3) and Lad Bua Khao Community Enterprise (CEb3) were selected as case studies. Both CEs are located in Lad Bua Khao Sub-district, Ban Pong District, Ratchaburi Province. The former produces chilli paste and curry paste while the latter produces various kinds of snacks such as cereal/dried shredded pork topped banana chip and cereal/dried shredded pork topped rice cracker.

In the last region, southern Thailand, case studies are in Nopphitam District, Nakhon Si Thammarat Province. The selected CEa is Nopphitam Community Enterprise (CEa4). It is located in Nopphitam Sub-district. This CE's product is wood furniture making of old roots or stumps which excavated from the land. These roots or stumps are big enough to make furniture such as tables and chairs. The best practice CE is Karoh Community Enterprise (CEb4) which is located in Moo 5, Karoh Sub-district. They produce Khanom Jeen noodle dough or Thai rice vermicelli.

After collecting data in eight case studies, data from the average CEs and the best practice CEs is compared in order to answer research questions. The comparison is made on topics including the way CEs have implemented their functions using VSM structure, knowledge required, and KM process.

4. Findings and Data Analysis

Applying VSM analysis to consider the way CEs have implemented their functions, similarities and differences are presented in Table 2.

Table 2: Functions Implementing Comparison between CEa and CEb

System	Similarities	Differences	
		CEa	CEb
S1	- Explicit production process - CE chairman takes responsibility in coping problems with outsiders	No authorised person to monitor the production	Have a supervisor in the production
S2	-	- Record about day-to-day operation is hardly found - Record manually	- Record about day-to-day operation is normally found - Use IT in recording
S3	- Resources allocating by CE chairman	- No annual budget and yearly production plan	- Have annual budget and yearly production plan
S3*	-	- Monitor by colleagues	- Walk the walk by CE chairman
S4	- No official person or function to monitor the external environment	- Not focus on environment changing - No product development plan - Passive	- A person monitor environment changing - Have product development plan - Active
S5	-	- CE chairman or CE committee	- CE committee

Regarding Table 2, it was found that clarity and formality of CEa is less than CEb in terms of implementing their functions. Both CEa and CEb have an obvious production process (S1). However, most CEa do not have formal supervisor to monitor and control the production. CEa's members who work together in the production process normally help each other to monitor the performance. Most CEb, on the contrary, have a clear division of labour and have a supervisor to monitor the production. Regarding S2, paperwork or forms in day-to-day operation are hardly used in CEa. If there is any record done by CEa such as an income and expenditure account, such record will be done manually. In CEb, paperwork or forms in day-to-day operation are normally found. Moreover, information technology or computer programme are used in recording and managing data in S2. Considering S3, most CEa do not have annual budget, yearly production plan or production target while most CEb have an explicit plan about annual budget and production target. In S3*, the way of informal monitoring in most CEa is working together and helping each other to monitor the performance as mentioned previously. In most CEb, a chairman or a manager uses walk the walk as an informal monitoring technique. Concerning external environment which is S4's task, both CEa and CEb do not have an official person or function to do this job. The difference is CEa do not focus on monitoring the external environment and do not have a development plan while most CEb have at least one person taking responsibility in this function. This may result in setting a development plan and a strategic plan in CEb. In S5, the ultimate authority in CEb is CE committee while it may be CE chairman or CE committee who use the ultimate authority in CEa. Considering CEs as System1-System5, knowledge required in each system is presented in Table 3.

Table 3: Knowledge Required in System 1-Systwm 5 of CEa and CEb

VSM	CEa	CEb
S1	- Production methods - Criteria for products / products standard - Ingredients / raw materials properties and selection	- Production methods - Criteria for products / products standard - Ingredients / raw materials properties and selection - Monitoring and controlling methods by S3 - Expected performance (target) of S1 - Gap between target and actual results - Causes and consequences of the gap between target and actual results - Actions to handle the gap between target and actual results
S2	- Income and expenditure account recording	- IT complementing / computer software using - Production methods - Expected performance (target) of S1 - Interdependencies between S1 activities
S3	- Production methods - Expected performance (target) of S1	- Organisational goals - Production methods - Expected performance (target) of S1 - Gap between target and actual results - Causes and consequences of the gap between target and actual results - Development plan from S4 - Desired goals for S1 based on the development plan - Gap between desired and current goals of S1

VSM	CEa	CEb
S4	- Production methods - Development or changing in the relevant environment of CE (including Market or customer trends)	- Production methods - Expected performance (target) of S1 - Organisational goals - Development plan from S4 - Development or changing in the relevant environment of CE (including Market or customer trends)
S5	- Annual performance of CE	- Organisational goals - Annual performance of CE - Development plan from S4

As presented in Table3, System 1-System 5 of CEb require more extensive knowledge than CEa. This is because CEb implement their functions more explicitly and more formally than CEa do. Performing tasks of System 3-System 5 in most CEa is the responsibility of CE chairman. Moreover, S3 and S4 is harder to find in CEa as mentioned previously. Therefore, knowledge required in these three systems normally is tacit knowledge rooted in the chairman. After getting knowledge required in each system, the next step is considering how CEs manage such knowledge. Knowledge generation, knowledge sharing, knowledge retention, and knowledge application are four KM processes employed to the analysis. The similarities and differences of KM in CEa and CEb are presented in Table 4.

Table 4: KM Comparison between CEa and CEb

KM	Similarities	Differences	
		CEa	CEb
Knowledge Generation	Do not officially employ KM in CE management	- Get most knowledge from outside - Focus on the beginning stage of CE formation	- Get knowledge from outside and generate knowledge by itself - Continuous generating knowledge
Knowledge Sharing		Hardly share knowledge both inside and outside	Normally share knowledge both inside and outside
Knowledge Retention		- Tacit knowledge - Manual data collection	- Explicit knowledge - IT supporting in data collection
Knowledge Application		- Use tacit knowledge in the production - Knowledge application is hardly happened	- Use tacit and explicit knowledge in the production - Knowledge application is normally happened

From Table 4, it is found that KM is not officially adopted in both CEa and CEb. However, four basic processes of KM can be found evidently in CEb. In CEa, knowledge generation and knowledge sharing can be found sometimes while knowledge retention and knowledge application are scarcely happened.

According to the way CEs implement their functions, knowledge required in each system, and the management of knowledge, all of them are summarised in a model presented in Figure 2.

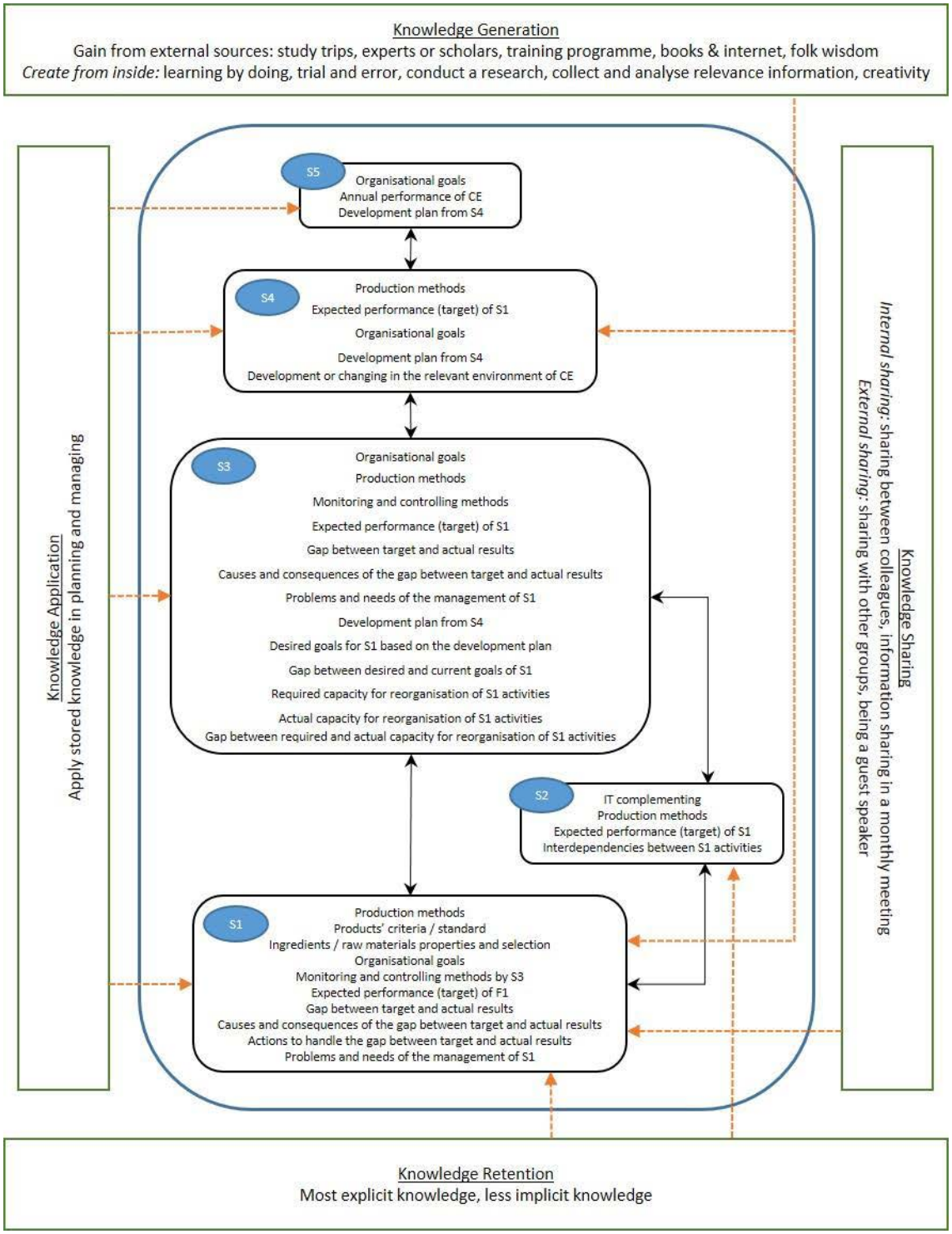

Figure 2: Proposed KM Model based on VSM Structure

CEb have more requisite functions for viability according to VSM criteria than CEa. This explains their major success over CEa. The model allows us to analyse the type of knowledge required at each level to increase the viability based on Achterbergh and Vriens (2002)'s study about domain of knowledge required by each function in VSM to be viable. Although, in actual operation of CEs, each system should employ all KM processes in managing their knowledge, it is found that each KM process is used by S1-S5 differently. The dashed arrows represent the main KM processes used in each system. This

model may be used as a guidance for other CEs which would like to improve their viability in terms of the management of knowledge.

5. Conclusions

In this paper, an attempt has been made to present a way to study viability and the management of knowledge in community enterprises. Knowledge management is employed to this study because it involves knowledge, thinking and learning that have proved to be a key weaknesses of most CEs in maintaining their viability. The viable system model is also applied to complement KM because it indicates all necessary functions for organisational viability. Eight CEs from four regions of Thailand are chosen as case studies. Four of them are the best practice CEs (CEa) the others are the average CEs (CEb). Data collection is done by interviewing and observing in these two groups of CEs. The following conclusions are drawn from this study.

1. When using VSM analysis to consider the way that CEs have implemented their functions, it is found that CEb have more explicit and more formal implementation than CEa. This may be a reason that CEb are better than CEa in remaining viable. Moreover, the differences in implementing their functions between CEb and CEa may result in the next conclusion.
2. System 1-System 5 of CEb require more extensive knowledge than CEa as presented in Table 3.
3. Although both CEa and the CEb are not officially adopted KM in their operation, four basic processes of KM which are knowledge generation, knowledge sharing, knowledge retention and knowledge application can be found more clearly in CEb. In CEa, however, knowledge generation and knowledge sharing are occurred informally from time to time while knowledge retention and knowledge application are hardly found.

According to collected data, a KM model based on VSM analysis is proposed in Figure 2. It is hoped that this model and the findings from this study will be useful for others CEs and organisations involved in the development of CEs in Thailand. Furthermore, these findings will be applied in order to help CEs to reduce their problems and improve their viability. In addition to practical contributions of this study as mentioned, theoretical contributions are also found. These are the gap in using KM to directly study the viability of small organisations as CEs will be filled; knowledge in complementing KM with VSM will be extended; and using VSM to improve organisational viability will be extended to unique organisations as CEs.

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Cooperativism and Organizational Cybernetic Self -organized, yes it is possible a viable path through Scarcity Water and Food Crisis in the XXI Century

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Abstract

In this paper the authors face the highly likely scenario of Scarcity Water and Food Crisis in the XXI Century, proposing cooperativism as viable path between the emergence of this crisis and the indifference of the political class in general, arguing on the basis of the Danish cooperative experience late nineteenth century (Paldam, Meller et al, 1990). However the cooperativism suffers a strategic weakness, located in the decisional process, given its wide and community structure based on assemblies in which decide is highly complex, making it unattractive when it is time for socially formalizing (Confecoop, 2013). We argue based on the concept of meaning Processing Systems that "the organization is an autopoietic system " (Luhmann, 1997, quoted by Achterbergh & Vriens, 2010) we proposing firstly make visible the decisional process capturing it on a phase-space (Ashby, 1956, quoted by Jackson, 2003; Minkowski quoted on Martinez A., 2009) in which decision making is deployed, so in a second instance, through applying organizational cybernetic, promptly the Viable System Model (Beer ,1972) because its recursive property allows us to navigate through the organizational structure. A successful example of such

an application is published in an Irish cooperative organization (Espinosa et al, 2011) and ending with the conclusion proposed by the authors.

Methodology Quotes by authors and analysis cases are discussed about how self-organization with cooperativism improved by organizational cybernetic become an effective and viable response to emergent scarcity water and food crisis.

Findings

• Self-organization in a cooperative framework it´s able to efficiently meet the needs of a Community.

• Understand the language as an autopoietic system of meanings, contributed by Luhmann Who defines organizations as an autopoietic systems decisions, proposing the Meaning Processing systems.

• The space-time diagrams (light cone) of Minkowsky applied on the decision- making Process according Luhmann, facilitate its objective understanding.

• Successful implementation of viable system model of Stafford Beer, over management of an Irish cooperative, published in Espinosa et al., (2011). http://www.cloughjordancommunityfarm.ie/

Keywords: self-organization, Organizational Cybernetic, meaning processing System, cooperativism, Scarcity Water and Food Crisis.

Introduction

In West and over second decade of this century, the national decision-making has been in hands of governments each more recede of the benefit for their citizens in exchange, they government legislating for the sole benefit of transnational corporations. Just remember cases like the P.I.G.S. countries, or the Pacific Alliance in Latin America. This perspective clearly disconnected from citizens, brought a wave of privatization policies and hyper-exploitation, rapidly preying natural resources (including human and intangible resources) of developing economies (V Summit of the people, Colombia, 2012). The strong anchoring to the productivist and materialistic paradigm of the last century has been the argumentative framework of the conservative position, expressed in its obsession with economic growth. However, even whether they have obtained growth in GDP, this sole indicator does not informs us about the degree distribution of that wealth among the inhabitants, ecological impact or what percentage of this economic growth is being invested in the actual development of the host country (Meller & Blomstrom, 1990), such as the case of impoverishing growth or "Dutch disease", this is a hyper-exploitation scenario, as the gold rush, high exploitation in few time, generating increased incomes for their exports for cause of the specialization, incomes that make damages to the remaining items not specialized as also to the prices in the domestic market, due to the increase in foreign exchange and these are transferred in the local currency market by pressing the increase in money supply circulating in the local market, leading all in inflation and loss of wealth. While all this

happens, water scarcity advances, as well as public policies imposed by recent governments to the detriment of its citizens, leaving rural populations without the vital element. Examples abound; Chile, Central America, Mexico, Paraguay, Brazil. The scarcity water it is also food crisis, because have a direct impact on food production as cereals, vegetables and livestock farming (FAO, 2003).

Cooperativism as a solution

The solution raised here collects historic and successful experience of the Danish people, who in the late nineteenth century, in a bipartisan political context in which the directing class and the privileged class stagnated for over 30 years in an interlock of actions, opting its citizens for self-organized from a cooperative perspective, for which acted in three key areas; Credit (non-profit) and international trade, education and manufacturing processing. This strategy allowed them to enter the twentieth century with a strong production structure and highly skilled human resources, while international trade managed to position Denmark as one of the more robust European economies and high levels of quality of life (Paldam, Meller et al, 1990). The current ineffectiveness of governments is an opportunity for self-organization of communities as a strategy to safeguard and manage their local natural resources tangible and intangible. This self-organization emerges in dynamic local patterns without knowledge of global patterns (Camazine et al, 2003). Similarly, social organizations and social movements emerge with little local information and very little or no information on global patterns or higher recursive levels (Keeney, 1994) showing a proper CAS behaviour (Miller et al, 2007) this is complex Adaptive Systems, where the leadership deployed and in self-organization -such as social movements- unfolds in complex dynamic in which the set of roles of leadership is shared by different actors, rather than a single leader (Petit & Bon , 2010). This fragmentation of power into decision-making is critical in the internal communication system causing rapid wear between those who give life to the organization. This weakness is common in cooperative organizations given the dynamics of assemblies, however can be overcome with the help of soft technologies applied in management (Espinosa et al, 2011).

The key is communication

To start a reflection on communication, we will overcome by the popular definition of Shannon & Weaver (1963), where communication is understood as a bi-directional data transfer tube in packets. We will argue from the conceptual framework of systems thinking.

What is communication for Maturana? For Maturana (1987), the communication is the behaviours coordinated into a 3rd order unit. This third level of recursion, Maturana defines it as a new unit that arises because two autopoietic units have joined without losing its identity. Of which the field of 3rd order is different from the field of an autopoietic unit. In this sense a social system understood from the perspective of Luhmann, is a unit of 3rd order as it will be any kind of organization such as a cooperative.

What is communication for Luhmann? For Luhmann communication is a gestalt relationship, which he called the triple synthesis of communication (Luhmann, 1996) that in the words of Luhmann, emerges from make three selections -or three distinctions in the words of Maturana-, these are: Information, utterance and

Understanding where the first two are made by alter while understanding is made by ego, and communication is the combined result of these three distinctions between individuals of gestalt mode.
For our case, communication according to both authors, occur as emergent dynamic between at least two psychic systems according to Luhmann or in the emergence of a 3rd order after the communication between two autopoietic units according Maturana. Key in the understanding of communication as emergent dynamics, is the structural determinism (Maturana, 1987), this is why changes in an autopoietic unit is a finite set of changes that its structure allows it adopt. In this sense, communication is not a transfer of information if not that each autopoietic unit interprets the communication as its structure allows.

Already at this point we can apply the Luhmannian concept of "Meaning". For Luhmann meaning is like a medal with two faces, one, the focus of discourse and the other its context or direct references as to possibilities of meaning (Luhmann quoted Achterbergh & Vriens, 2010). Then a meaning processing system according to Maturana Luhmann will be medium by which social systems and psychic structure the production achieved its own structures (achieving autopoiesis). For Luhmann the Meaning Processing Systems are a type of autopoietic system in parallel of living systems according to Maturana. In turn subdivided into; Societies, Organizations and the interactions between them.
See Figure 1.

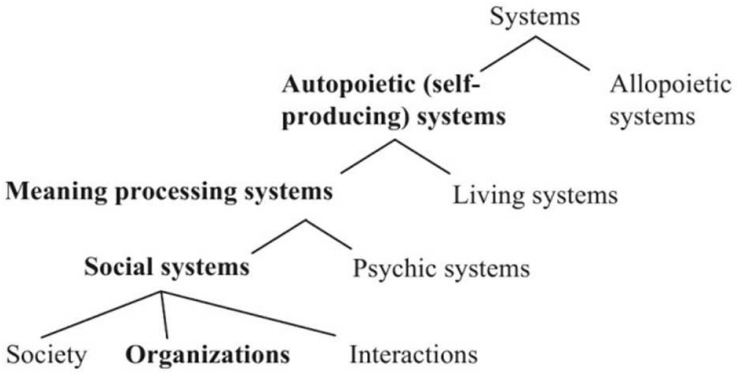

Fig. 1 Luhmann´s classification of systems (adapted from Greshoff, 1999, p.70. Quoted by Achterbergh & Vriens. Organizations as social systems conducting experiments, 2010, p.118.

In this paper we focus on cooperative type organizations which have a structural determinism, evidenced in its decisional process like assemblies. Where the breakdown of power in its various leaderships increases the complexity in decision making, which becomes a critical weakness in this type of organizations. Given the dynamic structural of a MPS of kind Organization for Luhmann, we shall have than the organization make its structure through decision producing by decisions. Well, the conceptual framework of systems thinking allows us to argue that the problem in cooperatives is intrinsic to their structure expressed on the assemblies deciding which way the degree of depth reached in communication is one -if not the most important- of the critical factors for the viability of a cooperative.
Following with Luhmann, the basic structural unit of an MPS is a meaning, so on the MPS of kind Organization, the basic structural unit are each and every one of the

decisions. For which we can keep the record of all decisions made, deployed in time into a phase space (Ashby, 1952) and even more clearly if we use a diagram Minkowsky space-time (Minkowsky quoted by Martínez Téllez, A. 2009) see figure 2.

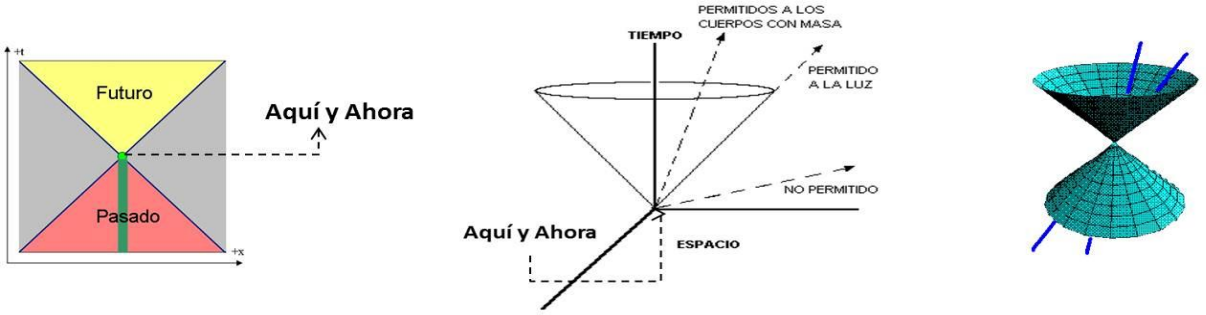

Fig. 2 Diagram of space-time of Minkowsky, cited by Martínez Téllez, 2009

Because of the recursive property of the MPS, we can navigate between decisions through different levels of recursion. To Bradford Keeney (1994), this will be a trajectory of punctuations, or distinctions according to Maturana , hence the decisional record is simply the trajectory over time of the decision-making process in an organization. With all I argued above we can sustain that the weakness in cooperative organizations, is cause for structural determinism and hence the way in which decision making is deployed, this is, the particular punctuation or style in making decisions of the assembly as a whole in which many autopoietic units are related without losing their identities, although making emerge a system of 3rd order (1987). The following is to distinguish which shall be their key functions and each and every one of her decisions, so achieve make diagnose and repair via some type of intervention or systemic consulting.

Organizational Cybernetic

The main reference in this field will always be Stafford Beer and the Viable System Model widely known in Europe as the three Americas (North, Central and South), we can also mention important and varied authors than their works have successfully developed organizational cybernetic, here just a few; (Espejo and Harnden (1989), and Espejo and Schwaninger (1993), Espejo, R., Schuhmann, W., Schwaninger, M. and Bilello, U. (1996), Espinosa, A. (2002) cited by Jackson, M., 2003), Espinosa, A. et al, (2011), Espinosa, A. & Walker, J. 2013), Patrick Hoverstadt (2009), Bradford Keeney (1994) ... the list is extensive among those based on the 1st order of cybernetic of Wiener and Ashby and Stafford Beer's work in 2nd order of cybernetic, have achieved to shape more than 30 years of research action over it what Beer (1972) coined as organizational cybernetic. The brevity of this paper focus on the values of organizational cybernetic for managers and in general for all who actively participate in the co-creation of a cooperative organization. The following are five (5) key points that Mike Jackson (2003) points us to as key for the managers interested in organizational cybernetic and its application in organizations.

- Possess a clear identity for the organization, based on achievable targets in the environment, remembered and understood throughout the organization. If the environment changes, the organization will have to re-set consistent.

- The VSM facilitates the understanding of organizational complexity through precise to address issues of organizational design language.

- She gets a dichotomy centralization and decentralization. Let's empower the units without threatening the management control and organizational cohesion. So Freedom and control complement.

- Established an identity and clear objectives, the VSM to determine key business units and support services required for these. It is an epistemological tool for diagnosis and design, making visible structures and processes which are essential and which can be given.

- Because the spreads VSM decision-making and control over the "architecture" of the system embodies the idea that leadership is at all levels.

Applications of Organizational Cybernetics Cooperatives

The empirical confirmation of the implementation of organizational cybernetic supported by various soft technologies (Espejo & Harden 1989, cited by Jackson, M., 2003) has been amply demonstrated by many authors and cases. Here we refer briefly and narrowly limited to one case in a cooperative organization. The case of the Irish cooperative Cloughjordan Community Farm (Espinosa et al., 2011) was based on the application of MSV, along with CAS and SNA as soft technologies aimed at improving organizational management in critical or highly complex states. This investigation confirmed the complementarity of two approaches to manage complexity, as is the viable system model of Stafford Beer and the CAS or complex adaptive systems (Miller, 2007), allowing make to face to the self-organization into cooperative organizations into critical situations or high complexity, through mapping functions and the status of these for next corrections, serving into guide decision-making and the emergence of various leadership with help of SNA-social network Analysis-.Thus giving solid and understandable diagnostic support and organizational design for cooperative organizations in states of high complexity.

Conclusions

In the current global scenario of the 2nd decade of the present century and into Latin America in particular, our nations have been governed detriment of its citizens and in favour sassy of transnational corporations. The punctuations (Keeney, 1994) that these rulers have demonstrated with objective clarity expose the strong partiality of legislating to liberalize the tangible natural resources including intangibles natural resources. This imposed by force of our own armies acting against their fellow citizens, overthrowing legitimate and democratic governments opposed to this predation or repressing strongly with militarized anti-riot police the logic complaint of citizenship. Well, we are at a crossroads such as the Danish case discussed above in this paper. This is; an oligarchy and a political leadership trapped on a dreadlock both get blocked while citizens lose freedoms and quality of life. Hence as the Danish in the late nineteenth century, it is imperative that citizens we self-organize into cooperatives, that although is not easy, can overcome the weakness in the decisional processes of assemblies, with the support of organizational cybernetic. Thus to live socially and economically in viable

way and coherent mode with our planet, which certainly also is an autopoietic system, a living being (Lovelock, 1985).

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Running Heads:

An organization's environment and the generation of its legitimacy: Case Study: Ingenieros Sin Fronteras Colombia

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Abstract

The name EWB- Ingenieros sin Fronteras has been adopted by organizations in various countries. They are organizations that promote collaborative work between engineer's actors and other community and government stakeholders in order to support the solution of problems in vulnerable communities. In Colombia, since 2006 is given to the home country organization called Ingenieros sin Fronteras Colombia (ISFCOL) led by two universities: Corporación Universitaria Minuto de Dios (Uniminuto) and the Universidad de los Andes (Uniandes). The organization was created in a joint effort by a group of professors from both institutions in seeking to create spaces that allow, from academia, to develop initiatives for solutions to problems affecting Colombian communities within the framework of an institutional arrangement and an informal working practice. The main proposal is centered upon the creation of autonomous spaces through which students and professionals from the two universities develop roles that allow them to be apply in real Colombian situations. Likewise, the work is developed with the community, hence its local sense and historical knowledge is the guiding principle in the development of any of the initiatives. Since its establishment, ISFCOL has won a place for participation in various activities of innovation, engineering and social spaces within the respective universities. It is important to add that the initial design was based on the basic concepts proposed by Stafford Beer in the Viable System Model.

Thanks to a study conducted in 2013 at Universidad de los Andes entitled "Diagnosing the organizational culture as a tool for the analysis of the mission of an organization with social order " it was possible to illustrate in detail the evolution of ISFCOL since its conception to its present structure by giving a clear picture about how its own organization with a social purpose and academic characteristics have had on the fulfillment of its mission and therefore its dynamic structure Based on this study and the results it yields, the question of research that arises is addressed in this article, Whish mechanism has allowed ISFCOL's survival?

According to what has been previously mentioned, this article analyzes the case of ISFCOL, as an organization that has been structured and molded over time from a logic that does not follow the cost-benefit guidance and therefore makes evident the effects that its environment has had on their quest for legitimacy and survival as an organization. The analysis is made by the establishment of two stages where ISFCOL used different types of complexity management mechanisms and it conclude that its survival has been related

to the adaptation of its resources to the academic context.

Keywords
Complexity management, environment, survival, organization

1. Introduction
Inequities observed in cities and in several Colombian regions are reflected in indicators such as GINI. And major engineering works are noted, the country has large problematic situations that do not allow the Colombians have their basic needs met. To justify such a scenario is presented below a historical scenario reported by the Departamento Administrativo DANE (DANE)
According to the paper "Spatial dimension of poverty in Colombia", there is evidence that points to a spatial dependence of poverty in the country, both regionally and locally. Evidence of this is the formation of clusters of wealth or poverty at the municipal level, which are energized by natural or anthropologic factors, or externalities (Gutiérrez, 2008). The same study relates the index of Unsatisfied Basic Needs (UBN) and the index of Living Conditions (ILV) showing a close interdependence between local poverty levels, which constitutes the so-called neighborhood effect, of both first and second order. Moreover, the supply of higher education in the country is inversely proportional to the condition of poverty; as a result about 72% of professionals are located in the five major cities (MinEducación, 2010). 22% of these professionals are engineers from different disciplines, who choose to remain in the main urban centers (167,395 professionals in the period 2001-2008) (MinEducación, 2010). This tension between access to higher education and the spatial dimension of poverty, reinforced by the limited coverage of universities in the national territory, represents an additional challenge in the process of Education for Development (EfD).
We will understand by EfD, the educational contribution that allows the practitioner to gain a better understanding of the global world especially regarding the social inequality, in its educational effect as people, and in participatory action (Pérez, 2005). This new proposal requires innovative spaces where the national core issues can converge so they can be addressed from multi and pluri-disciplinarity. Spaces such as EWB become a responsible alternative and an effective tool to address this gap, creating their own dynamics with local, regional or global actors, and developing a toolbox of methods and methodologies appropriate for intervention. The construction of these formal spaces are an institutional challenge, which requires a detailed organizational design, guided by clear principles and concepts, such as cycles of learning, service learning, equity, solidarity, among others. As a result of this company has such a structure that allows the action of the various engineering within a framework of cooperative learning.
The construction of these formal spaces is an institutional challenge, which requires a detailed organizational design, guided by clear principles and concepts, such as: cycles of learning, service learning, equity, solidarity, among others. As a result of this endeavor, ISFCOL has a structure that facilitates the activities of the various engineering disciplines in a framework of cooperative learning.

2. Concepts

2.1. Complexity management

The complexity is a measure of variety. Another way to define such concepts is "variety is the number of possible states of a system (that is a measure of its potential) and hence the complexity is the number of observed states (distinctions) in a system. It is a measure of its relevance. Examples of complex situations are like:

- A mayor in charge of generating opportunities for community development
- A community leader responsible for ensuring that the community has access to good quality water
- A teacher in charge of developing a class with real life impact

The complexity of the systems in which people should perform is usually greater than the complexity that is owned individually. That is why the strategy must be found to ensure good performance through the management of this complexity. To that extent it relies on the so-called Act requirement Variety of Ross Ashby "Solo absorbs complexity." Under this law, the more complex the system, the more complex must be the system controller. To that extent should design and implement mechanisms "administration" of complexity. These mechanisms are complex attenuators and amplifiers. An attenuator is a complex mechanism that reduces the number of states of a situation. Some examples for the cases mentioned earlier in this chapter are:

- Classification of the basic needs of communities
- Grouping of the community according to proximity to water sources
- Classification by type of work (practical or theoretical)

In parallel to design an amplification mechanism, for example a mechanism that increases the responsiveness of a particular situation. Some examples for the cases mentioned earlier in this chapter are:

- A community radio station
- A sub-group of community leaders who specialize in every type of water management procedure
- Internet

In conclusion, the management of the complexity must follow a systematic method to ascribe purposes associated tasks, determine what the required performance, determine which are the generators of complexity and design and implement tools, mechanisms and procedures to mitigate capacity-amplifying response

2.2. Organizations with social cope

Based on the Colombian legal position, an organization with a social purpose relates to the term "nonprofit organizations" and more specifically to foundations and associations (Major of Bogotá, 2014). In contrast, an organization with social order is also related to what is called, social enterprise, which generally is characterized by not aim to maximize profits for their investors but face problems of social nature (Yunus, 2010). Other examples that will relate to the term "organization with a social purpose" include: NGOs, third sector and voluntary organizations. That said, although there are different denominations who come mainly from the legal framework, an organization with social order is characterized by a closed network of relationships with their own identity (Espejo & Reyes, 2011) that has the purpose or rationale, contribute the resolution of an issue of social and non-profit-making.

Organizations with these guidelines, when born, but follow a similar behavior having any enterprise must create mechanisms that take into account the very complexity of a social

problem and in almost all cases, the need to confront the logic of a based on the formulation and implementation of projects, understood as temporary efforts being carried out to create a product, service or result ending system when they fail to meet targets, when it determines that it is not possible to meet them or objectives that were expected are no longer needed.
In general, the birth of these organizations is giving back to the emergence of an initiative to solve a problem that is affecting the quality of life of a particular community **Fuente especificada no válida.**. After the existence of desire, enters a job where mechanics based on the perception of a problem, you come to a learning period that allows the emergence of several alternative solutions. After defining a model solution (or parallel) seeking resources for implementation is done. Achieved the above is implemented as a general hypothesis, is expected to generate the resolution of a problem. The process ends with the visibility and recognition of the work done by the project (McKinsey&Company, 2004)
Defining this as a first step, from there the organization is ready to grow, a fact that for this particular case relates to the application of the model in other situations or with finding new social problems. The organization faces the very complexity of the problems and situations of common knowledge to any enterprise: the pursuit of sustainability. Sustainability is also related to the ability to manage the new dynamics of growth, for example increased capabilities to meet the emerging dimensions hauling situations in which the organization is faced **Fuente especificada no válida.**. As the organization gains greater commitments, resources, lines of action, the complexity increases and it is necessary to acquire the necessary administrative tools to define the mechanisms on which they can anchor their survival (Porter, 1987).

2.3. Organizations survival

Survival of organizations has been studied through several theoretical focuses. Three of the most important framed in organizations theory are associated to: new institutional theory (Meyer & Rowan, 1977); (DiMaggio & Walter, 1983), contingency (Burns & Stalker, 1961); (Lawrence & Lorsch, 1967) and resource dependence (Pfeffer & Salancik, 1978).

Survival on new institutional theory is dependent on institutional environment (Meyer & Rowan, 1977); (DiMaggio & Walter, 1983), if the institutions surrounding the organization are supportive and include in their network of relationships the organization it has more possibilities of survival. Given the dependence of the organization on its relationships with other organizations or institutions the role of legitimacy is central in the survival of the organization in focus. Legitimacy is understood as the generalized perception that the organizational actions are appropriated framed in a current system of believing and values (Suchman, 1995)that means that are related with the criteria employed by the surrounding environment to make a judgment of the actions of one organization about the well doing that it make in the institutional context. Once organization´s legitimacy is shared in its environment, it receives the critical resources needed for its correct functioning, according to Greenwood et al (2008) (Greenwood, Oliver, & Sahlin-Andersson, 2008), the organizations need to have legitimacy in the field which they operate in order to survive. Scott (2003) proposes three types of legitimacy (Scott, 1987): pragmatic, moral and cognitive, the first one is related with the practices, the second one with the social rules and the last one is about the professional and learning skills consider accepted.
A second theoretical approach proposes that the organization is dependent on its

environment and some organizational characteristics favor different organizational shapes which can favor or not the survival in a given environment (Burns & Stalker, 1961); (Lawrence & Lorsch, 1967), this contingency theory in that sense the organizations have a variety of roles in their environment and as consequence adopt several organizational forms, the fit between the organizational form and the environmental contingencies have an strong incidence in its survival.
A third theory is framed in the resource dependence concept, that means that the survival can be controlled from inside of the organization managing appropriately its resources and sources of power Pfeffer y Salancick (1978). This theory is based on an open system perspective where the environment is crucial in the survival of the organization, but the manager has a central role in this result. The managerial team can develop their managerial skills in order to manage the uncertainty and the power to develop internal agreements inside the organization in order to maintain the autonomy in face to the uncertainty of the environment.

3. Case study

The case that is going to be displayed is based on a study developed in the Universidad de los Andes-Colombia entitled "Diagnóstico De La Cultura Organizacional Como Herramienta Para El Análisis De La Misión De Una Organización Con Fin Social" or "Diagnostic of a the organization's culture as a tool in the understanding of social organization's cope"
This research concluded that a cultural diagnostic can be used in order to understand the reason why a social organization, that has a different behavior in terms of displaying the cop than non-social organization, has a missions drift.
The case study was the group Ingenieros Sin Fronteras Colombia (ISFCOL). To display its cultural diagnostic it was necessary to construct a methodology, with a soft systems approach, compound by different research tools as interviews and workshops. It was also essential the participation of the ISFCOL's actors that have had an important role in its development. As a result, it was possible to construct an historical register of the group.
Taking the historical register of ISFCOL, it is possible to tell that the group was born in 2007 without a clear organizational perspective but with a strong sense of the important of the university as a space to face Colombian's social and environmental problems. Nowadays ISFCOL, as a result of the research presented, can be defined as a group constitute by the Universidad de los Andes and the Corporación Universitaria Minuto de Dios that through the development of community projects and academic training looks for set up people with the abilities to generate social, sustainable and environmental changes.

Taking into a count the historical register mentioned before, it is possible to say that ISFCOL has survived as a result of the establishment of complexity management mechanisms related to its context and its resources. Following are presented these mechanisms and later an analysis in terms of its role into ISFCOL's survival.

3.1. Complexity management mechanisms of ISFCOL

In order to understand why the complexity management mechanisms developed by ISFCOL have allowed its survival, it is necessary to establish them.
In terms of complexity management mechanism, ISFCOL's transformation can be gather

in two periods: First, (from 2007 to 2009) and second, (from 2010 to the present). This establishment is based on the fact that in the first period, all ISFCOL activities revolved in to the development of only one project. As a result of the first project success, ISFCOL started to obtain, as a work space, not only the opportunities to develop more than one project, it also allowed to have academic spaces like seminars and courses. Next are presented the complexity management mechanisms that were established by ISFCOL in each period:

- First period (from 2007 to 2009)

ISFCOL activities: Project developed in Guayabal de Síquima.

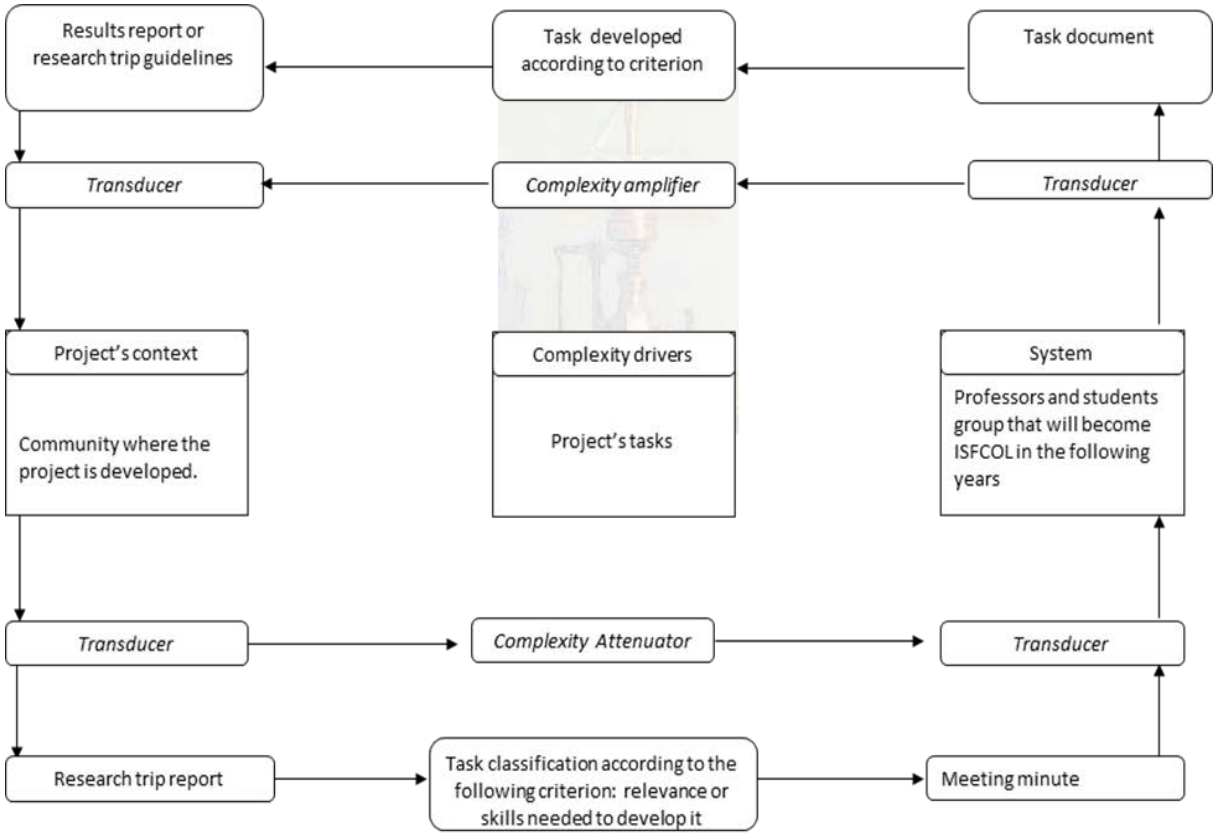

Figure 1. First period complexity management mechanisms

As it is show in the previous image, the complexity drivers were the project's tasks. These tasks where established after the research trip and displayed all the complexity management mechanism. The systems was by then the first group of professors and students that later became ISFCOL. As attenuator, the task was organized according to some criterion and as amplifier the task was displayed with this division. As a task and criterion example: the need to development of quality water proves only could have been managed by the environment engineering professor that was participating.

- Second period (from 2010 to 2012).

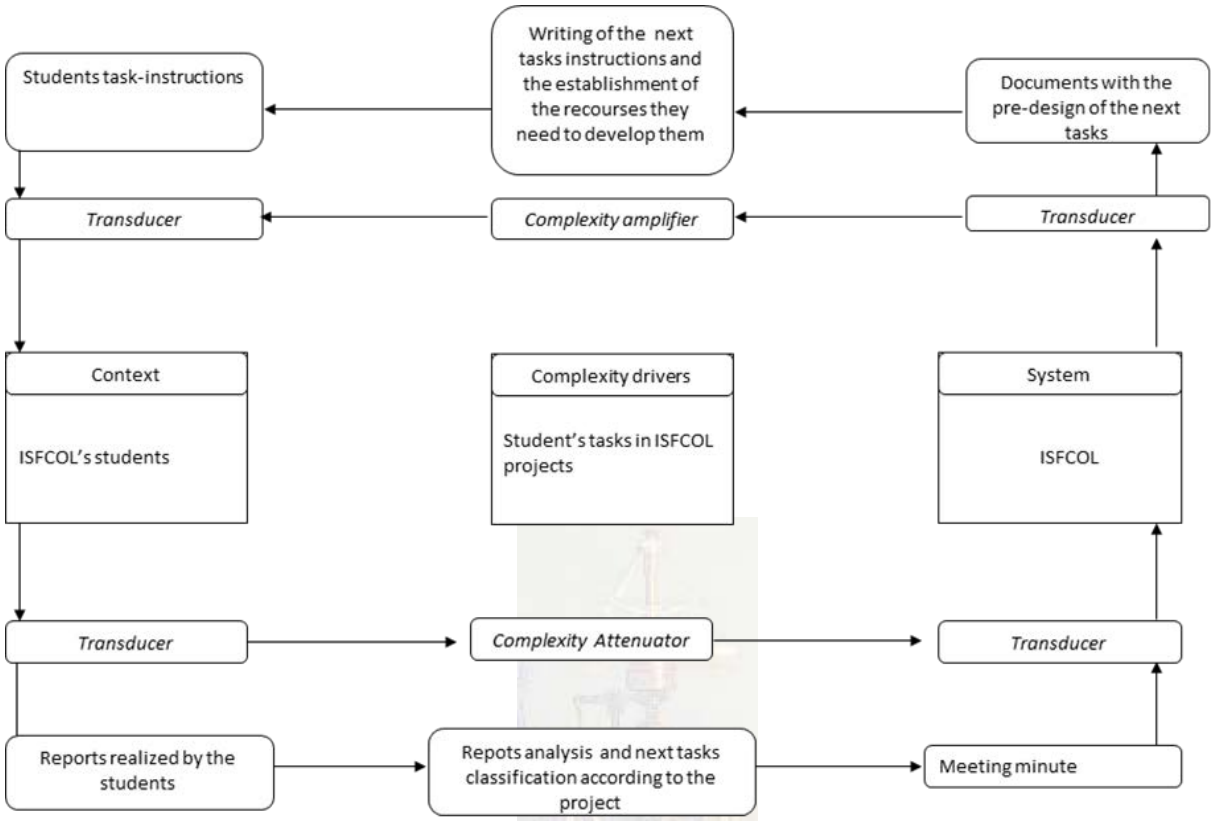

Figure 2.Second period complexity management mechanisms: complexity drivers, student's tasks

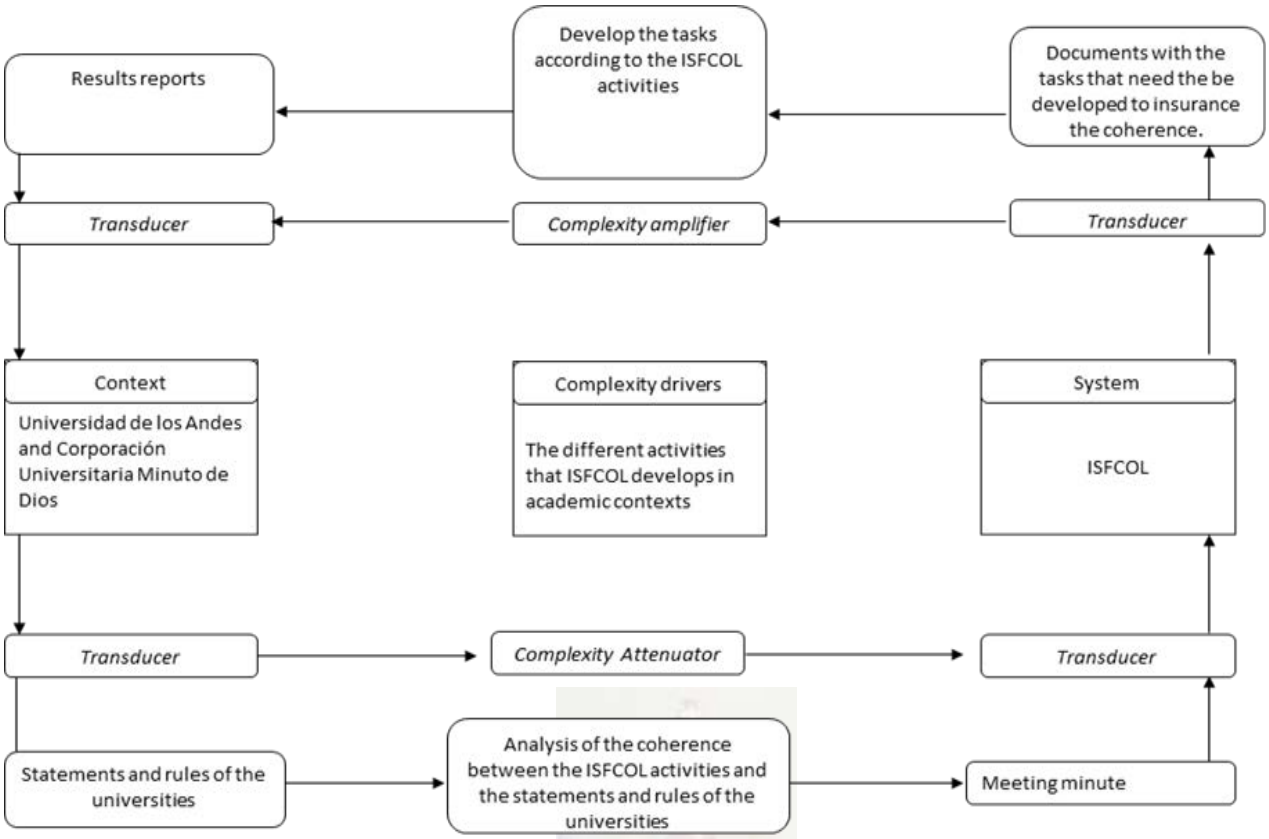

Figure 3.Second period complexity management mechanisms: complexity drivers, ISFCOL's activities developed in academic contexts

As it was told, the second period is characterized by an augmentation in the ISFCOL's complexity. After the success of the first projects, ISFCOL was able to establish the following activities:

- Class at Universidad de los Andes and in Universidad Minuto de Dios
- The international seminar.
- The development of more than one project.

It is important to mention that this transformation was gradual allowing that the adaptations of the recourses group to the development of the new activities. Based on that, the principal complexity management mechanisms were related to the project's and courses development where the first was done for each project developed and the second in order to make possible the university student's participation in social and engineering projects.

The last complexity management mechanisms was established in order to structure all the ISFCOL's activities taking into account the statements and rules of the universities.

Established the complexity management mechanisms in the next section it will be analyze its role into the ISFCOL's survival.

4. Discussion

Since ISF Colombia has created to generate learning processes of engineering in real contexts. Initially it was not clear if the complexity was responding to troubleshoot was vulnerable communities or generates processes of active learning engineering. As identified throughout the article, has been presenting a construction of group identity. Constructed mechanisms have sought to respond to learning and generate engineering solutions. However the rapid growth and the formation of alliances have created some confusion in the identity of the organization. Notwithstanding the foregoing has been successfully built, above all, a scenario of collaboration to address the complexity you want to assume.

For ISFC given the nature of their social projects and the voluntary participation of many of its members, makes the survival not obey logic of cost-benefit in economic terms but survival that allows the institutions that welcomes, in this case universities that provide the conditions for its operation and Uniminuto /Uniandes. From the above it can be said that the legitimacy, for example the recognition that organizations make the relevant environment on the work of ISFC, is a results of the management of variety that makes the organization in relation to its relevant environment.

Variety attenuators have allowed ISFC prioritize and select projects and stakeholders in each of the moments of its life cycle, making more effective control over their results and more targeted use of their resources in selected projects. This has the effect of recognition of two aspects: the organization has clear action your interests and produces a clear result with their performances.

As result of that management, the organizations in the relevant environment of ISFC recognize two aspects: the organization has well defined interests and produce concrete results with its projects.

As was mentioned in the previous sections, once established the complexity management mechanisms the probability of survival of ISFCOL increased. That can be attributed to two main elements: pertinence of its projects, and an appropriated reading of its own relevant environment. About the pertinence, it not only refers to the design and development of relevant and makeable solutions, it refers to the participatory nature of the methodology of the projects. People that participate in the projects is engaged because they feel that can contribute to real solutions, for real persons, on the other hand persons which are the beneficiaries of the projects fell that they are part of the solution.

The appropriated reading of the relevant environment, includes the projects but also the institutional environment in Uniandes and Unimiuto, and how the institutional priorities can be articulated with the purposes of ISFC, although at the beginning the role and importance of ISFC does not broadly recognize in those organizations, its role has been increasingly recognized in both institutions, as a result of a good variety management design addressed to that managerial and institutional level.

5. Conclusion

The appropriated evolution of the variety management mechanism in relation with the actors of its projects, has had as a result that the target population and population affected indirectly by the developed projects, recognize the organization as a driver of change and improvement of the local conditions. As a result of that dynamic, ISFC has presented an incremental path of recognizing as an organization for sustainability with a clear identity.

ISFC, also has played a role of institutional entrepreneur not only by its own conformation and design process, it is an institutional entrepreneur because has gave form to its own niche of actuation Uniandes and Uniminuto.

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Complexity, Sustainability and Self-Organisation: Using the VSM for improving sustainable governance

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Abstract

There is evidence that the results of global sustainability policies, strategies and programs, hasn't been as effective as expected, and that there are organisational and governance issues that need to be addressed for achieving better results. The author has suggested elsewhere that one of the core reasons for failure of implementation of many environmental policies and programs may be that they are implemented by hierarchical structures using rigid methodologies that are not able to cope with the complexity that most sustainability challenges are posing to organisations and communities.

This paper introduces current research on progressing the VSM as a meta-language to talk about viability and long-term sustainability of business, communities and societies, with particular focus on the governance challenges associated with long-term sustainability. It continues previous research where this proposal has been presented as an alternative conceptual and methodological approach to consider core issues of viability, sustainability and governance in organisations and societies.

It first presents the VSM as a meta-language to facilitate debates on core issues on self-organisation and self-governance in communities or businesses. Based on Beer's original theory, but taking a clear interpretivist approach, it then offers a briefing of the "Methodology to support self-transformation' in businesses and communities, based on this way of understanding the theory of viability.

As the purpose of this methodology is to support self-governance in organisations aiming to improve their sustainability or contribute to their regional or local sustainability agendas, the paper then explains the criteria suggested to assess sustainable governance in an organisation. Such criteria guide the formulation of a framework for assessing sustainable governance, which is then explained in some detail.

Later on the paper presents a critical review of a few experiences where this methodology and frameworks have been used in practice. They are examples of real situations where the self-transformation methodology inspired bottom up approaches to self-organisation and

self- governance. In each case the paper introduces the use of the sustainable governance framework to assess such experiences.

The reflections on each experience, using this assessment framework leave us with interesting lessons regarding how much governance issues can affect long term sustainability. They include reflections on the research implications in using this methodology and associated framework in the context of organisations aiming to improve their sustainability and self-governance.

Even if the methodology and related framework have been used in a limited number of situations up to now, it is recommendable to have more exposure and wider testing of these tools to improve their reliability and their possibilities of generalisability.

Regarding practical implications on the use of these tools, the paper also explains the lessons learnt from the experience in terms of the design of each of the systemic interventions, the choice of tools, the role of the analysts and the interactions with the organisational members. While there have been very positive experiences so far in using these tools, there are certainly issues that need improvement, like more robust assessment strategies that could be comparable among different applications.

The contribution of this paper is to provide a summary of a new theory of viability, sustainability and governance, from an organisational cybernetic approach, and related methodology and tools; to reflect on how these theoretical and methodological contributions fill some of the identified gaps in current literature concerning sustainability and governance. And to offer examples of insightful applications of these theories and tools in different contexts and scales, reflect on these experiences and identify possible research paths for further applications and further developments of the theory and related tools.

Keywords: viability, sustainability, requisite variety, governance, transformation,

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Corporate sustainability and Systems Thinking Methodologies: a literature review

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Structured Abstract

Purpose: The purpose of this paper is to review published works that have applied systems thinking methodologies to corporate sustainability (CS) situations. An overview of the available methodologies is presented and an analysis of the available works is developed.

Design/methodology/approach: Literature review of works related to sustainability in the context of organizations. A sample of top MS/OR and systems journals is surveyed looking for works that include keywords like systems dynamics, organizational cybernetics - viable systems model - team syntegrity, complexity - complex adaptive systems theory, soft systems methodology, critical systems heuristics.

Findings: For decades, systems thinking has strongly contributed to advance knowledge related to sustainability. However, scarce direct applications of methods derived from this field have been done to CS. In order, organizational cybernetics, system dynamics, complexity – CAS, soft systems methodology and critical systems heuristics have been those systems methodologies mostly used to address CS. A description of the specific topics addressed by each of these works is presented.

Originality/value: To sum up what has been done in the context of corporate sustainability using systems thinking methodologies / To build knowledge among managers and practitioners about the power that these methodologies have to adequately address CS issues.

Keywords
Corporate sustainability; Systemic methodologies; Operational research

Paper Type: Literature review

1. Introduction

Over the last decade, the idea of sustainable development that emerged in the context of a very agitated international agenda (Meadows, 1972; Meadows et al., 1992, 2004; Ruckelshaus, 1992; WCED, 1987) has started to be adopted by more and more companies. The initial idea that the current complex industrial system, which includes organizational and technological worlds, is the main responsible for global environmental destruction and a substantial threat to the future survival of the humanity (Capra, 2004) is getting more evident. It has been indicated that keeping consumption at the current levels, the Earth will not be able to sustain future world's population (Shrivastava, 1995)

Attending the need of an industrial system's change, organizations have been adjusting their practices and operations. However these have not produced the same results for all, and remain insufficient to achieve the expected global goals (Halt and Milstein, 1999). Some organizations see sustainable development as a cost (Lawrence and Morell, 1995) while others implement only punctual initiatives. In fact, most of these corporate efforts are closer to rhetoric that to effective actions (Strong, 1997). In general, it has been indicated that changes are superficial, and not conducive to the constitution of truly sustainable organizations and industries (Halt and Milstein, 1999; Senge et al., 2001). The implementation of Corporate Sustainability (further CS), and the changes that have to be performed within organizational structure to meet it, are anything but trivial (Holton et al., 2010).

Traditionally, sustainable development in organizations have been approached using the dominant paradigm which assumes that the path to sustainable development is the one where conditions like rapid global economic growth, free market access to products originated from developing countries, greater technological transfers and larger capital flows are present (Espinosa and Walker, 2011). According to the WCED, the probability of a sustainable future lays in the positive results generated by economic development (WCED, 1987, p. 89). Despite the attempts to make changes following this logic, it has been demonstrated that programs based on these ideas have not reached the expected results (Espinosa and Walker, 2011). For this reason, multiple calls have appeared suggesting the use of new approaches and paradigms to work or to study CS. Systems thinking has appeared as one of those alternative approaches that could give answers to this regard.

Despite these persistent claims, there is no real accounting about how systems thinking approach has contributed to CS. Until now, there have been few papers that started to make this work. On the one hand, and adopting a general view on several topics, Mingers and White (2010) developed a review of the contribution that systems thinking has done to the practice of operational research. They performed the review looking at papers from a theoretical and an application orientation, and concluded that while systems may not be well established institutionally, in terms of academic departments, it is very strong in terms of the quantity and variety of its applications. On the other hand, and focusing on environmental management, the paper written by Paucar-Caceres and Espinosa (2011) is another very important contribution. The authors made a description of the systems management science methodologies developed recently, and how these methodologies have been used in tackling environmental management and sustainable (EM/S) problems.

Nevertheless, these papers informed about the use of systems methodologies (SM), developed in management science / operational research (MS/OR) to address several

problems including the environmental management and sustainable (EM/S) practices, we have not found a work focusing on the application of systemic thinking methodologies to the issue of sustainability inside an organization.

For this reason, in this study, we want to advance the knowledge about sustainability in the context of a firm or what is named as Corporate Sustainability. The guiding idea in this paper is that CS can be studied and implemented using systemic approaches. We firmly believe that systemic management science methodologies could help in the endeavor to advance the implementation of CS. In this paper, we will focus on CS, researching on the contributions that systems thinking methodologies have done to the field. We focused on studies that use methods classified as systemic.

The paper proceeds as follows: (i) we describe how the research on CS has developed and the reasons why traditional approaches to it have not produced the expected results; (ii) secondly, we explain the reasons why we consider that systems thinking can help or have helped to the implementation of CS; (iii) the third section explains the theories and methods that belongs to the area of systems thinking and that compose the framework used to tackle the problem of CS; (iv) based on this, we describe the framework used to classify the systems discourses on CS; (v) we explain the strategy in surveying the journals and a set of established SMs is assembled: several typical keywords associated with them are used to identify papers that corresponds to each discourse. Finally, (vi) the main characteristics of a sample of articles in each discourse are discussed and conclusions are drawn together with points for further research.

2. Corporate sustainability research development and the need of a new approach

Sustainability has become a very debated goal at the governmental, urban, and corporate, public or private organizations' levels. For long time, several aspects of sustainability have been studied in the academic world, mainly from the economic and accounting perspectives. However, it was not until 1970s, 1980s, and 1990s that sustainability went beyond the economic setting. Academics around the world started to show more interest on the link between economic activity and environmental impacts (Daly, 1996; Ekins et al., 2003; Meadows, 1972; Meadows et al., 1992, 2004). It was the appearance of the Bruntland report (1987) and the UNCED 'Earth Charter' Conference in Rio de Janeiro in 1992 that initiated the interest on sustainability at the corporate level.

This constant debate around the concept of sustainability brought side effects to the development of knowledge in the field. At the societal level, more than one hundred different definitions exist (Steurer, 2001, p. 537), making the sustainability concept a very confusing one. Nonetheless, these seem to have points of consensus, mainly regarding "the aim to create a development towards the best possible quality of life for an indefinite period of time which can be extended to the whole globe" (Schaltegger and Burritt, 2005, p. 197). At the corporate level, the concept of sustainability has been understood from the viewpoint of the "triple bottom line" (Elkington, 1998). Here, the known dimensions of sustainability (economic, social, environmental) are tailored into actions regarding financial, social and environmental organizational dimensions (Porter, 2008).

However, and given the poor results achieved by corporations that have tried to internalize sustainability, it seems that traditional approaches are not the appropriate lens to understand the complex nature of sustainability at the level of the firm, and lack the capacity to deal with the ample number of variables found in complex situations like CS. As Meadows et al. (1992) indicated, we need nothing else than a paradigm shift. It is not only a matter of

recognizing causes and consequences derived from complex issues, but to develop new ways to understand and deal with these issues.

Several disciplinary areas have identified the need of utilize new approaches to the management of CS issues. For instance, from environmental management fields, scholars have made claims towards the use of new approaches to CS management research and implementation (Lewis, 1997; Schaltegger et al., 1998). From systems thinking fields, the claims have been toward the use of holistic approaches and a systemic conception of sustainable development (Espinosa and Walker, 2011; Meadows, 1972; Pérez-Ríos, 2012; Schwaninger and Pérez-Ríos, 2008; Schwaninger, 2000, 2001; White and Lee, 2009). In this study, we argue that holistic or systems-based approaches could be a more appropriate paradigm to face the problem of CS implementation.

3. Soft Operational Research (OR), Systems Thinking theory and methods

Since its beginnings, the field of Operational Research (OR) has developed a series of tools to model decision making situations with the aim to achieve well-defined objectives within a systems framework. However, this hard approach, traditionally called Hard OR, does not always resulted in adequate solutions for all problematic situations. This approach is 'systematic' in nature, which means that it relies in quantitative-, logical- oriented set of tools and techniques (Paucar-Caceres, 2008). When a group of OR thinkers declared to be in opposition to the hard OR approach (Ackoff, 1979; Checkland, 1978), a set of alternative approaches (called soft OR) for decision-making and problem solving appeared. From this moment, soft OR and soft systems thinking academics have been involved in the creation of new methods, specifically aimed to handle multiple, and conflicting values (Jackson, 2009).

Given the fact that CS issues are very complex in nature, we consider that the methods developed by systems thinking discipline are appropriate to support those firm-level adaptation initiatives related to CS. The achievements accomplished by systems thinking promise more adequate tools to face with these types of situations. As Pérez-Ríos has stated "Systems Thinking provides an intellectual framework of great utility for dealing with the numerous problems affecting both humanity (ecological disasters, the unequal distribution of wealth, threats of biological, chemical and nuclear terrorism, corruption, the absence of a suitable global judicial system, massive migratory movements, climate change, etc.) as well as organisations and firms" (2012, p. 1).

Systems thinking have a tradition that started in the beginning of the twentieth century, but it was not until the mid century that this tradition became a discipline. The work done by Wiener (1948) and Von Bertalanffy (1968) established the initial path for the developments to come. The years between 1950 and 1970 was the period when systems thinking influenced the most not only on management sciences but also on other disciplines (Pérez-Ríos, 2004). However, since the 70s, the traditional systems thinking have been under criticism principally because of its usefulness in situations that deal with ill-structured problems, that cannot reach easy agreements, or that face opposing interests (Pérez-Ríos, 2012). As a result of these critiques, a new set of alternative approaches appeared, capable to deal with these problematic issues. Lastly, new critical currents, called emancipatory or critical movement, emerged addressing issues related to how system thinking approaches and science, in general, have been applied.

4. The development of systems thinking approaches to management and its methodologies

In the case of systems approaches related to management, the development have been done through three main waves (Midgley, 2000a). The first wave of methods and tools (functionalist systemic approach) based on systems analysis, systems engineering, and early versions of systems dynamics, were useful to study unitary problems clearly identified and with specific goals. Here, the main belief was that organizations can be seen as objective worlds (Paucar-Caceres and Espinosa, 2011), and problems could be solved in full knowledge of all the possibilities. However, because of its reliance on mathematical models, these new methods were not useful on complex situations and were criticized because of its insufficient consideration of individuals' perception of reality (Pérez-Ríos, 2004). More recent elaborations of this wave have developed what is called as Complexity Theory Paradigm (Nicolis and Prigogine, 1977; Prigogine and Hiebert, 1980), looking at open systems characterized by elements that interact dynamically, nonlinearly, and that exhibit unpredictable behaviors.

The situation described stimulated the appearance of several approaches. By 1970s, appeared Stafford Beer's Organizational Cybernetics, directed to find the foundations for viability (Pérez-Ríos, 2012). Then, the second wave of systems thinking (interpretive systemic approach) surged, putting emphasis on dialogue and inter-subjective construction of realities, where people is located at the center of the study making perceptions, beliefs, values, and interests its main concern. With this wave, emancipatory systemic approaches appeared, taking into account that there are multiple perceptions of reality. Under this point of view, the importance is to identify the different "world views" (Weltanschauungen) or "appreciative systems" people use in order to understand and construct social reality (Churchman, 1971, 1979, 1983). The issue therefore becomes a search for "accommodation" among the different groups in the coalition that an organization represents. This wave also encourages the evolution of systems dynamics that adopted some of the ideas brought by this second wave (Lane and Oliva, 1998; Pérez-Ríos and Schwaninger, 1996; Schwaninger and Pérez-Ríos, 1996).

Despite the achievements made by the methods created during the second wave (combining first wave's tools with the incorporation of the subject and dialogue) the new methods did not escape the criticisms. The critics principally signaled an inadequate treatment of the power relations and the interests that the tools served (Ulrich, 1983). Thus, a third wave of systems thinking born (emancipatory systemic approach), following the same critical tradition existing in philosophy and sociology (Pérez-Ríos, 2012). The goal of this new wave was to develop an approach directed to "explore purposes", to "ensure fairness", and to "promote diversity" (Jackson, 2003). In the last few years, this evolutionary process has been accompanied by the interest on the use of several methodologies in the same study (Jackson and Keys, 1984; Jackson, 2000; Midgley, 2000b; Mingers and Brocklesby, 1997; Pérez-Ríos and Schwaninger, 1996; Schwaninger and Pérez-Ríos, 2008; Schwaninger, 1997), leading to an increased interest in methodological pluralism.

Organizational cybernetics, which was born during 1970s with the language and tools developed by Stafford Beer (Beer, 1979, 1981, 1988), continued its evolution specially with the development of the VSM (Viable Systems Model) and Team Syntegrity (Beer, 1995). Also Von Foester (1995) and Maturana and Varela, with their second order cybernetics (Maturana and Varela, 1987; Maturana, 1980), advanced the knowledge of organizational cybernetics.

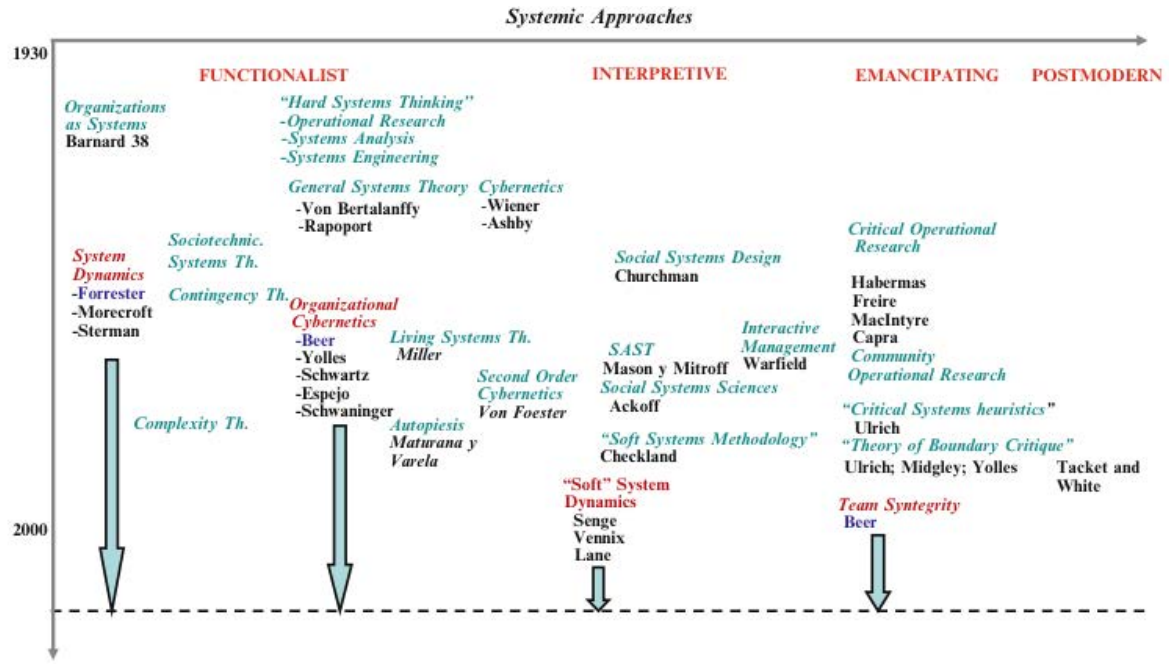

Figure 1. Several representative methods of different systemic approaches (Pérez-Ríos, 2012)

Figure 1 shows several trends in the systemic thinking approach, named functionalist, interpretative, emancipatory and post-modern, with their correspondent schools. This figure pretends to show a possible setting for the existing systemic approaches. Taking into account the way systems thinking has developed a description of several systemic discourses created in the context of this is approach is presented in the next section.

5. General description of the survey

Journals included in the survey

We decided to make the survey using a sample of journals dedicated to publish academic works on operational research (OR), systems practice (SP), business and environment relationship (BE), and management science (MS). We decided to include in our sample not only those journals with high impact factor in the ISI web of knowledge or that have appeared in various quality journal list scoring two or more stars (Academic Journal Quality Guide, 2010), but also journals that are well known in the fields mentioned, but that are not yet included in the ISI index nor have a high impact factor. Additionally, we decided to limit our search to European and American journals. The sample of journals is composed by 29 publications: two OR, seven SP, four BE, and fifteen MS journals.
OR journals: the Institute of Operations Research and Management Science (INFORMS) publishes 12 journals. From these, we selected two journals: *the Journal of Operational Research Society (JORS) and the European Journal of Operational Research (EJOR)*.
SP journals: most of the journals included in this sample were selected from the publications born inside the UK systems community because of its influence in the dissemination of knowledge regarding soft and critical OR, information systems and environmental management (Paucar-Caceres and Espinosa, 2011). We have selected

Kybernetes, Systems Practice and Action Research (SPAR), the Systems Research and Behavioural Science (SRBS), Cybernetics and systems, International Journal of applied Systemic Studies, and IEEE Systems Community, System Dynamics Review.
BE journals: the journals included in this sample were chosen according to its influence to the study of business and environment relationship. We selected Business strategy and the environment, Sustainability, Corporate Social Responsibility and Environmental Management, and Sustainability Accounting, Management and Policy Journal.
MS journals: The journals in this sample were primarily selected according to their impact factor in the ISI web of knowledge, and because these have published sustainability studies of any kind. Despite the fact that we know these journals prefer studies that apply more traditional methods, we wanted to confirm if systems thinking has permeated this community at any level. The sample included Academy of management Journal, Academy of Management Review, Administrative Science Quarterly, California Management Review, British Journal of Management, Journal of Management, Management Science, Strategic Management Journal, International Journal of Operations & Production Management, Journal of Organizational Change Management, California Management Review, Organization Science, Organization Studies, Organizational Dynamics, Journal of International Business Studies, and Journal of Operations Management, System Dynamics Review.
Survey methodology
The search was performed using the academic databases available at Universidad de los Andes library. The databases included were EBSCO HOST, Emerald, JStor, Proquest, Sage Premier, Science Direct, Springer, and Wiley Online Library. The goal was to find all the articles available online that where published between January 1989 and December 2013. We adhere to the idea suggested by Paucar-Caceres and Espinosa (2011) in the sense that we not only considered that this period of time is the most representative for non-classical MS/OR, but also because it was during this two-decades that this approach really emerged.
Regarding the keywords used during the survey, we built two different sets of these. The first one included words related to CS. The second set included the words related to systems thinking. Thus, the first set of words is: business sustainability, CS, corporate environmental management, corporate environmentalism, organizational viability, and organizational sustainability. The second set is: systems thinking, systemic thinking, problem structuring methods.
To perform the survey, the following conditions were applied:

a. Each keyword related to CS (keywords in the first set) was paired to each of the keywords representing the methods (keywords in the second set).
b. Each pair of keywords was searched for its occurrence in any part of the article.
c. An additional filter was applied, classifying the papers in one of two sets: those papers where the focus was on public organizations and those where the focus where on private organizations. We wanted to study in which of these contexts the systemic methodologies were most applied.

6. Systems thinking responses to CS

Nevertheless we built what we considered an extensive sample of journals in different disciplines, the survey performed resulted in a short list of works, giving support to the argument of White and Lee (2009) in the sense that OR approach is yet to be fully utilized

in the context of sustainable development. Now, focusing on CS, this is even more evident. Direct applications of systems thinking methods to sustainability in the context of organizations are very scarce.

As already has been noted by other works (Mingers and White, 2010; Paucar-Caceres and Espinosa, 2011) that compile what has been done regarding soft OR, systems thinking, and sustainability approaches, we found that the contexts of application are diverse. For example, in the context of sustainability, we found several papers applying these methods to communities (Mannen et al., 2012; Wals and Schwarzin, 2012), cities, regions (Bell and Morse, 2005; Khisty, 1995; Wei et al., 2012; White and Lee, 2009), environment conservation (Hjortsø, 2004; Lister, 1998), and disaster management (Preece et al., 2013). Some others have suggested the application of these methods to the study of sustainability inside firms but without going into much details about how to do it (Broman et al., 2000). In the specific context of CS, **48** papers were located.

7. Discussion of results

Table 1 presents those relevant works applying systems thinking in the context of problems related with the implementation of CS. In the survey, we have found that the systems thinking academics had predominantly used five systems approaches to study CS. The methodologies found are: (i) Systems dynamics, (ii) Organizational Cybernetics - Viable systems model - team syntegrity, (iii) Complexity - Complex Adaptive systems theory, (iv) Soft Systems Methodology, (v) Critical systems Heuristics – CSH. Regarding the most applied systems thinking methodology to study CS are: (i) 23 papers use organizational cybernetics - viable systems model - team syntegrity, (ii) 14 papers use systems dynamics, (iii) 9 papers use complexity - complex adaptive systems theory, (iv) 1 paper uses Soft Systems Methodology, and (v) 1 paper uses Critical systems Heuristics – CSH. The discussion about how the academics apply the mentioned methodologies to the study of CS is ordered in the next sub-sections according to each of the methodologies.

	Author	Year	Title	Journal	Type of organization(s)	Main issues explored	Type of paper	Method used
1	Achterbergh, J., and Vriens, D.	2002	Managing viable knowledge	Systems Research and Behavioral Science	private	The authors use the VSM as a framework to understand and to realize the organizational functions required for viability. With the application of the VSM, firms can guide their production of knowledge needed to maintain its viability.	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
2	Achterbergh, J., Beeres, R., and Vriens, D.	2003	Does the balanced scorecard support organizational viability	Kybernetes	private	The authors use VSM as a criterion to analyze the contribution of BSC to organizational viability. The achieve the goal, BSC is compared to the VSM.	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
3	Backstrom, T.	2009	How to organize for local resource generation	The learning organizacion	private	The authors use a simple model based on CAS to find that decentralized resource generation is one way of obtaining sustainability. Additionally, the co-existence of both autonomy and integration of employees, combined with a leadership of transformative character, all encourage the organizational actions to obtain sustainability.	Theoretical / Empirical	Complexity - Complex Adaptive systems theory
4	Benn, S. & Baker, E.	2009	Advancing Sustainability Through Change and Innovation: A Co-evolutionary Perspective	Journal of Change Management	private	The article proposes to see the organization as a Complex Adaptive System in order to increase the preponderance of ecological values.	Theoretical / Empirical	Complexity - Complex Adaptive systems theory
5	Bianchi, C. & Montemaggiore, G.	2008	Enhancing strategy design and planning in public utilities through "dynamic" balanced scorecards: insights from a project in a city water company	System Dynamics review	public	The article shows the use of "dynamic" balanced scorecards to improve the planning process in a strategic learning perspective.	Case Study	Systems dynamics
6	Bianchi, C., & Bivona, E.	2002	Opportunities and pitfalls related to e-commerce strategies in small–medium firms: a system dynamics approach	System Dynamics review	private	A system dynamics approach is used to demonstrate how a model built under this approach can help in persuing an e-commerce strategy.	Theoretical / Empirical	Systems dynamics
7	Bivona, E., & Montemaggiore, G. B.	2010	Understanding short- and long-term implications of "myopic" fleet maintenance policies: a system dynamics application to a city bus company	System Dynamics review	public	A systems dynamics model is built to help managers of a city bus company to understand how a decision about a financial variable causes unintended consequences on performance and affects long-term sustainability	Empirical	Systems dynamics
8	Brewis, S.	2002	The application of managerial cybernetics to the creation of a viable enterprise	Journal of the Communications Network	private	The author presents how managerial cybernetics can be applied to the development of a viable firm.	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
9	Cavaleri, S.	2013	Corporate Sustainability Dynamics: A Systems Analysis	System Dynamics review	private	The purpose of the article is to demonstrate how organizational context, dynamics, and strategy can work together as part of a systemic framework to improve firm sustainability performance.	Theoretical / Empirical	Systems dynamics
10	Duran-Encalada, J. A., & Paucar-Caceres, A.	2011	System dynamics sustainable business model for Petroleos Mexicanos (Pemex): case based on the Global Reporting Initiative	Journal of the Operational Research Society	private	The paper presents how a firm can understand the complexity that surrounds the implementation of sustainability policies and strategies in a firm. To achieve this, systems dynamics were used to build a model to understand this.	Empirical	Systems dynamics
11	Espejo, R., & Stewart, N. D.	1998	Systemic reflections on environmental sustainability	Systems Research and Behavioral Science	Public / Private	By using the concepts of organizational cybernetics and considering the ways that the relationships between firms and society are developing in the current economic environment, the authors develop a discussion about the structural requirments that plants, industries and corporations needed to be more responsible to their environment.	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity

	Author	Year	Title	Journal	Type of organization(s)	Main issues explored	Type of paper	Method used
12	Espinosa, A. & Porter, T.	2011	Sustainability, complexity and learning: insights from complex systems approaches	The learning organizacion	private	The authors explore contributions from the Viable Systems Model (VSM), and the Complex Adaptive Systems (CAS) to complexity management in organizations aiming to improve their sustainability	Theoretical	Organizational cybernetics - Complex Adaptive systems
13	Espinosa, A. & Walker, J.	2006	Environmental management revisited: Lessons from a cybernetic intervention in Colombia	Cybernetics and systems	private	The authors use the Viable Systems Model as a tool to diagnose and to deal with high complex environmental problems	Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
14	Flumerfelt, S. Siriban-Manalang, A. & Kahlen, F.	2012	Are agile and lean manufacturing systems employing sustainability, complexity and organizational learning?	The learning organizacion	private	The paper discusses about how Agile management and Lean management both supports successful organizational systems excelling at sustainability, complexity management and learning.	Theoretical	Complexity - Complex Adaptive systems theory
15	Gary, M. S., Kunc, M., Morecroft, J. D., & Rockart, S. F.	2008	System dynamics and strategy	System Dynamics review	N/A	The paper studies how system dynamics can help to understand the differences in the evolution of firms' performance and argue that managerial decision making is the source of such a difference. This article also presents paths for system dynamics contributions to the field of strategy.	Theoretical	Systems dynamics
16	Hoverstadt, P., & Bowling, D.	2005	Organisational viability as a factor in sustainable development of technology	International Journal of Technology Management & Sustainable Development	private	The authors show, through three case studies, how a lack of organizational viability led to technological unsustainability in established industries. VSM is the tool used to assess organizational viability	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
17	Jenner, R. A.	1998	Dissipative enterprises, chaos, and the principles of lean organizations.	Omega-International Journal of Management Science	private	The article develops a theoretical discussion in which the main proposition is that a lean enterprise is successful because of its self-organizational behavior.	Theoretical	Complexity - Complex Adaptive systems theory
18	Keating, C.	2000	A systems-based methodology for structural analysis of health care operations	J. of Management in Medicine	private	The paper develops a methodology to asssess the current organizational structure, to determine its deficiencies, and to improve the "structure-in-use" to gain better performance	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
19	Kira, M. & Van Eijnatten, F.	2008	Socially sustainable work organizations: A chaordic systems approach.	Systems Research and Behavioral Science	private	This paper focuses on human and social sustainability in contemporary work organizations. The aim is to outline a theoretical approach inspired by the complexity theory to promote human and social sustainability at work. The authors compare general open systems thinking (OpST) with socio-technical systems (STS)	Theoretical	Complexity - Complex Adaptive systems theory
20	Kira, M. & Van Eijnatten, F.	2010	Socially sustainable work organizations and systems thinking.	Systems Research and Behavioral Science	private	The authors discuss about socially sustainable work organizations and also about systems thinking as an important tool in promoting social sustainability.	Theoretical	Complexity - Complex Adaptive systems theory
21	Knowles, K., & Espinosa, A.	2009	Towards an Holistic Framework for Environmental Change: The Role of Normative Behaviour and Informal Networking to Enhance Sustainable Business Practices	Systems Research and Behavioral Science	private	Based on the hypothesis that most methodologies and practices for environmental management do not adopt a holistic perspective, causing significant problems in implementation, the authors explain the reasons why meta-systemic principles of self-organisation and distributed network management offer clear criteria to design an environmental management system	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
22	Kouloura, T. C., Panagiotakopoulos, P. D., & Safigianni, A. S.	2008	A Systems Approach to Corporate Sustainability in Energy Management of Industrial Units	IEEE Systems Journal	private	The paper describes how a cybernetic intervention, using VSM, improves the company's energy costs and contribute to energy planning and environmental protection goals	Empirical	Organizational Cybernetics - Viable systems model - team syntegrity

	Author	Year	Title	Journal	Type of organization(s)	Main issues explored	Type of paper	Method used
23	Lewis, G. J.	1997	A CYBERNETIC VIEW OF ENVIRONMENTAL MANAGEMENT: THE IMPLICATIONS FOR BUSINESS ORGANIZATIONS	Business Strategy and the Environment	private	The author use the VSM as a tool to analyse current environmental management practices in seven manufacturing organizations	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
24	Lyneis, J.	1999	System dynamics for business strategy: a phased approach	System Dynamics review	private	The paper presents a four-phased approach to consulting to offer reliable means to develop system dynamics model for supporting business strategy implementation while, at the same time, educating the clients.	Theoretical	Systems dynamics
25	Marshall, R. S., & Brown, D.	2003	The Strategy of Sustainability: A SYSTEMS PERSPECTIVE ON ENVIRONMENTAL INITIATIVES	California Management Review	private	Using systems dynamics modeling, a company can identify relevant components of an environmental sustainability initiative, assist managers to facilitate systemic change, and clarify roles of stakeholders	Empirical	Systems dynamics
26	Martínez-Suárez, X. & Pérez-Ríos, J.	2014	An Organizational Cybernetics Approach to University Planning in an Urban Context: Four Intervention Experiences	In Understanding Complex Urban Systems: Multidisciplinary Approaches to Modeling	public	The chapter discusses the use of organizational cybernetics to identify the variety of needs that have to be considered in a planning-related intervention in a Spanish university campus.	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
27	Mitleton-Kelly, E.	2011	A complexity theory approach to sustainability A longitudinal study in two London NHS hospitals	The learning organizacion	private	The paper is a case study where there is a discussion about how leadership enables the right environment for developing sustainability. These cases highlight some essential elements of Organizational Sustainability, and underline that Organizational Sustainability is a continuous process of co-evolution.	Theoretical	Complexity - Complex Adaptive systems theory
28	Moizer, J., & Tracey, P.	2010	Strategy Making in Social Enterprise: The Role of Resource Allocation and Its Effects on Organizational Sustainability	Systems Research and Behavioral Science	NGO	The paper aim to use causal-loop diagramming to frame the strategic challenges facing social enterprises and to help identify possible solutions. These Causal-loop diagrams have been used as a tool for conceptualizing a wide range of organizational issues, but it has not been used to consider the challenges facing those leading and managing social enterprise.	Theoretical / Empirical	Systems dynamics
29	Panagiotakopoulos, P.D. & Jowitt, P.W.	2007	Sustainability concepts and tools: a cybernetic approach	Proceedings of the 10th International Conference on Environmental Science and Technology	private	The paper compares Triple Bottom Line, The Natural Step and the Ecological Footprint using as a template VSM	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
30	Paucar-Caceres, A. & Rodriguez-Ulloa, R.	2007	An application of Soft Systems Dynamics Methodology (SSDM).	Journal of the Operational Research Society	private	This paper reports on the application of a multimethodological approach that combines SD and soft systems methodology (SSM), and applies it to a latin-american company	Theoretical / Empirical	Systems dynamics
31	Pérez Ríos, J.; Martínez X.L.; & Velasco I.	2012	Design and diagnosis for viable organizations in practice: University Urban Planning	Kybernetes	Public	The paper shows how Organizational Cybernetics has been used by a public institution to guide its strategic management. Issues related to sustainable development and university urban planning are treated in detail.	Theoretical / Empirical	Organizational Cybernetics and Urban Planning
32	Pérez-Ríos, J	2012	Design and Diagnosis for Sustainable Organizations: The Viable System Method	Book	NA	The author combines systems theory with cybernetics to help managers to shape their organizations, and transform them into viable ones.	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
33	Pérez-Ríos, J. & Martínez-Suárez, X.L	2012	Organizational Cybernetics and Urban Planning: The Case of the University of A Coruna	In S. Grösser & R. Zeier, eds. Systemic Management for Intelligent Organizations: Concepts, Model-Based Approaches, and Applications	public	This case shows how organizational cybernetics and specially, the Viable Systems Model was used by the top management of a public univeristy at Spain.	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity

	Author	Year	Title	Journal	Type of organization(s)	Main issues explored	Type of paper	Method used
34	Porter, T.	2008	Managerial Applications of Corporate Social Responsibility and Systems Thinking for Achieving Sustainability Outcomes	Systems Research and Behavioral Science	private	The paper studies how to achieve sustainability goals inside an organization using CAS and interpretive systemic approaches	Theoretical	Complexity - Complex Adaptive systems theory
35	Potocan, V., & Mulej, M.	2009	Business cybernetics – provocation number two	Kybernetes	private	The authors suggest a holistic definition and fundamental guidelines for implementation of specific cybernetics dealing with business systems	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
36	Potocan, V., Mulej, M., & Kajzer, S.	2005	Business cybernetics: a provocative suggestion	Kybernetes	private	The authors use cybernetic concepts to propose requisitely holistic consideration of business sytems.	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
37	Putnik, G. & Putnik, Z.	2012	Lean vs agile in the context of complexity management in organizations	The learning organizacion	private	The paper explores the thesis that "lean" and "agile" are two exclusive concepts, and that "agile" has a higher potential for serving as an instrument for starting "a journey" towards a new sustainable organizational paradigm. In that sense, agile is preferable. Based on this and using the chaordic organizations (CO) framework, the phases where lean and agile approaches could be applied.	Theoretical	Complexity - Complex Adaptive systems theory
38	Ramirez, G.	2012	Sustainable development: paradoxes, misunderstandings and learning organizations	The learning organizacion	private	The paper develops a theoretical discussion about how managerial cybernetics, organizational learning and holistic approaches to the sustainability problem contribute to its better understanding	Theoretical	Organizational Cybernetics - Viable systems model - team syntegrity
39	Reynolds, M.	2008	Getting a grip: Critical systems for corporate responsibility.	Systems Research and Behavioral Science	private	The paper analyses the potential that critical systems heuristics (CSH) has in addressing corporate social responsibility dylemmas	Theoretical	Critical systems Heuristics
40	Richmond, B.	1997	The Strategic Forum: aligning objectives, strategy and process	System Dynamics review	private	The author presents the "strategic forum" process as a method to align strategy and business processes with stated objectives looking for internal consistency among these.	Theoretical / Empirical	Systems dynamics
41	Schwaninger, M.	2000	Managing Complexity—The Path Toward Intelligent Organizations	Book	private	A framework for the design of intelligent organizations is proposed using: the Model for Systemic Control, the Viable System Model, and the Team Syntegrity model. The proposition is that this framework enables an effective response to complex situations.	NA	Organizational Cybernetics - Viable systems model - team syntegrity
42	Schwaninger, M., & Perez-Rios, J.	2008	System dynamics and cybernetics: a synergetic pair	System Dynamics Review	private	The paper makes a detailed review of the strengths and weaknesses of Organizacional Cybernetics and System Dynamics and why and how they can be used in combination	Theoretical / Empirical	Organizational Cybernetics- Viable System Model- System Dynamics
43	Škafar, B., & Mulej, M.	2008	Business excellence in public-utility companies by innovativeness based on dialectical systems thinking	Cybernetics and Systems: An International Journal	public	The authors develop a new model for business excelence based on dialectical systems (the science about interdependence and its resulting dynamics). This model pretends to apply holistic principles to management even more than the well-recognized ones like the EFQM-EQA	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity
44	Smith, P. & Sharicz, C.	2011	The shift needed for sustainability	The learning organizacion	private	The paper shows how sustainability is currently viewed and implemented in organizations, and suggests from a systemic point of view which critical components of sustainability are yet to be seriously addressed.	Theoretical / Empirical	Systems dynamics

	Author	Year	Title	Journal	Type of organization(s)	Main issues explored	Type of paper	Method used
45	Somerville, M. & Mirijamdotter, A.	2005	Working Smarter: An Applied Model for "Better Thinking" in Dynamic Information Organizations	Proceedings of the 12th National Conference of the Association of College and Research Libraries	private	The authors present an applied model for cultivating 'better thinking' for 'working smarter' within dynamically changing information organizations. Based in systems thinking, the methodology Dialogue- Driven Dynamic System, presupposes that contemporary organizations exist amidst constant changes and "vaguely graspable futures" (Holst et al. 2004, 13). It follows, then, that organizational sustainability depends on growing persistent capabilities to collectively and continuously adapt.	Theoretical / Empirical	Soft Systems Methodology
46	Stave, K.	2010	Participatory System Dynamics Modeling for Sustainable Environmental Management: Observations from Four Cases	Sustainability	private	A participatory systems dynamics modeling framework is used to involve stakeholders in a deliberation about different decisions	Empirical	Systems dynamics
47	Thompson, J & Cavaleri, S.	2010	Dynamic Knowledge, Organizational Growth, and Sustainability	int. studies of mgt. & org	private	The paper illustrates how a consultant used system dynamics to catalyze improving the quality of knowledge in an organization. The authors propose a tool for assessing the quality of knowledge to improve organizational sustainability	Theoretical / Empirical	Systems dynamics
48	Zlatanovic, D.	2012	Viable system model in (re)designing an organization – case study	Economic	private	The authors develop a theoretical discussion where VSM features are introduced in the context of design and re-design of organizations looking for learning and adaptavility.	Theoretical / Empirical	Organizational Cybernetics - Viable systems model - team syntegrity

Table 1. Articles applying systems thinking methodologies to the study of Corporate Sustainability (CS)

i) Organizational Cybernetics - Viable systems model - team syntegrity

From Table 1 we found that perhaps organizational cybernetics has been the most used systems thinking methodology for the support in the CS implementation. Under this perspective, viability is considered as a necessary condition to achieve sustainability. Taking this into account, the VSM is the preferred tool, and several papers utilized it as a template to determine organizational viability in diverse contexts. By using the core concepts of VSM, Espejo and Stewart (1998) discuss the structural requirements that plants, industries and corporations could be more responsible to their environment. Achterbergh, Beeres, and Vriens (2003) use VSM as a criterion to analyze the contribution of Balanced Scorecard to organizational viability. Achterbergh and Vrien (2002) and Brewis (2002) use the VSM as a framework to understand and to realize the organizational functions required for viability. Panagiotakopulos and Jowitt (2007) also use VSM as a template to compare the Triple Bottom Line, The Natural Step, and the Ecological Footprint. Lewis (1997) analyzes the VSM as a tool to assess current environmental management practices in seven manufacturing organizations. From a theoretical point of view, Ramirez (2012) makes a theoretical discussion about the contribution that organizational cybernetics has on the understanding of sustainable development. Schwaninger and Pérez-Ríos (2008) propose the combination of organizational cybernetics and systems dynamics to work regarding organizational viability. Others like Skafar and Mulej (2008), based on cybernetic principles and dialectical systems present a model for business excellence, applying holistic principles to management. Moreover, Potocan, Mulej and Kajzer (2005) and Potocan and Mulej (2009) utilize organizational cybernetic principles to suggest basic principles and guidelines to deal with business systems. They propose the concept of Business Cybernetics (BC). The rest of the papers use the VSM as the main tool to deal with complexity in the context of sustainability and viability inside an organization (Espinosa and Porter, 2011; Espinosa and Walker, 2006; Hoverstadt and Bowling, 2005; Keating, 2000; Knowles and Espinosa, 2009; Kouloura et al., 2008; Martínez-Suárez and Pérez-Ríos, 2014; Pérez-Ríos and Martínez-Suárez, 2012; Pérez-Ríos, 2012; Pérez-Ríos et al., 2012; Schwaninger, 2000; Zlatanović, 2012)

ii) System dynamics

This methodology is the second most used after the cybernetic tools. Despite the importance that system dynamics has had in the development of models to study and analyze sustainability at different levels (i.e. regarding sustainability, our search showed 82 papers in System Dynamics Review), few of them were related directly to CS. Specifically, the system dynamics methods support the development of models that help decision makers and managers to understand the complexity surrounding the implementation and development of business sustainable policies (Duran-Encalada and Paucar-Caceres, 2012), and to identify components and variables involved in sustainable initiatives (Bivona and Montemaggiore, 2010; Cavaleri, 2013; Marshall and Brown, 2003; Moizer and Tracey, 2010; Smith and Sharicz, 2011; Stave, 2010; Thompson and Cavaleri, 2010). Organizational strategy, a topic related to ensure long-term organizational operations, is an additional field to which system dynamics has done strong contributions. To increase the rates of success in the strategy implementation (Bianchi and Bivona, 2002; Gary et al., 2008; Lyneis, 1999; Richmond, 1997), and to help decision makers to improve the planning processes (Bianchi and Montemaggiore, 2008) have been some of the topics addressed by academics in this area. Other academics have tested multi-methodological approaches in

the context of CS, for example Paucar-Caceres and Rodriguez-Ulloa (2007) who developed the called "soft systems dynamics" to face this issue.

iii) Complexity - Complex Adaptive systems theory

Regarding complexity theory and CAS, the focus of the papers found is on the application of concepts like self-organization and emergence to develop models or alternative approaches to CS (Backström, 2009; Benn and Baker, 2009; Flumerfelt et al., 2012; Jenner, 1998; Kira and Van Eijnatten, 2008, 2010; Mitleton-Kelly, 2011; Porter, 2008; Putnik and Putnik, 2012).

iv) Soft Systems Methodology and Critical systems Heuristics – CSH

Finally, two additional methodologies were applied to situations in the context of CS. On the one hand, soft systems methodology was used in the construction of a model that enables to "work smarter" within dynamically changing information organizations (Somerville and Mirijamdotter, 2005). On the other side, critical systems heuristics was used to address dilemmas involved with corporate social responsibility (Reynolds, 2008). According to the authors of this last paper, the concept of CSR is in close relation to CS.

8. Conclusions

There are persistent calls that suggest the use of new approaches and paradigms to work or to study sustainability inside an organization or what is called as Corporate Sustainability. There is evidence showing that systems thinking is one of those alternative approaches that could give real answers in this regard. However, until now, there are few papers accounting the contribution that systems thinking has done to the sustainability issue, and we have not found works accounting for contributions that systems thinking has done to CS. In this paper, we have responded to this issue, researching about how systems thinking have contributed to advance knowledge about CS. Despite the comprehensive sample of journals used for the survey, and the set of keywords applied during the research process, there are scarce direct applications of systems thinking to CS. Additionally, what has been found regarding systems thinking and CS has almost entirely published in systems thinking journals, conference proceedings, books and not-well renown journals. We can say that this fact has avoided an extended dissemination of this new knowledge about CS among firms and academics around the world.

Regarding the results, several systems thinking approaches have been used to study CS. In order, we have found that organizational cybernetics is the most applied method followed by system dynamics, complexity - CAS, soft systems methodology and critical systems heuristics.

Organizational cybernetics assumes that viability is a necessary condition for sustainability, and uses VSM as the tool to work in this context. Systems dynamics utilizes models to help decision-making process inside firms, and to understand the complexity surrounding CS. Complexity - CAS uses concepts like self-organizations and emergence to understand the environment in the context of CS. Soft systems methodology supports the development of models to help firms to work in a more intelligent way. Critical Systems Heuristics has been used to address dilemmas in the context of CSR.

We can conclude that despite the very scarce works found that use systems thinking methodologies to study and work CS, there is evidence that these methodologies could give answers to the issue of the implementation of corporate sustainability. We think that systems thinking has an ample set of tools to put into practice sustainability principles. We

strongly recommend further research in this regard and not only in the context of firms, but also in the context of entire industries or inter-sectoral and public policy.

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The Complicatedness of Self-organisation in Social Systems. A Systemic View of the Application of Self-organisation in Management – Case Study

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Abstract

Since the introduction of the concept of self-organisation (SO) in management by Ashby (1947, 1961) two main variants in the application of this concept can be identified: one branch closely related to the development of Cybernetics (e.g. von Foerster, 1960); Organisational Cybernetics (e.g. Beer, 1966;1979) and socio- cybernetics (Haken, 1984; Aulin, 1986; Gayer and van der Zouwen, 1986; Klabbers, 1986; Latane and Nowak, 1997; among others); Systems Thinking (e.g. Von Bertalanffy, 1968); Complexity Theory and more recently with the theory of Complex Adaptive Systems (e.g. Schmickl and Crailsheim, 2008; Carapiet and Harris, 2005; Anderson and McMillan, 2003; Mitleton-Kelly, 2003; Heyleghen, 2003; McMillan, 2004; and Arcaute et-al 2008; among others) which application have varied from the use of cellular automata and computer model to the use of the concept as an analogy to describe social processes.

The other branch, is related with the organisational revolution in manufacturing processes based on the socio-technical work design theory emphasising the autonomy and organisational independence of the work units as described by Trist and Bamforth, 1951; Herbst 1962; Cherns, 1979; Emery, 1972.

The successful application of autonomous groups worldwide during the 60s and 70s resulted in the generation of many different approaches, descriptions of the autonomous - self-organising - group dynamics and classifications as the ones provided by Davis and Wacker (1987), Susman (1976), Hackman (1986), Cooney (2004), Manz and Sims (1987, 1993), Wellins et al (1991, 1994), Cohen (1994), Druskat and Pescosolido (2002) and Druskat and Wheeler (2004), among others. From this branch Some of the SO distinctions that become popular in the las decade were Self Directed Working Team (SDWT), Self Managed Working Teams (SMWT) and Self Governed Managed Teams (SGMT); and the most popular methodology the AGILE/SCRUM widely used in the software industry.

Despite the increasing popularity of SO in the last decade, increasing criticism is arising with evidence of poor performance of SO teams - mainly due to lack of rigour in the application of SO principles and many cases also related with poor management practices and a shallow understanding of the context in which SO can - and cannot - operate effectively (Palermo, 2008).

In this paper the benefits, misconceptions and limitations of the many different shades of SO behavior in social systems are - cybernetically - discussed through a case study in

which SO was observed for over a period of three years - as a complementary analysis on the observations on SO previously reported by Cardoso, 2009, 2011 and Espinosa et-al 2010.
This paper concludes with comments on the resilience of SO teams and a cybernetic validation of the key roles, functions and context required for SO to be effective.

Keywords
Self-organisation; attractor, Agile/Scrum; CAS; Socio-cybernetics

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Viability of industrial networks; Sustainable supply networks in Mexico

Extended abstract

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Research Objective

This research addresses the viability of industrial networks considered as complex organizations aiming at sustainability. The Viable System Model (VSM) is used as a conceptual framework to study sustainable supply networks considered within Industrial Ecology (IE). So far no research has integrated the VSM within the context of IE. This study demonstrates its relevance in the context of sustainable supply networks by answering the following question: *How to understand organisational collaboration and viability in ecological industrial systems such as sustainable supply networks?*

This study contributes to new theory by integrating the conceptual frameworks of IE and VSM, which allows us to emphasize collaboration and synergy as important elements to work towards viability and sustainability in supply networks. Four normative management functions for viability of systems: harmonisation, generating synergies, adaptation, and identity, were introduced in the context of industrial ecology. Further, the VSM framework is used to make recommendations to begin to identify the critical factors needed to establish sustainable supply networks.

Method

The research method selected to understand organisational collaboration and viability in ecological industrial systems such as sustainable supply networks, followed an explorative case study approach, deemed appropriate insofar as research on the subject is scant (Eisenhardt, 1989). The VSM model provided the analytic lens for our case study of the emerging Mexican sustainable supply network.

The recent experience based on a Mexican sustainable supply network (MSSN) offers a unique opportunity to study how a complex industrial system emerged, through the conceptual lens of the VSM. First, the emerging network is significant of scale involving over 6,000 firms. Second, the same source confirmed outcomes from the emerging network show environmental improvements that were far better than expected. Third, the experience of the

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emerging Mexican sustainable supply network (MSSN) illustrates what the requisite paradigm shifts for individual organisations and the network as a whole actually mean in practice when organizational learning and collaboration among networks of firms are put into practice.

We used a simplified version of the 'Methodology for organisational self-transformation' (Espinosa & Walker, 2013), to identify the boundaries of the organisational system (the Mexican Sustainable Supply Network), and the embedded subsystems (each sustainable network group, SNG including one large anchor company and between 7 and 15 smaller companies which, between them, constituted the supply network for the anchor company). Our viability analysis focused initially on this last level, the clusters of companies, which met monthly for the 10 workshops of the MSSP. These will be referred to as sustainable network groups or SNGs.

As our system for analysis is seen as the emerging 'greener organisational network' and this is a temporary organisation, not a permanent one, we won't expect to find in all the elements of organisational structure which will emerge in a more permanent organisation. We will though concentrate on those aspects of the MSSN that our theory of viability for sustainable organisations and networks would suggest to strengthen, aiming to improve the whole network's sustainable performance (e.g. identity, green ethos, knowledge of green technologies, synergies, collaboration, self-regulation, etc.). The stages of analysis included, deciding on the identity of the SNG, identifying levels of recursion, agreeing on the system in focus, and doing VSM analysis of the system in focus in the lower levels of recursion.

Results and implications

Results for our case-study analysis confirms that each SNG was a temporary complex industrial system where collaborative efforts and viability started to emerge. Outcomes also show that the system was strongly influenced by an induced public-private initiative, designed to disseminate cleaner production in supply networks. What distinguishes the MSSN from other networks is not only the intention of improving environmental performance of the workings of the associated companies, but the capacity to do it through collaboration, and the sense of collective achievement. The MSSP provided the organisational umbrella to both define the network identity and to monitor its evolution and performance, that is, to give closure.

However, if the viability of the SNGs is considered once the MSSP ceased to function there are several problems. The demise of the program terminated the SNG meetings and thus the focus of the Meta-systemic activity at this level. With no MSSP, there can be no Systems 3 or 4, and thus no synergies between companies of adaptation. Clearly all hope of viability has gone.

To function effectively, the MSSN level needs intermediate levels of recursion in order to deal with massive complexity of the national organisation. Meta-systemic functions will need to be put into place at all levels of recursion to ensure each cluster of viable systems coheres into a well organised whole.

These include follow-up to cleaner production implementation, continuous improvements, design of collaborative actions, improved communication throughout, adaptation to the environment. In all viable systems it will be essential to position the potential of cleaner production at the outset of the programme.

Research findings help to understand various dimensions of collaboration and viability of ecological industrial systems such as the MSSN. In the first place VSM diagnosis identified collaboration as an essential meta-systemic function for viability of the embedded organisational systems. In other words, eco-industrial systems such as supply networks require collaborative action for continuous improvement of performance and to be sustainable in time. For viability, all four meta-systemic functions must be present, fit-for-purpose, and properly interconnected. All of this was apparent in every SNG during the workshop program, and thus resulted in the emergence of a new, larger viable system, the SNG, capable of achievements, which would be impossible for the individual companies working in isolation.

The VSM analysis identified different types of collaboration as meta-systemic functions such as collective learning, development of collaborative actions, and dissemination of practices among different subsystems. Collective learning involves exchange of information, experiences and the development of a shared vision as an important element of harmonisation. The synergies which emerged from the various forms of collaboration account for the unexpected success of the program.

Outcomes of the SNG analysis also show how meta-systemic functions can be induced by design of external mechanisms, such as the ones offered by the MSSP. Quantitative data and interviews confirmed how the learning by doing training method, as part of the MSSP mechanism, was recognized as the main facilitator of cohesion in the operative systems by generating trust and a common vision. The same evidence proved cleaner production to result from the development of integrative actions and resources from different operational elements that generate multiple benefits. The organization of sub-systems (participating supply companies working with their anchor company) promoted harmonisation.

Collaboration to be fruitful, requires of the design of a coherent and consistent meta-systemic role at different recursion levels. Our case analysis showed that the growth of the MSSN increased the level of complexity and declined the levels of collaborative action among sub-systems. Evidence illustrated how collaboration emerged at the level of the SNG sub-systems. However, collaborative action within the whole system of the MSSN was limited, and so were the meta-systemic functions for harmonisation and synergies at this level. This role was stronger at the level of the individual networks, operating around the supply chain. It is possible that in order to enhance collaboration and viability of the whole network, intermediate management levels (new recursions) were required in order to manage properly the level of complexity of the whole network.

Another outcome of our study emphases the temporal dimension of the organisation under study. Results of the MSSN analysis confirm that the SNGs were not viable in the long time even when some emerging and temporary viability characteristics were identified. As meta-systemic functions were taken care of by the MSSP, an external and temporary agency, it was to be expected the system as a whole was only viable for the duration of the program. For systems to be viable in the long term, the meta-systemic functions should be embedded in the system itself to stimulate self-organisation. For the MSSP this implies a complete shift in its original design as a supportive programme towards a constructive programme to ensure the SNGs continue to function after the workshop program has concluded.

Recommendations for the implementation of the MSSN and similar emerging initiatives need to consider various dimensions of its design and maintenance. In the first place if we wish to consider sustainable supply networks as viable systems, external agencies such as Profepa and Semarnat should realize that temporal supportive programmes such as the MSSP are limited in their contribution towards sustainability and change in society. As soon as the external facilities cease to function, declination of the networks viability is to be expected.

As alternative approach which can be recommended is to stimulate self-organising sustainable supply chains, where companies themselves manage and take-care of meta-systemic functions such as harmonisation, looking for synergies, adaptation and the system´s identity. Such a scenario would need stronger and on-going involvement on the companies' part in the supply network. This would involve costs for the companies involved, but would be offset by the substantial savings which were demonstrated during the program.

A complementary recommendation involves the introduction of intermediate recursion levels for the management of the MSSN at regional levels. This will introduce the capacity to create new viable systems from clusters of SNGs by considering the whole picture, looking for synergies, and producing strategies relevant to the higher levels of recursion. In all viable systems at all levels of recursion the common identity will be critical and mechanisms will need to be establsihed that deal with issues of accountability, sustainability performance management based on appropriate information systems, and legal and corporate issues. In all cases the VSM provides the theoretical basis for the design and implementation of these mechanisms

Moreover, meta-systemic functions such as identity and contact with the environment might be strengthened. Identity could be strengthened by recruitment of more members from appropriate companies. Greater cohesion would be created by clear communication of the recruitment criteria and the terms of reference for association to the MSSN by writing a contract for all participants establishing the terms of engagement based on the principle of maximised autonomy, limited only by the cohesion of the whole. Also communication with the environment can be strengthened, for example, by introducing mechanisms with provides recognition such as permanent labels of

certification schemes attached to performance improvements as outcomes of MSSN participation. Extra resources need to be assigned to this function.

Conclusions

This research provided insights into collaboration and viability in ecological industrial systems such as sustainable supply networks. Collaboration was understood as a multidimensional complex management concept part of the meta-systemic functions of a viable system. It was demonstrated how collaboration among companies which are part of ecological industrial systems might be stimulated by induced mechanisms. Viability was introduced as a concept resulting in continuous improvement in environmental and economic performance of both the companies, which are part of the supply networks and the whole SNG system.

The VSM explains how a larger coherent structure can emerge from a cluster of companies. In these terms, the SNG is a viable system, which can achieve results impossible for the participating companies working in isolation. This approach not only explains the success of the MSSP, but also provides guidelines to enhance the effectiveness of the program.

Theoretical contributions of this research result from the integration of industrial ecology and VSM literature, and emphasize the managerial and sustainability dimensions of ecological industrial systems. Moreover, we introduced normative management practices (meta-systemic functions in VSM terms), required for collaboration and viability of ecological industrial systems.

There are limitations to this research, due to the explorative research strategy chosen. Even when quantitative and independent data collection made part of the analysis, subjective selection and interpretation might have influenced outcomes. For example, a complex case such as the MSSN might involve additional collaborative actions and viability elements that were overlooked by the researchers. Critical feedback from VSM experts might improve the validity of our findings.

Moreover, our analysis is one of the first attempts to apply the VSM model to ecological industrial systems. As the VSM was originally designed for organizations and its sub-systems, its application at a complex network organisational level is challenging. Therefore complementary research using VSM for diagnosis of collaboration and viability of other ecological industrial systems such as symbiotic regional symbiosis is recommended to fully explore the potential of the VSM within an industrial ecology context.

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Mechanisms of Self-organization and de (coupling) in Scientific Networks Promoted by Public Policies: A case in the field of nanotechnologies in Colombia

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Abstract

Purpose –The purpose of this paper is to examine the coupling and decoupling processes between the top-down policies that promote scientific collaboration networks and the practices of the participating actors.
Design/methodology/approach – We use a case study design, with the focus on a Colombian network of research groups in the field of nanotechnology. To this end, semi-structured interviews were carried out, and activity reports and documents were analyzed. With an insight of intellectual craftsmanship, we gradually combine theoretical approaches, methods and fieldwork.
Findings - We found several mechanisms of self-organization through the practices of the actors, that allow the coexistence of policies and emerging forms of organization that enable collaboration: Construction of reliability of socio-technical infrastructures; Management of belonging to the network; Heterogeneous forms of articulation among actors.
Originality/value – The results contribute to the construction of a socio-material perspective to the study of loosely coupled system, by recognizing the heterogeneity of actors and forms of integration among actors, the asymmetries in the relationships, and the evolution of the exchanges. The findings on the processes of coupling between science policies that promote scientific collaboration networks, and practices to allow introduce them; provide insight into their evaluation beyond the black box view of resource inflows and outflows of tangible products.
Research limitations/implications: We take the perspective of the agents who benefit from the policies, but not that of the policymakers. Future research may provide insights into the mechanisms of coupling and decoupling between policy-making bodies, and actors that benefit from them.

Keywords

Scientific collaboration network, self-organization, loosely coupled system, nanotechnology, Colombia

1. Introduction

The dynamics of scientific and technological development increasingly involve different fields, institutions and regions (Arvanitis et al., 1995; Vinck, 1996; Wagner & Leydesdorff, 2005). In this context, several studies have shown that scientific collaboration can improve the impact of the research results (Bermeo Andrade, De los Reyes López & Bonavia Martín, 2009; Benavent-Pérez et al., 2012; Wagner, 2008).

Furthermore, policies promoting science, technology and innovation have supported the creation of cooperation networks for the development of specific fields. Caroline Wagner (2008) has suggested that the current development of science reflects the rise a "new invisible college", a complex adaptive system in which the researchers *"interact in both competitive and cooperative ways, with no overall direction"* (p. 35), the networks and their components "*respond to changing environmental conditions*" (p. 35) and is an open system in which scientists move from one area to another. In this approach, the role of policymakers is to understand the rules and patterns of these systems to promote their development. Some authors have shown the limitations of this perspective of "new invisible college" for not recognizing the asymmetry of access to resources between regions and countries, and not accounting for how these networks are built (Arvanitis, 2011).

Following these thoughts, in this paper we investigate how scientific collaborations evolved in a Colombian network of university research groups in the field of nanotechnology, supported by a science policy. We are interested in studying the links between science policies, and practices of the actors. In this end, we take as a central notion in the analysis the concept of 'loosely coupled systems' (Weick, 1976; Orton and Weick, 1990). We study the processes of coupling and decoupling among the actors involved in the network, and the policy.

The paper is organized in five sections, including this one. The second section presents the methods and data collection. The third section illustrates our theoretical framework. The fourth section reports the results, by stressing the socio-material coupling and decoupling processes in a network promoted by science policy. The fifth section presents the discussion and conclusions.

2. Methods and data collection

In this study, we adopted a qualitative and case research design (Yin, 1994). Such design is relevant to our research question about ongoing articulation processes among entities.

We focus on the case of the "*Centro de Excelencia en Nuevos Materiales - CENM*" (Center of Excellence on Novel Materials), a network of university research groups in

the field of nanotechnologies in Colombia. The CENM was selected by Colciencias[1] for funding through program 'Centers of Excellence', in the area of 'advanced materials, and nanotechnologies'. Such science policy began in 2004 to promote the development of strategic areas of national interest (Colciencias, 2004).

We take an insight of intellectual craftsmanship (Mills, 1959). This means that we gradually build our object of study from theoretical approaches, methods and fieldwork. To this end, we develop the fieldwork in two phases, using semi-structured interviews. In the first phase, carried out between 2007 and 2008, we conducted 13 interviews with actors of nanotechnologies in Colombia, but not belonging to the CENM. This allowed us to build some intermediate research questions in connection with the theoretical approaches used. In the second phase, we conducted 28 interviews during the period 2009-2010, with researchers, students and staff members of the research groups belonging to the CENM in the cities of Cali, Medellin and Bogota (Colombia) and one of its main international partners (Le Mans, France). In addition, we review the activity reports submitted by the CENM to Colciencias between 2006 and 2012, and also we analyse documents available on its official website.

The research was guided by the symmetrical perspective of the "Actor-Network-Theory" (Callon, 1986; Latour, 2005). This means maintaining the same analytical lens for viewing diversity of actors and situations, sometimes contradictory. The symmetrical approach allowed us to study the phenomena of interest: creation and breaking of links in networks; integrations and tensions between scientific policies, and practices; bonding and identity preservation. At the end of the investigation, one of the authors of this paper suggested to take the concept of "loosely coupled systems" in order to enrich the analysis of the study previously conducted. We identify the dialectical interpretation of the notion 'loosely coupled systems' presents consistent with the symmetrical approach of the 'Actor-Network-Theory'. Furthermore, Orton and Weick (1990) suggest the methodology of case study to enrich our understanding of the phenomena showing loose coupling, and to go beyond the categorization of a system as 'loosely coupled'.

3. Theoretical perspectives: Loosely Coupled Systems and Networks

3.1. Loosely Coupled Systems

Karl Weick proposed the notion of loosely coupled systems, in the context of studies on educational organizations, to work questions about the indeterminacy of organizations and to avoid the "*danger of portraying organizations in inappropriate terms which suggest an excess of unity, integration, coordination, and consensus*" (Weick, 1976, p. 4). The concept of loosely coupled systems aims to capture the situations in which several elements are responsive, but each preserves its own identity (Weick, 1976). Based on a dialectical interpretation, the concept allows to explain simultaneous existence of interdependent elements that preserve some degree of independence (Orton and Weick, 1990).

[1] Colciencias is the "Departamento Administrativo de Ciencia, Tecnología e Innovación" (Administrative Department of Science, Technology and Innovation) in Colombia. This entity promotes policies for science, technology and innovation in the country. For more information, see: http://www.colciencias.gov.co/

The proposal of Weick (1976) has shown its fruitfulness in organizational studies, with different perspectives. Orton and Weick (1990) analyze approximately 300 works that incorporate the notion of loose coupling and they identify five approaches to dealing with the concept. The first one attempts to explain "*why some systems are loosely coupled and others are not*" (p. 206).

The second approach studies the types of loose coupling depending on the kind of connected elements: individuals; subunits; organizations; hierarchical levels; organization and environments; ideas; activities; intentions and actions. The third perspective argues that the "*loose coupling has specific effects and the effects are desirable"* (Orton and Weick, 1990, p. 210). The fourth view holds that "*loose coupling is an unsatisfactory condition that should be reversed*" (p. 211). This position proposes managerial strategies to minimize the loose coupling: "*enhanced leadership, focused effort, and shared values*" (p. 211). Finally, the fifth perspective notes some indirect effects of loose coupling such as stability and continued operation, prevention the spread of problems, assimilation and accommodation to the change.

The perspectives synthesized in the previous paragraphs focus on the causes and effects of loose coupling or its prescriptive view. Orton and Weick (1990) suggest that these approaches often involve a unidimensional interpretation of loose coupling and they drift away from a dialectical view.

In this paper our interest is to exploit the dialectical approach of loose coupling phenomena among actors to understand the connection and disconnection processes operating simultaneously between elements of a collaboration network. To this end, we discuss in the next section literature that has applied the notion of loose coupling to the study of such networks.

3.2. Loose coupling in collaboration networks

Recent studies have taken the notion of loose coupling to understand the dynamics of interaction between actors that are integrated into networks. We identify two approaches to the notion of loose coupling in these studies: the managerial perspective and the analytical perspective.

The managerial perspective argue that innovation networks can be seen as loosely coupled systems of individual firms and focuses attention on the management processes required to generate benefits to network participants (Ritter, Wilkinson & Johnston, 2004). In this direction, Dhanaraj and Parkhe (2006) propose orchestration processes through which actors with central positions in the network structure (hub firms) create and extract value from it. Such processes promote the generation of dynamic network stability, "*a nonnegative growth rate while allowing for entry and exit of network members*" (p. 661). These networks are characterized by multiplicity, since "*two or more types of relationships occurring together*" (p. 664).

Based in that framework, Levén, Holmström and Mathiassen (2014) explore how a government sponsored research and innovation program, in Northern Sweden, was designed and orchestrated in order to provide value to the participating companies. These authors identify that the managing research and innovation networks is developed

through of "*configuration of the network, orchestration of partnerships between participants, and innovation in dedicated development projects*" (p. 166).

The analytical approach has used the notion of loose coupling to evaluate the types of structures and evolution of collaboration networks. Chang and Huang (2013) examine the international collaboration in astronomy and astrophysics between 2001 and 2009 from coauthored papers. They find a low density of the network, i.e., a low percentage of the total connections possible, and they associate this behavior with a loosely coupled network structure. In the same direction, Peng and Wang (2013) argue that "*loosely coupled networks rich in structural holes enable individual nodes to access fresh insights and obtain innovative ideas*" (p. 677).

The above studies show various modes of coupling among participants in a network and describe analytical tools to understand these phenomena. However, ignore the presence of objects in the exchanges. For scientific collaboration networks, materiality is a central issue, since objects are present in the interactions between social actors. To address this point, in the next section we will explore the socio-material dimension of coupling mechanisms.

3.3. **Socio-material coupling in collaboration networks**

Social science studies have provided socio-technical approach to the examination of scientific collaboration networks. From the study of networks of scientific cooperation in the field of medical sciences and public health, Vinck (1996, 1999) proposes the notion of intermediary object, like the physical entity that connects human actors. Another approach to the materiality of social interactions is the notion of boundary object, proposed by Star and Griesemer (1989). Such object is defined as one that is built around an activity, from interactions at the intersection of various social worlds or groups. It combines robustness and plasticity, so that fits the constraints and needs of each social world, while maintaining identity through connecting multiple sites.

Recent studies have associated the socio-material dimension of organizations with loose coupling processes. In this direction, Keshet, Ben-Arye and Schiff (2013) examine the interprofessional collaboration in a case of integrative healthcare. The authors argue that collaboration between complementary medicine practitioners and the staff of Western biomedicine is a loosely coupled system. Their results suggest that boundary objects facilitates communication and coordination while, at the same time, securing social-structural boundaries. Also in the health sector, Heldal (2010), from the study of multidisciplinary collaborations as loosely coupled systems, investigates the role of objects used in interactions as elements of such systems. The author finds that some uses of those objects inhibit integration.

Until now, we have explained the notion of loosely coupled systems and their incorporation into the study of collaborative networks. We identified that the concept has been extended to consider the objects as part of the system. However, the socio-material perspective has been absent in the study of collective coupling and decoupling processes that enable the evolution of networks induced by top-down mechanisms. Additionally, in organizational studies the socio-material dimension has gained importance, but has still been little explored (Gherardi, 2006; Carlile, Nicolini, Langley

and Tsoukas, 2013). In this paper, we propose contributions in that direction. In the next section, we present the results from the case study.

4. Results: Socio-material Coupling and decoupling processes in the CENM

The field of nanotechnology often involves policies to promote networks and clusters (Robinson, Arie and Mangematin, 2007; Delemarle et al., 2009), with the participation of various disciplines and organizations. Science policies to encourage the development of this field tend to operate under a discourse of technological convergence (Roco & Bainbridge, 2002, 2013), although working practices between disciplines and actors do not show such scenario (Rafols, 2007; Rafols and Meyer, 2007). Some authors argue that the nanotechnology "*is not necessarily one but a loosely coupled set of related technologies*" (Meyer, 2007, p. 802) and that in this new emergent domain "*the division between applied and theoretical sciences looks out of place*" (Zarama, et al., 2007, p. 371). It has been shown that in this area the interactions and the ways in which policies are implemented are varied (Invernizzi, Hubert, Vinck, 2014).

In this section, we present the case of the CENM, a network of research groups in the field of nanotechnology, supported by a science policy. We will show that the actors involved in the initiative self-organize and generate various mechanisms of coupling and decoupling with the guidelines established by the policy. The self-organizing mechanisms identified are: Construction of reliability of socio-technical infrastructures; management of belonging to the network; Heterogeneous forms of articulation among the different actors in the network.

4.1. Construction of reliability of socio-technical infrastructure

One of the strategies of the CENM's policy is to build shared infrastructure equipment for the use of members of the network. The coupling mechanisms are associated with the definition of use and access rules. However, this goal is challenged by the practices of researchers. The CENM operates as a mechanism to facilitate the availability of these resources, but the existence of an instrument at national level does not necessarily translate into increased access for the scientific community. Some researchers prefer to continue doing experiments in foreign laboratories, while others use CENM infrastructures, as illustrated in the following quotations:

> Although we currently have X-ray Diffraction Instruments in Colombia, we still send the samples to Mexico because of greater reliability of results - Researcher of CENM (Pérez Martelo, 2013, p. 184).

> …measures that could not be done before in Colombia can now be made here. So here they come, or send the sample or the researchers come to make the measurements here. If we need a measure of Raman [Raman spectroscopy], as we shipped the sample to Antioquia [Universidad de Antioquia, Medellín, Colombia]…that is available. On the website there are clear formats use of instruments, it is by web. Without equipment is impossible. How are we going to make a measurement of nanoindentation without the nanoindenter? But at this point the measures are being made in the CENM - *Researcher of CENM* (Pérez Martelo, 2013, p. 170-171).

During the evolution of CENM, a coupling mechanism between actors arises, based on the experience of working together. Such mechanism is related to informal practices to

test the infrastructure available for the experimental and simulation work and build shared knowledge on reliable sites to carry out the experiments. Around the formal map of instruments available to share a map of reliability that makes effective collaborations is generated. This reliability of socio-technical infrastructures is connected to several aspects: a respected researcher, reliable equipment, measurement practices and appropriate interpretation, trained personnel to generate results that make sense, practices that respect the rights of intellectual property, and relevant maintenance routines of the instruments.

The researchers test the reliability through practices like sending samples of the materials to various sites and compare the results, without a formal program of inter-calibration. Thus, they legitimize a site, and delegitimize other, in a constant process of validation. These are forms of self-organization of actors and translation of science policy in its strategy of 'sharing resources'.

We noticed that in this coupling mechanism between the actors a collective knowledge about network resources is generated. This is given by sociomaterial exchanges. The instruments and the people that operate them, and formalizing protocols and organization, are mediators in collaborations of the CENM. The apprenticeships developed in some experiments nurture the work of other research groups because the CENM capitalizes experience. The socio-technical infrastructures that are created include instruments, protocols, organizations and know-how. The CENM benefits from the capitalization of experience that comes from the services.

The coupling from these infrastructures varies among members of the network and generates asymmetries. This situation has been shown in other cases of policy incentives in nanotechnology (Suárez and Dutrénit, 2014). We consider that the identification of this collective knowledge generated in the network about how to interact can help address these asymmetries.

4.2. Management of belonging to the network

The CENM organized formal structure around four themes of interdisciplinary research: Coating Materials; Nanocomposite Materials; Nanomagnetism; Solid State Devices, Sensors, and Mesoscopic Systems. Each of the 19 research groups from the CENM participated in one or more themes.

In the study of the CENM, we adopt a performative view of the organization. To this end, we study "*structure as something that organizations do, rather than merely as something they have*" (Orton and Weick, p. 218). To analyze practices from which research groups and researchers manage their network membership allowed us to study this phenomenon. The CENM functions as a label to which the groups are connected and disconnected over time.

The management of belonging to the network is through coordination for access and investment of financial resources, participation in activities with other members of the network and the membership statement naming the CENM in publications. These different forms of belonging to the center can be seen in the following quotations.

> The materials required in the operation of the instrument have a cost. Where does the money come from? University funding, or they charge the service, well, unlike CENM one says to the researcher: "I am a member of CENM, characterize the sample in the instrument, and you charge the CENM and do not charged to me" - *Researcher of CENM* (Pérez Martelo, 2013, p. 175).

> We also voluntarily cease to participate… This is fictitious, because those items are not produced through the efforts of CENM, but our work group. If you see CENM reports are filled of items that type… reports last year, for example, are filled of papers that mention the CENM, but ... the CENM has done nothing for this production - *Researcher of CENM* (Pérez Martelo, 2013, p. 167-168).

We find that the interactions do not correspond to themes of interdisciplinary research initially declared. This can be explained because the formal organization is based on cognitive affinity interactions while responding to different logics (problems of common interest, complementary themes, use of laboratory instruments). The coupling and decoupling strategies defy the formal structure of the CENM.

4.3. **Heterogeneous articulation among actors**

Forms of articulation among actors of the CENM are heterogeneous and change over time. We identify several schemes of integration.

One such scheme is the complementarity of research topics. The definition of a problem is structuring of the cooperation, and participants contribute from different and complementary skills. Convergence is also ontological, under the mediation of the object as an element of interaction between the participating groups. The scientific problems are treated jointly make sense to them within the themes of interdisciplinary research to which they belong. This situation is illustrated in the following quotation.

> …they do experiments low dimensional systems, low dimensional semiconductor systems and our group has done some theoretical work to explain some types of results related to the experiments that have been made in that group - *Researcher of CENM* (Pérez Martelo, 2013, p. 201).

The division of labor is another form of coupling and decoupling between actors. At some points in the production cycle and characterization of materials, disciplines come to knowledge that is domain from other disciplines. The disciplines maintain their borders and the exchange zone is in the activities of experimentation and production. As a researcher says: "*We are physicists and we do not handle this part ... of these chemical reactions. Then on sintering should I go to a chemist*" (Pérez Martelo, 2013, p. 205).

An additional coupling mechanism identified is the differentiated integration. The CENM is the opportunity to work new areas associated with the themes of interdisciplinary research, but with features that allow the group to generate original results.

Finally, the coupling between the actors is also associated with the credibility of the leader or the possibilities of the area of nanotechnology. These mechanisms allow the generation of some initial links in the CENM, but are transformed in time. We also

found that some groups minimize their integration into the network because they do not find benefits in their participation.

5. **Discussion and conclusions**

Our study offers contributions to the study of socio-material dimension of organizations (Carlile, Nicolini, Langley and Tsoukas, 2013). From the results, we suggest that in a network occurs various mechanism of loose coupling, with different modes of articulation among the participating actors. Such coupling mechanisms are sociomaterials, since the objects are present in the generated interactions. Thus, we extend the loose coupling types identified by Orton and Weick (1990). We note the loose coupling processes occur between heterogeneous elements, mediated by objects, and not only among similar entities (individuals, organizations, units).

The study also indicates simultaneous forms of coupling and decoupling between entities of networks. This is associated with the phenomenon of network multiplexity, or several types of relationships occurring together (Dhanaraj and Parkhe, 2006). We find situations in which the discourse of science policy is not a coordinating mechanism, but informal exchange practices generate links.

With the increase of science policies that promote the generation of networks, the question of how to monitor and evaluate them has gained importance (Hertting and Vedung, 2012). We have explored the coupling and decoupling processes between science policy and practices. In these contexts, our findings highlight the need to integrate the managerial and analytical perspectives in the study of loosely coupled systems. Understanding the mechanisms of self-organization allows us to identify the learning of actors and evaluate policy outcomes beyond the black box view of resource inflows and outflows of tangible products. We argue that this learning of the participating actors is a second order effect of the collaborations (Lawrence, Hardy & Phillips, 2002) that transcend the time period of policy support. Emerging forms of organization facilitate future cooperation. Evaluating the second order effects of science policy contributes to the study of long-term dynamics, from the focus on practice as a hinge point of loosely coupled systems.

An important element of policies promoting networking is the continuity of links created. We identify that the actors manage their belonging to the networks through their practices. This is a dimension that emerges in the relationship between autonomy and interdependence. The notion of autonomy in policies that promote the integration of actors has been highlighted by other studies (Zarama et al., 2007). Our results suggest that the policy evaluation can recognize these phenomena with the notion of dynamic stability of networks that account for the various forms under which the entities, preserving their autonomy, belong to the network.

These results contribute to understanding the relationship between policies, and practices that allow to introduce them. The findings of our research provide insight into the asymmetries that can occur between actors in the network and how the exchanges evolve. Other dimensions of interaction can be identified by recognizing the heterogeneity of forms of integration of the actors to the networks.

This study provides insights into the implementation of policies that promote scientific collaboration networks. The results show a coexistence of forms of organization emerging from the practices of the actors, and established formal mechanisms for science policy. However, in our research we take the perspective of the agents who benefit from such policies, but we do not regard it from the policymakers' vision. Future research may provide insights into the mechanisms of coupling or decoupling between policy-making bodies and actors that benefit from them during implementation.

Several studies have examined the scientific collaborations from phenomena emerging from the interactions between actors (Leydesdorff, Wagner, Park and Adams, 2013; Wagner & Leydesdorff, 2005; Wagner, 2008). The results of our study illustrate forms of self-organization associated with the way that the actors adapt the guidelines established by science policies to their practices.

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from manufacture to cognofacture: A relational viable systems theory for warping network

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ABSTRACT

Purpose*: The aim of this paper is contributing in developing a new approach related to the viability concept.This paper also demonstrates the relevance of change from the 'object' concept to the concept of 'relation' for organizational design.*Design/methodology/approach:*A system, or a viable unit in a relational sense, cannot be separated from its circumstances, what surrounds it must remain with it. What is referred to as external is not an entity apart from the unit, and, for that reason the definitions of 'medium'and 'environment' that are being used do not correspond to these criteria.* Findings*:Inthe present context, the value generation process is mainly located in the strategic role of intangibles; as noted earlier, value propagation necessarily implies understanding that this process is definitely distanced from traditional physical rules whenever there emerges a relational field that allows its implementation. If we understand that the fundamental unit is the relationship, then, complex weaving together is the result of the relational semiosis that has no representation as a sign, given that its expression comes from an emergence of differences that are not located in time-space.* Originality/value:*Emergent Design or Warp Network is fundamentally a relational process developed from co-autonomy upon a heterarchical operational structure. The main difference with previous models is we can warp a network from cognitive styles, semiosis and trust. That is, the connectivity presented is derived from a notion of intangibles.*
Keywords: *Relational theory, entorno, Viable Relational System, Warp Network, intangibles,knowledge, intellectual capital, networks, organizational design, second order cybernetics.*

A BRIEF INTRODUCTION

The Cartesian view and the disjointed image of the human world, insomuch as the so-called natural world, has been and is still the classic argumentative style of science (Berman, 1987; Buzai&Mateucci, 1998; Ritzer, 1993). The opposing forms of the same argumentative axle can be replicated by thousands; the subject and object are a priori entities, chance is an argument of the measure of maximum uncertainty, chaos is the name of a poorly determined regularity, etc. This is a dual world, but determined in the object, or rather, in the objectivity of the subject. Objectivity allows validation of the arguments against a reference point in experience, something that tautologically confirms the objectivity of the subject, which certainly is a predicate of the object (Glasersfeld, 1998). In the conception of this world that we have been taught and struggled to

learn, the relationship as philosophy did not take place. For most scientific works, this is a given world of objects that demands the researcher to elaborate interactions, transactions and co-actions among other forms of action (Berman, 1987).

RELATIONAL VIEW

We call the relational approach of knowing the *epistemological position* that privileges the observer/entorno relationship as a process of construction of territoriality, defining territoriality as a process of effective equivalence in the exchange of maps or landscapes (configurations of meaning), based on the activity generated in entorno's observers in communication. Effectiveness emerges in the affective domain.

This school proposes that knowledge is an emergent process of relational configurations that are generated from the extraction of differences by an observer within his entorno,which only has meaning for him (Lavanderos & Malpartida 2001; Malpartida, 1991; Malpartida & Lavanderos, 2000, Lavanderos, 2002). This meaning is what allows patterns of territoriality solicitation or, put another way, from creating identity through appropriating and belonging. From this process, territoriality as a collective idea is co-constructed among observers that constitute the network. Consequently, descriptions and interpretations are determined through cultural strategies of communication (communication closure) which we define as the generation of configurations of territoriality.

Therefore, from this point of view, territoriality cannot be experienced as a physical object, but as the strategy of the selection of alternatives from descriptive elements that emerge, as a property constitutive of the relation of observation (Abel, 1998; Bateson, 1984; Bullen, N., Jones, K., & Duncan, C., 1997; Edmonds 1999; Heylighen, 1997; Varela et al., 1992). From this perspective, the descriptive-interpretative process does not apply to a territory, but is a process of co-circumstantiality in distinguishing units, since it involves both the definition of the observer as the definition of the unit observed. The observer is constituted in the act of distinction as a unit (Maturana& Varela, 1982), being a centralizer of the relation with what is observed, and therefore, a participant in all of this. From the relational school, we could summarize the cognitive process as the generation of configurations of distinctions in relation to the meaning of the exchange of these distinctions, a product of the territoriality of the observer. The territoriality of the observer is evidenced through its discriminative-affective way of acting (distinction) in relation to the unit of

observation, which, through some criterion, interrupts a sequence and exposes it, acting on the basis of some meaning to be explained.

The possibility of describing comes out of our history of descriptions, our culture: we must recognize ourselves as part of the system of observation implicated in the communicational plot. From this perspective, the configuration of territoriality is co-constructed from our distinctions, as a relational organization/territoriality. The observer can no longer be considered only as autonomic, that is, responding only to internal mechanisms of self-organization (Varela et al., 1992) but rather as eco-semio-autonomic, that is, what is reproduced in relationship based on semiotic production. In this context, the observation as a form of distinction not only begins with certain criteria that it is necessary to make explicit, but also responds to a strategy and, of necessity, a cognitive style. Recall that in this, the communication among observers is of vital importance; for them, messages have meaning that is determined by the history of previous relationships and communications. Classifications, hierarchies and, finally, organization, emerge as part of the process of preserving the organization/territoriality relationship: territoriality organization, that is, they are not "applied to something."

The relationship is the basis –we say, as observers– for which and upon which we extract differences, and that these differences, extracted from the relationship, are argued as distinctions. Indeed it is a *trifference*, since the process involves what it extracts. In this process information is the first news added to the differences extracted.

This entire process occurs in an entity capable of 'trifferencing' and processing it as information. The information thus generated can then enter the domain of human communication with its enunciation, which, for the speaker, takes the form of a message. Gregory Bateson (1984) wrote that information was the product of a difference that makes a difference at a later time. In this process, then the referent and the observer/entorno are united into a single function. What is known as relations is what emerges from the multiple distinctions that observers generate in their entorno of observation; since this is the case, the basic relationship can receive multiple characterizations.

Our language is objectual, and in the continuous process of substantiation, we have turned verbs into nouns. The relationship –what is relational should be understood as a verb, as a functor, and not as an object– in fact shows that verbs predicate actions, and rarely are links between subject and predicate.

The primary differentiation of the relationship is the difference, and its argument, a distinction (information). From the cognitive relationship, the first consists in distinctions, recognizing as different that which surrounds it. The distinction predicates the ability to cut out, circumscribe a unit and separate it from the rest. The extraction of a unit, the distinction foreground and background, has to do with the individualization and not necessarily with these being different "in fact", either generically or specifically. The generic or specific difference lies between one thing and another within something, something that should be common to both for an observer. Successive distinctions around objects distinguished as distinct from the observer, enter into the process of successive differentiations that form the spiral of what is: different/like. It might appear that the difference between this approach and the previous is very subtle; however, this subtlety for us is abysmal.

In summary, from the different cognitive positions we can say that if we consider the cognitive conception as related to the organization/territoriality relational unit to be pre-given, external or representable –as in symbolism and connectionism–, then cultural organization can be considered heteronomic in relation to the territoriality. This implies action schemes that consider the history of territoriality independent from culture. This is likely to be characterized as a perspective that understands the cultural organization and the territoriality (in this case, territory), where "and" makes explicit the disjunction between the two. The consequences of this, translate into the classifications, hierarchies and organizational models being applied to the territory as an object, because they are seen as separate entities.

Moreover, if we consider that the possibility of describing comes from our history of distinctions, that is, recognizing ourselves as part of the observing system involved in the communication plot; then, the territoriality is the result of a co-construction between the actors of that plot, beginning with their distinctions as a relational process. This having been said, the organization as organization/territoriality can be considered as an enactive system only if organization and territory have created a history of co-determined structural coupling, but in this case we would still de thinking of territory as an object. Alternative to this scheme, the territorial process arises as effective equivalence in the exchange of maps and landscapes (configurations of meaning), based on the activity generated in the observers/entorno in communication. Effectiveness emerges in the affective domain in the differentiation process through agency and belonging. In this relational perspective there is no structural coupling. Classifications, hierarchies and finally organization emerge as part of the viability process of the organization/territoriality

relationship, i.e., “they are not applied on something”. Thus, the relational unity organization/territoriality and their configuration are a process which, as such, changes continuously in the maintenance of its organization.Consequently, the organization/territoriality system modeling process requires epistemological approaches that allow acting out of relational concepts. This means that for a given system, as eco-semio-self-organizing, organization actively determines the arrangement of its components and the significance of its character or behavior is meaningful only with respect to itself. This way of acting generates the plot of distinctions from its own diversity and connectivity. From these perspectives, organization does not apply to a territoriality; it is a process of co-circumstantiality in the distinction of units, which, in turn, implies both the definition of the observer and the definition of the unit observed. The observer is constituted in the act of distinction as a unit (Maturana& Varela, 1982). The observer is the centralizer of the relationship with the observed and, as such, participates in that; the possibility of the observed lies in the centralization and the self-referential state of the observer. It is always the observer who argues, discourse belongs to the subject observer in relation to what is observed, creating the observer system which, as such, is self-referential (Keeney, 1987).

This decisional configuration takes place in the relational space of semiosis, which means that our status as observers/speakers is experienced in the way we relate to each other to generate “natural” sense. So, an organization/ territoriality system is only possible, from this perspective, within a semiotic network. Therefore, a configuration of territoriality, is established as part of this network when members of the organization make it happen and bring it about by living it. As such, the identity and complexity of an organization continually arises when they live culturally the territoriality to which they belong.Beer makes the following hypothesis: “Invariance would exist in the behavior of individuals, 'normal' or not, that could spread to the group, reaching even the highest levels within the unit to which they belong”. In other words, there should be rules or codes within a network that generate identity and allow self-organization.

With this in mind, Beer took 30 years to satisfy the question of how these units maintain themselves or how they manage to exist independently if their exterior is changing. This he called its 'viability' and called his explanatory model as the Viable Systems Model (VSM). The concept of systemic viability has been widely used as a conceptual tool for understanding organizations, their redesign and support for change management. The VSM is perhaps one of the most insightful and powerful models currently available for the study of the structure of organizations. As Espejo observes(1989), it focuses on the resources and relationships needed to support the viability of an

organization rather than on the formal structure of the organization, providing a way to overcome the traditional overemphasis on hierarchical relationships. Its underlying assumption is that viable organizations arise when people find successful strategies for working together, to the extent they are able to develop and maintain a group identity, despite environmental disturbances.

If we follow Beer and Espejo, we find that the emphasis is located in a double ontology: the being of the organization and the being of the environment. Faced with this, self-organization is a function of the preservation of the identity of the group. Otherwise, an external observer ought to distinguish two units, one of which has an ordering process that allows the observer to remove it from its surroundings or environment, an ordering process that also allows it to be classified as different, in an identity process. Given their training, Beer must necessarily make explicit the criteria on which to build identity and also, as a basis for conservation, maintaining the status of invariants. We will discuss this in the following paragraphs.

BEER'S INVARIANCES

As noted by Beer (1985):"The invariances that I had finally unearthed were stated; and the central principle of recursion (that every viable system contains and is contained in a viable system) stood duty as the explanation of all the observational evidence that had begun to accumulate from the military experience onward". If we pause a moment on this, we could assert that what Beer designates as viable are configurations within a continuum that has the status of being stored, it implies for practical purposes that no matter where you make the cut, the condition for viability will be there and will be reproduced at all levels of the organization. But how do we know? The possibility is to generate a second ontology, an "environment" against which the organization will have to adapt. This necessarily leads us to unveil the communication mechanisms that facilitate this ability to adapt, beginning with their own learning processes. That is, the participation of the same configurations will be observable at any level of organization: these settings that speak of complexity can be viewed as cohesive and coordinated autonomous networks. Coordination and cohesion are processes that need a happy ending, one which can be achieved by control, monitoring and adaptation processes.

Let us move forward a little more. Reading RaúlEspejo (1989), we find categorical statements like "We are surrounded by a complexity much greater than we can confront with answers one to one". So necessarily, under this paradigm, we can say that organizations have less complexity than their environment, "there is a natural imbalance (inherent) that needs to be

recognized and addressed through the leveraging of various strategies that the organization employs to carry this complexity within its range of response". Therefore, to address this complexity implies somehow to "measure it", since by stating that it is much greater we are somehow circumventing quantity. In this sense, Beer moves to Ashby's idea of variety, specifically the law that predicts that "Only variety can absorb variety". Thus, the VSM can enter under complex operating as an autonomous unit. In summary, the three cornerstones of VSM are located on dissociation: viable unit and environment, recursiveness and complexity.

Previously, we have mentioned that Beer was a precursor for the idea that relation can be found in the midst of variety since, necessarily and explicitly, the measurement takes place according to the observer and his relationship with what is observed. Nonetheless, Beer's starting point –that is, his disassociation from the base viable unity-environment– distances him from the relational to remain subsumed in the paradigm of the object and its lineal simplicity. For this reason, we need to break the Cartesian dualism object/environment.

While we agree with part of Beer´s definition, the fundamental difference is that the "viable" is the relational structure, the content that is reproduced, in different scales, is relational dynamics, so a relational viable system is one that "resolves its organizational conservation through a relational structural change strategy which consists in propagating value from the quality of relationships and the fit between them and their material-energetic resources". We understand that, as an organization, the set of relations that shape their identity that your condition is conservative. In this way, which may vary is the relationship structure, under the condition that the change holder is made or allowed by the organization.

Consistent with the above definitions, we define a **Viable Relational System**, **VRS**, as a configuration of relational networks that has achieved a coherent coupling between their relational configuration (tenability) and its material energy system (sustainability) so that it does not jeopardize the relationships that generate their organization. Tenability or relational quality is evaluated from the coherence of command and its congruence or the capacity to exchange intra and inter network. Sustainability is assessed from the set of breakdowns or gaps identified in the processes that define production. In other words, managing a VRS translates into coupling processes, whether by design or redesign, with the possibility of reconfiguration of the network of relationships in order to approach the Pareto 80:20.

LANGUAGE PROBLEMS, SUSTAINABILITY AND TENABILITY

To deal with this, the first thing we do is separating the water. When we talk about sustainability we are making distinctions within the realm of energetic materials, in other words, it is the strategy in the use for the resources needed for operations that constitute potential products or services in the case of a productivity organization.Moreover, we talk about the tenability distinctions that arise within the ambit of relational networks. Therefore, developing indicators involves evaluating the robustness of this structure in relation to the semiosis that the system generates to preserve itself. Unlike traditional indices, this proposal permits assessing whether the organization, faced with a particular concept such as entorno, generates or not coherence and congruence in the decision-making process in relation to that. Sustainability, from this perspective, is the conservation strategy of the organization, as a relational system, starting from structural or configuration changes in relationships, determined by the culture.

As an example, let us suppose that you marry the daughter of a banker who has just died and left her his inheritance: it is highly possible that your sustainability is settled for a while. But, as your wife and you cannot stand each other, this makes your daily relationship become untenable. _But, if you are able to hold on, taking into account that your material and energy needs are satisfied, then we could say that your marriage has a viability strategy although the emotional cost is high. We could put it another way, your marriage, although it has viability, is far from the Pareto 80:20, such that the inheritance will tumble in less time.

ORGANIZATION STRUCTURE FOR VIABILITY

An organization is relationally viable if and when its relations make it viable. This assertion is fundamental to establish the form that constitutes organized relatedness. From this point of view, each and every process is productive: it is not possible to separate processes into primary and supportive ones. The identity of the organization is not the result of what it produces, be it product or service, but of the strategy to produce it. From this perspective, an organization can be explained as a semiotic flow which, like the irrigation ditches, should be organized to achieve the most effective span and the best quality of meaning. Therefore, the organization of the 21st century should bid farewell to the Taylor model if it wishes to incorporate the cognitive domain into its value scheme.We need to build a structure that allows us decisional reliability and agility. We begin by defining their outline or border on the basis of changes in flow. This leads us to use processes of interchange or trade or value exchange with other semiotic flow system. The border

of our organization is defined by the semiosis of exchange value, which subsumes the semiosis of each and every relational process that are not produced for this purpose, both in content and meaning.This taken into account, the relational network *eco* defines itself making itself viable as a meta-network, which is co-formed from the coupling among units from the domains of tenability and sustainability. Unlike the viable systems of Beer, here co-autonomy occurs so that coordination is not a function of correcting the variety generated in the autonomic dynamics, but rather a catalytic process of selection of alternatives.

The viable relational model is based on a heterarchical network structure as a condition, which is organized into 4 processes: cohesion, coordination, communication and conduction (CO4). Heterarchy is a system in which members don't think about deciding about others, but interacting with others. This form of participation can generate multiple ideas, suggestions and support for a whole group to function properly. It provides greater freedom of action. Heterarchies are networks, often hierarchical, interconnected and overlapping with individual components that belong and act simultaneously on multiple networks and with a whole-system dynamics that governs and emerges precisely from this whole set of interactions. Starting with this idea, we can define the organization of an organization as a political system which designs and declares the political configuration of management. When we refer to configuration, we are giving an account of the form that results from the criteria that produce the organizational –political– fabric, the kind of relationships that permit putting it together –economic–, the coherence and congruence of the weaving –social– in relation to the political configuration an its erotetic base –ontology, epistemology and methodology.

In short, an organization is composed of:

- Political System or 'viabiliazer': It configures and communicates the sense of management and the organization of this sense.
- Achievability or Relational System: It corrects the quality loss of the policy configuration consistency due to variety in coherence and congruence, propagating the sense of management.
- System Sustainability: This enables matter/energy resources so that the sense of management achieves its viability objectives.

To ensure that the processes that constitute it are viable, the Co4 unit needs to produce continuous data streams to ensure the nature of the conduction, continuously improving

communication, coordination and cohesion. In the case of coordination it acts as a selector of processes that increase reliability, availability and decisional agility, that is, decisional catalyst.

THE WARP NETWORK (AN IMAGINARY DIALOGUE)

In a dialogue, a manager asks his colleague: “How were you able to make such large improvements in productivity in so little time?” The colleague replies: “I applied a warp drive, the kind NASA is experimenting with.” The first, perplexed, exclaims: “A what, a warp? And what does this have to do with NASA?”

Now, what is this all about? In 1994, the Mexican physicist Miguel Alcubierre published in the *Journal Classical and Quantum Gravity* (1994) a mathematical model that allows traveling faster than the speed of light, at superluminal speed, by performing tricks with space-time. The system envisioned by Alcubierre for space travel system in English is called “Warp Drive” (the same name used in Star Trek movie). The basic principle of this method of hypothetical superluminal travel is that, instead of accelerating an object (the spaceship) to *c* or near *c*, the very “fabric” of space-time would be curved, so that the objects would be able to travel without any movement of the ship in the usual sense of the word: rather than the ship moving, space-time is moved: curved, “warped”. In terms of the organization, the ship is the decisional, with a hierarchical structure that remains invariant, and space-time are infinite networks where the organization (suppliers, customers, managers, administration, and so on) “surf”.

If today the decisional speed has increased thanks to TICS, then how do we achieve the “superluminal” trip? To put it in another way, if the increasing in Internet connectivity and other notable progresses have accelerated speed decision in unthinkable ways, how do we take this advantage of this acceleration? In first place, what is needed it is not the use of the hierarchical structure to speed up decisions, but rather using the “curve” of networks. Or, to explain this in another way, the curving or deforming (warping), means using informal networks that are more flexible, accelerating them, achieving this superluminal voyage in the process of decision-making.Decisional shapes and styles curve or deform the decisional “fabric” of relational networks. Therefore, we must take advantage of these deformations, letting the casual functionality of the organization, as relations among units are not in the organization chart and become warped according to the importance of the objective and the decisional urgency to achieve it. In this way,

we increase productivity by using the flexibility of relational networks, keeping only the hierarchy of responsibility: our “superluminal” trip.

The *Warp Network* is the configuration that results from the relational system, determined by the political vision of management. The latter is what defines legitimate connectivities or tautologies for communication; in other words, it is the shape of the relationship **oikos-semio-auto** organized from the semiosis of political vision.

In this design, there are no fixed limits regarding the beginning or end of organization, it reproduces itself continuously and, for that reason, the interior/exterior process of organization cannot be viewed separately (if, at this point, it is even possible to speak about that). From this point of view, it is strategic to understand the following:A change in the command structure must take place, that is, it isn’t possible to continue making semiotic flows hierarchical. This implies making the hierarchical structure coexist with a horizontal system that allows for co-autonomy (*oikos-auto*). The political vision must be configured in such a way that its reproduction by propagation subsumes the independent decision-making processes of the structure type. This does not deny the importance of structural change in the sense of making propagation horizontal.

CONCLUSION

Organizations of the twenty-first century need plasticity, being understood as the existence in the here-and-now of operating methods that are defined to work transversely against strategic objectives; the minimum requirements having to do with the transversal, not permanence. The structural basis of *Emerging Design*(Warping Process) is the generation and concatenation of three main networks: *networks of reliability*, *availability* and *decisional agility*.

In addition, being a manager in an organization involves a particular way of being in the world, defined by the language game that a person must play to function and be recognized as a manager. Organizational concepts that shape notions of rationality, bureaucratic structure, delegation, control, etc., are management concepts that label and account for a world in which managers can act as managers. In a similar way, the concept and detailed language of leadership creates and defines the nature of leadership as an ongoing process. Seeing this in terms of the metaphor of language game, organizations are created and sustained as patterns of social activity through the use of language; they merely constitute a special form of discourse.In other words, the network is a way of thinking and doing, given from its history of decisions, which is conserved by acts of closure or protecting against external agents. This means that a person who joins a

network to work for the first time will not understand the working codes of the network, even though the words are the same as he or she uses.

This being so, the state of Relational Viability of an organization implies thinking of it as a structure of relational networks that propagate value based on the quality of their relationships and the fit between these and the matter/energy resources that make it possible as an organization. In this way, if we understand organization as a group of persons that interact and manage processes for the production of knowledge and value, viability will depend on the strategic axes previously mentioned (tenability and sustainability). For this reason, making organizations viable under the present conditions of global knowledge implies making them change from rigid structures, such as hierarchies, to flexible structures such as heterarchies.

***Mind-facture today has only one currency, the speed of decision-making*.**

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Explanatory model and its appliance to the organization for research and consultancy

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The purpose of the present document is to explore the explanatory model's nature and utilization in research and consultancy. For this purpose, the structure of the document will be as follows: I) discussion context; II) model definition and relationship between theory and model; III) how models are used in academic fields of interest; IV) a usage proposition of the explanatory model concept in research; V) exposure of an appliance in consulting; and, finally, VI) conclusions.

I. Context

Deleuze and Guattari (1993), in the discussion of what philosophy and science is, attain the possibility of posing the context of what an explanatory model is in relation to theory and scientific knowledge. Let us look at an interpretation of their proposal.

Deleuze and Guattari's approach

Philosophy and science establish conditions in chaos, defined 'less for its disorder than its infinite speed at which any sketched form vanishes. It is a void that is not

nothingness, but virtual, that contains all possible particles and extracts all possible forms that emerge to fade in the act. Without consistence or reference, no consequence.' (Deleuze and Guattari, 1993, p. 117).

Science actualizes the virtual, the chaos, for functions on a plane of reference. The reference is a refusal to infinite. (Deleuze and Guattari, 1993, p. 124).

Though, how does science actualize the virtual? It does it by descending from chaotic virtuality to the things or forms. (Deleuze and Guattari, 1993, p. 157). Science, firstly, endeavoured to organize chaos, detect it. (Deleuze and Guattari, 1993, p. 157).

Based on the former chaos approach and science function in this context, let us consider the relationship between science and knowledge, the science object and its reference plane. Likewise, we will consider what is understood by function.

In relation to knowledge and theory, science, in its own way, must teach us to understand, that 'knowledge is not a form, or a force, 'but a function': 'I function" (Deleuze and Guattari, 1993, p. 218). The subject 'extracts' elements that are characterized by distinction and discernment. These elements align scientific proposition.

The object of science is, ergo, the establishment of functions in reference planes that are presented as propositions in discursive systems (Deleuze and Guattari, 1993, p. 117). Assuming that 'the elements of these propositions are called functors', we are making reference to the possible existence of functions where the independent variable may be substituted by an argument. The first functors, or function elements, are the limit and the variable.

Hence, the scientist bears variables from chaos, as such, transformed into independent variables. The emphasis is not on the object's properties per se, but on the coordinate set, referenced on the variables, that in their affiliations raise the function. These coordinates occur in the reference plane that is formed

therefrom. In this reference plane, local probabilities come in to play. (Deleuze and Guattari, 1993, p. 203).

In that event, establishing functions, theorizing, as knowledge avocations, limits are enacted defining a reference plane; variables that cover the limits are organized: independent variables are coordinated, between them and the limits, in which functions act; the state of things is determined in the plane to which functions ascribe to (Deleuze and Guattari, 1993, p. 217).

The scientific process is an interrelation with chaos, in which intelligible variabilities are expressed as constants. Limits are also established when selecting a small number of independent variables in a coordinate's axis, being determined in this relationship movement, allowing future states or multiple variables and breeding probabilistic junctures. (Deleuze and Guattari, 1993, p. 206). '[…] the creation are […] the scientific variables that emanate in a plane capable of sectioning chaotic variability' (Deleuze and Guattari, 1993, p. 208).

Science moves in a reference or coordination plane (Deleuze and Guattari, 1993, p. 218). Summarizing, science supposes (1) a reference plane; (2) independence of the variables in 'conditionable' relations under a 'necessary reason'; (3) 'scientific functions have as a state of reference things or mixtures '; (4) the actualization of events by functions in a thing's state or in a thing or in bodies (Deleuze and Guattari, 1993, p. 127); (5) events are the state of things in a system of reference (Deleuze and Guattari, 1993, p. 128); (6) a creation process, as long as functors do not pre-exist (Deleuze and Guattari, 1993, p. 129); (7) partial observers are given with a perspective that limits themselves, creating insufficiencies. The partial observer perceives and experiments in relation to the thing's study object (Deleuze and Guattari, 1993, p. 131). This presumes a correct point of view in the appreciation of things (Deleuze and Guattari, 1993, p. 133); (8) the function 'determines a state of things, a thing or a body that actualizes the virtual on a plane of references, and in a coordinate system' (Deleuze and Guattari, 1993, p. 134); (9) the creation field is a problem that implies adapting – 'coadapting' 'the corresponding elements in the determination process'.

Scientific functions have reference with the state of things (Deleuze and Guattari, 1993, p. 143). The functions, therefore, (1) 'are functions of the state of things' constituted by arguments as independent variables; (2) are functions of things, objects or bodies as logical propositions; secondly, the experience's functions develop opinions (Deleuze and Guattari, 1993, p. 156). Science opposes opinions.

To sum up, in science, theory as a knowledge act has its own space each time the virtual actualizes, chaos, through functions on a reference plane.[1]

Let us look at the role that the model plays in the scientific process and in the acts of knowledge through which the virtual is updated.

II. Model definition and existing relationships between theory and model

Considering semantics, models are representations of a phenomenon, data models or theory representation, in the sense that they interpret the axioms and laws of the theory (Frigg and Hartmann, 2006, p. 3).

If theory is a set of phrases in a formal language, the model is a structure that shows these phrases in a certain form (Frigg and Hartmann, 2006, p. 12). However, models may act as preliminary theories (Frigg and Hartmann, 2006, p. 26), and often it is difficult to establish the separation line between models and theory (Frigg and Hartmann, 2006, p. 23). Models may be considered, among others, as theories, preliminary theories, theories complement or simplified models of complex theories. Even though models are relatively independent from theory they still interpret it (Frigg and Hartmann, 2006, p. 24).

Pending epistemology, models are vehicles for learning about the world, allowing a substitute reasoning when moving this knowledge from the model to what we know of the objective's system (Frigg and Hartmann, 2006, pp. 18–22). When

[1] In agreement with Maturana's (1991, p. 2) definition of theory as an explanatory model that interconnects phenomena that are apparently not related through coherent explications, in that functions can be presented as propositions in discursive systems.

assuming that some elements of the model are compatible to the world,[2] we may comprehend the nature of external things ('the reality') (Frigg and Hartmann, 2006, p. 22), this being extremely useful in research and consultancy, acting as a tool to search relationships of causality between facts and processes (Frigg and Hartmann, 2006, p. 31). This transfer of knowledge or premise of compatibility must consider that the model as the modelled phenomenon is in a phenomenological command that do not intersect (Harnden, 1989, p. 392); hence, one is not the source of the other.[3] The model is not a copy of what is modelled. (Reyes, 2001).

Models as representations and means of knowledge have been recently analysed by Grune-Yanoff (2013) and Isaac (2013). Both define representation characteristics as isomorphism and similarity (Grune-Yanoff, 2013, p. 85) or realism, generality and precision (Isaac, 2013, p. 3613). Regarding learning, they are useful, even when these do not have a representation relationship or discrepancy with the real world (Grune-Yanoff, 2013, p. 851; Isaac, 2013, p. 3622) when granting the generation of relevant hypotheses to the problem (Grune-Yanoff, 2013, p. 851; Isaac, 2013, p. 3613).

The models, as a learning vehicle, must be able to explain. For this, in the model (1) the explanation *(explanans)* makes reference to the model, (2) there must exist a structural isomorphism between the model and the phenomenon by explaining its relevant aspects, and (3) the applicability domain of the model must be established (Bokulich, 2011, pp. 38-43). Noting this, and being

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[2] 'Things that do not have anything in common with others may not be understood one for the other, this is, the concept of one does not imply the concept of the other one.' (Spinoza, 2001, Part I, Axiom V).

[3] Deleuze and Spinoza consider this duality. For Deleuze (2013) there is the authentic dualism, namely: 'There are two and one is irreducible to the other' (p. 215). When Deleuze refers to knowledge in Foucault he emphasizes the discussion between two ambits that do not intersect – statements and visibilities. For Spinoza, dualism occurs between the attributes of thought and the extension – utterly reducible from eternity.

In the case of Deleuze (2013, p. 256), between the two ambits only abductions and captures are produced. In Spinoza, a concordance between the order of ideas and things is established (Spinoza, 2001, II Prop. 7). From Descartes, passing by Kant and Raymond Russell, Deleuze distinguishes three types of dualism.

established in this way, the model defines a reference plane where its validity is obtained.

Models may also offer scientific recommendations. For this reason, in scientific work of normative character (i.e., medical and military sciences) the construction of models is essential (Grubbstrom, 2001, p. 1127). The model is constructed based on assumptions and observations, mapping part of reality in some set of abstract concepts and relationships (Grubbstrom, 2001, pp. 1126–1127). In business administration the search for optimal politics occurs. Therefore, the use of models is an essential ingredient. (Grubbstrom, 2001, p. 1127).

Visually, it is possible to define 'model' as a graphic representation in which the virtual is actualized in the reference plane established by the relationships that give rise to its limit. From this perspective, 'model' is understood as the conceptual scheme assembled by parts, interrelated and dynamic (Seldon, 1986). To the extent in which all these are particular and concrete, its utility acts as an intervention, and/or analysis instrument. These are the explicative models usually employed in applied science.

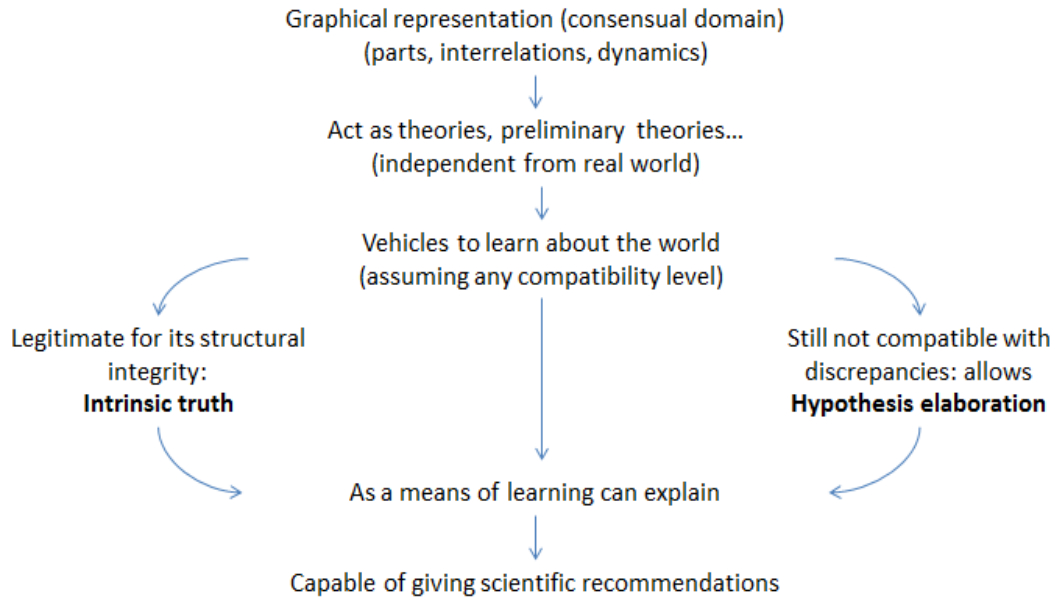
Models as representations or mediums to create theories, that actualize the virtual, engender shared meanings in a given consensual domain (Harnden, 1989, p. 396).

Nonetheless, as conceptual instruments of knowledge, these say more of the individual who conceives them than the phenomenon that they represent as such. (Spinoza, 2001, II, Prop. XVII Esc.).

The model generates its own space to 'be' when emerging with 'structural integrity', in a particular context (Harnden, 1989, p. 395), regardless the 'real' world. This structural integrity concedes the presence of a truth attribute due to the form of the true thought that resides in the thought 'the falsehood consists solely in the affirmation of something that is not contained in the concept that has been formed of it […]' (Spinoza, 2003, Prop. LXXII).

As a conclusion, Figure 1 shows the interpretation of the model here discussed, its relation with theory, its use in comprehending, its possibility as a medium to explain and learn, as well as to enhance scientific explications.

Figure 1. Model interpretation



Let us look at the utilization of models in organizational cybernetics.

III. Its utilization in organizational cybernetics.

In organizations the use of models is common, and the quality of management decisions is conditioned by the quality of the models used (Pérez Ríos, 2010, p. 1529); these, reduce uncertainty, give sense to data, are proficient when determining the value of an action in the market, and guide every action of the business (Brewis, 2004, pp. 579–580, 852, 587). In addition, operational models facilitate the representation of an organizational phenomenon. Therefore, the

observation and analysis of the organizational phenomenon are enhanced with the view from adequate distance, endorsing an effective management of the organization being represented (Winter and Thurm, 2005, p. 421).

In cybernetics, Pérez (2010) establishes that several authors have developed the use of the Viable System Model (VSM) for diagnostic design; Beer (1979, 1981, 1985, 1989), Clemson (1984), Espejo and Harnden (1989), Espejo and Schwaninger (1993, 1997), Flood and Jackson (1991), Jackson (2000), Pérez Ríos (2008), Schwaninger (2009), Yolles (1999). The use of VSM in diagnostic design implies the description, explication and materialization of organizational structures modelling its parts (Holten and Rosenkranz, 2011, pp. 562–565).

Models have been used recently in organizational cybernetics (1) representing 'self-organizing systems'; (2) explaining organizational survival; (3) complementing the VSM with other theories to show viability; (4) for the design of communication channels in the organization; (5) as an 'extended' form of acquiring knowledge in the organization; (6) showing a perspective of leadership and management.

In order, (1) Adeagbo-Sheikh' (2003), with regards to the idea we have of how a system works (conceptual model), elaborates a mathematical model of self-organizing systems (Adeagbo-Sheikh, 2003, pp. 1328–1329); (2) Vriens and Achterbergh (2011) show the role of organizational structures in incrementing the regulatory power for the accomplishment of viability, in this way modelling 'organizational survival' (Vriens and Achterbergh, 2011, p. 405); (3) Achterbergh and Vriens (2011) relate VSM to the theory of De Sitter, defining VSM as the functional model when establishing what the subsystems that integrate it do. The joint concept is the one of viability. Then, both models are understood as functional viability models (Achterbergh and Vriens, 2011, pp. 429–433); (4) Holten and Rosenkranz (2011) use the VSM to construct the model for controlling and managing the iteration scheme of the organization through the design of information channels (Holten and Rosenkranz, 2011, pp. 560–565); (5) De Zeeuw (2004) illustrates VSM as the way to acquire knowledge through the

interactions of the subsystems that compose it (De Zeeuw, 2004, pp. 722–723); (6) Rowe (2010) ascertains that leadership and management are vital processes for the organization embedded in the VSM, and constitute the essence of how it is organized from cybernetics (cybernetics of organizing), emphasizing the ¾ homeostat (Rowe, 2010, p. 1110).

For Beer (1971), the model is a medium of the relationship between the manager of an organization and the things ('the model intervenes between the manager and the situation', p. 400). It is composed of elements that are related and is used as a hermeneutic tool to comprehend. By proposing a way to understand how we 'operate' in the world, we establish that the models used by organization managers emerge from the assumption that these reflect reality. Nonetheless, Beer defines: (1) the model reflects much more our nature than the external reality [4] and (2) people may confuse the model with reality, acting in the model or in a degraded version. According to Beer (1971), when explaining an organizational phenomenon, each of us acts under models[5] which are operationally an interface between us and external things; due to this, the model may be confused with reality or acting in it. Ultimately, models may be surrogated.[6]

Using a model with the capacity of explaining, Beer offers an interpretation of the organizations that perform under acceptable levels. Let us look at this conception and its treatment.

The author begins by mentioning that viable institutions have two main characteristics: stability and adaptability. During the discussion of these characteristics, Beer poses as a hypothesis that one of the basic characteristics of our society institutions is their increased delay in reaching equilibrium when affected by an external shock. The suggested solution to recover institutions'

[4] For Spinoza, in Pablo representing Pedro, speaks more of Pablo's nature than Pedro's (Spinoza, 2001, II, Prop. XVII Esc.).

[5] 'Every one of us is committed to operate in the World in terms of his conceptual understanding of the World—his model of it, if you will" (Beer, 1971, p. 400).

[6] In correspondence with Axiom 5, from the first part Spinoza's Ethics.

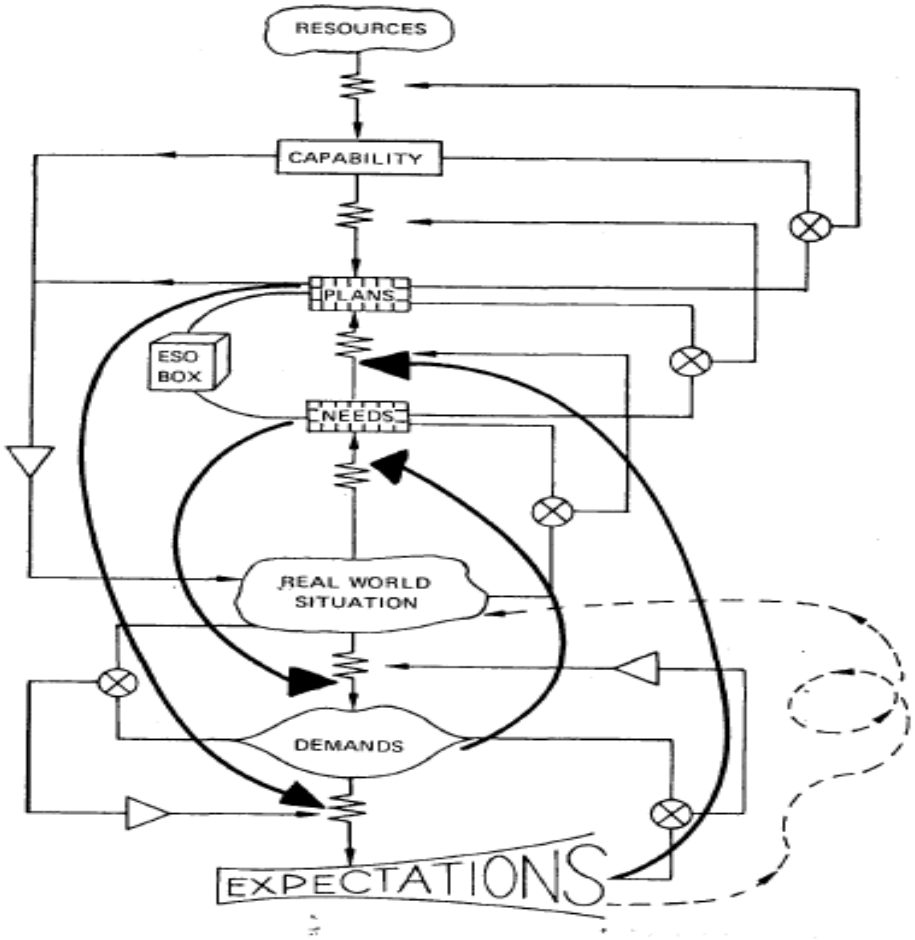
equilibrium is the investigation of ‘the world’ from the systemic perspective, to create new institutions with organizational structures that are able to ‘map’.

Beer aims to comprehend the mechanics or the form of how institutions fail, to be able to know what to do and how to intervene in the real world. For this, Beer uses the model. The author describes the situation with a model, which denominates ‘The Surrogate and the Reality’ (see Figure 2).

Regarding this proposal, the author establishes mechanisms and dynamics in the model, interconnected through comparators and feedback flows. These mechanisms proceed from a theory that relates communication flows and control: the cybernetic basis of the model. For Beer, in this model the feedback flows are connections that must be inserted between needs and demands. In the model, plans and expectations must be, then, balanced. The model considers parts, interrelations and dynamic forces graphically.

From the established model, based on Beer’s perception of things, a series of propositional premises are settled. This way, the model serves to study an organizational phenomenon.

Figure 2. Reality and the substitute world



Source: Beer (1971, p. 408).

Beer (1971) uses a model that, referring back to section II of this document: (1) is graphically represented; (2) acts as theory based on the body of premises; (3) explains the inadequate answers of organizations from a communication and control perspective; (4) has integrity and is intrinsically truthful in its internal logic; (5) allows the elaboration of hypotheses, which turn is (6) learning that gives rise to (7) scientific recommendations; (8) perform with the explanatory model characteristics already mentioned.

Next, Beer (1971) apprised another way of using models in organizational cybernetics that goes beyond the six forms outlined in the present document.

First, let us consider a different approach to VSM application.

IV. Explanatory model utilization in organizational research

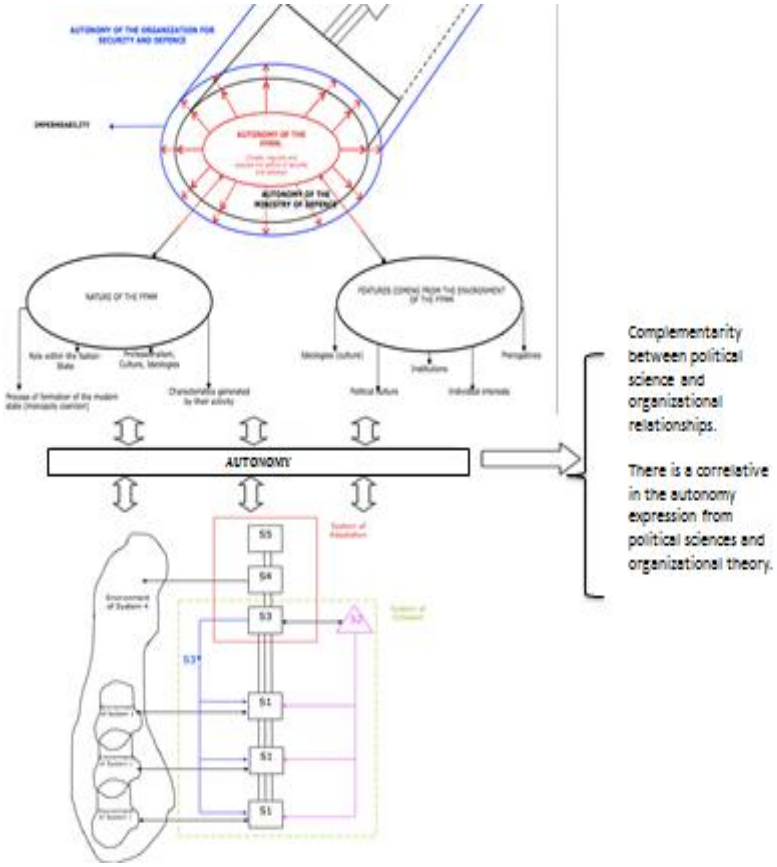
As an example, and briefly, the application of a model is shown to explain a concrete organizational phenomenon: organizational change (see Figure 3).
Investigation objective: understanding the organizational change dynamic in the Ministry of Defence of Colombia 1990–2002 (Romero, 2009); a period in which for the first time a civil ministry was designated, this led to a structural transformation in the organization of the ministry and military forces, and the guerrillas had the sure option of taking power in 1999 through violence.

Central argument: from the literature review three elements were concluded and give rise to the central argument, expressed this way:

(1) The dynamics of organizational change in the Defence Ministry may be understood based on the idea that the Ministry is part of a political system, described by political and social sciences. This description of the Defence Ministry, as an illustration of the relationship between civil and military estates in terms of political and social sciences, has a correlation with a series of relations denoted as organizational relationships.
(2) It has been found that an important concept of political science is military autonomy; the concept of autonomy is fundamental in a model used in organizational theory.
(3) It is possible to propose an explanatory model as an interpretative tool of the organizational change dynamics in the Defence Ministry, where we link, through the joint concept of autonomy, literature from political science and

organizational theory. We establish that, differently from traditional organizational theory, we must consider elements or perspectives arising from political science and organizational cybernetics to explain a complex process of organizational change as shown below.

Figure 3. Model of the dynamic of organizational change



Basic description of the model: Here, briefly, two components of the proposed model are described (Figure 3): the component from political science and organizational perspective.

The component from the political sciences perspective. This is constructed based on the story of the period, from political science description, of the autonomy of the military forces and Defence Ministry, the autonomy with regard to the creation, regulation and politics execution. Based on the recursion principle, it is considered that the military forces are contained and make up part of the Defence Ministry that is to say, they are embodied in the governmental structure of the organization for security and national defence at the same time. The autonomy of the military forces is explained by its own nature and context particularities. The reports of autonomy, from secondary sources, were complemented with a period review of institutional changes regarding the creation, regulation and of politics.

The component from the organizational perspective. Based on Ministry and the General Commands from the General Command of Military Forces interviews, the changes occurred in the Ministry were described, regarding the creation, regulation and execution of politics. For this purpose, 29 themed questions were established and were resolved in open interviews that enabled the description of Ministry changes, having as interpretative logic the VSM and the interrelationships between its different systems. The information resulting from the interviews was complemented with a review of the period, stating organizational changes in hierarchies, functional aggregates, roles and responsibilities.

Analysis: In the correlation between the description of political science and VSM applied to the Defence Ministry, the following were established:

(1) The generation of new distinctions in the relationship between political power – expressed in the form of autonomy –and organizational systems.

(2) Complementarity of descriptions between the organizational perspective and political science description was founded.

(3) In organizational terms, in the main part, the political sciences expression concerning political power dynamics in terms of autonomy was confirmed.

Research conclusions (1) Efficient changes in military autonomy are not accomplished by modifying organizational relationships exclusively; (2) Modifications as to increase of capacity on civilian – as an expression of political will – to intervene in military politics require, to be effective, concrete organizational relations; (3) With reference to political science the organizational dimension is important for an enriched interpretation of political phenomenon; (4) Relevant to organizational theory: the dimension from social sciences, in general, and relating to political science in particular, is important as interpretative complement of organizational phenomenon; (5) Regarding the explanatory model: the institutional vision gives birth to other explanatory elements and is coherent with what is observed in the model.

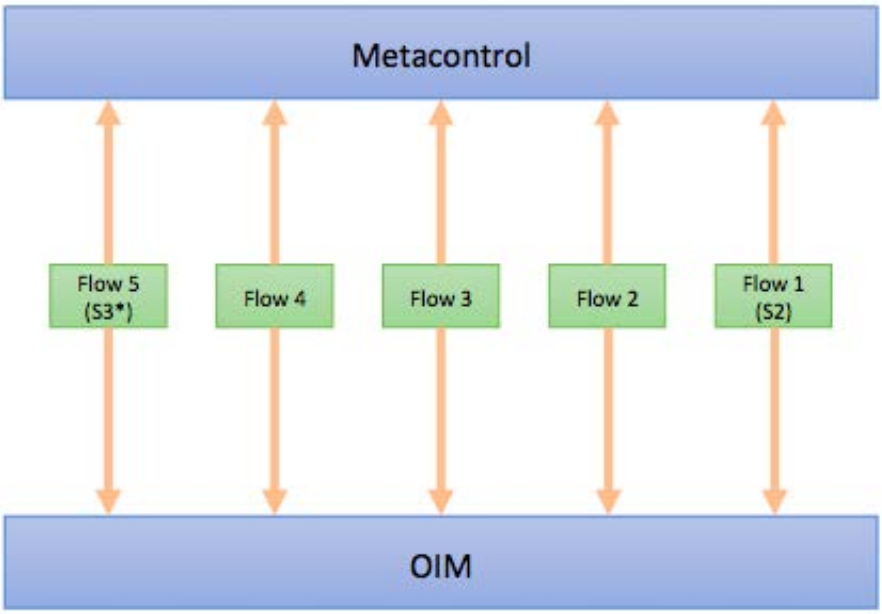
V. Explanatory model concept application in consultancy. Metacontrol design

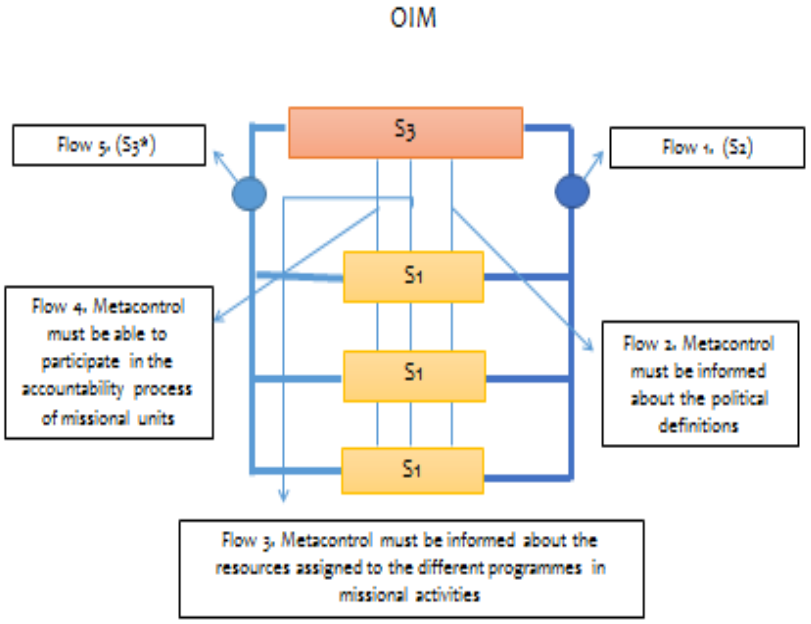
Consultancy objective: to elaborate a management and organizational design of the metacontrol of an organization in the information management sector (OIM). The objectives of this organization, OIM, are the collection of information, its analysis, and the divulgation of knowledge and prospective products.

Interrelation model between metacontrol and the OIM

Central argument: metacontrol is required to propitiate a control environment that enhances a reasonable security in respect that the OIM acts according to the values that are the foundation of their mission. That is, to assure that the activities related to the management cycle of information, are taken efficiently, effectively and according to the law. Precisely, they must adjust to the expenditures and activities of information management to the mission objectives, values and human rights. The metacontrol reports functionally to the dependence line of the OIM (see Figure 4).

Figure 4. Extended model of metacontrol and OIM interrelations





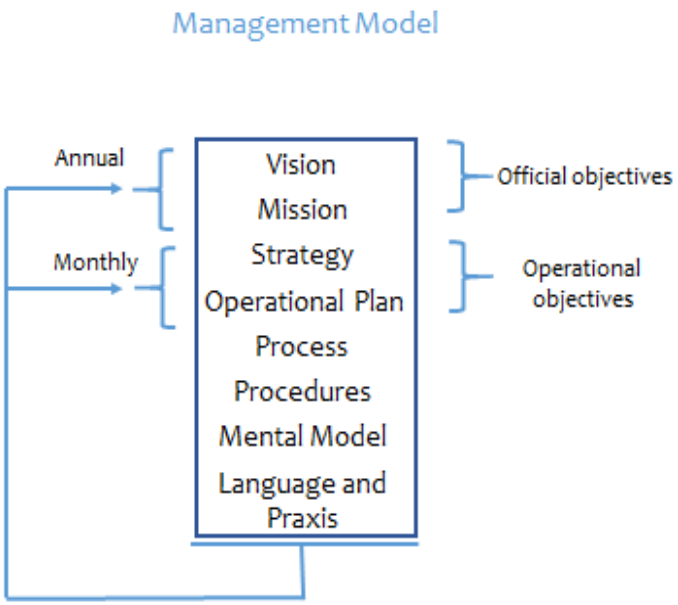
Basic description of the model: the communications as information flows between metacontrol and OIM (Figure 4) are defined based on the assumption that metacontrol should have access in real time to information flows that are advocated according to the VSM, between the systems S1, S2, S3, S3*.

Model application: as a consequence of the model application, the minimum information required for metacontrol and the creation in the metacontrol of a functionally specified unit in communication and information technology, is defined. The unit purpose is the creation and avocation of permanent information flows of S1, S2, S3, S3* to the metacontrol.

Management model of metacontrol

Central argument: the metacontrol requires the definition of official objectives that are going to be accomplished. From these objectives, operational objectives are derived, and, subsequently, and in the same order, the strategy (basic processes to develop), the operational plan, processes, procedures, mental model and language and praxis (see graph 5).

Figure 5. Metacontrol management model



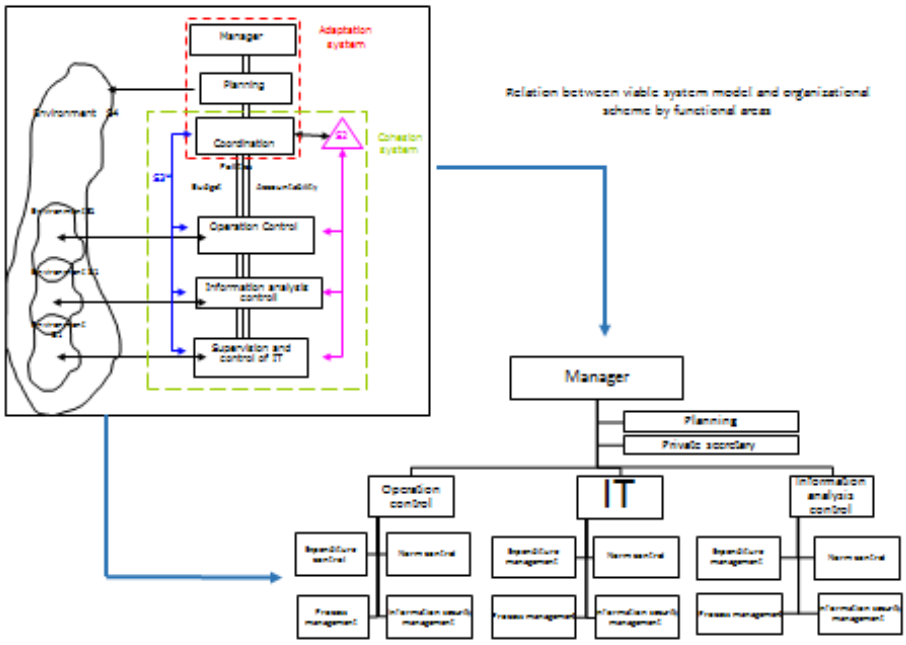
Basic description of the model: in an organization (Figure 5) objectives are defined and how to accomplish them. This is achieved by also establishing consecutively the identifying elements in the model: (1) from the vision-mission official objectives are derived; (2) the strategy jointly with the operational plan lead to operational objectives; (3) the operational plan requires processes and procedures to execute it; (4) the interactions between the organization members, based on processes, generate mental models, understood as the operational interface between them and the organizational reality; (5) the language and the practices emerge from the organization members, based on their interactions rule by codified procedures and processes.

Model application: vision and mission are defined based on standard methodologies of general use in consultancy. In this case, statutes and the ethic code are elaborated, according to norms generally accepted by the IIA (Institute of Internal Auditors). Processes and procedures are elaborated afterwards to accomplish the operational plan.

Organizational model of metacontrol

Central argument: once the management model is defined, it requires the definition of the organization that carries out the management model. This organization can be expressed as communication and control relations with its equivalent in terms of hierarchical structures and areas of functional specialization (see Figure 6).

Figure 6. Metacontrol's organization model



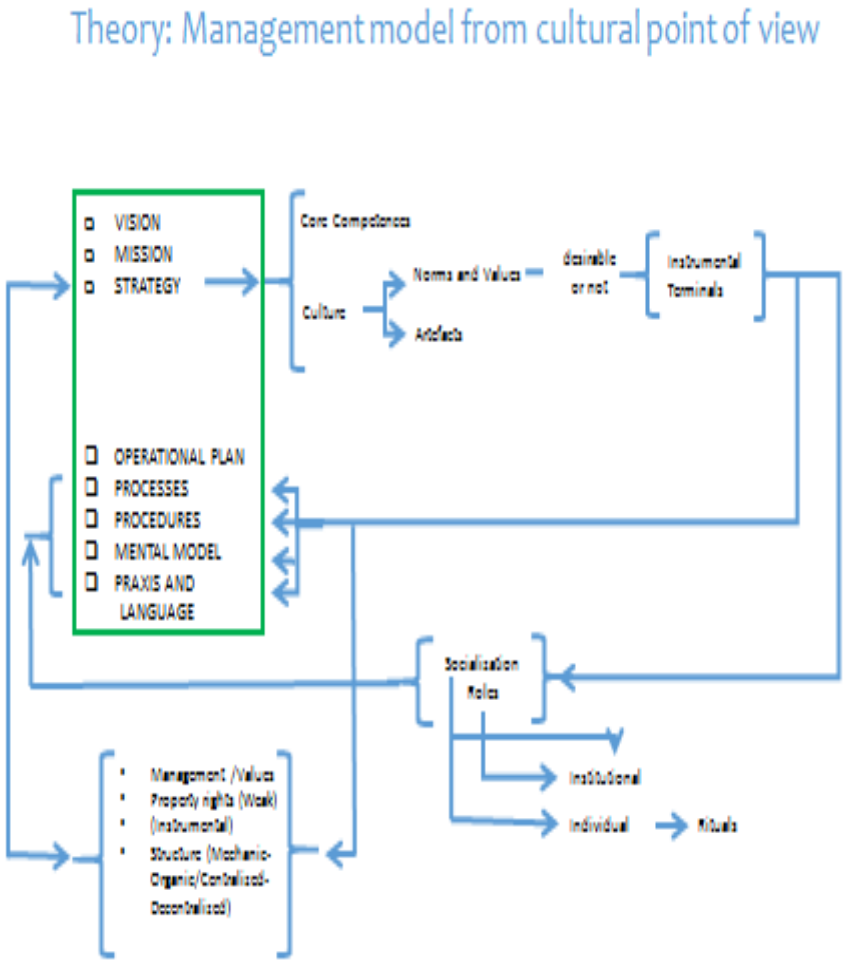
Basic description of the model: the proposed communication and control model based on VSM (Figure 6) is related to the description and the organization chart, of the metacontrol. The organization chart is expressed in hierarchical terms and areas of functional specialization.

Model application: the organizational model in both perspectives is applied through activities that give place to their materialization and institutionalization. The processes of discussion and formalization of the model with the metacontrol individuals have place and feedback to each other, simultaneously. Based on the range of activities to control, the operational plan is defined, which agrees to the establishment of the number of people and their professional profiles for each of the functional specialized area. Operational and process handbooks are interiorized and materialized, assigning roles in the organization of metacontrol.

Strategy application model

Central argument: the strategy is focused on culture and process. It is not enough, then, having access to the information flows in real time, specified in the interrelation model between metacontrol and OIM (Figure 4). Furthermore, it is necessary that everyone and each of the OIM organizations yield an effective self-control. Self-control is satisfied when an organizational culture, in which self-control is an essential part, emerges. Self-control must be expressed through concrete ways such as processes, procedures, language and praxis (see Figure 7).

Figure 7. Management model from cultural perspective



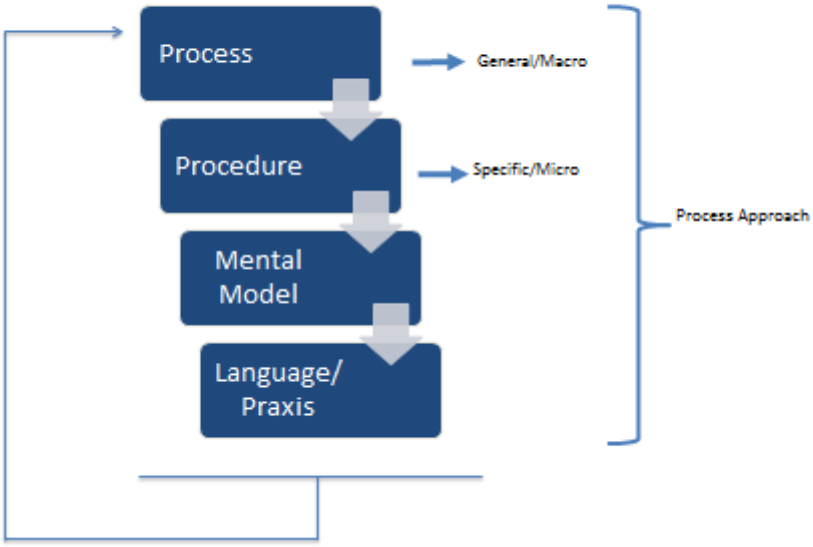
Basic description of the model: the model shows how culture – that defines what is or is not a desire for the organization – is expressed in processes, procedures, mental model, language and praxis (PPMP). The block (PPMP) is compared with expectations from the management. From these comparisons feedback relationships appear with the strategy. The strategy, then, adjusts to achieve the expectations in terms of values and their interiorizing method in the OIM.

Model application: the application in the OIM is exerted when different activities that conform to a process ascribe specific members from the OIM. Using a standard methodology of 'enterprise risk management' (ERM), processes are created, operative risk is administered and self-control is settled. Risks, considered in this way, go beyond those that arise from the accomplishment of efficiency, effectiveness and efficacy. These risks are related to the information management cycle the OIM. This is, that are adjusted to the expenditures and activities of information management to mission objectives, to the values and the law. This gives rise to the need to establish in the processes new risks and controls, and from there, the extension of the operative risk management towards other facets and matrix risk-control, and qualifiers that guide towards effective self-control.

Model of application of strategy to process levels

Central argument: self-control is accomplished when the individuals responsible for activities defines the process, the risks, the controls and indicators, and are self-evaluated and establish improvement programmes within the distinguished methodology of enterprise risk management (ERM). The definition of processes, risks and self-control is oriented based on norms that constitute what is desirable in terms of terminal and instrumental values (see Figure 8).

Figure 8. Control model in process level



Basic description of the model: the model (Figure 8) shows the interrelationship between process, procedure, mental model, language and praxis. The process is composed of' a series of activities that may be disaggregated. The procedure is the disaggregation of activities at the head of those responsible for. Procedures are the base of interactions between those responsible for the assignments, which leads to the creation of shared mental models in the procedure and process level. The mental models organize and give sense to the processes and procedures regarding the accomplishment of the organization objective. Mental models, then, acts as the interface between the activities responsible and their environment. The continuous interaction between the responsible individuals allows the creation of particular languages. Particular languages originate in the utilization of words with specified meanings. Non-codified procedures constitute practices.

Model application: when applying the model, space is given to reconsidering all the missional processes due to the incorporation of new risks. New controls are defined that imply new indicators. These indicators will reformulate improvement plans, the result of self-evaluation, enhancing self-control activities in the procedure and process level, with an amplified risk perspective. This amplified perspective considers among others, the risks associated to human rights.

VI. Conclusion

Explanatory models are an important medium in the upgrade of the virtual through functions on a reference plane, a plane that is established by the same model. Likewise, models define a state of things, the state being represented by parts, relationships and dynamics.

Explanatory models may act as theories and allow the comprehension of things, assuming that some elements of the modelling are compatible with the world. However, the model as the modelled phenomenon is in phenomenological domains that do not intersect.

Models may explain if: (1) the explanation makes reference to the state of things defined in the model; (2) there are existent model elements that are compatible with the things needing explanation; (3) they define the reference plane or explanation domain. Given these elements, the model may offer scientific recommendations.

In organizational cybernetics, recent literature shows the utilization of models representing systems; explaining system characteristics; relating models to explain system characteristics; for organizational design; explaining organizational and leadership phenomena

An additional way of adopting models in organizational cybernetics is shown in research. An explanatory model is proposed for understanding an organizational phenomenon. This phenomenon is organizational change in a determined period

of time. What is certain is that the model entails two disciplines: political science and organizational cybernetics. The interrelation point between both disciplines is the definition of autonomy as the capacity of free initiative within the limits imposed by the system. One result is that the investigation ratifies Ashby's thesis that in science development it has been proven that, often, when describing that two disciplines are related to each other, both contribute to their mutual development (Ashby, 1977, p. 16).

Finally, the application of explanatory models in the organizational design was elucidated. Explanatory models were used to design and implement the operation of a metacontrol regarding management and organizational structure points of view. Management and structure were interrelated via processes. These processes were grouped in functional specialized structures and hierarchies, mediating the VSM. The models that were used empowered the act of taking to organizational life new ways of accomplishing mission objectives of metacontrol.

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A Holistic Emotions Measurement Model: Using the Viable System Model to Diagnose Workforce Emotions

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Abstract

Workforce emotions constitute a significant part of an organization's life. Scholars in organizational behaviour discipline are constantly faced with challenging question of model utilization to best investigate the emotional phenomena. The current methodologies and frameworks available for understanding the antecedents of workforce emotions lack in explaining the work environment and its features adequately (e.g. AET). This deficiency results in the fragmented investigation of the affect oriented work related aspects which may undermine the comprehension of its effect on the work related outcomes. Therefore, the current study attempts to redress the 'narrowness' in the research on the causes of workforce emotional experiences by utilizing Beer's cybernetic Viable System Model (VSM; 1979) framework, and developing a reference model to facilitate the integrated view of the related aspects of affective workplace environment.

The conceptual basis of the study is that reasons behind the emotional experiences of the employees within the organization need to be observed holistically for its better conception and management. The cybernetic Viable System Model is adopted to comprehend the complex work environment and its interrelated aspects-functional, relational, personal- for the holistic understanding of the work environment and its features, responsible for triggering emotions amongst the employees. VSM provides 'a meta-language to represent complex social systems' by mapping the structural elements of the organization and the patterns of interaction existing amongst them and the environment (Espinosa and Walker, 2011). Several investigations proposed VSM as a valuable, effective and state-of-the-art reference framework capable of diagnosing and designing the structure of an organization from a variety of perspectives, facilitating managers in coping with complexity more efficiently (Espinosa et al., 2011, Gmur et al., 2010, Leonard, 2007). Prior research has further confirmed that VSM can significantly aid in gaining a consolidated functional and

social account of an organizational working environment, including its operations, management and the external environment. This functional and relational aspect of the organization together with the individual's personality dimension can provide a holistic account of the reasons behind the production of emotions within the organization at the individual level. In essence, the VSM can provide a holistic comprehension of the work environment eliciting employee's emotions and subsequent reactions.

Based on VSM distinctions, an analytical tool (named as Holistic Emotions Measurement Model – HEMM) has been developed for gauging the broad range of the causes of emotional experiences prevailing in the work environment. It facilitated the joined-up functional and the relational view of the entire working environment adequate for holistic diagnosis of the antecedents of emotions within the work settings.

Subsequently, HEMM has been tested empirically by conducting survey in Pakistan corporate sector. The development and test of the reference model was guided by the constructivism-positivism philosophy respectively. The research framework specified for field investigation included three exogenous (i.e. functional work events-FWE, relational work events-RWE and core self-evaluation-CSE) and five endogenous (emotions experience, job satisfaction, organizational commitment, organizational citizenship behaviour and counterproductive work behaviour) variables. The systematic assessment of the measurement models and the structural model was undertaken using partial least square structural equation modelling (PLS-SEM). The results suggested the validation of functional (FWE) and relational (RWE) work events variables modelled to capture the holistic view of the workplace day-to-day affective events along with personality dimension (i.e. core self-evaluation-CSE), for comprehending their influence on employees emotions and subsequent work-related outcomes. Thus, the field testing results confirmed the potential utilization of the tool in diagnosing the antecedents of affective experiences of the employees while at work.

The current study provided an empirical account on the effective utilization of cybernetic principles in the field of organizational behaviour which has remained largely unexplored till date. VSM framework has been proposed as a tool for better depiction of the work environment and its related aspects for understanding the underlying causes behind the production of workforce emotions within organizational settings, which has enhanced the state-of-art theories on emotions management. The application of the reference model on field provided evidence about the convenient use of VSM in conjunction to AET as emotions measurement tool. This study further reflected the appropriateness of the event-based approach adopted by the management and academicians for assessment of the causes of employee's emotional experiences, wide-spread in the work environment.

In nutshell, the study illustrated the potential of the VSM as a conceptual device for classifying the causes of workforce emotional experiences widely-spread in the

organization. It further developed a tool capable of giving the snapshot of the entire working environment and its aspects for identifying the reasons behind the emotional occurring at the individual level within the organization which was further tested to assess the effectiveness of the reference model in gauging the emotional experiences and reactions of employees within the workplace settings.

Keywords

Viable System Model, Affective Events Theory, Workforce Emotions, Emotional Antecedents, Emotional Consequents.

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Outlook of China's State-Owned Enterprises Transformation

yi hu

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Transformation of China's state-owned enterprises(SOEs) have been lasted for over 30 years since the beginning of China's reform In 1978.SOEs makes great success accompanied by growth of China's economy. The mainstream view about SOEs is that most policymakers and scholars wish construct a socialist market system which embedded in public ownership. The system not only uses market to efficiently allocate resources but also uses macro-control to protect mass interest and avoid intensification of wealth. However, New Institutional Economist Eric Brousseau (2008) insists that because of high transaction cost 'Privatization was assigned top-priority within most reform packages for developing and transition economies'. My research proposal creates a new historical institutional analysis framework to analyze the problem.

Description of research agenda

Transformation of China's SOEs can be defined as institution change without technology innovation, Hence the research agenda rises: when the structure of SOEs should be changed? What sequence should be followed about the priority of China's SOEs transformation within reform package? What factors contribute to evolvement of SOEs? transaction cost is a relative static concept,Foundation of evolutionary economic is thought that "novelty---replication---retention".Both of them is inappropriate to explain the transformation of China's SOEs .As far as logistical positivism is concerned,"such accounts usually rest on a model of causality that requires the assumption of unit homogeneity" Daniel Ziblatt(2010) Historian need deal with heterogeneous facts.

Methodology foundation:

The highlight of my proposal is creation of new historical institutional analysis framework .It is original without prior research. Stimulated by work of professor Maria Cristina Marcuzzo (2008) ,'the most important of rational reconstructions consists in the reformulation of the arguments of past authors into a modern theoretical framework '.My research proposal is reconstruct thought of old Institutionalism , historical materialism , phenomenology and some soft system method to form a new framework. Gerald Midgley(1997) pointed out creative design of methods is "synthesis which is generated that allows each individual research question to be addressed a part of whole system question" In my view ,Creative design of methods is reconstruction of assumption and law to explain and predict event.Based on soft system thinking,the root definition of China's SOEs transformation is structure change which is compatible with China's economy transformation process to more efficient economy system.

Engels(1890) said "according to the materialist conception of history ,the ultimately determining element of history is production and reproduction of real life" and "the connomic situation is the basis but the various element of super structure …also exercise their influence upon the course historical struggles and in many case preponderate in determining their form". Edmund Husser.(1954) pointed out "the

truth is established only in the self-evidence of critical over-all view which brings to light ,behind "the historical fact" of documented philosophical theories and their apparent opposition and parallels a meaningful final having" Peter Checkland (1999) thought 'Social reality is the ever-changing outcome of the social process in which human beings ,the product of their genetic inheritance and previous experience, continually negotiate and re-negotiate with others their perceptions and interpretation of world outside themselves'. historical materialism , phenomenology and soft system methodology constitutes the philosophy basis of my new method. Hence the framework is comprised of three parts below.

1) Reduction of conviction and motivation inside typical case which based on 'Behavior Subject' is deemed as inducing factors of system change. According to actor-system-dynamics theory ,"actor ,individual and collective agents---in their various positions embedded in complex structure"Tom R.Burns(2006) 'Behavior subject' is a new Multi-actor assumption. Michael C. Jakson (2003) also said that 'We now have six elements that a root definition make reference,…W="world view" makes transformation meaningful'.
2) System change will be ultimately beneficial to the efficiently allocation of resources. Concept of Adaptive Efficiency is reconstructed in micro and macro lever
1) Typical case

Simple upholding to prove the rationality and contractibility of the framework

There is a typical economic factor in China's economy that the amount of deposits over loans reached 13 trillion yuan, which is the source of liquidity. According to the analysis of Keynes, the motivation of deposits is due to the prudent motive and investment motive. The factor shows our social security system is not good enough to meet people's requirement, people lack investment channels. It results in a large number of deposits.We have to reduce state-owned shares to enrich the social security fund, give more investment opportunities to private capital.Now we have come to conclusion that changing economic growth mode must rely on independent innovation. According to thought of **Joseph Schumpeter**, entrepreneurs is the main organizer of economic development, which is a new combinational factors of production and innovation.Innovation of entrepreneurs also has motives of obtaining ownership, In order to stimulate innovation ,We have to reduce some state-owned shares to entrepreneurs .Based on our concept of successful reform ----two-track system, the core thought of two-track system is that let new market factor gradually play the role meanwile maintaing the operation of the old scheme until new market factor ultimately replaced the old scheme. Our successful reform of price is a good example .Our state-owned enterprise reform should be similar to price reform, From the protection of private property into the

Constitution to support of non-public-owned enterprises development, we have gradually play the role of non-public enterprises. That means non-public-owned enterprises would replace state-owned enterprises.

Time that non-public-owned enterprises replace state-owned enterprises.is decided by whether it is beneficial to the efficiently allocation of resources.(1) Chinese state-owned enterprises Transformation will minimize the negative effects of the asset bubble ," **Reducing state-owned share not only benefits social security system to stimulate demand but also absorbs invest demand in real estate market." Yi Hu.(2011).**

(2) From a sustainable development perspective, It is not rational that economic growth relys on investment for the investment rate reaching 50%. Also because the United States secondary debt crisis is spreading ,it is not realistic to rely heavily on exports to boost economic growth , we have to speed up the building of the social security system to stimulate consumption growth, and stimulate innovation to achieve sustainable growth. (3) Since the introduction of independent directors ,we have use up all company internal control approach. We have to let enterprise free market price, improve low operating efficiency by freedom of mergers and bankruptcy. This also require reduction of state-owned shares. (4) For the good quality of state-owned enterprise assets, there is someone who object reform of state-owned enterprises, we have to point out that many state-owned enterprises rely on the scale effect and its monopoly position to maintain their own **dominance**, In fact,in some competitive field of advanced productive forces private enterprises have made great progress and obtain dominance. such as Huawei and Sina, however state-owned enterprises dispeared (5) Mr. Deng Xiaoping pointed out that "Let market play basic role in resource allocation " .To accelerate the reform of state-owned enterprises ,we must implement this ideology

Conclusion

Prevaricating SOE is unavoidable but priority is not the top. Efficient allocation of resources is the ultimate goal of economy system. My research is helpful for transformation of economy system which is in planned economy, It also enhance undemanding the evolvement of economy system.

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3

Ecosystems - Renewal for Sustainability

Sustainability and governance:

Complexity and contradictions in Ecuador

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Abstract

Sustainability and governance need to be understood at a variety of layers and scales, from a micro to a macro scale, and their intertwined relationships need to be better represented and monitored. This paper treats sustainability and governance as two distinct, yet closely interrelated terms which affect each other and are being challenged by similar conflict and management problems. Complexity theory is examined as an approach that may effectively help understand relationships between various levels and scales of sustainability and governance. Complexity theory management tools such as Viable System Models are being examined as diagnosis and management tools.

With Ecuador as a case study, the paper addresses environmental, economic, societal and governance sustainability issues from a systems and complexity theory approach.

1. Introduction

Over recent years, Ecuador has been developing strategies which are novel worldwide and the country has been working towards a paradigm shift which may be referred to as the '*Ecuadorian experiment*'.[1] As Ecuador is exploring alternatives to the current productive economy matrix and the social framework of the country, it seems to produce conflict and occasionally discontent, for lack of access to appropriate tools and methods for implementing and sustaining them.

In examining various sectors in Ecuador we see that environmental sustainability doesn´t always coincide with economic and social sustainability, with the Yasuní case a prime example. The same phenomenon is being detected at various levels of governance. Conflict of interest is being recorded between the local scale of communities and municipalities, and the national and state level, as the recent municipal elections demonstrate. Also in the context of a pluri-national state, which Ecuador has declared to be, the radically different cosmovisions between indigenous and urban populations and their expectations, hopes for the future and respective niches, need to be addressed (Maturana & Varela, 1980).

Sustainability is being examined within the current Ecuadorian context both in a traditional framework and in new approaches, relating to such national concepts as

[1] An independent debt audit commissioned by the government of Ecuador, the Yasuní ITT and asylum t to the "information rebels" Julian Assange and Michael Snowden. Also investment in research towards transition to an open-knowledge based economy, among others.

Sumak Kawsay, *Buen Vivir* and the *Rights of Nature*, as introduced in the 2008 National Constitution.

This paper forms part of research being undertaken by the author in Ecuador.[2] It addresses sustainability within an environmental, economic, societal and political framework from a *systems* and *complexity* approach. With Ecuador as a case study, the goal is to examine the applicability of complexity management tools, in order to address the multilevel and complex nature of sustainability and governance, and examine alternatives to understanding conflicts, in hope of identifying effective conflict resolutions.

2. Research methodology and tools

The methodology has entailed bibliographical research, combined with fieldwork, observation, interviews, collection of data and collaboration with academic researchers and various working groups.[3]

Subsequently a diagnosis process tries to identify conflicts and problems. In case that a conflict is detected at various levels and scales, resolution tools need to be identified and tested in order to elicit a different result. This then will be communicated to various actors, such as government bodies, other researchers, NGOS, academics, etc.

Among complexity, governance and conflict management tools being researched and tested Viable Systems Model (VSM) which "*considers an organization as a number of Operational units and the systems needed to ensure they cohere, or work together as an integrated, harmonious whole*" is deemed appropriate as methodological tool for analysis, diagnosis and assessment. (Espinosa & Walker, 2012, 126).

3. The Ecuadorian experiment[4]

The state the country has been experiencing (2006-) is being referred to here as the '*Ecuadorian experiment'*, as it may be likened to a quantum leap process of emancipation and change. The country's recent history and some of the government's experimental and risk-taking strategies of the past eight years in various sectors of the national productive matrix, combined with a unique political strategy in the global front justifying this definition, are briefly outlined below.

In November 2008, Ecuador became the first country to undertake an examination of the legitimacy and structure of its foreign debt. According to the report, carried through by an independent debt audit commissioned by the government of Ecuador, the loans violated Ecuador's domestic laws, US Securities and Exchange Commission regulations, and general principles of international law. Ecuador's use of legitimacy as a legal argument for defaulting set a major precedent; (Denvir, 2009; Faiola, 2008). The financial press came down upon Ecuador with condemnations and predictions of dire consequences. Nevertheless, Ecuador's economy strategy regarding debt, has

[2] The author has been conducting research in Ecuador as Prometeo researcher on the topic of "*Redefiniendo la sostenibilidad, resilencia y Buen Vivir en el contexto de una economía social del conocimiento: Teoría e implementación*", Instituto de Altos Estudios Nacionales (IAEN).

[3] These include so far the FLOK Society Project, INER, IKIAM and various communities.

[4] "*An experiment is an orderly procedure carried out with the goal of verifying, refuting, or establishing the validity of a hypothesis. Controlled experiments provide insight into cause-and-effect by demonstrating what outcome occurs when a particular factor is manipulated". (Wikipedia)*

triggered an extraordinary period of social and economic renaissance for the country. Since the rise to power of *Alianza Pais* and the so-called *Revolución Ciudadana,* an impressive array of changes and reforms have been addressing issues of equality, justice, education and plurality. Figures confirm these changes, indicating a growth of the economy which has favoured the underprivileged and a process of socioeconomic convergence in Ecuadorian society[5].

In 2009, Ecuador's National Assembly signed the new National Constitution which introduces two innovative concepts worldwide, marking a significant departure from western thought in both fundamental concepts and in legal history: The *Rights of Nature* and the *Buen Vivir/ Sumak Kawsay* concepts. The *Rights of Nature* concept recognizes Nature as an entity outside of man. The much theorized Buen Vivir principle draws inspiration from the indigenous *Sumak Kawsay* concept, acknowledging "life to the fullest" and a good and "harmonious life" as a goal for all beings, not just man.
This visionary and extraordinary text was produced as a result of the contributions, intellectual efforts and activist voices of several people and groups. An ambitious set of social, economic, social, production and environmental changes has been in effect since then, but not without contradictions and frictions. These contradictions originate from the efforts being made to achieve social progress and social reform in public education, health and services, while they are being funded by an economy based largely on unsustainable and environmentally problematic practices.[6] All the while a long-term strategic scheme is centered around the vision for a transition of the national economy currently based on extractivism, towards a knowledge-based economy.[7]

Regarding the use of "Ecuadorian experiment" as a term, inevitably the case of Chile comes to mind with the *Chilean experiment,* a term known for exactly the opposite goals, as it refers to the neoliberal reform approaches in the latter years of Pinochet's dictatorship and Milton Friedman's use of the country for his neoliberal *shock therapy experiment*.[8] Eerily enough the analogue between Chile and Ecuador does not stop to the use of the term "experiment" but recalls Stafford Beer, his research team and the ground breaking research on Viable System Models (VSM) in the brief visionary period of Salvador Allende´s presidency prior to Pinochet´s dictatorship, as research towards a reform in the economy has taken place in Ecuador as well (Beer, 1985, 1995).
It is interesting that VSM tools made available from the research that originated in Chile are being considered to be put to use in Ecuador.

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[5] Poverty has fallen by 11% and the Gini coefficient by 12 %. See Ecuador in Figures. (2008). http://www.nationsonline.org/oneworld/Country-Stats/Ecuador-statistics.htm

[6] The economy of the country is heavily dependent on oil production.

[7] Besides reforms in the economy and the constitution, as well as the IKIAM, Yachay and FLOK Society case studies discussed, several other projects and strategic moves of various scales have been taking place during the period of the Ecuadorian experiment which are not being mentioned.

[8] The term *Chilean experiment* describes the neoliberal and free market reorientation of the economy of Chile in the 1980s by Nobel laureate economist Milton Friedman and was a flagship case study for the perceived benefits of economic liberalism.

4. Scales and levels of Sustainability, Governance, and Complexity

Sustainability indicates the capacity of being maintained in existence without interruption or diminution. Sustainability of human societies and ecosystems is the outcome of complex relationships but more often than not, sustainability is being reduced to environmental management, or applied to a specific field. The interwoven as well as intricate relationships between societies, economies and their environments tend to be ignored, downplayed or misunderstood, and confusion originates from the fact that sustainability as a term resists specialization and isolated investigation.

Going back to the Latin origins of the word *complexus* (that which is woven together), Morin defines Complexity as a "*fabric of heterogeneous constituents that are inseparably associated, and as a condition posing the paradox of the one and the many*" (Morin, 2008).

The origins of the word *governance* (as well as of the words government and cybernetics) are found in the Greek verb *κυβερνάω* [*kubernáo*] meaning *to steer*, to manage, to control, as well as to use a method or system of government or management.[9]

What do such vastly different examples as a building, a city, a community, a research group, and a nation have in common, is that they all may be understood as systems which function, in order to achieve a particular purpose and for which a management methodology between its parts, bodies and subsystems is required (Beer, 1985; Capra, 1997; Meadows, 2008). One environment changes affecting one system, and other dependent systems or subsystems must adapt accordingly, towards a new state of balance. This leads to the need to approach sustainability on multiple levels and scales, both local and global, and of an assessment method addressing *multiple level and scale* sustainability.

Sustainability is a characteristic profoundly related to *complex systems*, and therefore only a systemic approach appears to be effective in providing meaningful answers.

The ideas of *scalar* and *multilevel* sustainability are being introduced here. *Scalar* sustainability indicates that there are several scales in which sustainability may be examined and sustainability principles may be applied. *Multilevel* sustainability places emphasis on interdependence between various facets of life and human activity, such as the environment, society, and the economy, and the interconnected nature of sustainability in each and every one of these areas.[10] Scalar and multilevel sustainability principles include awareness of the interconnectedness of systems and ecosystems, with society and the economy through all scales, and the need to work with these multiple scales and levels in mind. Some indicators of scalar and multilevel sustainability are society and the ecosystems´ well-being and sustainability, in such a way that a thriving local economy is sustained and flexibility is achieved with necessary exchange between various levels and at a global scale.

But conflict is often bound to arise between different scales and levels. When we depart from the dominant paradigm of specialization into an isolated area and embrace a holistic view in an effort to look at the larger picture, we may begin to

[9] Random House Kernerman Webster's College Dictionary, 2010.

[10] Besides systems theory, permaculture is one of the theories that embrace a holistic understanding, the working with and not against nature principle, systemic thinking and scalar sustainability. (Mollison, 1997)

decipher the sources of problems, conflict and contradictions which otherwise may be ignored. It is because of sustainability and governance understood as a multi-scale and multilevel condition that a complexity approach seems most appropriate in order to have a true understanding of the whole (Espinosa & Walker, 2011).

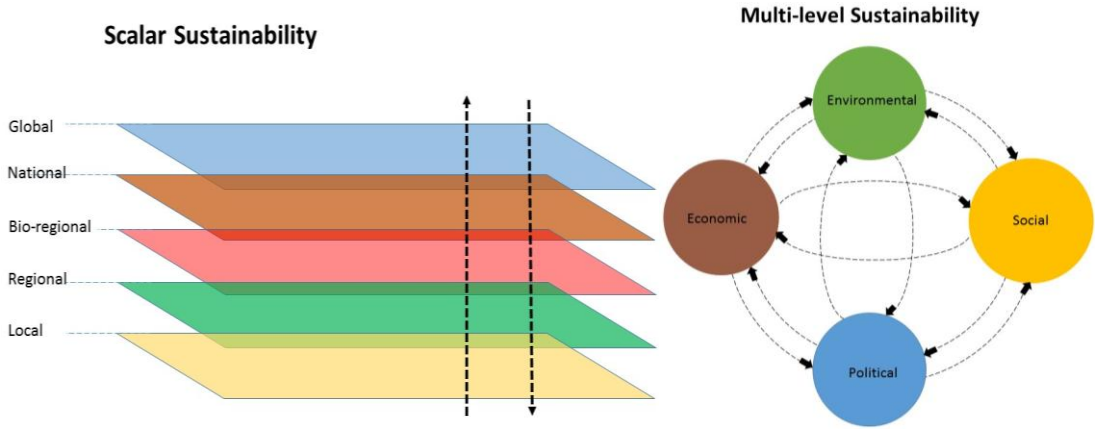

Figure 1 Schematic diagrams illustrating the Scalar and Multilevel sustainability concepts (Source: the author)

5. A scalar and multilevel sustainability approach in Ecuador

Research currently being conducted in Ecuador by the author relates to sustainability, governance and complexity and is directed towards identifying conflicts, contradictions and shortcomings. Tools and ideas are being explored at a later stage within the context of scalar and multilevel sustainability for conflict resolution. This includes stated goals for a transition of the economy from a natural resource extraction one, to a knowledge service-based post-petrol economy, and an effective vision for sustainable environmental management, matched with social well-being.
The case studies of *Yasuní* and *IKIAM* around the Amazonia region and the case studies of *Yachay* and *FLOK Society* around the transition of the resource-based economy into information and knowledge-based economy in Ecuador reveal some inherent controversies in the strategies deployed within the Ecuadorian experiment. At a higher level, regional and global economic and geopolitical relations and dependencies further complicate the situation increasing the variables that affect issues around sustainability and governance.
Scalar and multilevel concepts seem particularly pertinent to the case of Ecuador. As described above, in what I call the Ecuadorian experiment, bold moves have and are being taken at various scales, international, national and regional. The financial move of the present government regarding the debt, the efforts of restructuring of the economy to a diversified one and the regional projects such as Yachay or IKIAM, as described later, envision a multilevel approach to sustainability.

For the purposes of the research four case studies are being examined in two categories. The first category involves the Amazonia as a contested and endangered natural environment of global significance, and the use of natural resources in regards

with preservation strategies. The second category involves the current strategy of the state of Ecuador, towards an alternative social and economic model. Together, they compose a "map" of complexity nodes regarding sustainability and governance. In a paradoxical cycle the two categories are interdependent, in a conceptual model which links resource extraction that funds current projects which will free the economy in the future from intensive resource extraction.

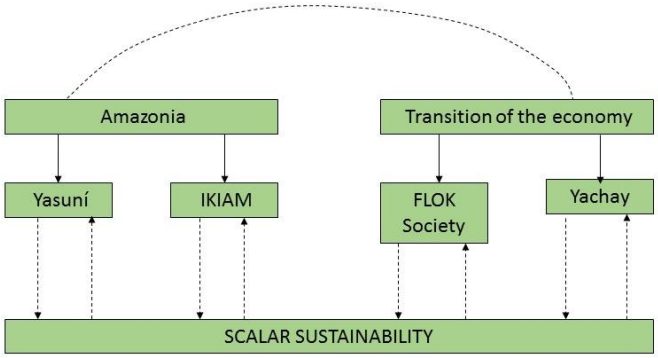

Figure 2 Scalar and Multilevel Sustainability diagram for the Ecuadorian experiment (Source: the author)

6. **The Amazonia**, Yasuní and IKIAM

As one emblematic case of complexity, the Amazon brings together heated debates relating to biodiversity, indigenous cultures, environment and the economy at the local, national and global level. Biodiversity teaches us that the natural environment is a complex system capable of self-organization through infinite and intricate relationships at all levels, a formidable case of *scalar sustainability* and of principles of complexity governing nature (Roe, 1997; Waldrop, 1993). All efforts in trying to control nature in non-compatible ways, especially in this highly complex and symbiotic environment as the Amazon have proven to be destructive, and at the same time futile.

6.1. Case study 1: The Yasuní

The most controversial in the Ecuadorian Amazonia of all issues in recent times has been the Yasuní region and the prospect of drilling for oil. This prospect once it was found that the Yasuní National park sits on top of an immense oil reserve. The International Yasuní-ITT (Ishpingo-Tambococha-Tiputini) Initiative was a call to the international community for 50% of the value of the reserves, or $3.6 billion over 13 years from the international community, in exchange for Ecuador to indefinitely refrain from exploiting the oil reserves within the Yasuní National Park.[11] The campaign failed to raise these funds. Subsequent discussions for a referendum posing the question to the Ecuadorian people didn´t materialize. The case remains open.

Observations:

The mobilization of citizens with a collection of signatures over the Yasuní "keep oil in the soil" cause, demonstrates that a heightened level of awareness about environmental issues has been attained. Meanwhile, a rapidly growing consumerist middle class is co-responsible for the flooding of the country with new cars, and for an increase in imports.

[11] The International Yasuní-ITT Initiative reveals the attempt to place a market value to natural resources deemed priceless, as well as the hypocrisy of the international community which largely remained idle towards a call to action for matters of global interest.

Two parallel and highly controversial, well publicized and contradictory points around the Yasuní concern the Chevron-Texaco oil spill case in Ecuador, arguably the largest that has occurred in the world and the financial dependency on oil and China exports (Neher, 2013).

6.2. Case study 2: IKIAM

La Universidad Regional Amazónica IKIAM, located at Tena in the Napo Province of the Amazonas region, is a strategic project which is meant to focus on the biodiversity of the Amazon and on the sustainable use of natural resources.[12] IKIAM expresses a vision for an integrated with the environment research centre and a university campus that will address the complexity and biodiversity of the Amazon in a highly innovative approach. The first price for the design of IKIAM University was won by a consortium of Ecuadorian architectural firms. The winning team of highly competent architects has demonstrated responsibility and awareness towards the complexity of the task and of what is at stake, and the proposed design as well as the methods and materials used envision a self-sufficient, highly complex and integrated to the local circumstances environment. The IKIAM project was thought to be an appropriate case study for INER's sustainability assessment method and protocols research project.[13]

As in the Yasuní case, this project also brings to light the complexity aspects around the Amazon, a region which has been contested and exploited in so many ways.[14]

The identity, site placement, design and performance of the university campus are all key factors which are going to be crucial for the future of the sustainability in all the above. It is imperative that IKIAM, a new institution with a unique mission in the unique Amazonian region, embodies scalar and multilevel sustainability principles in its educational and research ethics, and that the educational system used, may function as a methodological example of these principles. The IKIAM project, as a case study for INER, allowed participation to various working meetings, discussions with the architects, site visits and close observation, as well as its background, which afforded a solid understanding of the whole process and the possibility for well-informed observations.

Observations

The site chosen was the result of a long search and of the desire to construct a campus engulfed by nature and at a distance from Tena. The team had proposed instead an alternative site, a local non-functioning airport site, so as to leave the Amazonian environment intact, and integrate the university with the city. Certain components would be retained at the current site, maximizing advantages from both sites. For expediting the process and other reasons, the campus will be constructed at the original site. The already built first phase (outside of the scope of the architectural design competition) is a campus to accommodate foundation year students and it involves buildings

[12] For more on IKIAM see http://www.universidadikiam.com.ec/

[13] The author was invited to participate in INER´s ongoing research project towards establishing a sustainability assessment method and protocols. The Instituto Nacional de Eficiencia Energética y Energías Renovables (INER) is a governmental agency researching and implementing Renewable Energy Technologies and Sustainability. For more on INER see www.iner.gob.ec

[14] As Santiago del Hierro, principal architect from the winning team for IKIAM said, "*the Amazonia has been colonized in succession by the Incas, the Spaniards, the petroleum industry and the capital, and now is in danger of being colonized yet again by the academics*".
Santiago del Hierro, EstudioAO (www.estudioa0-archivo.info*)*

and infrastructure which have fallen into basic design mistakes, largely ignoring local conditions.[15] This will hopefully not be the case for the IKIAM main campus.

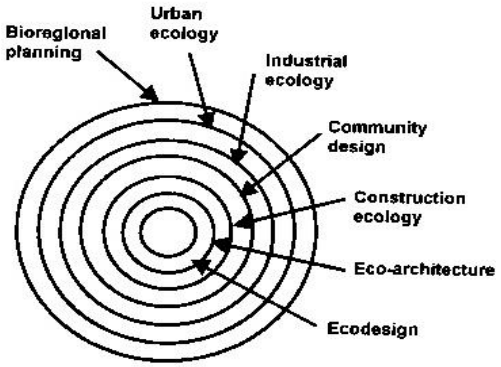

Figure 3 Scales and complexity: Schematic representation of scales sustainability through ecological design (Source: Design for sustainability, Birkeland, 2002).

Transition to a knowledge-based economy

The *FLOK Society* and the *Yachay* projects, though totally different in structure and form, appear to fall within the strategic efforts for a transition towards a knowledge, education and innovation-based economy. For this reason the two following case studies have great significance.

1.1. Case study 3: Yachay la Ciudad de Conocimiento[16]

Yachay, *la Ciudad de Conocimiento* (City of knowledge), is a much discussed project for a new city in Ecuador covering the huge area of 4.489 hectares. Its population at 2045, the time of maturity, is projected to reach 120.000. One could argue that Yachay distils the strategic plan and hopes for fulfilling the vision for a transition of the economic and productive matrix of Ecuador from the current *extractivist* economy towards an immaterial diversified economy. The future tech-city of Yachay was inspired and modelled after the, perceived as successful, Korean case studies. Consequently Korean expertise was sought by the Ecuadorian government for the project. Doubts about the effectiveness and applicability of the Korean proposal and standards which were found to not take into account any local specificities, led to the summoning of an international ´´*Think tank*´´ of experts which convened in July 2013 charged with an assessment of the project. This group of experts advised on some alternative visions for Yachay, which resulted in a revised plan which incorporated new ideas and an Ecuadorian team of planners and architects.

Observations:

There are several comments to be made (probably outside of the scope of this paper) about the design itself and the design and development process. Yachay is an ambitious project which is meant to address several scales and levels of sustainability, primarily economic sustainability through diversification. It is not certain that Yachay will not

[15] These include thermal behaviour, the use of appropriate materials and design principles, suitable for the local climate and conditions. These shortcomings result in a level of discomfort and the need for air conditioning. Certain areas are prone to turn into mosquito havens as a result of poor design with stagnant water, no light access or air circulation.

[16] The author conducted interviews on Yachay and site visits. He has participated as critic in a mid-term review of an architecture studio project with the same content, led by Professor Michael Sorkin at CUNY.

be an economic free zone haven, or that it will possess the mechanisms to be flexible over time, sufficiently diversified and in complementary balance to the urban centres in proximity.

1.2. Case study 4: The FLOK Society Project[17]

The Free, Libre, Open Knowledge Society Project (FLOK) under the leadership of Michel Bauwens of P2P Foundation, was commissioned by the Ecuadorian government to research and produce policy papers for a transition of Ecuador to an Open-Knowledge Cooperative Economy.[18] When the FLOK Society project was announced, it was received with great hopes all over the world and was greatly publicized. The FLOK Society project, inspired by commons theories and the emergent peer to peer culture (P2P) that the internet affords, stated at its onset that it aims *"to change the productive matrix towards creating a society based on common, free and open knowledge in Ecuador, as stated in the National Plan of Good Living".*

This radical approach toward open source knowledge and modes of production, which call for a transition to open, no-patent software, open source manufacturing, open education, distributed energy production (at household and community level), an open and P2P approach towards indigenous ancestral knowledge and biodiversity among others, was an extraordinary moment in the Ecuadorian experiment.[19]

Not without its problems though.

Observations:

The FLOK Society research team was composed largely of foreign activists and researchers. Responsible for the vision and the materialization of the FLOK project were René Ramirez, Xabier Barandiaran and Daniel Vasquez (academic and activist from Spain respectively).[20] Lack of adequate recursive cycles, intermediate assessment, as well as some cultural and communication breakdown created sore feelings, and prevented the project to reach its full potential.

6.3. Towards a VSM Diagnosis for the Amazonia

Applying VSM to the Amazonian ecosystem will be attempted and a list of its purpose and activities in being offered here. Looking at the Amazonia as a system, its primary purpose may be defined as *the safeguarding of this unique ecosystem by achieving a sustainable framework for the communities, the economy, research and other external but ongoing activities.*

Its primary activities may be defined as:

1. Producing and implementing a National Framework regarding the function of the system (education, rules, monitoring, etc).
2. The Monitoring of stability and sustainability of the defined ecosystem.
3. Protection of the livelihood of communities dependent on the Amazonian ecosystem.
4. The sustainable management of the current national economy's petroleum sector with the prospect to progressively reduce and finally stop it until the period of time of transition of the economy.

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[17] For more on FLOK see http://floksociety.org

[18] The author belonged to the FLOK research team from March to the completion of the project June 2014. He has co-authored a Policy paper "*Territorial Organization of Knowledge and Physical Spaces" (Anastasopoulos,Cabrera, Figueredo)*

[19] For a full list of the documents produced by FLOK see https://floksociety.co-ment.com/

[20] For the philosophy and visions of René Ramírez see http://reneramirez.ec/

Conclusions

Sustainability is inconceivable in a "bubble". Awareness from a specific project's environment of interdependencies of various scales higher or lower and of other levels (ie environmental *vs* social) is necessary.

The Ecuadorian experiment has succeeded for an initial period of time in introducing positive changes towards social progress and in achieving improvement in education, health and public services and access by all people. An all-encompassing strategic plan addresses scalar and multilevel sustainability through various projects, some of which were introduced here. In this ongoing process, there seem to be mixed messages in terms of the direction that will be eventually adopted. For every experimental and reform initiative, there are simultaneously developments in infrastructure (several shopping malls introduced into the everyday life) advancing the consumerist capitalist apparatus. Rapid progress over the past few years and a rise in the living standards of Ecuadorians has resulted among other things, in increase of private cars and in rapid industrialization. Within a multilevel sustainability context we identify present conflicts between environmental sustainability and economic sustainability in Ecuador. In order for the economy and the social well-being to be sustained to the present levels, there is no choice but to continue with oil extraction for the foreseeable future, until a transition of the economy to a non-extractivist economy has been achieved. The question then is, to what degree and for how long. It is one thing to set some limits and define what is absolutely necessary, and another to keep on going with resource exploitation without limits. The latter is the standard practice of capitalist economies.

The managerial approach of getting things done efficiently and within schedule, while sticking to an original vision or strategy, has been the leitmotif of the country's governance model. This has occurred to the expense of recursiveness and sufficient space of assessment and dialog. In key projects and through interviews with key people involved in them, as well as observation, was observed in more than one instance that the structure of governance was becoming more centralized. This has meant more concentration of power to fewer bodies and individuals, and less distribution of decision-making responsibilities. The result is often a breakdown in communication and exchange of vital information. Self and bottom-up organization is often at odds with centralization.

In order for a negative feedback cycle to be broken an alternative model of post-growth economy as well as of models of living, need to be adopted and alternative governance model needs to be examined. Provision for appropriate, all-inclusive recursive systems will allow for assessment of data and flexible responses.

As experiments do, the Ecuadorian experiment may also succeed or fail. But the Ecuadorian experiment is still ongoing and there are chances that either one will happen. What can be done as long as the experiment is ongoing is to introduce monitoring processes where such processes are missing and to introduce recursive systems that will ensure dialog.

Acknowledgements

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Keywords
Complexity, sustainability, governance, Ecuador

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Integrated Sustainability Management for Organizations

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Abstract

In recent years, sustainability approaches and methodologies have proliferated, creating confusion and hindering effective application. In this paper we adopt a holistic model of organization as the basis for the integration of sustainability tools; and that viability is a necessary condition for sustainability. The theory of organizational viability -the VSM - is used as an organizational model to examine three prominent sustainability standards: ISO26000, ISO14001 and ISO14044. A generic manufacturing company is used as a template; and its typical business processes are related to each of the VSM's components. Each clause of the three sustainability standards is then mapped on to the VSM model, creating three different models of the company, depicting how each corresponding standard relates to the company's organization and management structure. Next, these three models are integrated into one, by analyzing the differences, similarities and complementarities in the context of each VSM component, and by identifying common invariant processes. The result is an initial approach towards an Integrated Sustainability Management System, which is firmly based on VSM theory and which can serve as an effective integration framework of other sustainability standards and methods.

Keywords: VSM, sustainability, social responsibility, environmental management, Sustainability standards.

1 Introduction

In recent years, the emphasis on sustainable development is increasingly placed on the individual organization or company, as an important and necessary actor of change towards sustainability. In the current free market paradigm, corporations are indeed capable of significant impacts, on environmental, social and financial systems, often at a global scale. Following the Rio Conference (United Nations, 1997) and even before that (Asif et al., 2013) several efforts were made to help organizations become more sustainable, both at a theoretical

[1] The research project is implemented within the framework of the Action «Supporting Postdoctoral Researchers» of the Operational Program "Education and Lifelong Learning" (Action's Beneficiary: General Secretariat for Research and Technology), and is co-financed by the European Social Fund (ESF) and the Greek State.

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and practical level. Concepts such as Corporate Sustainability (CS) or Corporate Social Responsibility (CSR), have been adopted by businesses worldwide (Montiel, 2008), and practices, such as Environmental Management (EM) and CS or CSR reporting are widely implemented.

The relevant literature however, suggests that a significant gap has been identified in the implementation of sustainability into every level of the organization so as to become part of its daily operations and management. Further, a multitude of approaches, theories, definitions, concepts and tools (Waage et al., 2005) has created a confusing landscape for organizations wishing to implement more sustainable practices.

We consider that in order to deal effectively with these challenges, we need to consider these issues in the context of an appropriate model of an organization, capable of representing the key issues implicit in sustainability standards and related management functions. We have suggested elsewhere our own interpretation of Beer's Viable System Model (VSM), as a comprehensive way of modelling organisations to deal effectively with the complexity involved with sustainability issues (Espinosa and Walker, 2011).

In this paper we propose this interpretation of the VSM that explains sustainability as long term viability - as a framework to respond to the aforementioned challenges. Three prominent sustainability standards, ISO26000, ISO14001 and ISO14001 are analyzed using the VSM, in order to establish its interpretive value as a common framework to study different tools.

2 Integrating Sustainability

Ranängen and Zobel (2014) provide a comprehensive review of the literature on the efforts to integrate CSR in the everyday management of an organization. A common root for this integration is the **Plan-Do-Check-Act (PDCA)** cycle, which is the base of most Management Systems (MSs). A number of integration frameworks expand the scope of one of these MSs to cover more sustainability aspects, while others attempt to integrate multiple MSs into one Integrated Management System (IMS) or Sustainability Management System (SMS) (Maas and Reniers, 2014; Ranängen and Zobel, 2014).

Finnvenden and Moberg (2005) use three classification attributes for environmental assessment tools: a) the *types of impacts* considered, b) the *object of study*, and c) whether the tools are *analytical* or *procedural*. Hacking and Guthrie (2008) attempt to provide a basis for comparing the different sustainability assessment techniques, by identifying the main features underlying. They employ three main properties for characterizing the assessment features: a) *Comprehensiveness*, b) *Integratedness*, and c) *Strategicness*.

The above frameworks provide good understanding on how the various methods are differentiated; however, they do not provide an *operational* model that could help in their synergetic application. Working towards this direction, Robèrt (2000) introduced the **Framework for Strategic Sustainable Development** (**FSSD**), further elaborated by Robèrt et al. (2002), that attempts to operationally integrate the various sustainable development models and tools. Waage et al. (2005) and later Waage (2007) further elaborated on the FSSD by incorporating more tools, criteria and actions on the models framework, and by focusing on their impact on the product design process.

Closer to the logic of this paper is the analysis of sustainability tools or initiatives by Lozano (2012), which is based on how they relate: a) to the *company system*, and b) to the *sustainability dimensions*. For the company system, Lozano uses Porter's (1985) approach that distinguishes between *primary activities* (core competencies) and *secondary* (support) *activities*, which is similar to the VSM distinction of operational and meta-systemic management components within an organization. His analysis concludes that most initiatives focus on the Operations & Processes, as well as the Management & Strategy elements of the organization, while most initiatives address the environment dimension of sustainability.

3 The Organizational Scenario

In order to illustrate the logic of VSM to facilitate the subsequent analysis of sustainability standards, the example of the hypothetical company "Widget Co." is used (Figure 1). Widget Co. is a manufacturer of widgets, a fictitious industrial product used by consumers. The model can easily be adapted for service providers, and other types of organisations.

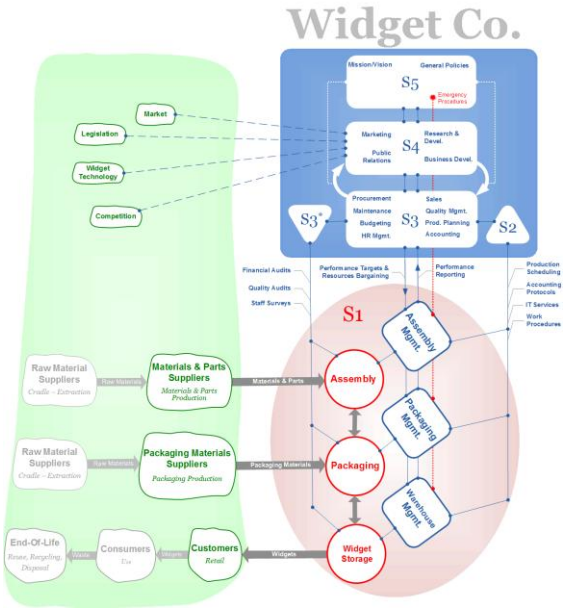

Figure 1 The VSM of the hypothetical Widget Co.

The Organizational Scenario is explained in more detail in Appendix I.

4 VSM Interpretation of Sustainability Standards

4.1 Interpretation method

The VSM interpretation method is based on a qualitative analysis of the standards' clauses and sub-clauses, which involved three steps:

a) qualitative assessment of the clause content[4],

[4] The analysis of clause content is crucial, since certain clause titles may be misleading in regards to VSM mapping. For example, clause *7.7.5 Improving Performance* suggests a System 3 relationship, but its content is more related to System 4.

b) identification of closely related VSM elements

c) description of relationship between the clause and the VSM elements.

Two types of relationships are described in the analysis:

- *Responsibility*: when a VSM element is mainly responsible for implementing the activities described in a clause. For example, System 4 is responsible for the activities in ISO26000 clause *5-Recognising SR and engaging stakeholders*.
- *Contribution*: when a VSM element is contributing to the implementation of the activities described in a clause. For example, System 2 is contributing to the activities described in ISO 26000 clause *7.7.2 Monitoring activities on SR*.

The results of the VSM analysis for each standard are presented in four forms:

a) a *VSM Relationship Table* showing the aforementioned type of relationships, (shown in Appendix II)

b) a *VSM Mapping Diagram* showing how each clause maps onto the VSM structure,

c) a *Variety Mapping Diagram* showing the flow of varieties among the various VSM elements specific to the new systems implemented as a direct result of the particular standard, and

d) a *detailed description* of how the standard is integrated within an organization, with references to related clauses (clause numbers in parentheses and italics).

ISO 26000 is interpreted in the next section, followed by ISO 14001 and ISO 14044.

4.2 ISO 26000

According to ISO 26000 standard on Social Responsibility (SR), the objective of SR is to contribute to sustainable development (ISO, 2010). The standard provides guidance on underlying principles, core subjects, and issues pertaining to social responsibility and on ways to *integrate* socially responsible behaviour into the organization. Moreover, ISO 26000 uses its framework of core subjects and integration practices in order to classify 40 cross-sectoral and 35 sectoral voluntary SR initiatives and tools.

The VSM and variety mappings of ISO 26000 are shown in Figure 2 and Figure 3 respectively.

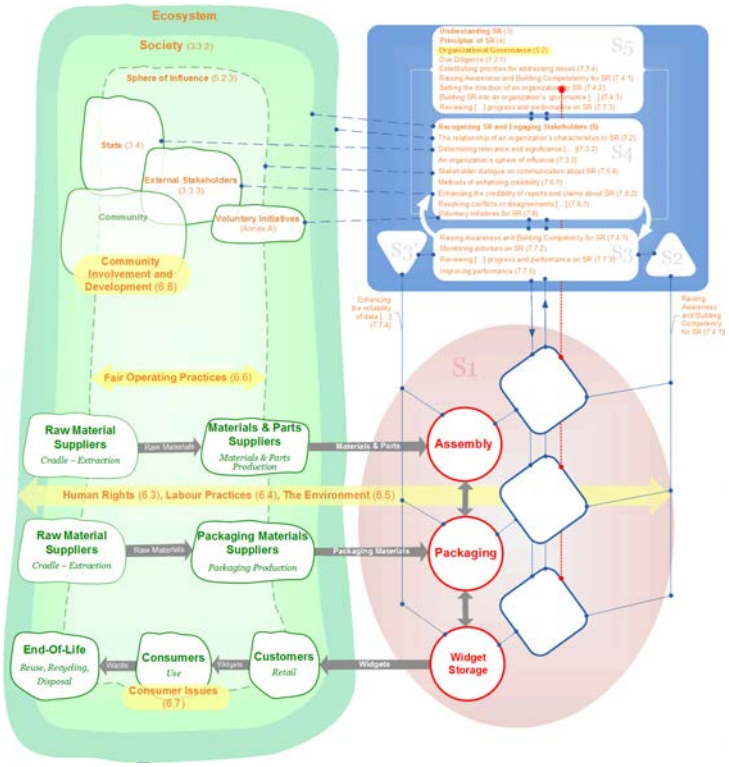

Figure 2 VSM Mapping Diagram of ISO 26000.
Orange elements represent the standard's clauses. Yellow elements represent the SR Core Subjects. Contributing elements are not shown for simplicity.

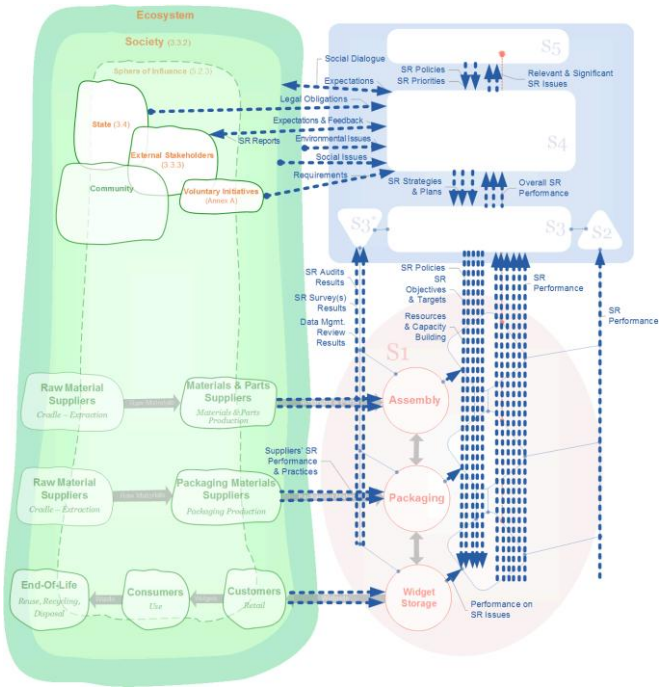

Figure 3 Variety Mapping Diagram of ISO26000
The number of arrows indicates the variety flowing in each information channel.

4.2.1 System 5

Similar to viability, the sustainability, or SR, of an organization is ultimately determined by the activities of System 5. It provides the general direction or purpose of the whole organization[5] (*7.4.2*) by determining its mission and vision. Therefore, System 5 should first of all understand the basic concepts of SR (*3*), and examine how they affect its purpose. In particular, it is important to gradually align the organization's purpose with the overarching **objective** of SR which is to contribute to Sustainable Development (ISO, 2010). Moreover, System 5 determines the **ethos and values** of the organization. ISO 26000 provides guidance on Seven Principles of SR (*4*) that should be followed as a minimum by every organization, as well as more specific SR principles (*6*) that could be incorporated in the policies of System 5. The Organizational Governance core subject (*6.2*), in particular, is the main responsibility of System 5, since it is about incorporating SR principles into decision making and implementation *(7.4.3)*.

Finally, System 5 is responsible for promoting and integrating SR within the organization, by means of **raising awareness** on related issues (*7.4.1*). A high degree of **commitment** at the top of the organization, through serious adoption and implementation of SR principles and policies, sets an example for the whole organization. All of the above activities of System 5 should ideally build up a **culture** that encourages SR practices throughout the organization.

4.2.2 System 4

In the case of SR, System 4 needs to recognize how the organization relates to its **external environment**, and what are the SR impacts, interests and expectations (*6, 7.2*). In other words, System 4 needs to build a **model** of the external environment in relation to SR (Panagiotakopoulos, 2005). Building on the general concepts (*3*) and principles (*4*) of SR, this model needs to be relevant to the organization's particular operational context and include those issues (*6*) that are considered by the organization as significant (*7.3.2*). Three overlapping concepts are useful in setting the boundaries of System's 4 model:

- the organization's *stakeholders* (*5.3.2*),
- the organization's *sphere of influence* (*5.2.3, 7.3.3*),
- the *life-cycle* (*6.5*) of the organization's products or services.

The practice of recognizing SR is essentially a process of *widening the traditional model boundaries* of System 4, across all of the above concepts, to consider more elements, issues and impacts. The System 4 model of SR should also consider the organization's **internal environment**. This information can be compiled and provided by System 3, which holds an overall view of operations. The results of sustainability tools, such as Life Cycle Assessment (LCA) presented in § 4.4, are particularly useful here.

Having built the SR model, System 4 needs to identify the **significant issues** that need to be addressed by the organization (*7.3.2*), with the help of Systems 3 and 5. Specific SR **strategies and programmes** are then developed by System 4 with the aid of System 3 (*7.7.5*), for those issues identified as significant and according to their priority.

Apart from identifying the organization's stakeholders, System 4 needs to enter into a dialogue and build relationships, (*7.5.4*). These relationships will provide the organization with valuable information and alternative viewpoints on the dynamic and complex issues of SR and thus increase the variety of its SR model. In order for this relationship to be meaningful, the organization will have to be **transparent** (*4.3*) and provide information regarding its own SR issues. A common practice is the production of a sustainability or SR report (*7.6.2*). System 4 has to guarantee the **credibility** of such practices, by following established tools and guidance (*7.8*), such as the G4 Sustainability Reporting Guidelines (GRI, 2013) and examining the trustworthiness of certification schemes. Finally, System 4 should have in place mechanisms to resolve potential disagreements or **conflicts** with its stakeholders (*7.6.3*).

4.2.3 System 3

One of System's 3 responsibilities is to ensure that Operations follow SR policies (*7.4.3, 7.3.1*). This involves making them more specific to the operational context of each System 1, by providing **specialized SR procedures, rules and directions**. This may also involve **integration of SR policies to** System 3's own processes, such as HR management and procurement, which are responsible for managing different aspects of Operations, and providing the respective resources. A particular form of resource is the provision of t**raining** that will build the capacity of Operations to manage demanding SR issues (*7.4.1*).

System 3 is also responsible for analyzing the SR plans and strategies of System 4 and deciding **more specific** operational plans, **objectives and targets** with each System 1 (*7.4.2*). It needs to encourage performance and self-regulation of Operations (*7.7.2*), through performance **indicators** appropriate for each SR issue, along three different channels:

i) *Central Channel*: on a regular basis via performance reviews and reports by Systems 1 (*7.7.3*),

*ii) System 3**: sporadically, via SR audits and surveys (*7.7.4*)

iii) *System 2*: on a regular basis via IT or similar coordinating systems (e.g. Enterprise Resource Planning -ERP, databases etc.).

This information allows System 3 to continuously negotiate with Systems 1 issues of sustainability performance, and intervene in Operations to modify their SR implementation plans only if it is affecting the viability of the whole organisation. Beer suggests that monitoring of performance on the Central, as well as on the System 2 channel, should be as close to **real-time** as possible (Beer, 1979).

Finally, System 3 compiles and processes the performance information and forwards it to System 4. This information should not be too detailed, but rather provide a **high-level view** of Operations that will allow System 4 to update its SR model.

4.2.4 System 2

In terms of SR, System 2 involves practices that deal with resolving conflicts of interest that emerge in the implementation of SR policies and programmes. This includes **negotiation** processes among Systems 1 that make sure no operational unit will be in a disadvantaged position. System 2 also ensures the **consistent management** of SR issues across Operations. This may involve the adoption of specific data collection and measurement protocols,

operating procedures, as well as other forms of standardization. Information Technology (IT) applications are particularly useful in this respect, as specialized software tools are now available that help organizations collect SR data in a consistent manner (Jamous et al., 2012), which is an otherwise challenging task for organizations with a large number of dispersed Operational units.

There is an important informal **bottom-up aspect** that can be identified as a System 2 function. Operations, and in particular employees, develop their own work ethic and culture, in parallel, or irrespective of organizational rules and edicts. In other words, they develop their own shared understanding or awareness on specific issues, allowing them to self-organize and find solutions to common problems. It is a common practice that organizations start their SR transformation journey, by identifying individuals that are aware and active in certain SR issues and empowering them to bring about change (*7.4.1*) (Taylor et al., 2012).

As Beer (1985) notes, it is also useful to think about the **work environment** that will foster a certain kind of culture, such as one for SR, for example through posters, announcements etc. Several SR programmes focus on creating these kinds of environments to raise awareness and drive engagement on specific SR issues. Again, IT can be very useful in creating an SR culture, for example through relevant employee forums, social media (Reilly and Weirup, 2012), or even gamification (Stevens, 2013).

4.2.5 Systems 1 – Recursion

In terms of SR, the Recursive System Theorem (Beer, 1979) implies that each Operational unit should develop *similar* SR functions to those analyzed in the paragraphs above at the lower level of recursion (*7.4.3*). The focus of these functions should be *adapted to the particular lower-level context and purpose* of the Operational unit.

4.2.6 SR Issue Management

Three of the ISO 26000 SR core subjects, namely *Human Rights* (*6.3*), *Labour Practices* (*6.4*) and *Environment* (*6.5*) relate to Operations and respective local environments (see Figure 2). The remaining three core subjects, namely *Fair Operating Practices* (*6.6*), *Consumer Issues* (*6.7*) and *Community Involvement and Development* (*6.8*), are related to specific elements of the organization's environment, while Organizational Governance (*6.2*) is related to the whole organization and in particular System 5.

ISO 26000 provides general principles and considerations for each core subject, and specific actions and expectations for the related SR issues (36 issues in total). Similar to the analysis of the previous paragraphs, the clauses of each issue could be interpreted with the same method by the VSM.

4.3 ISO 14001

ISO14001 (ISO, 2004), is a standard that sets the requirements for an environmental management system (EMS), which should take into account legal requirements, and information about the organization's significant environmental impacts, in order to develop and implement an environmental policy and relevant objectives. The standard requires that the EMS continually improves, following the PDCA cycle. An organization's EMS can be certified as being in conformance with ISO14001. The VSM interpretation of ISO 14001 is shown in Figure 4 and Figure 5. In terms of ISO 26000, ISO 14001 focuses on the Environment SR core subject, providing specific management guidance.

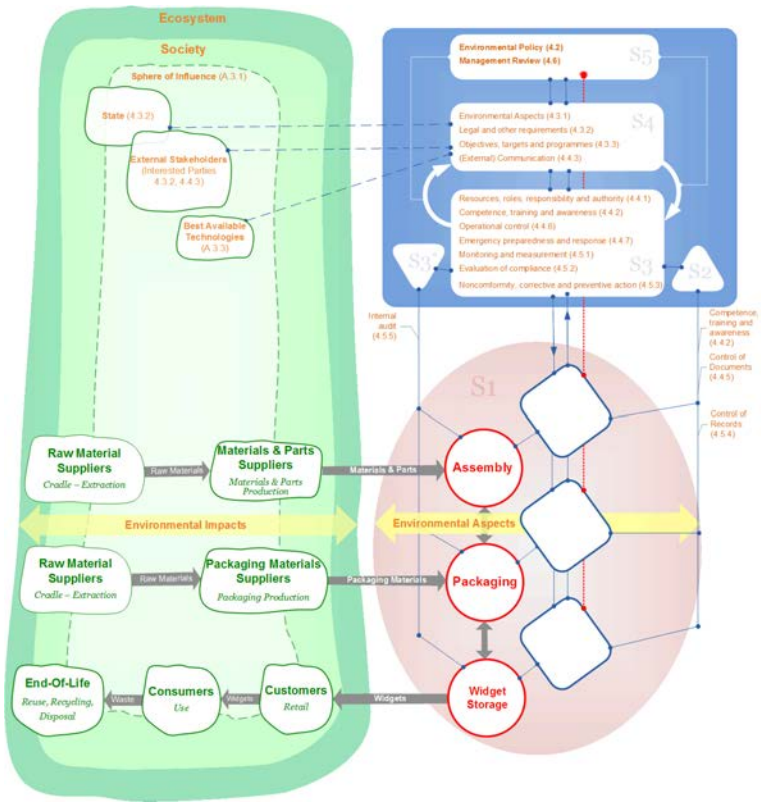

Figure 4 VSM Mapping Diagram of ISO 14001.

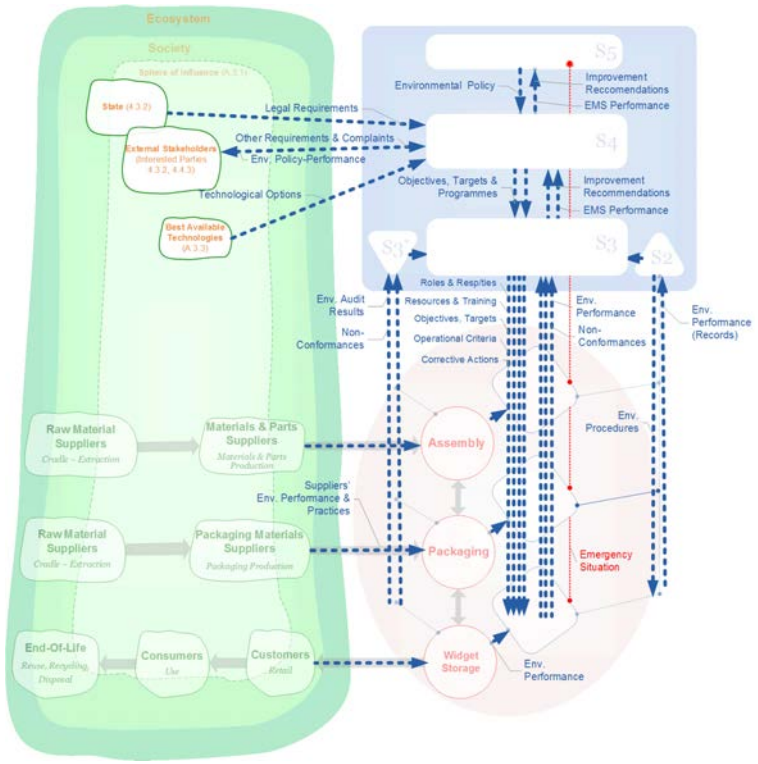

Figure 5 Variety Mapping Diagram of ISO14001

The EMS starts at the System 5 level which is responsible to determine the organization's environmental policy (*4.2*). This policy should: a) comply with legal and other requirements, b) undertake pollution prevention, and c) demonstrate continual improvement. System 5 is also responsible for the high-level management review of the whole EMS (*4.6*), with the help of Systems 3 and 4. The outputs of these reviews are potential changes to the environmental policy, objectives and targets.

System 4 is focused on developing the environmental part of the SR model of the organization (4.2.2). This model should include environmental aspects (causes), related to Operations, and environmental impacts (effects) related to the Environment (*4.3.1*). ISO 14001 places great emphasis on the legal and other requirements that should be continuously identified by System 4 (*4.3.2*). The outcome of this model is the development of environmental objectives, targets and programmes (*4.3.3*) that fulfil the environmental policy commitments, taking into account the related Best Available Technologies (*A 3.3*). Finally, System 4 is responsible to communicate the environmental performance of the organisation to external stakeholders.

ISO 14001 places great emphasis on System 3. First of all, it should assign resources, roles and responsibilities (4.4.1) relative to environmental management, and provide appropriate training (*4.4.2*), in order for employees to carry them effectively. Then, it should establish specific operational rules, procedures and criteria that ensure the proper implementation of the environmental policy, objectives and programmes (*4.4.6*), along with emergency preparedness and response procedures (*4.4.7*). Next, System 3 needs to close the loop by establishing monitoring and measurement processes of environmental performance of Operations (*4.5.1*), and by performing an Internal System 3* Audit (*4.5.5*). This information is used to evaluate the compliance of Operations to legal and other requirements (*4.5.2*), to identify non-conformities, and to develop related corrective and preventive actions (*4.5.3*) in order to mitigate environmental impacts.

System 2 relates to establishing consistent environmental management practices, such as common procedures, proper control of documents and records (*4.4.5, 4.5.4*), as well as to raising awareness on significant environmental aspects (*4.4.2*). Finally, at the Systems 1 level, each operational unit is responsible to autonomously monitor and manage its specific environmental aspects.

4.4 ISO 14044

ISO 14044 (ISO, 2006) is an environmental management standard that provides guidelines and requirements to perform a Life Cycle Assessment (LCA). LCA calculates the potential environmental impacts throughout a product's life cycle from raw material extraction (cradle) through production, use, end-of-life treatment, recycling and final disposal (grave). The VSM interpretation of ISO 14044 is shown in Figure 6 and Figure 7.

An LCA study usually initiates at the System 5 level, which determines its **goal** (*4.2.2*), e.g. intention to certify a product with an ecolabel. Next, System 4 is responsible for determining the **scope** of an LCA, which includes the product to be studied, the functional

unit[6], the system boundary (included life-cycle processes), the limitations of the study etc. These could be pre-determined by an external body, such as an ecolabel awarding organisation, otherwise System 4 should make sure the scope is appropriate for the intended application and audience of the LCA.

The bulk of the ISO 14044 LCA activities lie with System 3. It is responsible for **collecting data** and performing the necessary **calculations**, i.e. conducting the Life Cycle Inventory (LCI), as well as Life Cycle Impacts Assessment (LCIA) phases of an LCA. LCI data is mainly provided by Systems 1 through the Central Channel, or through direct data collection onsite. LCI data about upstream and downstream life-cycle phases, are either collected directly (e.g. through appropriate supplier and client questionnaires), or indirectly from public data sources that compile generic life-cycle data on multiple common processes (e.g. using an LCA software). If an organisation performs LCA studies on a regular basis, System 2 will ensure that common data collection methods are implemented. Moreover, environmental records can provide an alternative source of LCI data.

LCA is cyclical process. Once, System 3 has produced a draft LCA study, System 4 is responsible for doing a Critical Review (*6*), which may also involve external reviewers and require and internal audit. This review may result in modifications of all aspects of the LCA, from calculations and data collection, to the goal and scope of the study. Finally, System 4 is responsible for communicating the LCA results to third parties.

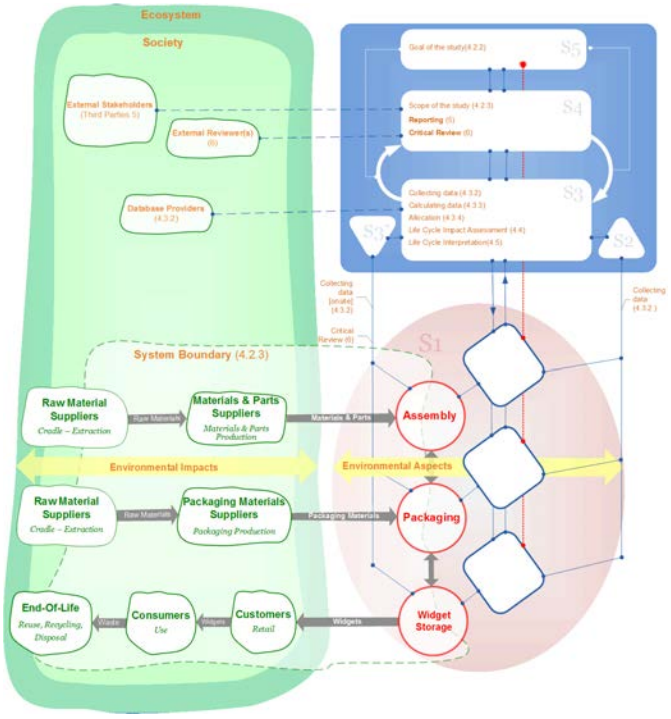

Figure 6 VSM Mapping Diagram of ISO 14044.

[6] This is the reference to which input and output data of the product system are normalized.

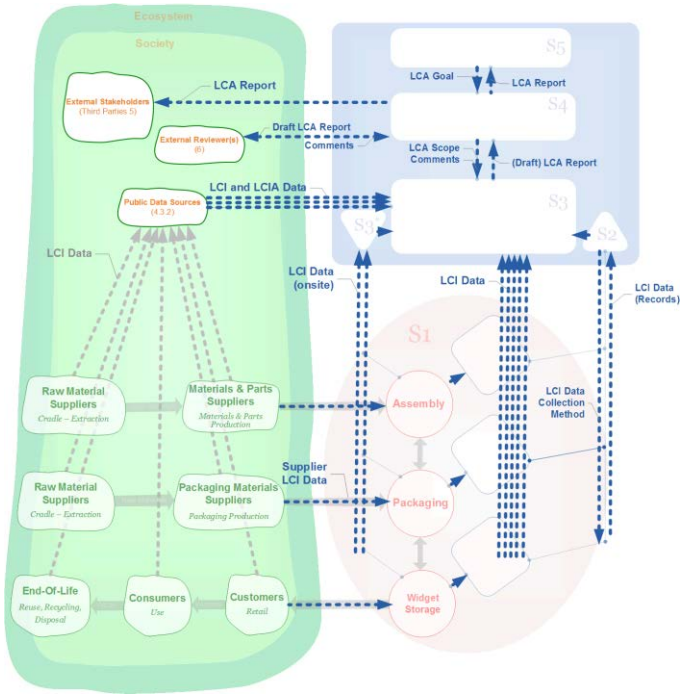

Figure 7 Variety Mapping Diagram of ISO14044

5 Towards Integrated Sustainability Management

Based on the VSM interpretation of ISO 2600, which has the widest scope, a number of *generic SR functions* per VSM system were identified, as shown in Table 1. These functions were then used to map the three standards in order to explore their differences and complementarities.

Table 1 VSM Integration Table

VSM System	Generic SR Function	ISO 26000	ISO 140001	ISO 14044
System 5	Alignment of Purpose	3, 4, 6.2, 7.3.1, 7.3.2, 7.3.4, 7.4.2, 7.4.3, 7.7.3	4.2, 4.6	4.2.2
	Creation of SR Culture	7.4.1	-	-
System 4	Development of SR Model	5, 6.3-6.8, 7.2, 7.3.3	4.3.1, 4.3.2	4.2.3, 6
	Planning of SR Strategies and Improvement Programmes	7.3.2, 7.7.5	4.3.3	-
	Stakeholder Engagement	7.5.4, 7.6.1, 7.6.2, 7.6.3, 7.8	4.4.3	5
System 3	Implementation of SR Policies	7.4.1,	4.3.1, 4.3.3, 4.4.1, 4.4.2, 4.4.6, 4.4.7	-
	Implementation of SR Strategies and Improvement Programmes	7.4.2, 7.7.5		-
	Monitoring of SR Performance	7.7.2, 7.7.3	4.5.1, 4.5.2, 4.5.3	4.3.2, 4.3.3, 4.3.4, 4.4, 4.5
System 3*	Monitoring of SR Performance	7.7.4	4.5.5	4.3.2, 6
System 2	Conflict Management	-	-	-
	SR Management Consistency	-	4.4.5, 4.5.4	4.3.2
	Employee Culture	7.4.1	4.4.2	-

ISO 26000 has the widest scope of the three standards, covers most of the VSM subsystems, and opens new horizons for Widget Co. Essentially the variety of its environmental niche has suddenly exploded and in order to restore Requisite Variety (RV), there is an urgent need to ramp up the variety of its operation in order to cope with these new levels of environmental variety. This can be seen in Figure 3 where a lot variety is flowing both inside and outside the organisation, depending on the number of SR issues the organisation identifies as relevant. Moreover, ISO 26000 places a lot of emphasis on the roles of Systems 4 and 5 in safeguarding the SR of the organisation.

In contrast, ISO14001 focuses only on the Environment core subject of ISO 26000. Therefore, the respective System 4 model has less variety, since it considers fewer items, resulting in less information flowing in and out of the organisation (Figure 4 and Figure 5). On the other hand, ISO 14001 provides more guidance in terms of System 3 and the **internal measurement and control** of environmental performance.

Finally, ISO 14044 is mainly focused on System 3, since LCA is essentially a more complex **performance indicator**, requiring challenging data collection and calculations. Nevertheless, an LCA study may well involve the whole organisation, as well as outside agents, as shown in Figure 6 and Figure 7.

A common characteristic of the three standards is the **absence of an explicit System 2**. The Management Consistency and Employee Culture are only indirectly dealt with, while Conflict Management is completely absent in all three standards. A possible explanation is that these standards were developed based on a traditional top-down management model, rather than an autonomic management of Systems 1, which demands a more rigorous System 2.

In conclusion, it is suggested that an organization wishing to adopt the three standards presented here will need to integrate them across the VSM sub-systems and the SR generic functions of Table 1. One way to visualise this is presented in Figure 8: each standard is presented as a distinct management layer, which needs to be integrated with the usual Business Management layer (section 3), as well as any other management layer relating to a specific SR issue (paragraph 4.2.6).

Figure 8 Integration of management layers

Integrating the layers of Figure 8, will be a difficult task for any organisation. Further research is needed to explore the specifics of this integration. The authors believe that this integration should not be based on creating distinct roles for each management layer, but rather incorporating these in the day-to-day Business Management, resulting in a unified (Sustainability) Management System.

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Appendix I: The Organizational Scenario

It must be noted that the internal elements of the company depicted in the diagram mainly refer to *processes* rather than organisational entities. There are two reasons for this. The first is that similarly labelled departments don't perform the same processes in all companies. For example, the accounting process may be performed by a "Finance", or an "Accounting" department. The second reason is that depending on the size of the company, a single person (e.g. Head of Department), or a whole team could be responsible for a process or processes. Thus, in a small company a "General Manager" could perform most processes in the Management part (blue square) of Figure 1, while in a large company several teams would be needed to perform the same processes.

Operations

Starting from Operations (red ellipse), this consists of the **production departments** or processes (S1s), which are necessary to manufacture widgets, i.e. realise the company's purpose. Each production department is controlled by a dedicated and semi-autonomous local management unit (blue square) that ensures its proper operation. In order to operate, a department depends on material and other flows (grey arrows) that are provided from suppliers located at the organisation's environment. In Widget Co., Assembly and Packaging depend on two separate supply chains consisting of two tiers: *direct suppliers* (material & parts and packaging suppliers), with which the company interacts directly, and *indirect suppliers* (raw material suppliers), located further upstream in the supply chain. This is of course a simplification, as more complex arrangements are possible with suppliers forming networks rather than chains and supplying more than one department. Internally, production departments are interacting, through material and other flows (grey vertical arrows), according to the specific production arrangement of the company. At the end of this arrangement is the widget storage department, which ships completed widgets to customers.

System 2

System 2 includes processes, such as *Production Scheduling*, *Accounting Protocols, IT services* and *Work Procedures* that support the harmonious co-operation of production departments and ensure the cohesiveness of the organisation. For example, if Assembly faces a technical problem and needs to go offline, an effective Production Scheduling process, will ensure that the rest of the departments are notified on time and their operation is not seriously affected.

System 3

System 3 manages the *overall* performance of Operations, by creating synergy. This is first of all performed through the *Production (or tactical) Planning* process, by means of allocating specific **performance targets** to each production department. Moreover, System 3 processes, such as *Budgeting*, *Procurement*, *Human Resources management* and *Maintenance* distribute to production departments the **resources** and services (money, materials, employees and machine services) that are necessary for the realisation of their performance targets. Since the performance of a department (or any system) is a function of resources available to it, performance targets and resources should be jointly negotiated between System 3 and Systems 1, in what Beer called a *resource bargaining process*.

However, System 3 needs to have information on the performance of each production department, for example, via a routine *performance reporting* process. This process will first of all include appropriate output **performance indicators** for each department, such as number of units assembled, packaged and stored. It may also include **efficiency indicators** in relation to the various resources provided, such as cost per unit, materials consumption, workdays and number of machine failures. Beer called this process the accountability loop, which can support the autonomy of Operations, when effectively implemented.

In addition to performance reporting, System 3 needs an alternative more reliable view of Operations. This is provided by System 3* processes, such as Q*uality and Financial audits,* as well as *Staff Surveys* that sporadically provide direct information on the status of production departments, without the interference of local management units.

As System 3 processes focus on different aspects of the organisation, they thus employ different processes along the three available channels connecting it to Operations, i.e. 1-3, 2-3 and 3*-3. All these processes need to be connected and holistically managed and this is usually the responsibility of a General or Production Manager.

System 4

Systems 1-2-3 are mainly concerned with current affairs happening in the internal part of the organisation (inside and now). In contrast, System 4 includes processes, such as *Business Development*, *Research & Development*, *Marketing* and *Public Relations* that help the organisation **adapt** to the changing external environment (outside and future). These processes investigate or interact with external entities, such as the market, competition, legislation, emerging technologies etc., continuously trying to identify **opportunities and threats** that may affect the viability of the whole organisation.

For example, the Business Development process may realise that competitors are about to introduce a new kind of widget in the market that threats to put Widget Co. out of the market in a couple of years. As a response, this process could come up with a plan that will allow Widget Co. to produce the new type of widget on time to beat competition. In order to do so, it will need to gather more information from the external environment and other System 4 processes. In addition, in order for this plan to be realistic, it will also need to obtain information from the internal environment about the current situation (financial, technological etc.) of the company, which can be provided by System 3.

System 5

The effective interaction (pair of white arrows in Figure 1) and balance between Systems 3 and 4 is of paramount importance to the viability of the organisation. This delicate balance determines the course and **strategy** of the whole organisation: if emphasis is placed on System 3 the organisation will be more static and focused on efficiency; if it is placed on System 4 it will be more dynamic and focused on development. The role of System 5 is to manage the **interaction** of these two systems and **decide** on the right balance for the organisation (white dashed lines Figure 1). Processes that shape the mission, vision and values of the organisation and related Policies that determine the way the whole organisation should operate are part of System 5. For example, Widget Co. may have an anti-corruption policy that should be respected by all members of the company. Organisational entities such as a Board of Directors or the President are usually responsible for System 5 processes.

Finally, Operations may face **emergency situations** that could threaten the viability of the whole company, such as a fire incident in the widget storage department that destroys a significant part of production. In these situations a fast intervention from System 5 is usually needed, which would have to bypass the slower intermediate processes between of Systems 1 and 5 described above. An emergency direct connection between Systems 1 and System 5 is therefore needed (dashed red line of central axis in Figure 1), which Beer called the *algedonic channel*.

Appendix II: VSM Relationship Tables

Table 2 VSM Relationship Table of ISO 26000

ISO 26000 Clause	System 5	System 4	System 3	System [illegible]	System 2	System 1
3 Understanding SR	**R**					
4 Principles of SR	**R**					
5 Recognizing SR and engaging stakeholders		**R**				
6 Guidance on SR Core Subjects						
6.2 Organizational Governance	**R**	C	C	C	C	C
6.3 Human Rights		**R**	**R**			
6.4 Labour Practices		**R**	**R**			
6.5 The Environment		**R**	**R**			
6.6 Fair Operating Practices		**R**				
6.7 Consumer Issues		**R**				
6.8 Community Involvement and Development		**R**				
7 Guidance on Integrating SR throughout an organization						
7.2 The relationship of an organization's characteristics to SR	C	**R**	C			
7.3.1 Due Diligence	**R**	C	C	C	C	C
7.3.2 Determining relevance and significance of core subjects and issues (…)	C	**R**	C			C
7.3.3 An organization's sphere of influence		**R**	C			
7.3.4 Establishing priorities for addressing issues	**R**	C	C			
7.4.1 Raising awareness and building competency for SR	**R**		**R**		C	
7.4.2 Setting the direction of an organization for SR	**R**	C	C			
7.4.3 Building SR into an organization's governance systems and procedures	**R**	C	C	C	C	C
7.5.4 Stakeholder dialogue on communication about social responsibility		**R**				
7.6.1 Methods of enhancing credibility		**R**	C			
7.6.2 Enhancing the credibility of reports and claims about SR		**R**				
7.6.3 Resolving conflicts (...) between an organization and its stakeholders		**R**				
7.7.2 Monitoring activities on SR			**R**	C	C	C
7.7.3 Reviewing an organization's progress and performance on SR	**R**	C	**R**			
7.7.4 Enhancing the reliability of data (...) collection and management			C	**R**	C	
7.7.5 Improving performance		**R**	**R**			
7.8 Voluntary Initiatives for SR	C	**R**	C			

R: Responsible VSM element, C: Contributing VSM element

Table 3 VSM Relationship Table of ISO 14001

ISO 14001 Clause	System 5	System 4	System 3	System 3*	System 2	System 1
4.2 Environmental Policy	**R**					
4.3 Planning						
4.3.1 Environmental Aspects		**R**	**R**			I
4.3.2 Legal and other requirements		**R**	C			
4.3.3 Objectives, Targets and Programmes		**R**	**R**			
4.4 Implementation and Operation						
4.4.1 Resources, roles, responsibility and authority			**R**			
4.4.2 Competence, training and awareness			**R**		C	
4.4.3 Communication		**R**				
4.4.4 Documentation						
4.4.5 Control of Documents					**R**	
4.4.6 Operational control			**R**			
4.4.7 Emergency preparedness and response	C		**R**	C		C
4.5 Checking						
4.5.1 Monitoring and measurement			**R**			
4.5.2 Evaluation of compliance			**R**			
4.5.3 Nonconformity, corrective action and preventive action			**R**			
4.5.4 Control of records					**R**	
4.5.5 Internal audit				**R**		
4.6 Management review	**R**	C	C			

R: Responsible VSM element, C: Contributing VSM element

Table 4 VSM Relationship Table of ISO 14044

ISO 14044 Clause	System 5	System 4	System 3	System 3*	System 2	System 1
4.2 Goal and scope definition						
4.2.2 Goal of the study	**R**					
4.2.3 Scope of the study		**R**				
4.3 Life cycle inventory analysis (LCI)						I
4.3.2 Collecting Data			**R**	C	C	C
4.3.3 Calculating Data			**R**			
4.3.4 Allocation			**R**			
4.4 Life cycle impact assessment (LCIA)			**R**			I
4.5 Life cycle interpretation			**R**			
5 Reporting		**R**				
6 Critical review		**R**				

R: Responsible VSM element, C: Contributing VSM element

Sustainable innovation farm: A project built from stakeholders Study case, Farm located in the Guavio Region

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Abstract

Working with communities implies interactions between the different stakeholders in a way that solutions to problems are created in a joint form. This makes turns system into complex system with multiple involved agents. For a proper integrations of agents involved in a particular problem, there are methodologies that help taking in to account all their opinions. The purpose of this paper is to show the importance of construct a solution to a problem with the stakeholders. For this, in this paper is analyzed a particular case in which the above was taked in to account.

The study case is based on a Farm located in the Guavio Region. This farm has 166400m^2, although only 51000 m^2 are been exploited. Since its foundation, the farm has being a boarding school that today only receives boys with home problems (Enciso, 2005). Nevertheless, a new perspective wants to be given to the farm, by wanting to give a place where they can have tools for their personal and intellectual growth and also to be sustainable. The farm consumes a lot of water, which is expensive and not always available. In consequence, the farm residents' health is reduced. For this reason, the income obtained from farm activities wants to be increased and also for donation dependency reasons.

Considering the situation described above and the number of the stakeholders, the Interactive Planning methodology was used. According to Michael Jackson (Jackson, 2003), this is appropiate to solve situations in a pluralist complex system with various stakeholders. The Interactive Planning helps coordinating the stakeholders in a common goal to achieve an ideal future for the system and allows to establish the gaps between the current system and its ideal future, and the resources required to minimize them (Jackson, 2003). In this way, a porfolio of projects to achieve the desired objectives was proposed.

In the application the interactive planning methodology many meetings with the decision making agents were made, in them, each one of them gave their understanding of what the farm is today and what they expect it can become in the future, this helped the construction of a shared vision of the farm. In a similar way, involvement of the boys in the project was encouraged and their opinion about the farm, past and future projects were taken into account. On the other hand, plans were brought down to earth into tangible results through field visits and the information provided by the stakeholders.

Finally, it can be said that to solve problems involving many diverse stakeholders all interest of all of them should be considered in a participative way in order to achieve a systemic decision process. In this way, it is possible to obtain a favourable solution that all agents agree with. Systemic methodologies such as the interactive planning and others such as the Decision Theory was a tool that let us achieve the study goal. Results obtained from their application, considered mechanism to let the organization survive by adapting to the ongoing changes.

Keywords
Systemic, Methodology, Farm, Sustainable, Stakeholders, Innovation.

1. Introduction

Padre Lunas´s Farm actually has 166400m^2 of land, although only 51000 m^2 have been exploited. Since its beginnings, the farm has been a boarding school that today only receives boys with problems in there home (Enciso, 2005). Nevertheless, a new perspective wants to be given to the farm. To do this, stakeholders drafted a proposal for the farm. For this, all of them presented their points of view. Through this process, the stakeholders coincided that the most important goal was the involvement of the children living on the farm but also to ensure that the project would be self-sustainable. To achieve this, there are different stakeholders that are involved in the project. Below, in Figure 1, it is possible to see the stakeholders of the Farm and there particular interests.

Table 1. Stakeholders' interests.

Stakeholders	Description
Siemens	Want to help Granja del Padre Luna as its corporate social responsibility.
Fundación Siemens	Want to ensure a food future to children living in the farm thought donations and through implementation of projects that contribute with the self-sustainability.
Facatativa Diocese	It is the Farm's owner and wants children welfare.
Ingenieros sin Fronteras	Seek that university students participate in projects that involve vulnerable communities.
Farm's psychologist	Seeks that children resolve their personal problems and be integral people.
Farm's worker	Seeks increase Farm's incomes with milk production.

2. Literature Review

The Interactive Planning was proposed by Rusell Ackoff. He said that to evaluate a particular situation, the people should change their way to think and considerate that are a part of everything, in which a lot of stakeholders interact. Having different interests, highlight the importance to emphasize in a future constructed since the actual situation, in which not only the problems are resolved, but also that the problems been dissolved (Jackson, 2003).

The Interactive planning is constituted by different phases that are described below:

Phase 1: Idealization: Formulating the Mess (Pachón, 2010).
In this phase is established the state of the organization studied. Also the set of opportunities, the nature of threats. This formulation needs different types of studies:

i) Systems analysis: is described the situation of the organization and its environment.
ii) Obstruction analysis: is determined the obstacles to organizational development. Exist two types of obstructions: discrepancies and conflicts. The discrepancies are the differences between the ones that the organization be and the thing that it think that it be. The conflicts are presenting when exist more of one interest and to achieve one prevent achieve the other one.
iii) Projections and reference scenario: are extrapolations of the future of the organization, taking in to account the recent past behavior. It is propose scenarios to avoid this situation.

Phase 2: Ends Planning (Pachón, 2010).
In this phase, are specified the ends to be pursued. In this ways, is designing the desirable future. The purposes are of three types:

i) Idealized design: are the purposes that are supposed like unattainable, but that is possible to walk to it.
ii) The objectives: are purposes that want to achieve after planning period, but that are possible to advance in this period.
iii) The goals: are the purposes that are achieved during the planning period.

Phase 3: Means planning (Pachón, 2010).
In this phase, are selected means that are going to use to achieve the purposes, this means, to achieve the deseable future, taking in to account that exist a reference scenery. The goals are:

i) Acts: are actions that need few time.
ii) Actions, procedures and processes: acts that are directed to produce the desirables result.
iii) Practices: acts that are repeated frequently.
iv) Projects: simultaneous and sequential actions' systems, directed to the desirable results.
v) Programs: Projects systems directed to the desirables results.

Phase 4: Resource planning (Pachón, 2010).
For the resources planning is important evaluate the type of resources or inputs that the project need, how many resources are need and the available of these, and the way to finish the gaps. The resources are suppliers, workers, equipment and money.

Phase 5: Implementation design and control (Pachón, 2010).
This last phase is concerned with the execution of the decisions made in the other phases. In this phase is important to define the activity that each stakeholders is going a do, when and where.

3. Methodology

As above was mentioned, the Interactive Planning is constituted by different phases. Below it's described the way that each phase was developed in the Silvana Vargas and María Paula Flórez grade project (Vargas &Flórez, 2013).

Phase 1: Idealization: Formulating the Mess
In this phase was established the state of the organization studied. Also the set of opportunities, threats, the nature of these ones. This formulation needed different types of studies:

i) System Analysis:
The farm works like a home for children in which it is promoted the study and facilitated the education in a school. The production and sale of milk is a unique activity that is developing Granja del Padre Luna and is providing income apart from donations. This activity represents 20% of their income. Joint with stakeholders was established that a new perspective wants to be given to the farm. To do this, stakeholders drafted a proposal for the farm. For this, all of them presented their points of view. Through this process, the stakeholders coincided that the most important goal was the involvement of the children living on the farm but also to ensure that the project would be self-sustainable.
Every activity that its development in the farm, needed to pass before for the Siemens junta and for the Siemens foundation, whose are the ones that take the decisions. They have help from Ingenieros sin Fronteras Colombia, in which some of its members are professors and students of the Universidad de los Andes and the Corporación Universitaria Minuto de Dios. This group evaluates problems and propose solutions.

ii) Obstruction analysis:
Taking in to account the things that were founded in the system, was made a comparison between the ones that the organization be and the thing that it think that it be. Below it is possible to see an analysis of the discrepancies proposed by Ackoff (Pachón, 2010).

Table 2. System discrepancies

DISCREPANCIES	DESCRIPTION
About Organizational ends	Reality: 1. Want to shelter children and young men with problematic homes and to give education in agricultural, academic, ethic topics. 2. Development projects that permit increase incomes and decrease Siemens donations. Perception: 1. Teaching to children about countryside activities to achieve that them could administrate one in the future. 2. Be a self-sustainable farm.
About the means employed to pursue these ends	Reality: 1. Children are enrolled in Domingo Savio School and farm has people with the capacity to proportionate integral formation to children and a psychological support. 2. Are development projects without the basic phases of a life project. This is reflected in the joint planning lack. Perception: 1. Equal to reality 2. Joint planning with the farm and the documentation are not necessary because haven't be exit process.
About the resources available for such pursuits	Reality: 1. Farm has the necesary resources to ensure children welfare. The resources becomes from donations and volunteering. 2. Farm has some of the resources to initiate the execution of some projects, however, these are note enough and for that reason it is necessary doing an initial inversion. Perception: 1. Equal to the reality 2. Although the farm has useful resources to initiate execution of some projects, anyone of the activities that actually are generating or are going to generate important incomes.
The way pursuits are organized	Reality: 1. The way of administrate the farm changes constantly. 2. The activities that are executing, normally are not in charge of a person with knowledge to direct projects to apply in the countryside and obtained a good performace. Perception: 1. It not considere as a problem, the constantly administration changes. 2. Everyone that propose a Project is going to carry out it.
External stakeholders and other aspects of the environment	Reality: 1. Children's farm interact in tree environments; in Domingo Savio School, in where they are relating with Guavio Region population; in the Farm, where they are relating with workers and volunteers; and in their homes, where they are related with their family and close friends. The Family Welfare intervenes. 2. Farm receives donations for the sustainable and to development projects that generate incomes. An organization calling Corpoguavio intervenes is some project involves the natural resources exploitation. Perception: 1. It is not so clear the way that the Family Welfare intervenes. 2. It is considering that Siemens Foundation is the only farm sponsor. It is thinking that it can exploit the water sources of the farm without necessity of transact a permission.

Ackoff also say that can exist conflicts between stakeholders interests because are different. Conflicts that are presenting in the organization can see in the table below.

Table 3. Conflicts in the system

CONFLICTOS	DESCRIPCIÓN
Conflicts within individuals individuals who are part of the organization	Can be detected that exist intern conflict between children because most of them have problems in their homes, they don't have a coherent education with the things that are taught in the farm.
Conflict between units at the same level of the organization	It is possible see that exist a conflict with children because not everyone have the same interests and not everyone want to know things about countryside.
Conflict between organization and external groups.	In occasions it is observed a conflict between Granja del Padre Luna of Guasca and the Family Welfare because the people think that the last one could change the way that farm Works.

iii) reference scenario and projections:

Granja Padre Luna's projections were made with the purpose to doing extrapolations of the organization actuation, since its recent past to its future, to evaluate implications of continue with the same model and project development that have follow last years. In Table 4 was development projection based in farm's resources.

Table 4. Referece scenario and projections

REFERENCE	PROJECTIONS
The farm did an investment in: Arequipe pot 12 milk cows Channels that collate rain water Deep well construction Machine for pumping water. Animal, fruits and vegetables for cultivation Only the 12 milk cows are using Children are disinterest in projects related with countryside.	Wastage of resources. Milk sale will represent the same and unique income. Same spending in water. Investment in new resources and projects that don't going to help with the Farm's self-sustainability neither the learning. The disinterest in projects will continuous.

Phase 2: Ends Planning

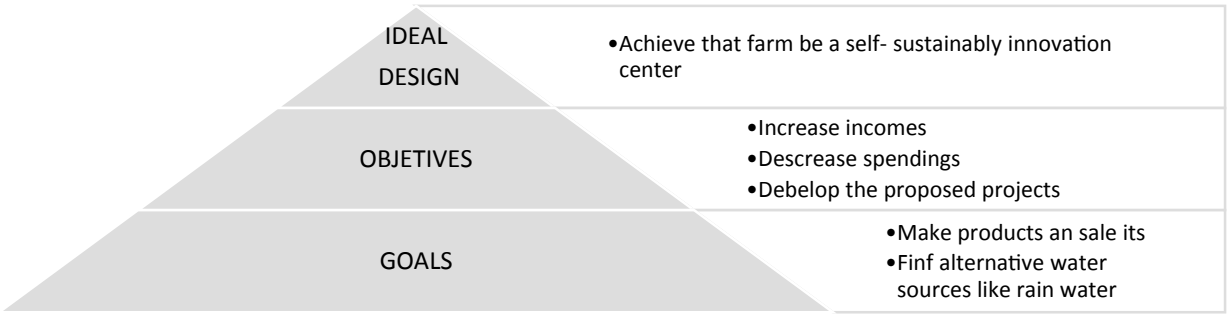

Figure 1. Ends Planning

Phase 3: Means planning

Comparing the ends planning with the reference scenario and projections, was founded some gaps:

A. The ideal design is that Granja del Padre Luna be self-sustainably but the reference scenario shows that if nothing changes, is going to exist a lot of wastage of resources, Investment in new resources and projects that don't going to help with the Farm's self-sustainability, also milk sale will represent the same and unique income and the water spending will be the same.
B. The ideal design also mention that Granja del Padre Luna be an innovation center but the reference scenario shows that if nothing changes, projects are not going to help with learning and children are going to continue with disinterest in projects related with countryside.

To close each above gaps, it is necessary achieve objectives and goals and for this it is important carry out acts, procedures or process, practices, projects and programs.

GAP A

Acts

Take a sampling of Granja del Padre Luna's well water.
Try the probe in the farm.
Learn to cook arequipe and evaluate the utility of the plot that is in the farm
Install a milking machine

Procedures

- Determine the product that is going to produce with the farm's milk.
- Take a sampling of Granja del Padre Luna's well to analyze its condition.
- Quote the filter system that is necessary to be potable water

Practices

Daily cow milking
Weekly arequipe production

GAP B

Acts

Design workshops to involve children with projects

Procedures

- Development a wokshop in which children's farm learn how prepare the selected product.
- Development a workshop in which children living in the farm learn how works the probe designed to evaluate land properties.
- Development a workshop in which children living in the farm learn the importance of a filter and how it works.

Practices

Documentation of process results
Join planning
Make workshops with children to explain the projects that are developing in the farm by Ingenieros sin Fronteras members.

Below are presenting the projects and the program that were proposed to close the two gaps:

Projects

Project 1: Treatment of water well and rainwater for its potabilization.
Project 2: Strengthening of milk production and arequipe production with this milk.
Project 3: Innovation and investigation in agricultural production.

Programs

The program consist in the portfolio of the tree projects mentioned before to implemneted during a collage semester by Ingenieros sin Fronteras members. In this way achieve that Granja del Padre Luna will a self-sustainable center. This portfolio is divided in the educational part that consist in workshops and in the innovation part that consist in development of proposed grade projects of college students.

Phase 4: Resource planning

Necessary Resources for Strenghtening of milk production and arequipe production with this milk

Actually, Granja del Padre Luna has the arequipe pot and 12 cows that are milking dialy. To development the projects it is necessary buy arequipe inputs and a milking machine to increase production. For this it is necessary a financial support.

Necessary Resources for tratement of water well and rainwater for its potabilization

For this Project, it is necessary the investment in a rainwater .Like part of the system, its necessary installed a filter like the Siemens' SkyHydrant filter.

Necessary resources for Innovation and investigation in agricultural production

Actually a student and a teacher of electronic engineer from Universidad de los Andes are working in the probe construction.

Phase 5: Implementation design and control

For the continuity of the projects was proposed a leader in each one of the projects. It is important that each leader transmit the information between levels.

4. Principal Findings

Was proposed a projects portfolio that can carry ouy in the farm in one semester. Each Project is going to have parallel workshops in which children living in the farm have opportinity to learn more about them. In this way it is possible to achieve that farm will be an innovation center. Projects that were proposed are:

Project 1: Treatment of water well and rainwater for its potabilization.

Together with the children living on the farm, a team of students and teachers of environmental engineering (María Paula Flórez and Juan Pablo Rodríguez), worked on the design of a rainwater collection system. They saw that this system could attack the problem of aqueduct water spending and also the problem of water shortage. Actually, half of the water is consumed by the cows, this represents an average of 27 m^3 per a month. This has a significant influence in the farm´s monthly spending because it represents approximately 330.000,00 pesos (170 dollars). For the design was used the Analytic Hierarchic process, which is a decision making methology, that uses a multicriteria model that allows the decomposition of a problem by hierarchy analysing qualitative and cuantitative aspects of the problem by obtaninig importance weights from the stakeholders (Castillo, 2008). This methodology help to conclude that the collector should be a surface tank and not an undergrought tank. Figure 2 shows the system that was designed (Flórez, 2014).

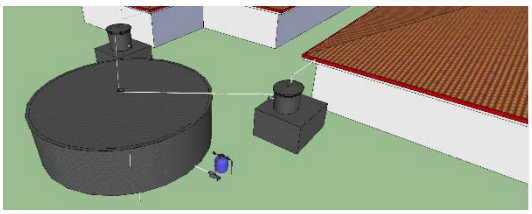

Figure 2. Proposal of the wastewater treatment system

This proposal was created after the evaluation of other options including, attaining portable water from the farm´s water well. This option was discarded because the water in the well had a lot of contaminant elements that would need a hard and expensive treatment. For that reason and considering that the farm had some ceilings channels and that the Siemens Company agreed to provide the SkyHydrant filter, it was concluded that the rainwater collector was the best possibility (Vargas & Flórez, 2013)..

Project 2: Strengthening of milk production and arequipe production with this milk.

The production and sale of milk is a unique activity that is developing Granja del Padre Luna and is providing income apart from donations. This activity represents 20% of their income. Currently, there are ten cows, which produce 80 liters (21.13 gallons) daily. Milking cows is an activity that is performed two times during the day by the farm worker. The objective of this project is to sell a part of the milk, as they have been doing, and then to also use the other portion to make arequipe. The farm has some resources that haven't been used like an industrial pot for making arequipe that could be useful (Vargas & Flórez, 2013)..

Granja del Padre Luna already sells 7000 gallons of milk a year. The objective of this project, in addition to their milk sales, was to increase profit by also selling arequipe. To do this, part of the milk will still be sold as before but another portion will be used to make arequipe. Figure 3 shows the product that was proposed (Vargas & Flórez, 2013).

Figure 3. Proposal of arequipe

Project 3: Innovation and investigation in agricultural production.

Was proposed carry out an agricultural activity in the farm, taking in to account the properties if its land. For this it is necessary evaluate land properties to decide which activity is convenient. For this,
Sebastian Arévalo designed a probe for the crop and land study. This project had the purpose of designing and constructing an economic, friendly and durably device that measures parameters like temperature, conductivity, moisture, and Ph. This project has also the purpose of providing this kind of technology to the little and middle farmers, involving at the same time, the children in the community, teaching them the importance of this kind of technology. Figure 4 shows the probe that was designed. (Arévalo, 2014).

Figure 4. Probe for the crop and the land study

5. Discussion and Concluding Observations

Ingenieros sin Fronteras- Colombia is developing social innovation through workshops and projects in which all the points of view of the different stakeholders are important for the solution. A particular case is Granja del Padre Luna in which ISF has been implementing projects that involve the interests of every stakeholder.

Ingenieros sin Fronteras team wants that all of the young adults of the Guavio Region, that is considered a vulnerability zone, have the opportunity to be involved in these kinds of activities. This knowledge is going to allow the young adults in the Guavio region to have the ability to create new business ideas for the region, which will create development.

To solve problems that involve many diverse stakeholders the interests of all of them should be considered in a participative way in order to achieve a systemic decision process. In this way, it is possible to obtain a favorable solution that all agents agree with. Methodologies such as Interactive Planning give tools that let achieve the study goal. Its application permitted results that let the organization survive by adapting to the ongoing changes.

In the application of this methodology, many meetings with the decision-making agents were made. In them, each one of them gave their understanding of what the farm is today and what they expect it can become in the future, this helped in the construction of a shared vision for the farm. In a similar way, involvement of the boys in the project was encouraged and their opinion about the farm, past and future projects was taken into account.

Projects that were proposed for the Farm, not only permits the self-sustainability but also permit creation of innovation. The opportunity to participate in workshops discussed topics about engineering also permits that children living in the farm find their professional vocation. This means that the purpose is more that give to people some things that needed, because is important generate the capacity for use those in benefit of their goals and aspirations.

At this time the project has only worked with children at the farm but hopes to expand to work with young people in the region. The desire is that young people from the Guavio region will look at the farm as a place in which they can have fun and at the same time acquire knowledge. This knowledge is going to allow the young adults in the Guavio region to have the ability to create new business ideas for the region, which will create development. The idea is that this farm could be a replicative Innovation Center.

6. About the Authors

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A Call for Sustainable Renewal and a Path to Achieving It

September 24, 2014

Markus Schwaninger

Abstract: *The quest for the ecological sustainability of planet earth at this stage is not successful at all. The purpose of this paper is proposing a structural framework for a sustainable renewal at various organizational levels. This should help humanity achieve a future in which economy and ecology are united in a mutually symbiotic relationship. The issue of sustainability has been addressed in different contexts — individual, local, regional and worldwide. I maintain that these efforts can only be effective, if actors at multiple structural levels strive simultaneously and cooperate for materializing the vision of a sustainable world. The distribution of tasks along these organizational strata is a nontrivial task. To master it, a recursive structure based on the Viable System Model is presented, which shows how the efforts for sustainability can be organized in a much more powerful way than by conventional approaches. The proposed structure enables agents at each level to generate variety in balance with the complexity they face. This article should also help decision-makers understand that pertinent frameworks are needed to enable actors at each level, from individual to global.*

This article is an extended version of the Ross Ashby Memorial Lecture delivered by the author at the European Meeting of Cybernetics and Systems Research, Vienna, April 24, 2014, under the title "Organizing for Sustainability".[1]

Keywords: Sustainability; Organization Design; Organizing for Sustainability; Sustainable Renewal; Cybernetics; Viable System Model; Structures; Systems Approach; Recursive Structure

Acknowledgement: The author is grateful to Dr. Felix Gress, Senior Vice President Communications & Public Affairs, Continental Corporation, and M. Franz Hermann, Mediationsforum Gastein, for providing me insights into the structures and history of their organizations.

[1] The lecture is made available in the Proceedings of that conference, under http://www.systema-journal.org.

1 Introduction

Can we restore the sustainability of our planet, and how?

Over the last 200 years, the separation of economics and ecology has led to a profound conflict. The basic notion that the two spheres have a common root – oikos [Greek], meaning household – has got somewhat forgotten. The consequence is an ecological crisis, and the economic crisis we are facing is intrinsically connected with it. Looking forward, we have to find the unity of economic activity and its natural basis again. This paper is a plea for ecological restoration, providing a framework and a path to its accomplishment.

We are caught in a quagmire: The complexities we have created ourselves do not loosen their grip on us. Ross Ashby and Stafford Beer, the eminent cyberneticians, teach us how to deal with the complexity of our world. Fortunately we can revert to their advice about how to cope with our predicament. Therefore, this proposal rests on cybernetics principles.

The Brundtland Report "Our Common Future", from 1987, which was delivered by the United Nations' World Commission on Environment and Development, defines sustainable development as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs".[2] Despite this well-intended declaration, we have not seen much change for the better.

Accordingly, the improvements have been punctual, for example in the partial greening of European industry. What we see, however, is a deluge of monstrosities - a gigantic squandering of resources, pollution of air, soil and water, depletion of biodiversity, altogether: a disruption of the web of life.

We humans are part of that web, and we carry responsibility for it. In other words, we need better ways of dealing with the ecological challenge. Hence,

[2] Ben-Eli (2012) provides a complementary definition which frames the concept of "sustainability" as "a dynamic equilibrium in the processes of interaction between a population and the carrying capacity of its environment such, that the population develops to express its full potential without producing irreversible adverse effects on the carrying capacity of the environment upon which it depends."

the question I would like to address in this lecture is: “How must humanity organize itself in order to develop sustainably?”

Sustainability has several dimensions known as the triad “Ecological, Social, Economic.” These three spheres interdepend (Figure 1).

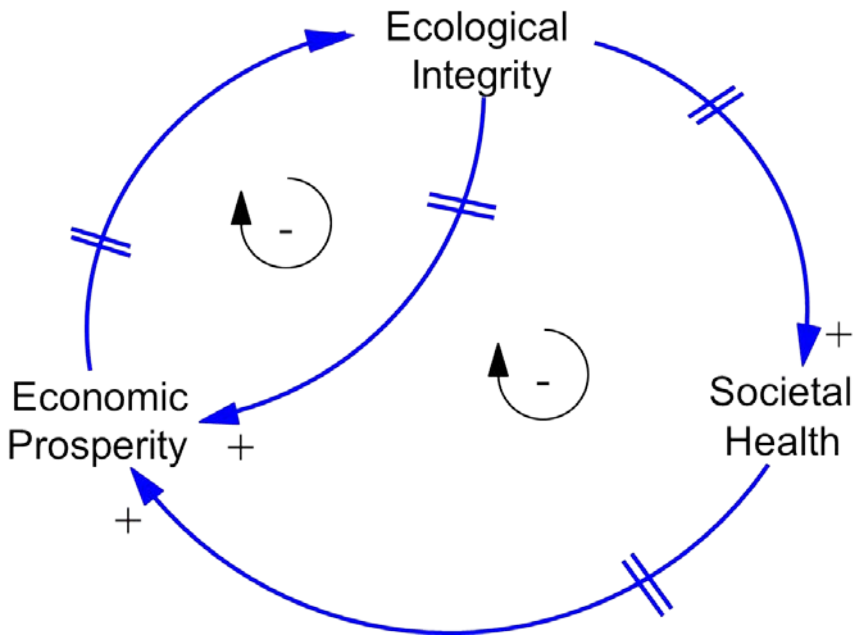

Figure 1: Dimensions of Sustainability

Ecological integrity furthers the health of a social system, which then enhances economic prosperity. A thriving economy – as the evidence shows – can become disruptive to the environment (therefore the negative sign on the arrow). That is what we have had in the industrialized world at least since World War II, and increasingly also in the emerging economies. The dynamics of this system are summarized in the negative signum denoting a balancing loop: This appears to be a self-regulating system, in which damages are eventually compensated.

Yet, the situation is more complex: A healthy environment enhances economic prosperity. Accordingly, injuries to the environment result in dysfunctionalities of the economy. This makes another self-regulating loop, which is supposed to be a good omen. But the appearance deceives: there are delays in the system (marked by the crossbars in Figure 1). Due to these retardations it is likely that the economy thrives even more, until at some point the environment strikes back, unexpectedly and forcefully.

Examples have been described, such as the collapse of the Easter Islands, where a whole society was eradicated within very short time, after having destroyed the forests, which were its main resource.

This diagram is a simplification, as additional feedbacks might play a role. My point here is that I will focus on ecological sustainability, which is, in some sense the most fundamental of the three dimensions. It is interdependent with the other two dimensions, to which I will therefore refer in my analysis as well.

From a long-term perspective, the viability of humanity hinges on a sustainable development. If we want to organize for viability, we have to organize for sustainability.

2 Choosing a Model

The strongest approach is to choose a model that targets viability and allows us to channel the efforts for sustainability into that quest for viability. In other words, organize sustainability measures so that they enhance the viability of a system.

There are two models that aim at making such viability possible:

- James Grier Miller's Living Systems Theory [Miller (1978)], and
- Stafford Beer's Viable System Model [Beer (1972, 1984, 1985)].

Both of these models have an organismic perspective in common. Both have an enormous potential which has spurred their increasing use in organizations. While Living Systems Theory is older and therefore has been corroborated by a greater number of published empirical studies, the Viable System Model (in short: VSM) has the advantage of being stronger in its theoretical claim and falsifiability, as well as its diagnostic potency. The claim is that this model specifies the sufficient preconditions for a system to be viable. This prerogative reaches much further than the mere reference to "necessary requirements". Even so, the VSM has not been falsified, in other words, it has not been proven to be wrong. Serious attempts to falsify the model have not been successful (Frost, 2005; Crisan Tran, 2006; Schwaninger & Scheef, 2014). Therefore, following Popper's Falsification Principle, it can be assumed that it holds. Consequently I shall revert to this

model as a guideline. It is a special pleasure to have Dr. Allenna Leonard, Stafford Beer's partner, among us.

In the VSM a set of "control mechanisms" is specified, which Beer describes as the necessary and sufficient conditions for the viability of any human or social system.

3 Outline of the Viable System Model

A social body is viable if and only if it has a dovetailed structure of regulatory units whose functions and inter-relationships are precisely specified in the theory. I will guide you quickly through the generic structure of the model:

To start with, the basic units: these might be divisions if we look at a firm, nation states if we look at a nation, nations if we look at a continent, and continents if we look at the world. These basic units absorb the complexity of the environment they are confronted with.

If we zoom in, this is what we get (Figure 2).

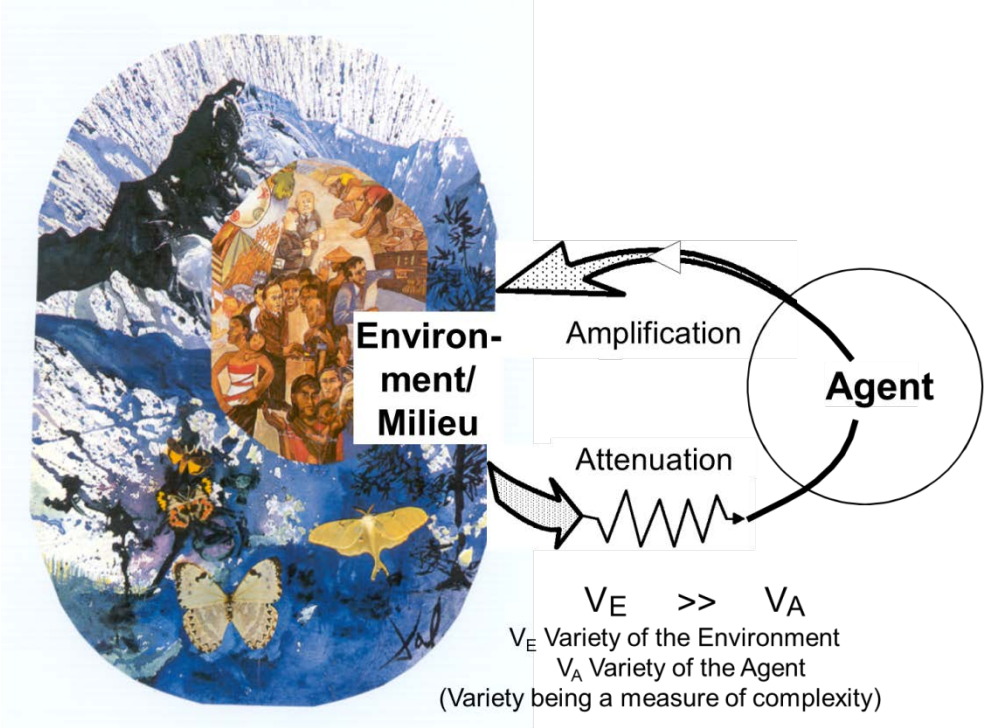

Figure 2: Variety Engineering with Attenuation and Amplification of Complexity

The basic unit (denoted as ‘agent’) adapts itself to the environment by attenuating its complexity and by amplifying its own Variety, namely its repertory of behaviors.

This way, environmental complexity and eigen-complexity are brought into balance. That is what Ashby called *Variety Engineering*. The term *Variety* here denotes a measure for complexity – the property (potential or actual) of a system to assume many states or behaviors.

Now, let us follow the components of the management system (Figure 3):

- *System 1*: This is the regulatory capacity of the largely autonomous and mutually adaptive operative basic units, in charge of optimizing the ongoing business. Basic units with their respective management are called *primary units*. An example: the company’s business units.
- *System 3*: In a company we would have the executive corporate management here. It provides overall direction, allocation of resources, striving for an overall performance optimum, which is often different from the optima of the subsystems (primary units).
- *System 2*: This is the coordination function, which reduces oscillations and enhances self-regulation. For example the information- and budgeting-systems, internal service-units, standards of behaviour, knowledge-bases, a good deal of communication.
- *System 3**: The Auditing Channel, where the information flowing through channels 1-3 and 1-2-3, are validated through direct access to the basic units. For example, monitoring and Management by walking around, social and cultural activities as well as informal communication.
- *System 4*: It stands for the long-term orientation to the future and the overall environment. Here we have company development /strategic management, research and development, knowledge creation, etc.
- *System 5*: Striking the balance between present and future, keeping the internal and external perspectives in proportion. Here we have the

supreme norms and values that govern the system – the ethos of the organization or normative management.[3]

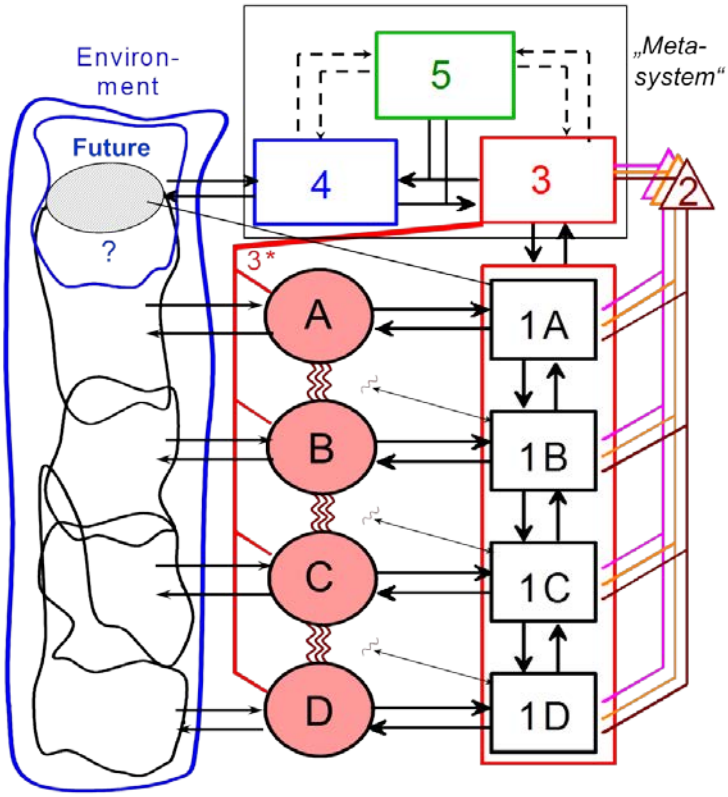

Figure 3: The Viable System Model – Diagram after Beer, simplified

Why do I take such a complex model? I am using it, because it is the only one that guides us straight to viability!

To sum up: *Systems* 1, 2 and 3 (including 3*) represent the Operative, System 4 (in interaction with 3) the Strategic, and System 5 Normative Management. 3, 4 and 5 together form the Meta-system.

The VSM is a tool of extraordinary power that I have used, with my team, many times to diagnose organizations of all kinds: big, small, public and

[3] In addition, certain alert devices can always be identified in viable systems. Beer (1985: 133) calls them „algedonic signals“ (from Greek ‘algos’ – pain and ‘hedos’ – pleasure). These warning systems decide if signals of imminent danger have to be sent directly up to System Five. This component will not be analyzed further in the present contribution.

private. Applying the model to a real firm brings diagnostic points to the fore, which can change its fate completely.

The model is of neurophysiological origin. It is homomorphic in relation to the human central nervous system (Figure 4). Humans are the best paragon of viable systems. What Stafford Beer discovered is an isomorphic structure for mapping both social and organismic systems.

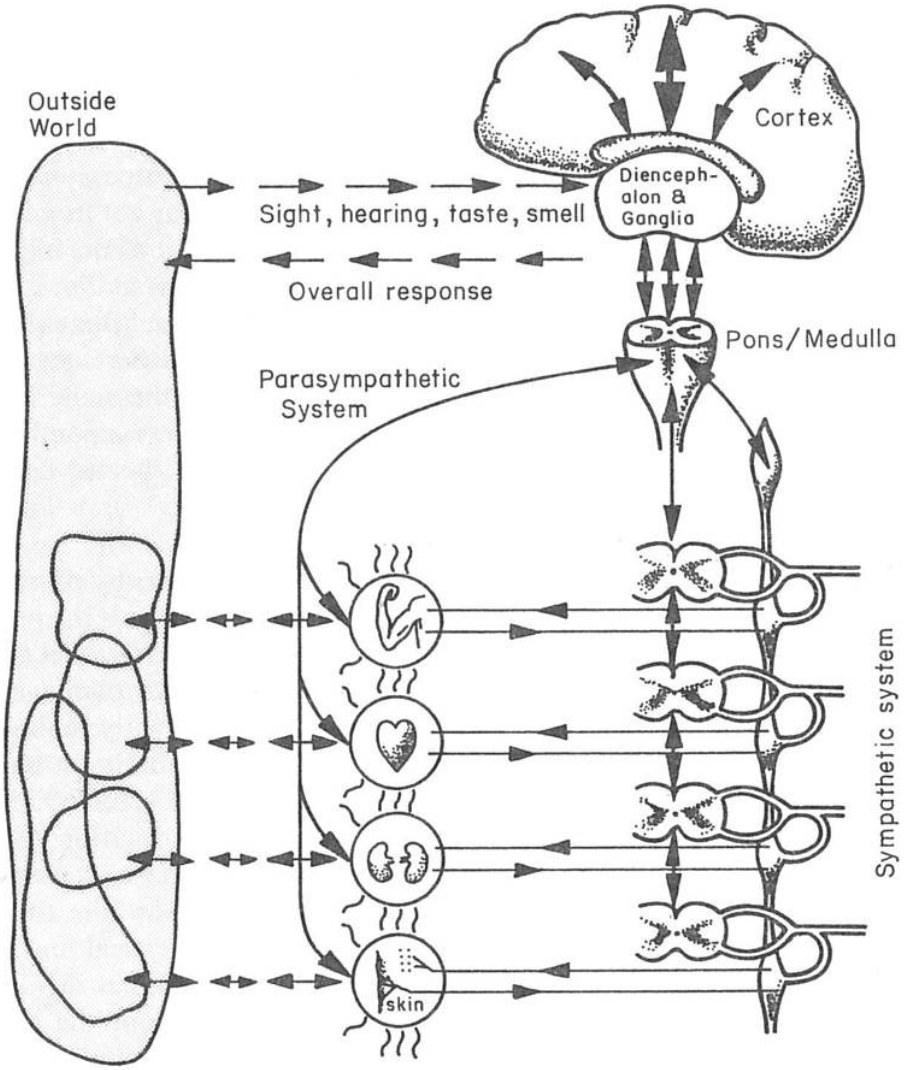

Figure 4: The Neurophysiological Basis of the Viable System Model (Beer 1981:131)

4 Two Principles: Autonomy and Recursion

The viability, cohesion and self-organization of a social body depend upon these functions being recursively present at all levels of its organization.

A recursive structure comprises autonomous units within autonomous units. Moreover, a viable social system, e.g. a company, is made up of viable units and is itself embedded in more comprehensive viable units (Figure 5). Each unit, inasmuch as it is producing the organization's task rather than servicing or supporting this production, replicates - in structural terms - the totality in which it is embedded.

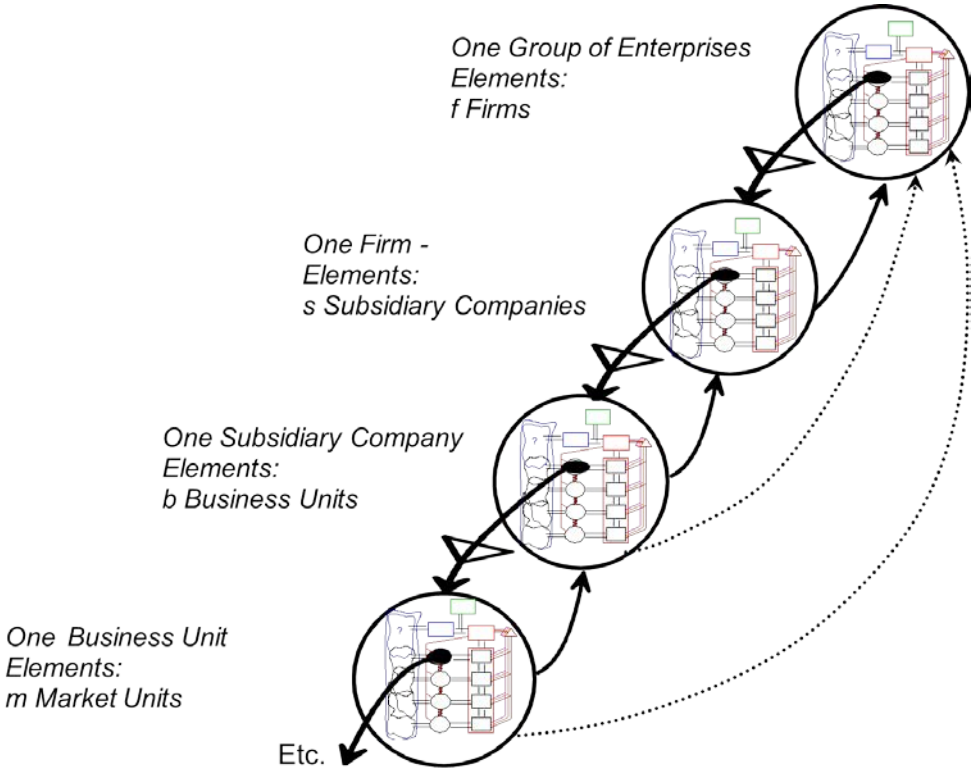

Figure 5: Recursive Structure of the Viable System Mode - Example1

So we meet the same structure over and over along the levels of the organization.

Autonomy is basic to the VSM. From Greek "autos" (for self-) and "nomos" (for law) this term refers to the primary unit as a whole being 'a law unto itself', as Beer defined it (Beer 1981). The autonomy in question is therefore

both a system's freedom and the responsibility to regulate itself. This is the pivot of an organization's adaptation and learning.

In case the challenges confronted exceed the capability of such a primary unit, joining forces becomes necessary. In many cases this can be achieved by a horizontal cooperation. However, it can indicate the necessity of jointly constituting a new unit at a higher level of recursion. For example, municipalities form states and states form nation states.

However the formation of a new organizational unit is not necessarily linked to a merger of all aspects of the activities of the Systems.

For example, two or more units can join forces to deal with the ecological challenge in a more prolific way than if they go on their own (Figure 6).

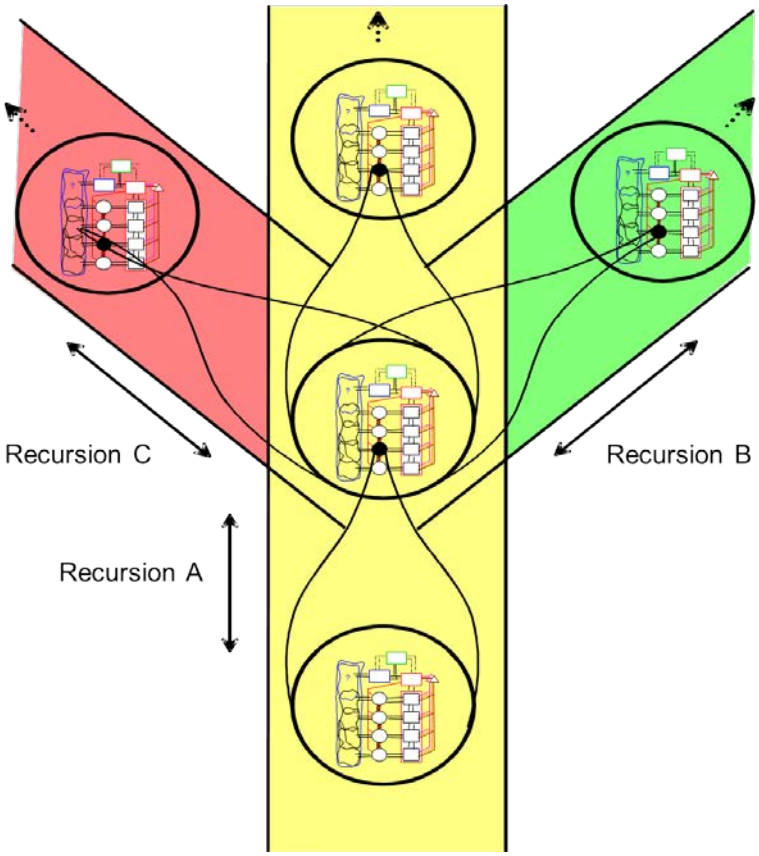

Figure 6: Recursive Structure, multidimensional

With this structure we were very successful in bundling the ecological effort – of a large division in a company of the chemical industry - in a critical and life-threatening phase.

The structure outlined here shows that one and the same organization can function simultaneously both as a sub-system and a super-system within the framework of different recursive organizational dimensions: Recursion is a multidimensional concept.

The division in focus is part of that large corporation and is itself composed of several Business Units (Recursion A). In order to cope with the ecological challenge, the division joined other enterprises from outside, to form an association for that purpose (Recursion B). Additionally, this company was a member of a consortium for research and development (shown in Recursion C).

5 An Organizational Framework for the Pursuit of Sustainability[4]

We can now apply the VSM in support of ecological sustainability.

Instead of starting at the global level, we shall begin with the individual agent. One often hears that sustainability starts in the head of the individual that acts according to ecological principles. However, agents exist at different levels, if you look at the world from a system-theoretic perspective. For example, we can identify a whole company as one agent: Let us take Interface, leading producer of carpet tiles, a company that excels by its ecological commitments: Closed loop products, zero environmental footprint, and a restorative approach just to name a few. Ray Anderson, whom I interviewed a few years ago, was the initiator of this orientation[5].

But today, when Interface announces its mission, that it wants to be “a corporation that cherishes nature and restores the environment”[6], it speaks with one voice, as one agent.

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[4] Based on Schwaninger, 2008.
[5] The path of Ray Anderson to ecologically committed entrepreneurship is documented in Anderson 1998.
[6] Corporate homepage: http://www.interfaceglobal.com/Company/Mission-Vision.aspx, accessed May 22, 2014.

Also, the aggregated results of the strategies to make this vision come true will be measured and reported in organs of the corporation as a whole. On lower levels of recursion, different divisions, teams or staff members will develop their own views, values and strategies: Following the logic “What is my contribution to our mission?”

As we know, strong and viable organisations thrive on that mutual alignment of values, strategies and actions, from bottom to top and from top to bottom.

Hence, we conceive of agents as human or social units, acting as wholes, at different recursive levels of a human or social system. In the context of the quest for sustainability, we can now outline a structure of the multiple agents concerned (Figure 7).

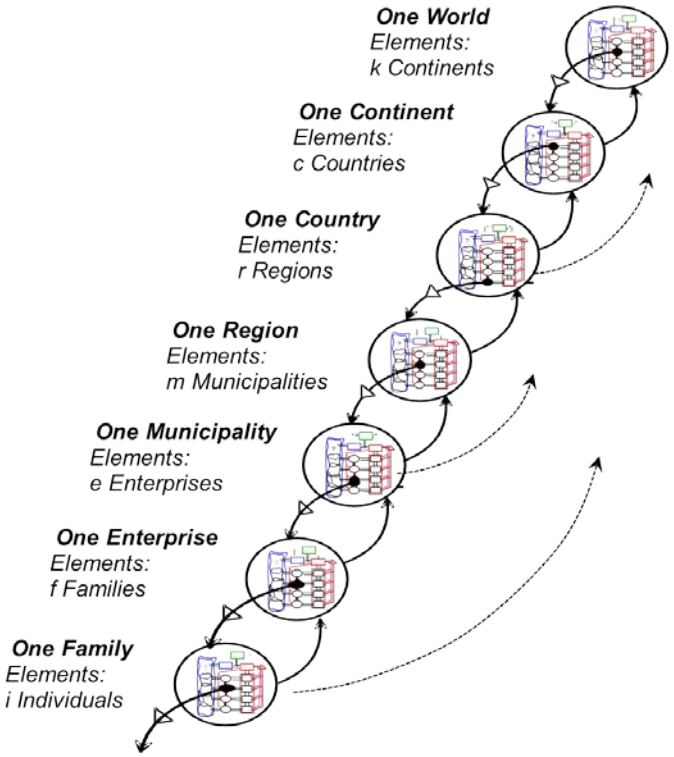

Figure 7: Structural Preconditions for Sustainable Development – A multilevel view

In this scheme, the structure reaches from the level of the individual to the level of the whole world. One might think that the multiplicity of agents forming the system at all of these levels is prohibitive to an endeavour of mapping all of them at once.

Why is this diagram so simple? Because it uses the recursion principle: Wholes at multiple levels absorb complexity along the fronts at which that complexity emerges. The reach of this structure is practically infinite. It visualizes that each level has its regulatory issues in their own right. To maintain viability, each agent has to deal with that task of absorbing the specific complexity by which he or she is affected, in accordance with Ashby's Law of Requisite Variety: It says "Only variety can absorb variety".[7]

That is Ashby's advice and it is the instruction for the design which I am presenting. Requisite Variety is the nucleus of viability.

Issues of ecological (and social) sustainability arise everywhere, but they vary according to the planes. It does not make sense trying to solve the pothole problem at the global level, this is a task of every mayor, in each city or village. On the other hand, forbidding a toxic substance is often a national or international issue. But a company can be even faster by interdicting that substance in its own plant or creating an incentive for not using it (for example, a fine per kilo, as done in a Swiss company).

Most affairs can be regulated at the bottom, so that higher levels should only regulate what cannot be taken care of at the lower ones. This corresponds to the principle of subsidiarity.[8]

The lines drawn bottom-up symbolize the principle of subsidiarity as well as the participation, mainly in regulatory activities, of higher level bodies. The lines drawn top-down indicate the unfolding of viable systems along different recursive levels.

The principle of recursion multiplies the capacities of complexity absorption. It is applicable ad infinitum, and therein lies its tremendous power.

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[7] Ashby's original wording was: „Only variety can destroy variety“ (Ashby, 1956). Beer inserted the more insightful verb “absorb” (Beer, 1979).

[8] Subsidiarity is an organizing principle according to which a central authority should have a subsidiary function, performing only those tasks which cannot be performed effectively at a more immediate or local level (Oxford English Dictionary). In other words, “a matter ought to be handled by the lowest, smallest and least centralized authority capable of addressing that matter effectively” (http://en.wikipedia.org/wiki/Subsidiarity, accessed May 22, 2014).

6 Systemic Environmental Management

Now, I would like to share with the readers some of the experience accumulated in my research team. We have studied and applied these theoretical foundations over decades and in the most diverse contexts.

My first example must be limited to one level of recursion only, just to avoid overstretching the case in point. This is an exemplar of a mid-sized industrial company in Switzerland from the pharmaceutical industry.

Let us now together walk through the sustainability-related tasks as they are distributed across the functions of the VSM:

- *System 1*: This is about regulation and optimization of ecological management, in the short term, of *the basic units*. I am referring to the general management provided by the business unit heads and factory managers, ensuring environment- and security-related direction and control.
- *System 2*: Coordinates the ecological efforts across the basic units, provides educational programs, as well as planning and control of ecology-related programmes. The main agents here are a small service unit for sustainability and quality assurance, and a "sustainability circle" with members of different sections. In this System-2-function, the circle is the prime diffusion-medium for ecological consciousness. The instruments used include an ecological accounting system, environment- and quality-related standards of behaviour and knowledge-bases.
- *System 3*: Here we have the overall responsibility for sustainable operations of the company. In charge is one of the three executives of the management board. The sustainability unit (see System 2) reports to this executive.
- *System 3*:* is about the a*uditing and monitoring* for ecological efficiency, through direct access to the basic units. Ecological audits and special environment-related investigations into the operations are important here, besides informal interactions of higher managers with workers.
- *System 4*: The long-term orientation concerning sustainability has several contributors, namely research and development and the sustainability circle (in its System 4 function), all coordinated by the sustainability staff. The latter does the systematic work on corporate development and strategy, such as investigation, and modelling. The top executives are part of the strategic management process, and all of these efforts are tied together in the hands of the CEO.
- *System 5*: determines the identity of the organization, its functions in the environment, incorporating the supreme values and norms, in short, the

ecological ethos of the system as a whole (Normative Management). The CEO is the protagonist and main catalyst of the corporate values seconded by the board. Pertinent instruments are the corporate charter (with values and business mission), and a sustainability vision statement. The corporate charter was elaborated with the participation of employees from all sectors.

This setup gets close to the ideal-type of a VSM-based structure. No wonder, the company is one of the best-managed in the country, in ecological terms. By the way, empirical studies indicate that high environmental performance goes hand in hand with superior overall performance, e.g., Meffert and Kirchgeorg (1992:190).

This was the structure for one recursion level, - the company as a whole. The same principles apply to the structures at other recursive planes. Let us just take a brief glance into this matter, and use the case of a larger company, - the Continental Corporation with whom I have been collaborating for many years. Continental is an organization dedicated to mobility and transport, best known for its tires and steering systems.

The management there is convinced that the effort for sustainability is more than environmental protection. It must go beyond end-of-pipe measures and be organized in a circular fashion (Figure 8). And it must be deeply ingrained in all domains: starting from research and development, supply chain, production, and the entire value chain.

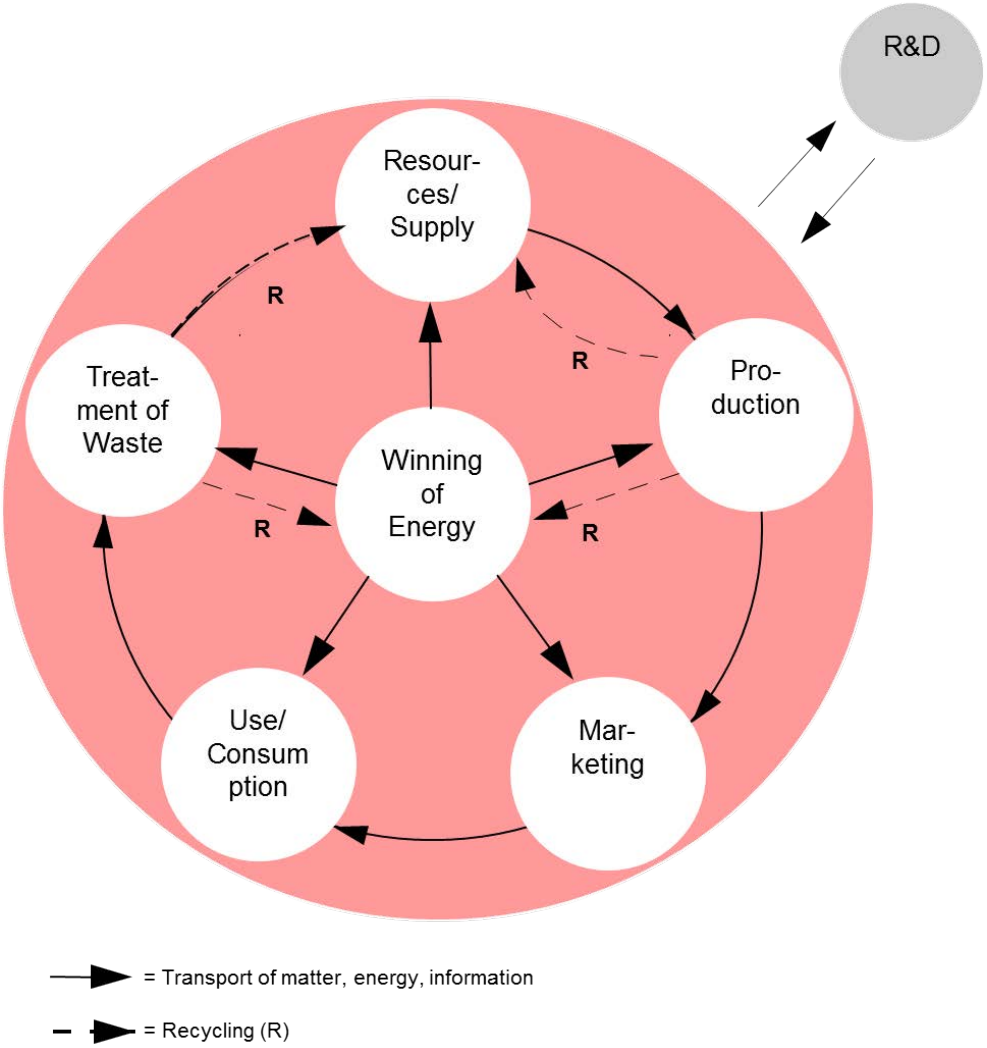


Figure 8: Circular Concept of the Value Chain

Therefore, Continental's approach is convincing: First, the quest for sustainability there is companywide considered a task of each member of the organization. This norm is contained in the leadership principles and practices.

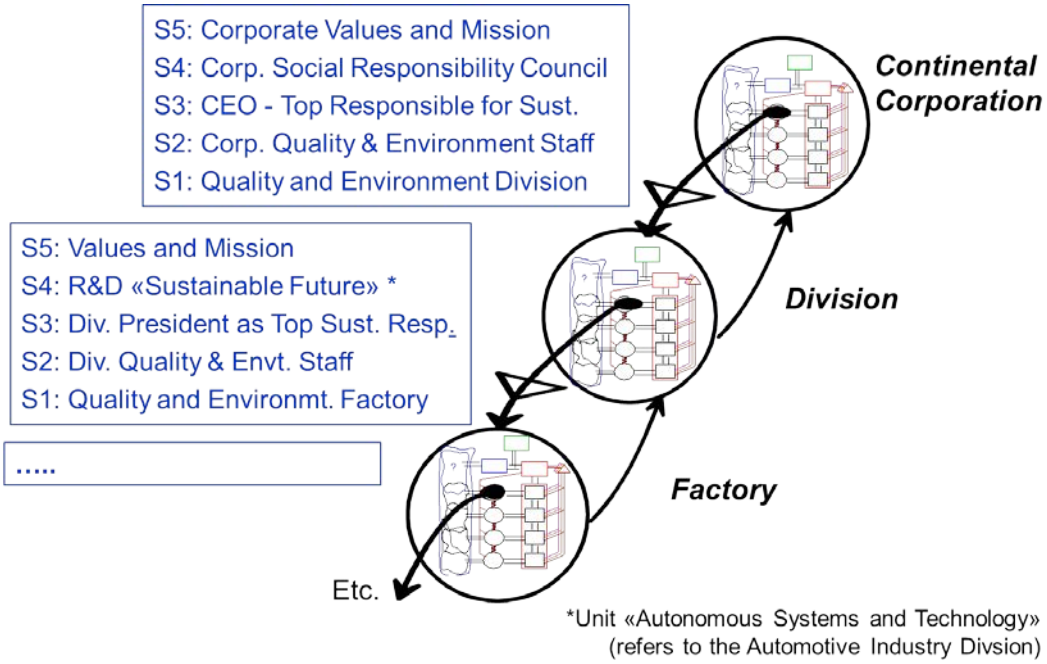


Figure 9: Ecological Management at Continental

Second, the responsibility for the greening of the firm is anchored throughout the line (Figure 9). At the level of top management to begin with: The ultimate responsibility for the sustainability of the company, in all respects, is with the chairman of the executive board ("CEO") together with the executive board as a whole. The CEO carries the line responsibility for quality and environment (System 3). At his side is a strong service unit called "Corporate Quality and Environment", which has very much a 2-3* function, in terms of the VSM. There is a second related line function for corporate social responsibility, - with the executive board member for human resources (part of System 3). There are also other mechanisms of coordination, such as rules and procedures, not only for quality and environment, but also for security, health etc.

The long-term issues of sustainability (System 4) are regularly handled by the Corporate Social Responsibility Council. The supreme tenets and principles (System 5) are well documented in corporate values and mission statements. This system is carried down to the divisional recursion. Here again, we find the same structure, in all five divisions (Tires, three Automotive Divisions and Continental Technologies). And the same logic continues further down.

The arrangement of tasks, as outlined, shows what Ashby's Law already taught us: ecological and social responsibility must not be confined to a single person or plane. The issues of these domains transcend boundaries. Hence, coping with them calls for distributed intelligence.

Moving up the ladder of recursions, we could now assess and design the structures for sustainability at the levels of community, region, country, etc. At these levels some notable successes have been achieved. I would like to acquaint you with the case of a whole region. There, I realized an ecological study based on cybernetics, which turned out to be seminal.[9]

The Gastein Valley in Austria is one of the most beautiful alpine valleys. Its three villages (Figure 10) have been much procured by tourists in winter and summer, since the Middle Ages. Around the turn of the millennium, the valley suddenly found its sustainability and viability heavily threatened.

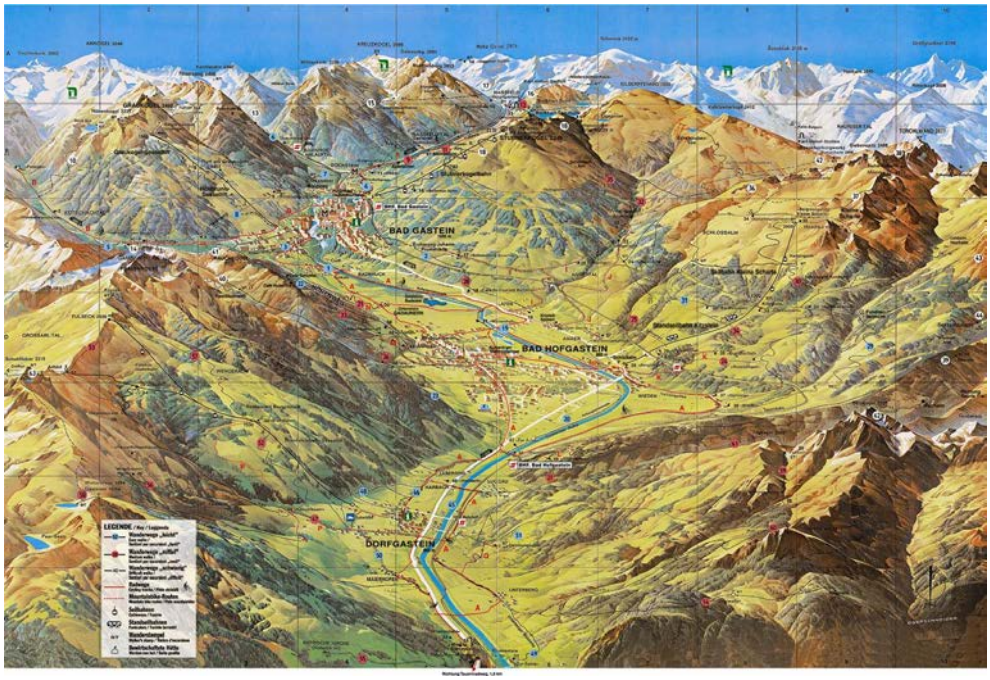


Figure 10: Gastein Valley, Austria

A plan based on the treaties with the European Union envisaged a counter-systemic intervention: The construction of a heavy-duty, high-speed train connection throughout the valley (punctuated line in Figure 10). The level of emissions (mainly noise) would be capable of jeopardizing the traditional

[9] More details about this case are available in Schwaninger (2012).

tourism and health industry, and the local socio-cultural web. Based on a local initiative, a mediation forum with authorities and all other stakeholders concerned was formed. This forum asked me for advice. The ensuing process of studies and negotiations led to a decision at the level of the Austrian Ministry of Transport, Infrastructure and Innovation, which averted the imminent danger from the valley. Our analysis, from hindsight, shows that, as the process went along, the Gastein Valley organized itself in view of the threat: It evolved a structure for sustainability and viability (Figure 11). A more detailed report about this case can be found in Schwaninger (2012).

The primary units here are the three villages, each one with its management. The metasystem 3-4-5 had not existed at all, and formed itself in face of the challenge: a management for the sustainability of the Gastein Valley a whole.

This enabled the creation of a concept that was far superior in ecological terms to the original plan of the ministry: More environment-friendly, less noisy, more sustainable. That new plan was incorporated into the overall transport policy of the Austrian Ministry of Transportation, Innovation and Infrastructure. This surprising outcome is vital for the valley as a whole. It resulted largely due to this enabling structure of viability and the culture that went with it.

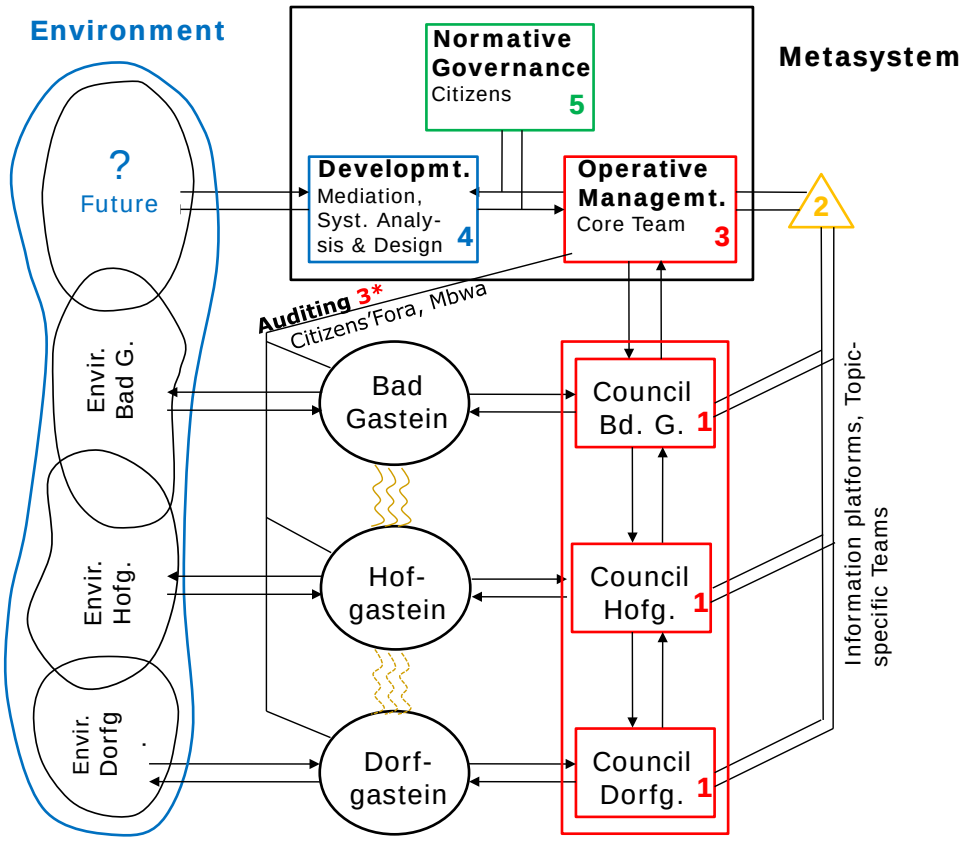


Figure 11: Regional Organization for Sustainability – Gastein Valley

So much for the regional level.

Carrying on, to the country level, we have at least two great analytical works: One is a design proposal by Stafford Beer (1989) for nations in general. The other is a careful diagnosis of the Swiss political system, by my doctoral student Maarten Willemsen (1991). His work analyzed some implications for ecology. But, a proposal for both a diagnosis and design for sustainability at the national level remains to be accomplished. What is needed in many countries is a transition to a more effective management framework, by which fragmentation and ineffective regulation for sustainability are overcome.

A main challenge at the level of both regions and countries is the design of System 4, by which the continual presence of a long-term orientation is provided. For that purpose, Future Councils have been proposed and implemented, e.g., in France (Conseil général de l'environnement et du développement durable), Costa Rica (Natural Resources Defense Council), as well as in the regions of Brussels, Montreal and Schleswig Holstein, among

others. The role of these organs is to warrant a high profile of the long term view in decision-making. The chances to avoid aberrations are better if these councils are in place. According to the current state of research, the ideal version would be a group of 7 to 12 independent individuals, elected for a longer period, say eight years, with a partial renewal of the body every four years.[10] The strongest instrument for such a council would be a veto right to be overruled only by a qualified majority in parliament.

If we move on to the last recursions, continental and global, we discern great ecological problems but low effectiveness in dealing with them (Simonis, 2005; Mazower, 2012; Goldin, 2013). Namely at the level of the world, a large number of institutions try to regulate something, with mixed results at best. The High Level Political Forum on Sustainable Development, a kind of World Council for the Future, instituted in 2013, could be a step in the right direction of building a more effective System 4 at the global level.

The VSM would be a powerful means for bringing about worldwide sustainability. Given by the need for more effective policies at the international level, a call for a multi-level governance has echoed recently (e.g., Bongardt, 2007; Brunnengräber & Walk, 2007). This is congruent with the postulate for recursive structures in this article. Therefore, it is also a validation of the goals proposed above, even though the suggested means are not necessarily the same.

Sustainability will not happen if it is merely enforced from the top or exclusively pursued at the level of individuals. If we take a view of the overall recursive design, it becomes apparent that a multilevel approach is needed. The issues must be tackled at each recursive plane. None of these is unimportant or "less important".

Regulations must be focused on the needs of specific planes. A fragmentation of the efforts of regulation is an obstacle to ecological balance. We often hear that the environmental crisis results from a deficient consciousness of citizens. I agree. But the crisis is, in equal measure, the product of a structural deficit in the current organizational and institutional makeup.

[10] This design is proposed by the Swiss Foundation Future Council (Unteregger, 2006; Sieber, 2014). A similar, more extensive proposal for an “Ecological Council” is presented by Binswanger & Wepler (2009).

7 Conclusion

This article has focused on a burning issue, - the ecological predicament of humanity.

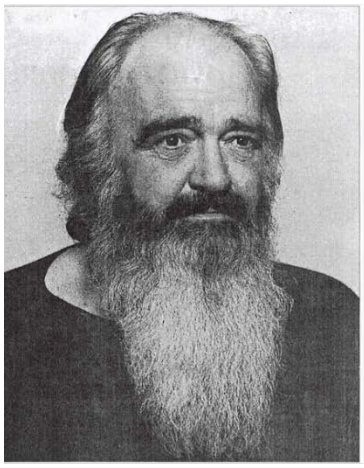
Overwhelming complexity is the challenge, but our response is potentially powerful enough: It is a design for requisite variety along a recursive structure of autonomous units.

In practical terms, all planes from individual to world need their specific organization for an "ecological management" enabling sustainable development and renewal. Specific kinds of challenges and issues arise at each one of those levels, and that is exactly where they have to be coped with. This way, complexity is absorbed wherever it manifests itself. This should be one of the foremost considerations of policy-makers when designing a framework for global sustainability.

Overcoming the current structural deficits calls for two things:

- First, better organizational and institutional frameworks for enabling agents at each level to make their contribution.
- Second, measures to enhance the ecological consciousness of citizens and their capacity for becoming environment-friendly (Last but not least, good frameworks as such should contribute to that environmental consciousness). But ultimately the success of the ecology movement will hinge on people’s love and compassion for nature.

Stafford Beer’s Viable System Model was inspired by Ross Ashby, - the two men were colleagues and friends (Figure 12).



Stafford Beer
(1926-2002)

W. Ross Ashby
(1903-1972)

Figure 12: Ashby and Beer – pioneers and vanguard thinkers

The model makes use of Ashby's Law of Requisite Variety: At each recursive level of the organization, the agents absorb the complexity as it unfolds. This principle is as powerful as it is simple.

The VSM has not been falsified yet. But that is not enough, it needs to be applied. It would be a sin not to use it for the betterment of the human condition. We need to work for the dispersion of that model. For example, I keep teaching people how to make good use of it. Hence, I am now addressing, in particular, the young people: **You will not run out of work!**

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Understanding the Impact of Public Sector Clients on Successful Socio-Economic Policy Implementation: a Case of the United Kingdom

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Abstract

Various socio-economic policies have been initiated across the globe by successive governments. The apparent increment in the number of these policies has been attributed to such governments' increasing desire to drive economic growth through them, particularly as they affect provision of economic infrastructure. The relationship between effective socio-economic policy implementation and efficient public procurement has since been established by extant studies.

Accordingly, attempts have been made within the United Kingdom to use public procurement to drive the implementation of such policies. In the Northwest region of England, for instance, such attempts led to the establishment of the Northwest Construction Hub (NWCH). Serving as a construction framework, this hub has recorded various degrees of success as an implementer of socio-economic policies through the procurement of construction works for local authorities. Of particular concern to this study is the use of construction-related public procurement to develop local apprenticeships and competitive local supply chains. However, it has been observed that the variance in the degrees of success recorded has been traced to features associated with the manner in which the individual public sector clients have engaged with the NWCH. This study seeks to develop an understanding of those peculiar values or attributes of the public sector client responsible for such inconsistency through a viable systems perspective.

Adopting a Viable Systems Model (VSM) enabled methodology, the Viable Infrastructure Delivery Systems Model (VIDM), availed this qualitative multi-case study with a suitable methodology for understanding the relationship between the client local authority and other parties through an interorganisational and multi-layered structure; a perceived shortcoming of implementation research. Two capital projects procured through the NWCH were adopted as case studies. Data was collected through a series of face to face semi-structured interviews and a review of project and policy documents. The collected data was subsequently analysed qualitatively with the aid of the NVivo software.

It is expected that the findings of this study will generate further discourse on the potency of extant methodology adopted herein, in studying the wider area of policy implementation.

Keywords: Policy Implementation, Northwest Construction Hub, VSM, Public Sector, Temporary Multi-Organisations

Introduction

Recently, successive governments have initiated policies geared towards enhancing socio-economic regeneration of their respective economies (Agénor and Moreno-Dodson, 2006, Arrowsmith, 2010, Binks, 2006, Hawkins and Wells, 2006). Whilst not being a new phenomenon, the upward surge in the number of these policies has attracted renewed attention. Furthermore, the use of public procurement in driving the implementation of these sort of policies has since been established within extant literature (Binks, 2006, Arrowsmith, 2010, Bolton, 2006, McCrudden, 2004).

In the United Kingdom, attempts have been made to use the public sector's bargaining power during public procurement to drive effective implementation of various socio-economic policies (Erridge, 2007). This was even more central to the procurement strategies of local councils in the UK(Preuss, 2009). Such attempts have led, for instance, to the establishment of the now rested Regional Improvement and Efficiency Partnerships (RIEPs). In the North West of England, a platform for the procurement and delivery of construction works for public and private sector clients, the Northwest Construction Hub (NWCH) evolved from this era. As a construction framework, NWCH has recorded varied performances as an implementer of policies through the procurement and delivery of construction works for local authorities within the Northwest region, owing to its perceived flexibility. Of particular concern to this study is the use of construction related public procurement to recruit and develop local apprenticeships and competitive local supply chains (Small and Medium Sized Enterprises-SMEs) within the NorthWest.

It has been observed that the inconsistency in performance levels was contingent upon by the manner through which the individual Public Sector Construction Clients (PSCCs) have engaged with the NWCH. Thus, it can be inferred that PSCCs have a significant role to play in ensuring effective implementation of these policies during the procurement and delivery of their projects through NWCH. The salient roles expected of construction client organisations, like PSCCs, in the attainment of successful project outcomes has been buttressed severally (Boyd and Chinyio, 2006, Kometa et al., 1995, Bresnen and Haslam, 1991, N.E.D.O., 1975). Furthermore, the ability of PSCCs to execute these identified roles during the project execution process is also contingent upon the values they espouse as such values are not only responsible for the decisions they take as it pertains to project identification and selection but also on how to derive these values from such projects(Kelly et al., 2008, Boyd and Chinyio, 2006, Kumaraswamy and Dissanayaka, 1998). Arising from the preceding discourse on client's influence upon successful implementation resulting from the possession of certain attributes and/or values, it can thus be inferred that the nature of the PSCCs vis-a-vis these attributes and/or values would affect the success or failure of the NWCH in delivering the expected outcomes of extant socio-economic policies through the procurement and delivery of construction projects.

However, studies within the realm of implementation research such as this have been constrained by the apparent absence of an appropriate methodology for conceptualising the extant interactions during the implementation process (Proctor et al., 2011) allowing for a reflection of its interorganisational and multi-layered nature (Hill and Hupe, 2003, O'Toole, 1986). Such limitations seem to have rendered the findings from studies attempting to understudy the implementation process, incomplete (Proctor et al., 2011). This is further buttressed by Dubois and Gadde (2002) wherein they observed the seeming inability of case study research-a strategy of choice in most implementation studies-to provide for the

interrelatedness of an investigation's several elements. They proposed for the use of sense-making in achieving this interrelatedness through the process of systematic combining. As such, the authors in this study relied on theoretical constructs associated with the base premise of the VSM (VIDM) in enabling the attainment of the study's objectives.

The Viable Systems Model (VSM) and its application in real world scenarios has continued to elicit negligible attention as it pertains to its inherent capabilities in conceptualising interorganisational relationships from a systems viability perspective; particularly in the areas of communication and control as a result of what has been described as the difficulty associated with its comprehension and usage (Awuzie and McDermott, *forthcoming*). The language and terminologies associated with the VSM have also contributed to this lack of interest. The paucity of VSM application literature appears to be noticeably prevalent within construction management literature where more emphasis is being placed on Soft Systems Methodology (SSM), Socio-technical Systems and System Dynamics (SD) which are deemed more appropriate to the construction management research (Jackson, 1988). This study expects to join others (Awuzie and McDermott, 2012, Adham et al., 2012) in generating interest in the applicability of the VSM and other models associated with it, such as the VIDM in organising project delivery/policy implementation systems for viability from a sense-making perspective(Weick et al., 2005). It intends to achieve this lofty objective through the explication of the manner in which the viability approach adopted enabled not only an unravelling of the interorganisational interactions within Infrastructure Delivery Systems (IDS), but also as is the case in this particular study, the interaction between the PSCC and NWCH and the impact of such interaction upon socio-economic policy implementation during infrastructure delivery.

Having highlighted the study's objective in the previous section, it is pertinent at this point to describe the structure of this paper for clarity sake. The concepts of Social Value (SV); a form of socio-economic policy, and viability are reviewed in the subsequent sections. A description of the methodology adopted in the conduct of this study will be ensconced in the succeeding section before a presentation and discussion of the findings. Based on these, the study will then conclude.

Social Value (SV)

The term 'Social Value' (SV) is generally regarded as being open to several definitions as well as interpretations. Its various definitions are contingent upon the realm within which it is being applied. For instance, Wood and Leighton (2010) defined it as the 'soft' non-financial impact of organisations, programmes of work and investments, which may include, but is not limited to, communities, individual and, in certain cases, environmental wellbeing. Furthermore, Russell (2013) also defined social value as the outcome benefits of certain activities, performed by any organisation, which are important to the organisation's stakeholders. Finally, the Social Value Act (2012) defined social value as the notion of maximising additional outcomes developed through procuring goods and services which surpasses the initial benefit of the goods and services themselves.

These definitions portray the subjective nature of SV and as such, implies that it can only be properly delivered following from the adoption of a relational approach to contracting by the various parties to the project delivery exercise. This is accentuated by the fact that often times, the attainment of SV is considered a secondary objective during project delivery and

not used in assessing project success or failure (Arrowsmith, 2010) , Therefore, it would be right to insinuate that this subjective nature of SV makes its measurement and enforceability through conventional contracts by PSCCs difficult if not impossible (Wood and Leighton, 2010). In this study, social value for public clients is defined as the additional outcome of investment programs, delivered through public funds, towards their local communities varying from employing local suppliers, using local work forces and creating apprenticeships opportunities.

Going by the nature of SV as a project deliverable and the need to ensure that project stakeholders align their respective organisational objectives towards its attainment, a proper understanding of the relationship between the PSCC procuring the project and the associated SV, and other project stakeholders becomes imperative. It is expected that such understanding, particularly as it exists between the PSCC and the project delivery vehicle, the NWCH can only be encouraged by the utmost reliance on the tenets of systems/organisational viability.

Systems/Organisational Viability

Schwaninger (2012) observed that for a system to remain viable and deliver its purposes whilst maintaining its identity within the ever changing world, it would need to consist of several integral layers all which must be present to make for a viable whole. Apparently, this understanding led to the development of the Viable Systems Model (VSM) by Beer in the late sixties (Leonard and Beer, 1994). According to Beer (1979), viability remains a common goal-either long term or, in the case of temporary organisations, considerably long enough to accomplish its intended purposes. Also, Hoverstadt and Bowling (2002) describe viability as an essential organisational attribute.

The VSM has been utilised in several ways by researchers to diagnose and/or design organisations for viability. However, the attention of this study is drawn to the following applications of the VSM to peculiar contexts; as a framework for understanding the systemic roles and functions of governance in the determination of organisational viability(Davies, 2007), as a systemic conceptual framework, consisting of functions ranging from policy-making to implementation allowing for structuralising the linkage of these functions to one another and to the system's external environment(Adham et al., 2012), as possessing the ability to provide a simple and clear structure to cater for proliferating complexity (Pfiffner, 2010), and mainly as being able to integrate outside and inside, present and future, structure and process, operation and management in one systemic, holistic model(Pfiffner, 2010).

Also, the age-long advocacy for the application of systems thinking principles to construction and construction-related research as championed by Morris (1983) and Winch (1989) and the views espoused by Pfiffner (2010) and Hoverstadt (2008) on the essential nature of models for improved management furthermore buoyed the decision to rely on the tenets of the VSM as replicated in the VIDM. Discussions on the suitability or otherwise of the VIDM for such tasks have been dealt with elsewhere (See Awuzie and McDermott, *forthcoming*).

Research Methodology

The use of the systems approach in studying client organisations and their relationships with other construction industry participants is not new as it had been used in the foremost studies carried out by the Tavistock Institute as shown in the works of Crichton in 1966(Boyd and Chinyio, 2006). However, the use of the VSM or associated models and frameworks for such

purposes remains at best underreported(Awuzie and McDermott, 2012). In this study, the use of the VSM tenets enhanced the presentation of the relationships between the PSCCs and other construction project participants within an interorganisational and multi-layered structure thus allowing for the identification of project stakeholder within the implementation (delivery) system. Using the VSM appropriately responds to the criticisms which has trailed implementation research over the seeming inability to present implementation as an interorganisational and multi-layered activity(Hanf and O'Toole, 1992, Hill and Hupe, 2003); see Awuzie and McDermott (*forthcoming*). This is in accordance with the features of the VSM as a tool for unravelling complexity within organisations (Espejo and Gill, 1997, Hoverstadt and Bowling, 2005, Schwaninger, 2006). Furthermore, the tenets of organisational viability were used as a sense making framework to make sense of the emergent data resulting from a study of the kind of interactions existing between the PSCCs, NWCH and project participants on separate projects through an abductive approach(Weick et al., 2005) . This is in line with the views espoused by Dubois and Gadde (2002) and Leiringer et al. (2009).

This particular study forms an integral part of a multi-case study into the NWCH's interrelationships between PSCCs and other construction clients as well as other project participants and how such relationships impact on the delivery of social value during procurement and construction of projects. As its eventual outcome, the entire study is expected to result in the development of a new business model for delivering SV through the hub. The case study strategy is a strategy of choice in assessing interorganisational relationships and the impact of such relationships on implementation (Dickinson et al., 2007). The use of case studies in research not only allowed for in-depth understanding of a particular phenomenon(Patton and Appelbaum, 2003, Yin, 2009); in this case, the impact of the interaction between PSCCs and NWCH on the implementation of SV during delivery of construction projects, but also encouraged the use of various data collection techniques(Yin, 2009).

Although the main study consists of several case studies in accordance with the characteristics of multi-case studies to allow for replication and analytic generalisation (Yin, 2009, Eisenhardt and Graebner, 2007), this particular study reports on the application of the VIDM within the context of two cases, Project A and Project B, respectively; exploring the interaction between PSCC and the NWCH. Subsequent studies will be exploring the entire relationships between all project stakeholders through a VIDM enabled prism. Figure 1 highlights the relationships being explored by this particular study. As Figure 1 readily shows, the VIDM extends the applicability of the VSM from conventional organisational structures to Temporary Multi-Organisational (TMO) structures. Such structures are prevalent within the context of project delivery(Murray et al., 1999, Cherns and Bryant, 1984). This is based on an understanding of the tenets of the VSM. Whilst the VSM insists on the presence of the following subsystems namely: policy (5), intelligence (4), control (3), monitoring (3*), co-ordination (2) and implementation (1) as well as effective cohesion between these various subsystems for viability to be attained within organisations, the VIDM in taking a TMO view, maintains that the achievement of viability is dependent upon the presence of various organisations carrying out functions identical to those represented by the subsystems in a VSM. Within the VIDM, it is expected that organisations representing each of the subsystems should be viable if overall organisational viability is to be achieved. Also, besides the presence of these organisations and their inherent capabilities to perform the functions in subsystems 5-1, effective communication, collaboration and transparency

between these organisations is necessary for the attainment of viability. Hence, successful implementation of SV can only occur within a viable TMO.

In Figure 1, the policy subsystem on a VSM is substituted for the socio-economic policy being implemented; in this case, SV. The PSCC represents the Intelligence subsystem as it is responsible for the development of the project and its expected outcomes, taking cognisance of the present and future requirements of the client organisation and the community. The NWCH as a delivery vehicle for the project represents the trio of control, monitoring, and co-ordination of the project implementation system ensuring the actualisation of the PSCCs' expected outcomes. Finally, the Implementation subsystem represents the project team working together to deliver the project and this is identical to what obtains on the VSM.

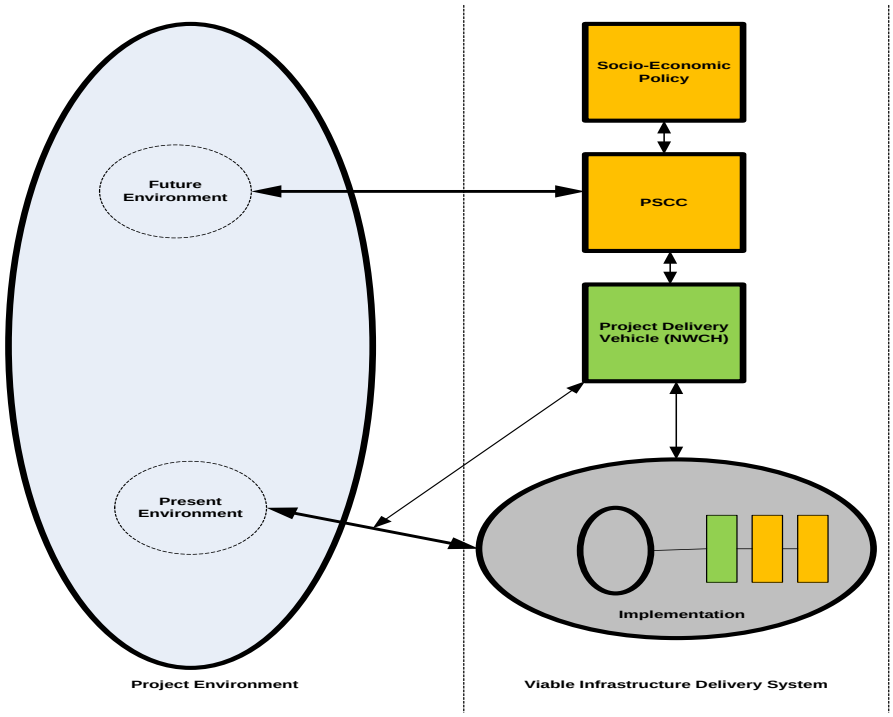

Figure 1 An illustration of the relationship between PSCC and NWCH on a VIDM

Projects A and B were capital projects procured through the NWCH at the behest of two distinct local authorities. A description of these cases lies beyond the scope of this paper. A case study protocol was developed, prior to the commencement of the data collection stage as recommended by Yin (2009).

Data was collected through a series of face to face semi-structured interviews with project participants. Triangulation was achieved through a review of project and policy documents(Patton, 1987).For the avoidance of source criticism, these documents were selected through purposive sampling (Miller and Alvarado, 2005) A mix of purposive sampling and snowballing sampling techniques (Patton, 2002, Denscombe, 2007) were utilised during participant selection. At this stage of the study, it was not the intent of the authors to select cases on the ability of the cases to fulfil the criteria required for either analytical generalisation or replication, but rather to describe the kind of relationship which currently exists between the PSCCs and NWCH and to highlight any areas where

improvements are needed; a familiar terrain for the VSM based on its diagnostic features(Brocklesby and Cummings, 1996).

A total of six interview sessions were held with representatives of the two PSCCs and NWCH, lasting an average of an hour, respectively. Table 1 below shows the distribution of the interviewees according to their organisations, project and position. It also shows the attributes of the individual PSCCs. Questions asked consisted of an understanding of the client's requirements (socio-economic benefits and asset); an understanding of the various procurement processes carried out by the hub in relation to the delivery of the project, especially selection of contractors/suppliers; choice of contracting strategy; measurement of the socio-economic benefits delivered; monitoring and regulation of the delivery of these socio-economic benefits; and the identification of any challenges encountered during the project. Also, PSCC and NWCH representatives were asked to identify areas where improvements were required as it pertained to the NWCH's operations. These interview sessions were transcribed verbatim and analysed qualitatively with the aid of the NVivo. The authors agreed upon the use of pre-set themes during the data analysis stage but allowed for the inclusion of emergent data (Taylor-Powell and Renner, 2003).

Findings

The findings arising from the data collected are structured according to the study's objectives and subsequently discussed accordingly.

Applicability of the VIDM

As stated in the introductory section, this particular study attempts to explicate the immense potentials held by the basic tenets of the systems viability theory in not only enabling an in-depth understanding of the interorganisational and multi-layered relationships existing within the delivery, particularly between the PSCC and the NWCH but also providing a platform for the evaluation of the influence of various parties, both on each other and on the attainment of the expected outcomes, in this case, SV, from a systems viability perspective.

Findings from the study indicate that the tenets of the systems viability theory as enshrined in the VIDM and the VSM respectively adequately enables the identification of the various actor-organisations involved in the delivery of Projects A and B as well as the implementation of SV during the delivery of those projects. This is firmly buttressed in the research methodology section of this paper. Such identification provided the platform for the conceptualisation of these actor-organisations and the tasks which they are designated to perform in achieving successful implementation of SV. The lack of this kind of conceptualisations in the past has been blamed for deterring implementation researchers from presenting credible findings (Proctor et al., 2011). However, as was evident from the ease with which these various organisations were identified and their relationships conceptualised, albeit from a systems viability perspective, the systems viability methodology appears to be very appropriate for conceptualising interorganisational and multi-layered relationships within an implementation cycle as well as evaluating such relationships to understand how it impacts upon successful implementation. Only when such is done can any issues affecting successful implementation of SV be identified and remedied.

Furthermore, the methodology also provided a platform for making sense of the emergent data obtained during the interviews as it concerns an identification of client attributes which impacted upon the implementation process.

Identification of Client attributes

According to the data collected from the interviewees, it was observed that indeed, certain attributes of the client organisations (PSCC) in this study influenced the implementation of SV in within Projects A and B respectively. Adopting a systems viability theoretical lens in making sense of the data, it would be apt to state that these attributes impacted upon effective communication and collaboration between the PSCC and the NWCH across both projects, hence being responsible for the varying degrees of successful implementation of SV in these projects.

Attributes of the PSCC identified during the course of this study as having influenced the implementation of SV within projects A and B include: the kind of values espoused by the respective PSCCs as it relates to community benefits and social regeneration; Funding source for the projects and the associated demands of these financiers; the capability of the PSCCs to develop a suitable procurement strategy and to recruit likely individual champions as client-side project managers for achieving the expected SV outcomes. These findings somewhat conform to the findings of similar studies on client attributes and their impact on project success such as (Nkado and Mbachu, 2002).

Conclusion

Given the plethora of extant literature highlighting the significant effects of construction clients on successful implementation of projects and policies alike, this study set off to gain an in-depth understanding of the relationship between project participants and how these relationships rub off on the success of implementation of socio-economic policies such as SV during the procurement and eventual delivery of infrastructure projects. It was expected that such an understanding would lead to the identification of particular PSCC attributes which possessed the capability to influence successful implementation. This led to the refocusing of the study's lenses on the relationship between the PSCC and the NWCH as PSCC attributes would usually have a direct impact on the relationships between the duo and an indirect impact on the wider delivery system's ability to achieve successful implementation (Viability). In order to carry out this task assiduously, the study sought to validate the applicability of the VIDM –a systems viability based model-in conceptualising and evaluating the relationships within the implementation process from an interorganisational and multi-layered stance within TMOs as previous instances of such studies have been within conventional organisation contexts.

Besides a validation of the applicability of the VIDM, the study proceeded to identify various attributes of the PSCCs investigated, which impacted on their relationship with the NWCH and the NWCH's ability to achieve the excepted SV outcomes through Projects A and B. In a nutshell, it is expected that the findings from this study would continue to reverberate and generate debates on the usefulness of the VSM and associated models in conceptualising and evaluating interorganisational and multi-layered relationships within TMOs as observed in this study.

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The animal and plant health service in Santa Catarina State (Brazil) from the perspective of VSM

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Abstract

A large part of the problems occurring in agriculture and rural areas results from the difficulty of operating a human activity system within an environment of huge complexity and uncertainty. In Santa Catarina State, South Brazil, the predominant agricultural production model demands high levels of inputs, generating the accumulation of pesticides residues and antibiotics in foods, beyond an increasing land concentration and rural exodus. Furthermore, due globalization, the State territory has become more susceptible to the entrance of new agricultural pests, what is of higher importance considering that the animal and plant health service only slowly detects, controls and eliminates pests entering and establishing in the State territory.

Considering this context, it is necessary to review the structure of the animal and plant health service in order to pursue the fulfilment of its purpose, promoting changes that are "systemically feasible and culturally desirable" in a constant search for efficiency, efficacy and effectiveness. The aim of this paper is therefore to present a brief diagnosis of the animal and plant health service performed in Santa Catarina, through the lens of the Viable System Model (VSM).

The purpose of the animal and plant health service, considered here the system of interest, is to promote the health and welfare of animal and plant populations and their products, the suitability of agricultural inputs and the soundness of the products offered to the people. In Brazil, the organization responsible for the coordination and implementation of the animal and plant health service is the Animal and Plant Health Service Secretariat, under the Ministry of Agriculture, Livestock and Food Supply (MAPA). Parts of its assignments are delegated to the States and to the Federal District. In Santa Catarina State, the animal and plant health service is coordinated by the Agriculture and Fisheries Secretariat (SAR) and one of its related companies, the *Companhia Integrada de Desenvolvimento Agrícola de Santa Catarina* (CIDASC).

Despite its role as a food producer, the authorities in Santa Catarina State have normally reacted slowly regarding the protection of its boundaries against incoming new pests of potential economic damage. Likewise, the State faces great difficulty in implementing processes for quality control of agricultural products offered to the consumers. In livestock production, a segment that makes Santa Catarina one of the leading Brazilian producers and exporters of meat, the measures related to animal health protection have achieved a relative success,

with international recognition of the sanitary status of its herds. However, this has happened at a very high cost, since has induced the concentration of production in the hands of few, jettisoning families from agriculture and from rural areas. This situation show us that agriculture in Santa Catarina State might be vulnerable, indicating that the system of interest under consideration (the animal and plant health service) is failing to fulfil its purpose.

Therefore, it is necessary to act in order to improve this problem-situation. To Stafford Beer, organizations must be viable, i.e., to be able to exist autonomously and to adapt to changes in their environment. The VSM allows us to understand if an organization is viable, or, in case it is not, what is necessary to do to become viable. Based on cybernetic principles, the VSM allows to identify conditions for an organization to survive adapting constantly to changes in its environment (BEER, 1985).

The system of interest animal and plant health service of Santa Catarina State is formed by the following organizations: a) MAPA, representing the interests of the federal government; b) SAR, representing the interests of the State of Santa Catarina; c) CIDASC, performing the activities of the animal and plant health service under delegation of SAR and MAPA; d) ICASA, performing some tasks under private financing and e) companies that outsource the inspection service of products of animal origin in registered establishments and f) public and private certified laboratories.

Considering the system of interest as the system-in-focus to be diagnosed with VSM, it was observed that the metasystem is not clearly defined, making the relationship between these diverse organizations difficult. This results partly due to the management model that is predominantly bureaucratic and dysfunctional. The structure of the system-in-focus, built around "repartições" (a sort of “departments”), complicates the relationship between and among the components of the lower recursive levels, resulting in weak communication and coordination between them.

In the system-in-focus the System 5 is not structured enough. There is not a strong initiative to integrate all these organizations around the same aims. There is not a common understanding about the purpose of the system-in-focus, as there is not a normative framework that governs its functioning satisfactorily. This makes room for the predominance of political and economic interests at the expense of social and environmental ones. Regarding System 4, there is a great difficulty for it to perceive the dynamics present in its environment. A concern with the agricultural conjuncture, as well as with the assessment of inherent risks and consequences of its activities is lacking. With regard to communication channels, they are not properly structured. The information takes time to arrive where it is necessary, both among the institutions that form the animal and plant health service in Santa Catarina, and internally. Furthermore, the existence of algedonic channels could not be identified. The perception of the occurrence of something critical to the viability of the organization takes a long time to happen.

The VSM allows a distinct view of a human activity system. It seeks to understand and to act in order to ensure its viability, seeking to balance the complexity among its components and between the system-in-focus and its environment. The adoption of VSM in combination with other systems methodologies will assist in the implementation of incremental improvements desirable and feasible, and for this to occur, it is essential to involve its leadership.

Finally, to keep its existence, beyond surviving and adapting to the prevailing environmental conditions, the system of interest must be able to comply with its purpose and to achieve this its operating structure should be arranged properly.

Keywords

Viable system model; VSM; Animal and Plant Health Service.

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Extension work in complex family farming communities: the challenge of mutual learning

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Abstract: The promotion of rural development has been a challenge to professionals and policies makers for decades. Different theories, and corresponding approaches, have followed the changes in the understanding of the very meaning of development and its implications. In Brazil the service named Technical Assistance and Rural Extension (ATER) has also gone through distinct phases reflecting the political importance of the less capitalized agricultural areas and farmers. The major public universities have also engaged themselves in bridging the gap between the centers of knowledge and the less favored communities through programs of university extension. This paper presents the university extension work carried out by professors and students of Universidade Paulista Júlio de Mesquita Filho" (UNESP) in a agrarian reform settlement area named Sepé Tiarajú, where eighty families of farmers struggle to make a living out of their four hectares of land. Farming systems tend to be complex due to the combination of natural and socio economic factors. In the case of family farms the complexity increases as it reflects their distinctive nature – the intrinsic combination of family, labour and access to the means of production. An approach to development or extension work that takes into account the complexity of family farming systems demands institutional arrangements that will enable long lasting educational processes. Yet, despite the participative/empowering discourse adopted by most institutions – including the universities – the reality falls far from providing the necessary means for mutual learning and the overcame of the barriers that hidden development in its many forms and understandings.
Keywords: settlement areas, agro forestry systems, sustainability, extension work

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Introduction

What rural development is about? This very straight forward question can hardly be expected to meet an equally simple answer. The understanding of what development implies has changed from the economic view that predominated in the 1950s and 60s, when income per capita was considered the parameter to divide developed from underdeveloped countries to the liberation theories of Paulo Freire (1987) and Amartya Sen (2010). It has also incorporated adjectives such as sustainable, local and endogenous, and is now linked to processes like empowerment and emancipation and concepts like social capital and multifunctionality. But poverty in rural areas remains a sore wound in developing and some developed countries. While certain rural areas became the locus for activities different than those related to agriculture others stayed behind, producing lithe more than low value work force.

Development theories and initiatives, be them (neo) liberal or Marxist, tend to adopt models based in a northern humanistic paradigm that believes that science and technology can promote social and economic development. Following this trend, rural development was equalled to yield increase through the modernization of agriculture. As it is well know, the so called green revolution benefitted only those farmers with access to good soil and other facilities such as rural credit. The small family farmers and peasants were, by large, left behind – unattended and misunderstood. The complexity of their agricultural systems and practices – developed by generations working on the land - was bypassed by development workers.

According to Schmitz (2005) the systemic approach was introduced in the research and extension work in the 1970s as a better equipped tool to analyse the complexity of family farms in developing and developed countries. This approach is particularly important when considered the great heterogeneity that exists among family farmers (SCHNEIDER, 2006). But it also demands a change in attitude from both technicians and farmers and a lot more time for the results to appear. The need for more time raises the need for more financial support for extension work. To "put people first and the poor people first of all", as phrased by Robert Chambers (1993), implies not only understanding the physical conditions for production but also the social, economic and political circumstances surrounding these communities.

According to Norman (2002, p.1): "… the approach of looking at farmers constraints and needs for technical change from within was eventually mainstreamed into most national and international agriculture research programs by the late 1980". Likewise the principles of production and agrarian systems were incorporated in the wording of most programs aiming to promote local and indigenous development and the empowerment of the most deprived groups. Since the 1990s, the environmental component was added to the majority of these programs and sustainability became a prior condition for funding. Participation was enlarged to include woman, youth, and representatives of different segments and interests in rural areas. In Brazil the years 2000 witnessed the creation of the Municipal Councils for Sustainable Rural Development.

In the two past decades, the development of more sophisticated statistic programs, such as the Multivariate Analysis and Statistic Package for Social Sciences enabled the addition of an increasingly larger number of variables in the study of farming

systems, especially when these studies tried also to assess the system sustainability. Thus the recognition of the complexity of family farming systems was fortified by the overall acknowledgment of the complexity of systems in general and the development of better equipped statistical tools for their analyses.

Since the 1990s, extension work in Brazil has adopted as a theoretical and political framework the dialogical, participatory and holistic principles in which technicians and policy makers should operate. Production unities and rural communities should be seen as complex systems and any intervention should be planned and carried out with the people concerned. An array of tools was developed to add the extension worker in the task of promoting community participation in the assessment of reality (diagnosis) and the search for problems solutions. But how to adopt a systemic approach to development work when operating in highly fragmented contexts?

The complexity of settlement areas

Largely a heritage from peasant societies, the family farms in developing countries tend to be more bio diverse and keep stronger family and neighbourhood ties than the more entrepreneurial types of farmers (LAMARCHE, 1993).

Brazilian settlement areas are usually the result of years of struggle for access to land and suffer from the countries lack of an effective program of agrarian reform and land distribution. Some of the more recent settlement areas in the state of São Paulo were established as a Sustainable Development Project (PDS) and as such must present production systems which combine the need for income generation with the preservation of natural resources.

Settlement areas can be seen as a set of systems, represented by the different production unities and families, within a larger system in constant exchange with the surrounding society. They are not the result of the natural evolution of an agrarian structure, but came into existence by a deliberate political measure – the distribution of private (expropriated) or public land to landless farmers. The beneficiaries share the desire to have access to land, but often come from different regions of the country and have different backgrounds. Usually prior to the settlement families expend years camping and waiting for the legal procedures, political will and a favorable conjunction of forces that enables the process to go through. During this period leaderships are established and conflicts started, both among themselves and with the State. Agrarian reform settlers form a peculiar relationship with the State encompassing confrontation, subordination, partnership, dependency and abandonment. Those elements are determinant to enlarge or constrain the settlers' possibilities to stay and prosper on the small parcels of land they fought hard to have access to.

According to Silva Neto (2005, p.93) we can group the elements of an agrarian system in two delimited yet interdependent groups: the agrosystem, that is, the physical, chemical and biological components of an agrarian system that are modified by the human exploitation of its resources and the social reproductive system that meets the technical, economic and social aspects. For the same author (2005, p.95) "... the dynamic of an agrarian system is defined by the reproduction of the agroecosystem fertility and the

capital accumulation in the production units" The fertility of an agrarian system includes the chemical, physical and biological conditions of the entire ecosystem and not just the availability of soil nutrients to produce the goods of human interest. The accumulation of capital in the production units means improvement of farmers living conditions.

In the book "Challenging the Professions" Robert Chambers (1993, p.63) outlines seven dimensions of complex, diverse and risk-prone farming systems. We will follow his frame of analyses to portrait the complexity of settlement areas:

Human dimension: related with the composition of households and their social structure. In a settlement area families come from different parts of the country and background. Their expectations and ability to succeed as farmers varies.

Physical dimension: has to do with soil conditions. In many cases agrarian reform settlements have poor soil conditions and a chronic lack of water. Sharing scarce water resources can be a source of conflicts.

Internal linkages: related with the interactions between crops and livestock. In settlement areas the diminute size of plots often do not allow animal husbandry and soil fertility reposition through animal manure. In our view the internal linkage can also be related to the relationships people establish among themselves. The obligation to form associations and cooperatives to have access to governmental projects can create hierarchies that also lead to conflicts.

External linkages: has to do with the import of organic matter for fertility maintenance from outside the system. Can also be seen as the links the community establishes with the State, technicians, researchers and all those with whom there is some sort of interaction. The ability to form alliances can be very important for the survival of these risk prone communities.

Temporal variation: can mean the seasonal variation of activities within the system or the changes it goes through with time. One important question is whether the children will be interested in staying in the community.

Multiple enterprises: there can be a diversity of farming activities or the conjunction of agricultural and non agricultural activities among the families. Many settlers are pluriactive – completing the farming income with other activities, often outside the community.

Risk: has to do with the fragility of the system itself, and in this case complexity can contribute to resilience, or the risk of losing the access to the land. Settlement areas in Brazil continue to belong to the State. Settlers have the right to use the land but not its legal propriety.

For rural extension to fulfill the function of acting simultaneously in the different components of an agroecosystem is necessary to understand their interactions and interdependencies as well as the possibilities of acting on or influencing its different components. The interdependent totality should be unveiled together with the farmers by using tools that enable participation in the diagnosis of reality and construction of intervention proposals. (SUZANEIDE, et al, 2011; VERDEJO, 2006)

The extension work this paper refers to takes place at the resettlement area Sepé Tiarajú, created in 2006, after five years with families living under plastic tends. The initial

work of the Empresa Brasileira de Pesquisa Agropecuária (Embrapa) guaranteed the presence of some sort of agroforesty system (SAF) in most plots. The basic principles of a SAF where incorporate by the families according to their needs and possibilities. Professors and students from the Universidade Paulista Júlio de Mesquita Filho" (UNESP) started to work in the area in 2012, carrying out a university extension project to help families to increase income generation through sustainable agricultural practices, such as the SAFs, following the principles of agroecology.

The challenge of dialogical and participatory methodologies in extension work

A public service of technical assistance and rural extension exists in Brazil since the 1940s and have gone through different phases ranging from a productive, technology spreading approach to the 2004 new National Policy of Technical Assistance and Rural Extension (PNATER) The new policy acknowledged the need for the use of more dialogical methodologies as the base for a public and free of charge service directed exclusively to family farmers.

That approach should place farmers and technicians at the same level of importance and sharing the same need to understand the different interactions at work on the farm system in order to plan actions that will increase the system resilience and the farmer's quality of life.

The work in the resettlement area Sepé Tiarajú started with a study of land use and occupation and generated precise maps that showed how the small area of the farmer's plots was divided to house the crops grown primarily for the market and those that are for family consumption or to keep the system equilibrium. Great bio diversity was found in all the plots analysed but the presence of SAFs varied considerable from plot to plot. The understanding and the incorporation of the concept of a SAF in the agro ecosystem followed farmer's preferences in how to work the land and their needs and possibilities as, for example, those related to the availability of family labour and capital.

For the students the proximity with farmers' reality proved to be an important opportunity for leaning and exchanging knowledge. Yet, as already stated, a truly dialogical and systemic approach proved to be a challenge for the professors and students - that have to deal with the university demands and deadlines and for the farmers - that sometimes demand quick answers when none can be instantly provided.

Figure 1: SAF at Sepé Tiarajú
Source: Field work. 2013

Despite the discourse put forward by the University - stating the importance of the extension work and how it should be a continuous action with an educational, cultural, artistic and technological character, it's clear the lack of interest of the present administration to support extension activities as part of a long lasting process. The resources for extension work suffered a reduction of 80% in the year 2013. Scholarships for students were reduced in 40%.

Other constraints for the carry out of extension work can be listed as:

- The legacy of past experiences, which makes settlers septic in relation to practices that were not well conducted and therefore did not succeed, such as some experiments with green manure and the very SAFs. The lack of a permanent extension project for technical assistance to settlement areas generates an intermittent and often unconstructive sort of work. Settlers at Sepé Tiarajú went through a period of lack of this service between the work of Embrapa in the early years of the settlement and the current technical assistance.
- Lack of infrastructure in settlements areas in its most basic requirements, such as a satisfactory water supply, roads and transport vehicles. The chronic lack of water prevents through out of the year vegetables growing, for example.
- The entangled web of bureaucratic procedures that hamper participation in governmental programs and projects.
- The difficulty to work in a really dialogical and participatory manner, due to the time such approach demands and the lack of practice from both sides – whose that perform the work and the settlers themselves, who often expect immediate answers from the technicians for what they perceive as their problems and needs . The growing integration of settlers in recently launched programs for participation in institutional markets demand a higher level of organization of production and generates greater concern for losses, through, for example, the attack of pests and diseases. In this context, readily applicable solutions to problems are looked for.
- The settlers' difficulties in organizing themselves - a legacy of imposed forms of organization and of conflicting interests. Most development programs demand the formal organization of the beneficiaries. However, practice has shown that the formalization and the monetization of forms of solidarity, whether traditional or acquired during the land struggle, can become a difficult bone of contention.

Conclusion

Discussions and practices in extension work and rural development, in Brazil and internationally, have advanced in recent years with the inclusion of tools such as participatory diagnosis and systemic analysis. The joint effort of extension technicians and representatives of rural social movements enabled the building, in the last two decades, of a policy for technical assistance and rural extension guided by the methodological directive of a transformative praxis. However, structural and financial constraints, coupled with the difficulties concerning the training of technicians and producers for a rural

extension truly participatory and dialogic are a constant threat to the political gains made in the past.

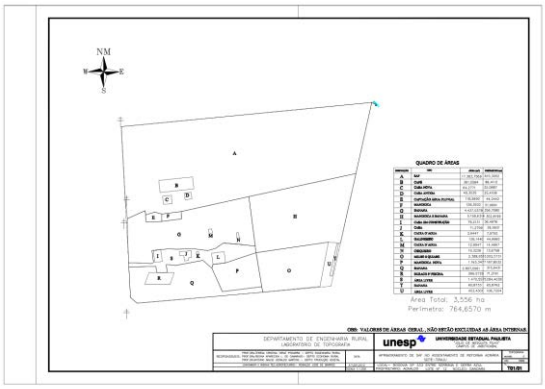

Figure 2: Map generated by the extensin activity
Source: Field work, 2013

Figure 3: Discussion of maps by farmers and student
Source: Field work, 2013

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Danilo Soares Figueiredo and Marcel Vinícius Gulla are Agronomy students at Unesp and fully engaged in the extension projects coordinated by professor Regina.

Ecological entrepreneurship as a strategy to manage complexity

Case Study:
Green Solutions Laboratory – Chingaza Paramo (Guavio Province)

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Keywords

Chingaza Paramo, Sustainable Entrepreneurship, Complexity, Green Businesses.

Abstract

The Paramo ecosystem is one of the most important in the production of the hydric resource. This neo tropical ecosystem is located in the northern part of the Andean and Central American mountain chain at an elevation higher than 3,000 meters above sea level.
Complex evolutionary processes that have occurred in this place have given place to a unique Andean tropical forest. Paramos are characterized for having a low annual temperature, 12 degrees Celsius at noon, with small variations during the day (at night they can reach temperatures under the freezing point). The annual precipitation is high, ranging between 1000 and 3000 millimeters with seasonal variations. Thanks to the complex evolutionary processes, Paramos present a unique and distinctive flora which is home to more than 3399 plants, the great majority of which are endemic making this ecosystem a biodiversity hyper hotspot (Londoño, Cleef, & Madriñán, 2014). Paramos are especially important for being sophisticated water storing systems with a high capacity to produce and regulate water. In addition, the rivers that come from Paramos have a constant flow throughout the year (Ríos-Sánchez, 2009).

Due to global warming that foresees a rise in the temperature of this characteristically cold ecosystem, there will be changes in the ecosystem's soil's characteristics and in its total extension contributing to a reduction in the production and water regulation (Ríos-Sánchez, 2009).

The second symptom of global warming is the reduction in precipitation; this will lead to a rise of forest fires that will change the type of vegetation and the water cycle's components, especially, the transpiration process. Also the total pass-through time will be less as a sign of melting glaciers which implies a more frequent water supply to the system (Ríos-Sánchez, 2009).

Both impacts of global warming over Paramos will have mainly two consequences: in the first place, water production in Paramos will be reduced. In second place, a there will be a rise of human activities such as agriculture, grazing, pine tree planting and tourism, all altering the hydrological behavior of Paramos. Both consequences will affect the water supply of major cities which will have a strong repercussion in economic terms because, going back to the Colombian case and the Guavio province, between 85% and 95% of potable water for the 8.000.000 Bogotá residents comes from their local Paramos (Ríos-Sánchez, 2009).

Although the Guavio province possesses such natural richness, the majority of its population belongs to the lower income segment and 27.2% of its residents have their basic needs unmet. Moreover, 75% of the business there are micro and family based which prevents the generation of employment opportunities. In addition, their main economic activities depend on traditional agriculture techniques and marketing where the producers receive a relatively low pay by middlemen (Cámara de Comercio, 2006). All these activities, as were mentioned, threaten the nearby Paramo Ecosystem's –Chingaza- biodiversity.

In this context, the Engineers Without Borders Colombia - ISFCOL (Ingenieros Sin Fronteras Colombia), made up by two Colombian universities, Universidad de los Andes and Corporación Universitaria Minuto de Dios, has identified along the local community, opportunities to generate an environment of sustainable entrepreneurship revolving around the projection of sustainable green businesses.

A green business refers to a specific business that is made with a good or service through processes and materials with the following characteristics: a. They are green processes meaning they minimize the use of energy and water, they impede environmental pollution (soil, air and water) and they minimize the generation of residues and b. they are green materials, which in other words means they are made or obtained from nature through green processes (Pacheco, J., González, M., Ramírez, M. 2013).

This article identifies an articulation model between the region's different entrepreneurs, through the construction of a proposed sustainable system that a. will keep in mind the needs of the systems actors, b. will tap into green business models that will conserve the environment's impact and c. will generate complexity managing mechanisms that will support development and the region's conservation.

Introduction

The more the economic benefits that come from environmental services are evident and widely known, there will be more, in the same measure, interest to prioritize, protect and repair that ecosystem. In the specific case for the Chingaza Paramo ecosystem, located in the Guavio region in Colombia, their environmental services come in the form of clean water supply and electricity generation via hydroelectric plants. These environmental services are consumed by Bogota city, the nearby provinces and 17% of the country if it is taken into account that the Orinoco River is born in the Chingaza Paramo. Thanks to these facts there has been an interest awakening to protect this ecosystem through its responsible administration.

This document presents a model to articulate different Guavio region entrepreneurs, through which, the construction of a collection of ecologic productive opportunities connected throughout the region is proposed that will a) take into account the needs of the system's actors, b) develop ecological entrepreneurship and c) generate complexity management mechanisms to produce the conservation and conservation of the Paramo ecosystem.

In the first section, context, the case study's essential actors are described and the place where it takes place. The second section, conceptual framework, talks about the concepts on which the article is based upon. The third section, introduced the case study and how the Green Solutions Laboratory was developed. In the fourth section, the results obtained during the event are presented. In the fifth and last section, the conclusions are presented in relation to the event's results.

1. Context

Guavio Region

The Guavio Region is comprised of 8 municipios that form part of the Cundinamarca department and it is a region of importance because it possesses 4 big strategic ecosystems. The natural region offers, through the Chingaza Paramo ecosystem, approximately 72% of Bogota's water supply; at the same time, the production of the Guavio hydroelectric corresponds to 9.88% of the national total. This means that the development of around 15% of the country's population, situated in Bogotá and it's outskirts, depends upon the sustainability of the Guavio Region's environmental offer (Cámara de Comercio, 2006).

Despite its regional importance, the Guavio Region's population has low economic income and 27.2% of its inhabitants have their basic needs unmet in part due to the fact that 75% of the local enterprises are very small sized or family-sized productive units (Cámara de Comercio, 2006). From another point of view, the main economic activities are dependent on processes of territory use and occupation, where traditional commerce schemes based on agriculture and animal rearing are implemented. Here the producer receives a low pay on behalf of the middleman and the biodiversity and sustainability of the ecosystem is threatened. Finally, it is important to highlight that the working opportunities for young people are limited and nearsighted. The most frequent jobs are as assistants in flower cultivations, in private farms and in some tourism establishments. This shows a lack of culture around entrepreneurship that generates a working force migration from the smaller municipios to the bigger municipios and cities(Ingenieros Sin Fronteras Colombia, 2013).

Paramo Ecosystem

The Paramo is a tropical ecosystem endemic to mountains and unique for the environmental services it provides. The most known services are the regulation and conservation of water. In Paramos, a great number of small and medium sized rivers are born. Colombia possesses 49% of the world's Paramos. In the American continent, the majority of Paramos are located on the Andes mountain chain (Greenpeace, 2012).

Paramos are characterized for having a low annual average temperature, 12 degrees Celsius at noon, with small variations throughout the day. At night below-freezing point temperatures can be reached. Annual precipitation is high, between 1000 to 3000 millimeters, with seasonal variations. Paramos present a unique and distinct flora, home to more than 3399 species of plants, the great majority endemic making this ecosystem a hyper biodiversity hotspot (Londoño, Cleef, &Madriñán, 2014).

The Paramo's behavior is not disconnected from what happens throughout the rest of the region. Paramos, "with environmental conditions sustained by low temperatures, climate extremes and slow metabolic rates, present a high vulnerability to perturbations (herding and local fires), which is responsible for the low response rates of these ecosystems." (Andrade, Sandino, & Aldana-Dominguez, 2011).

With frequent disturbances, biological biodiversity is lost and so, the system has a less response capacity(Andrade, Sandino, & Aldana-Dominguez, 2011).

Chingaza Paramo

This article's study case is located in the important Chingaza Paramo ecosystem. "It is located in the country's center, between the Cundinamarca and Meta departments. These paramos are distributed in 19 municipios mainly in Fómeque, Guasca, Junín, San Juanito, la Calera, Guatavita y el Calvario. This región contains the Chingaza, Gachalá, Guasca, Guatavita, Las Barajas, Las Burras, El Atravesado y San Salvador Paramos, and the localities ofAltos del Gorro, Tunjaque, Cerro Granizo, among others."(Vásquez & Buitrago, 2011).

The Chingaza Paramo "reaches 19 municipios, 64.500 square meters, between 3,150 y 3,950 meters above sea level. Its importance made it deserving of being declared a Natural National Park in 1977. As an additional fact, it shares the hydrographic areas of Magdalena-Cauca and Orinoco for rivers Bogota, Teusaca and Siecha. There are 40 lakes of glacier origin in the Chingaza Paramo and of this great hydrological abundance, 80% of Bogota's water is supplied."(Vásquez & Buitrago, 2011).

Engineers Without Borders Colombia – ISFCOL

Engineers Without Borders Colombia, abbreviated as ISFCOL, is an academic alliance between Universidad de los Andes and the Corporación Universitaria Minuto de Dios, "that through managing community projects and academic upbringing, seeks to promote people with strong capacities and with the most potential for social change for generating regional development based on equity and social, economic and environmental sustainability." (Duarte Gómez, 2013).

It has two sets of primary activities: in the first place, academic development and upbringing shown through the course Intermediate Project ISFCOL, the international course ISFCOL, the international seminar ISFCOL, the investigation group ISFCOL and ISFCOL dissertations (Duarte Gómez, 2013).

In second place, it manages community projects, and at the time of the publication of this article, it is currently executing a) Strengthening of Community Management of Water through reducing the amount of water consumed using Information and Communication Technologies; b) Quality of Water: Vereda Santa Isabel de Potosí, Guasca - Cundinamarca; c) Strengthening of Community Green Business in the Guavio Province; d) Center for Social Innovation in Guasca - Cundinamarca(Duarte Gómez, 2013).

Finally, it also develops as part of supporting activities, gaining visibility though awards along with publications as it gains institutional strengthening and formation of alliances.(Duarte Gómez, 2013).

Green Businesses Project

Engineers Without Borders Colombia managed to identify, in conjunction with the local community, the opportunities to generate and environment around sustainable entrepreneurship through the projection of sustainable green business in the Guavio Region. Such opportunities were explored formally and this is how the "Strengthening of

Community Green Business in the Guavio Province" project was born. A project formulated by Engineer Without Borders Colombia – ISFCOL and approved by the Sistema Nacional de Regalías through the Gobernación de Cundinamarca and its Secretaría de Ciencia, Tecnología e Innovación.

This project has as its objective the construction of a network that merged 35 or more productive units, meaning, already established enterprises o businesses, located in the Gachetá, Junín and Guasca municipio (municipios all part of the Guavio region). In addition to seeking to build or create ties between the existing productive units, the project wanted to strengthen the green profile of these productive units and awaken interest for entrepreneurship among the young people in the region. For this reason, the project used 350 Tenth and Eleventh grade students from the three municipios, along with university level students from Universidad de los Andes and the Corporación Universitaria Minuto de Dios through the courses offered by Engineers Without Borders Colombia in both institutions.

The project was constituted by workshops, events, data collecting and its announcing. Among all this, the essential was to generate democratically 10 green solutions. They, if implemented, would be the great innovations that would allow the construction and integration of the Green Business network amongst the 35 productive units in the project. In the section that talks about the study case, these mentioned green solutions will be explained.

2. Conceptual Framework

Ecological Entrepreneurship

We will start with the description of what will be understood as entrepreneurship throughout this article to then afterwards encompass the term ‘green’. There are articles solely devoted to categorize the different types of existing entrepreneurs. Therefore, we will now mention a set of cases that have been registered in literature as types of entrepreneurship. Schaltegger (2002)manages to select his favorite authors and gathers the following five phenomena. I) Entrepreneurship as the process of creating and establishing a new business. II) Entrepreneurship as constantly seeking out knowledge. III) Entrepreneurship as a social or environmental movement with its beginnings anchored to a community. IV) Entrepreneurship as the successful introduction of innovations into the market. V) Entrepreneurship as the set of characteristics associated with leadership: ambition, commitment and the capacity to build good work team practices.

With that stated, ecological entrepreneurship, being the union of two words, is the case where the entrepreneurship characteristics are channeled towards environmental reparation and conservation. Then, we define, the ecological entrepreneur as that who leads an enterprise which is not only economically viable, but that seeks to incorporate responsible environmental practices.

Finally, it is important to highlight, which are, generally, the motivations of the ecological entrepreneur (Schaltegger, 2002):

- Respect legislation: he or she seeks to venture through government sanctions and incentives.
- Market access: he or she seeks to venture to obtain the market’s positive incentives.
- Acting on moral conviction: he or she seeks to venture to change the relationship of the consumer with the envirionment.

It is important to mention that these motivations are not mutually excluding.

Strategic Ecosystems

Strategic ecosystems are “those areas inside the territory that thanks to their biological composition, physical, structural characteristics and ecological processes, provide environmental goods and services necessary and irreplaceable for sustainable and harmonic development(Vega, 2005).

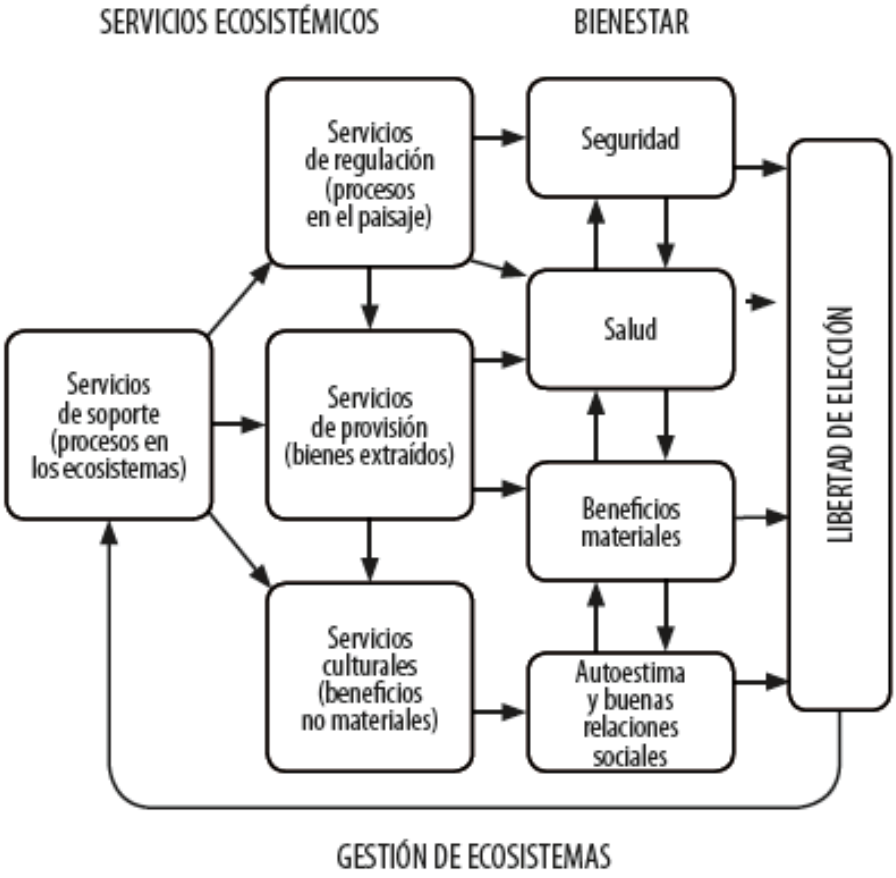
The Paramo is defined as strategic ecosystem in El gran libro de los paramos published by the Instituto Alexander Von Humboldt. In this document, the most important environmental services that this ecosystem provides is the production of sweet water, “the

hydrological balance in high mountain zones and the importance of these ecosystems in the conformation of hydrographic birthplaces [in Colombia]." (Vásquez & Buitrago, 2011).

In that order of ideas, it is important to examine what are the environmental services: "provide society with services that support, regulate, provision and cultural values that determine human well-being." (Andrade, Sandino, & Aldana-Dominguez, 2011).

To understand this fundamental concept, we included a graphic representation shown next that exemplifies the relationship between humans and biodiversity contained in strategic ecosystems as we already have named the Paramo.

1. ECOSYSTEMIC SERVICES AND HUMAN WELLBEING



SOURCE: (ANDRADE, SANDINO, & ALDANA-DOMINGUEZ, 2011)

This graph very well explains how the freedom of choice that society possesses, comes from the responsible managing of ecosystems. This liberty comes from the different processes that exist within each ecosystem. Then, as consequences of these processes, come the so-called services humans obtain. They comprise a range that society has known how to take advantage of: visually and for the aesthetic enjoyment of flora and fauna (cultural services); commercially for industrial development (provision services); need supply without damaging the landscape (regulation services). The benefits are

multiple and different in the long and short term: security, health, material wealth created by men and self-esteem and good social relationships.

Applying the previously stated to the ecosystem where the study case takes place: the Chingaza Paramo, the support services that occur are the production and hydrological regulation. This happens based on certain organisms, for example the endemic species, frailejones. Its aesthetic enjoyment, as the one that comes from the contemplation of a picture of these landscapes, o when one visits in the company of a guide, is a cultural service. This contributes to our self-image as a biodiverse and beautiful country. This hydrological regulation also supplies 17% of the country, 70% of Bogotá and also is a hydroelectric energy provider. This forms part of the regulation services. Finally, through the extraction of minerals valued commercially in the market such as coal, the provision services are manifested.

Sadly, although society is so closely tied to strategic ecosystems, in particular the one that is here talked about the Paramo ecosystem, there is not a consequent behavior with this reality. “The Paramo is one of the most altered ecosystems in the continent, the climatic conditions of the Andean mountain range are favorable for the establishing of a great deal of population, causing the progressive diminishing of these natural scenarios.” (Chaparro Barrera & Chaparro Barrera, 2012).

More worrying is the Paramo damaging that occurs directly and indirectly. The direct affectation, already mentioned, includes the agricultural activities such as potato growing and animal farming. The indirect affectation includes the climate change manifestations.

Due to global warming, that projects an increase on the temperature of this characteristically cold ecosystem, there will be changes in the characteristics of soil and of its total extension contribution to a reduction in the production and regulation of water (Ríos-Sánchez, 2009).

Also due to this same phenomena created by human activity since the final part of the 20th century, a reduction in precipitation will lead to a rise in forest fires that will change the type of vegetation and the components of the water cycle, specially the process of transpiration. Furthermore, the time that water takes to push through the system will be less as a sign of glacial melting which implies a more frequent entry to the system (Ríos-Sánchez, 2009).

And so, everything previously stated allows us to conclude that the Paramo ecosystem is extremely fragile but at the same time a great provider of essential environmental services, therefore, undoubtedly its protection and responsible management must be a national priority (Miranda, 2014).

Green Businesses

A green business refers to a specific business that is made with a product or services that is made or derived from processes and input that have the following characteristics: a) they are green processes: they minimize the use of energy and water, they prevent environmental contamination (soil, air and water) and minimize the generation of residue;

b) they are green input, manufactured or obtained from nature through green processes (Pacheco, J., González, M., Ramírez, M. 2013).

System Complexity

All the variables that have been taken into consideration generate a complex system that requires re-thinking to generate regional entrepreneurship. Complexity will be understood as the great quantity of systems/institutions related with the need to generate social regional sustainable entrepreneurship. Normally, such system's resources are fragmented (Espejo, 2007).Scenarios where each system seeks to respond to their own reality and point of view (without always taking into account other contexts) are generated. Therefore, how to accomplish autonomous closed systems in the creation, regulation and production of their own politics and norms?

A viable system that contains the following is proposed (Espejo, 2007):

- Norms for their own actions.
- Characteristics of an autonomous existence in their relevant surroundings.
- And a place where knowlegdge is to be generated.

Taking into account that the several systems interrelate, mechanisms that can manage such variety have to be taken into account to generated a system for autonomous entrepreneurship and generator of solutions.

3. Case Study: Green Solutions Laboratory

To handle the complexity just exposed, there is a quest to design a model that articulates the different actors of the Guavio Region's green administration. Such model is part of the macro project named "Community Green Business Strengthening in the Guavio Province" Business. The central phase of the project is the Green Solutions laboratory. This section seeks to describe the circumstances in which the event happened and in the next section the results obtained are shown.

Green Solutions Laboratory Objective

To build 30 ecological entrepreneurship ideas and to select democratically the best 10 ideas with relevant actors in the Guavio Region's conservation.

Methodological Proposal

Dynamics

During the Green Solutions Laboratory, 30 work teams were formed which individual members were already preselected. Each team was made up by at least one university-level student and a high school student. The great majority of the teams also had a productive unit.

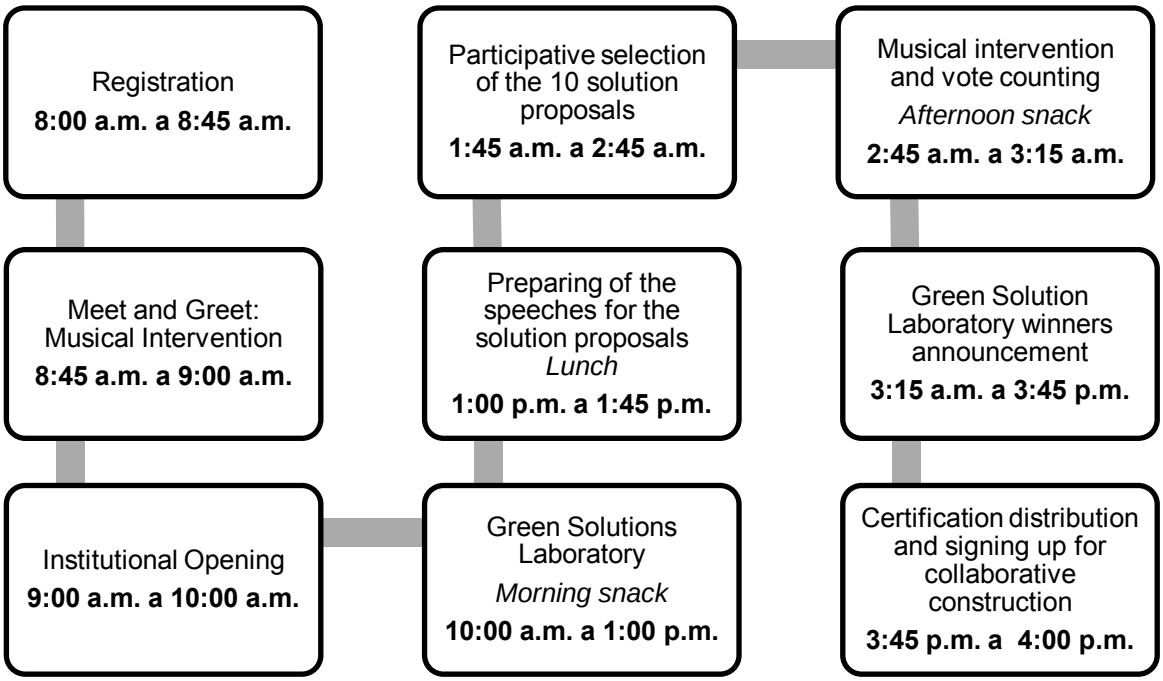
Each one of these 30 teams was divided in one of the three possible categories: tourism, services or agro-fisheries, according to the social reason of the assigned productive unit. The teams that did not have a productive unit were randomly assigned between the three possible sections.

To each team it was announced that their mission was to build between all members a business idea that was also green.

Day Processes

The Green Solutions Laboratory took place during just one day along an 8 hour session. The following table shows a time distribution during the event:

2. DAY PROCESSES–GREEN SOLUTIONS LABORATORY

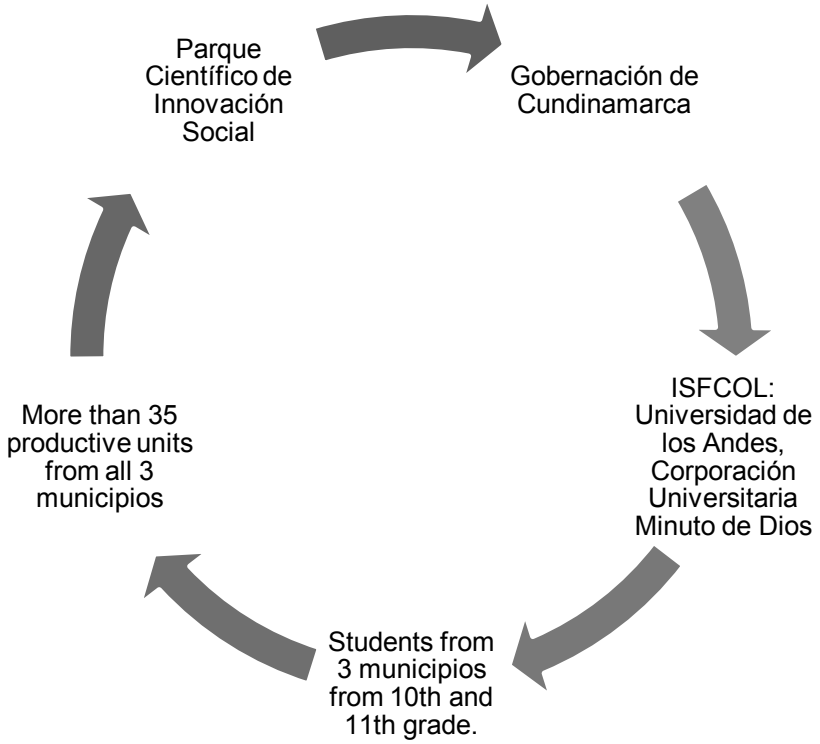


SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)

Participants

To the event the work team that belonged to the bigger team was called to action and it is represented in the following graphic.

3. GREEN BUSINESS PROJECT TEAM



SOURCE: OWN CONSTRUCTION

Material Resources

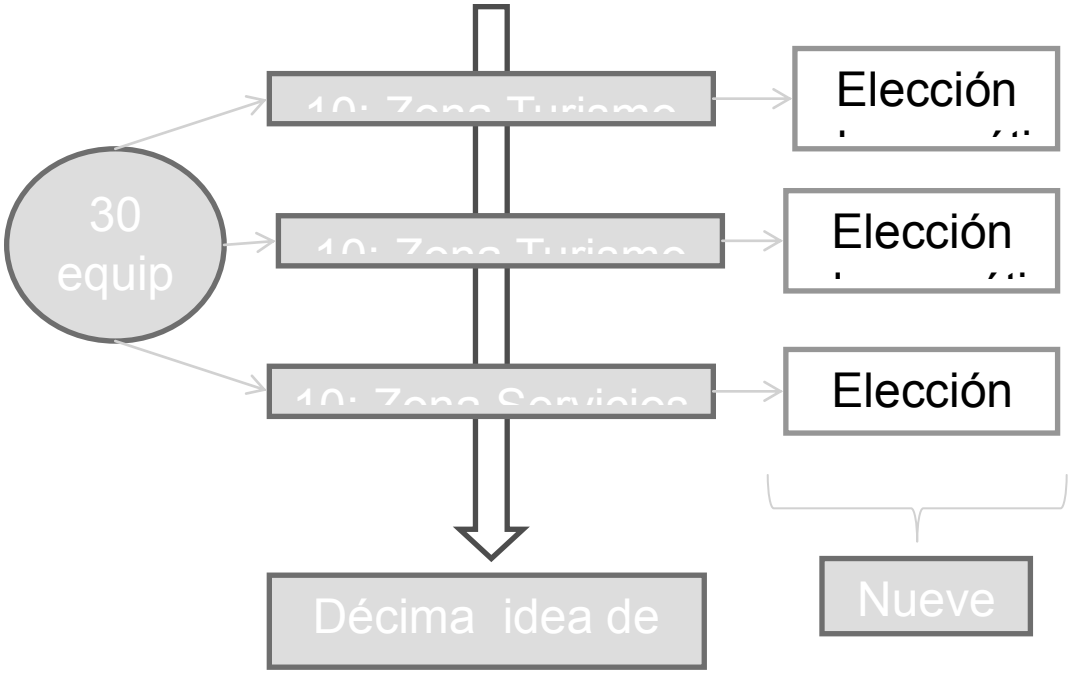
As resources, the team members had only some few stationary materials such as cardboards and markers that would allow them to share at the end of their day their idea and like that, convince the other participants to vote for their projects.

Process for selecting the 10 winning ideas

The instructions given to the participants were to develop an idea for a green business that had to be green and besides that, also had to be in the interest of the greatest number of competing teams because the winning ideas would be selected in a democratic fashion by the participants of all of the teams. This implies that each team should vote for an idea that was not their own.

The following graphic shows the described voting process:

4: WINNING IDEAS SELECTING PROCESS



SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)

Incentives

According to the role that the participant had, their incentive to win was different. The following table sums up the participant's incentive according to the category they belonged to.

5. PARTICIPANT CATEGORY AND THEIR INCENTIVE

CATEGORY	INCENTIVE OR MEANING FOR THE EVENT
HIGH SCHOOL STUDENT	Green Business Laboratory as part of the program in Science, Technology and Innovation where a representative of the 60 student teams (15 high school teams) practice what they've learnt during the Innovation-Action workshop to support the generation of an idea that can benefit the Guavio Province productive units. If a student manages to be one of the 10 winning solutions, his or her team will receive an incentive to participate in the "nearby expedition" weekend where they will learn from the productive units, practical concepts for businesses from the Guavio Province.
UNIVERSITY STUDENT	Green Business Laboratory as part of the Engineers Without Borders Colombia – ISFCOL subject taught simultaneously both in Universidad de los Andes (as a summer session) and in Corporación Universitaria Minuto de Dios (as a term for the academic period 2014-10).
PRODUCTIVE UNIT REPRESENTATIVE	Green Business Laboratory as an event that will allow them to propose an idea that will benefit in a participative way both their productive unit as well as the others. In addition to proposing, they are also offered the opportunity to be part of the 10 winning solutions that will be formulated during the month of August within the project framework.

SOURCE: RESULTS REPORT FOR THE GREEN SOLUTIONS LABORATORY (PROYECTO DE NEGOCIOS VERDES, 2014)

4. Results

The 10 winning solutions are now presented in the following table explained by name and premise:

6. 10 WINNING IDEAS FOR THE GREEN BUSINESS LABORATORY

Idea	Name	Premise
1	Smartphone application for the Guavio Province	Smartphone application that will allow showing the Guavio province's information and that of the productive units that have a ecological purpose.
2	Green Business Network: A Healthy Path	A Green Businesses network that provides a tangible education experience on ecological practices for visitors.
3	Development plan: Quinoa from All for All	Territorial brand to establish the Guasca municipio as the global quinoa capital through the progressive introduction of this crop in child nutrition.
4	Honey derived proposals	Honey-centered products pushing: a thematic restaurant, healing parks, high technology laboratory, honey caramels.
5	Bettering communication through technology	Learning through the use of interactive technologies in the Guavio region, mainly in its rural areas.
6	Green farm for responsible learning	Touristic and pedagogic model that allows the development of ecotourism activities in a natural environment that integrates teachers, farmers, tourism experts and fun activities.
7	Technological center for recycling	Museum with recyclable objects using bottles to build the external structure.
8	Agrotourism farm	Creation of a Agrotouristic farm in the Junín municipio with the purpose of educating and strengthening the biodiversity potential of the Guavio province.
9	Center for promoting tourism in the Guavio Province	Tourism in the Guavio province that promotes local and responsible activities. The places it should consider of upmost importance are the Guavio dam, La Bolsa, Cerro Redondo and Tembladores.
10	Self-sustaining biofarms	Expansion for a milk distribution center and dairy processing station that currently has 24 associates in different points of action.

SOURCE: OWN CONSTRUCTION

5. Conclusions

a) Within the Green Solutions Laboratory, 8 of the 10 winning solutions clearly manifest the importance of ecological entrepreneurship. Only two solutions, number 1 and number 5, do not explicitly mention responsible environmental managing.

b) 80% of the winning solutions revolve around ecotourism, responsible resource administration and sustainability. That fact states that within the community there is a high level of awareness about the place where they live and how they have to incorporate environmental responsibility within their entrepreneurships.

c) It could be said that in the Guavio region there exists a collective spirit of ecological entrepreneurship which was evidenced within the Green Solutions Laboratory.

d) The Guavio region requires economic investment and technical support to develop the latent potential that clearly exists.

e) The Green Solutions Laboratory participants have it clear that ecotourism is a very important alternative to generate economic revenue through the protection of the Paramo ecosystem.

f) Although in none of the winning solutions it is explicit the Paramo ecosystem management, 80% tries to push environmentally responsible practices leaving ideas of mining, extracting and exploitation aside.

g) The regional educational institutions have managed to leave in their students a preoccupation for the environment. This is explicit in all of the winning solutions as they do well know the basic concepts for green businesses.

h) Although the winning solutions, directly or indirectly, incorporate within their description the intention of implementing environmentally responsible practices, there is no guarantee that if they're executed, they will in fact be developed in such fashion.

i) It is important to highlight that, being the Green Solutions Laboratory a system of co-construction and real participation, it has become a system that allows that all points of view interrelate to create projects or ideas that benefit the whole region. All of these solutions where developed by beneficiaries or actors that participate in the development of the Paramo ecosystem. Therefore, who better than them to build viable, autonomous and cohesive solutions that build towards entrepreneurship and towards the non-destruction of the Paramo ecosystem. This was the greatest challenge of this participation model.

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Development of marketing processes of small horticultural producers under the concept of Sustainable Consumption Communities in the Sugamuxi Province of Boyaca Colombia

Parra Helien

ABSTRACT

About 32 million Colombians live in cities , however 94.4% of its territory is rural where about 17,670 people are owners of 64% of existing rural parcels . This has led to a growing discouragement of small producers who prefer to migrate to the cities leading the country to a food shortage in the medium term . Currently , small farmers in Colombia face a serious economic crisis caused the imbalance of the rising costs of farm inputs, brokering, large-scale production and the growth of urban centers , as well as imports of agricultural products.

Considering the family relationships between producers, the emerging organization of cities and the information and communications technologies , the research group of Business Management at the University of Applied Sciences and Environmental UDCA has proposed a model of social organization based on cooperation , ecology and the market economy that seeks to solve the problem of agricultural migration and loss of food sovereignty based on the Viable System Model and application design for mobile devices which are presented below

***Key Words*—Cybernetic, Nets, Social Order, Emergency, Small Farmer.**

I. THE PROBLEM OF AGRICULTURE IN COLOMBIA.

In Colombia, the agriculture development is a very complex problem when the ground property has come to be fragmented over time by complex processes of inheritance, armed violence, displacement and neglect of peasant activity more "urban" activities generating more income in the family and status in the community, where being a farmer means poverty and social backwardness.

Additional to the above, the Government does not take as a priority the process of peasant economy, understood as "a form of family production what productively utilizing the entire domestic workforce and the natural, social and financial resources acquired by inheritance processes or by entrepreneurship the own peasant to ensure both the survival of the family unit, as well as improving their quality of life" (Beltrán Fonseca, 2013)

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Today, the population living in rural areas accounts for 31% of the total population of Colombia. This number decreases daily by the lack of opportunities due to the hyper-minifundization and environmental phenomena, to search for better economic opportunities in urban centers (Arias Vargas, 2009)

About marketing processes, the Colombian farmer does not have the ability to buy credits that allow you to invest in improving its production capacity to ensure economic growth in their family and social environment. These credits are not accessible mainly because the access conditions are not adapted to systems peasant production and are of high financial risk due to weak trading systems where the gain is in direct function of the daily price of agricultural products in a market asymmetric information on production with high margins speculation (Mendoza Villalobos, 2001)

The peasant production is linked to markets through distribution systems that benefit both the producer (through the food system) and the intermediary. These can be classified into: 1) Family Self-sufficiency, and local consumption by mutual exchange systems are not traded in the market 2) direct supplying local and municipal markets by small brokers, and direct selling smaller producers 3) collective supply to major cities through an extensive channel of rural and urban intermediaries. (Restrepo, 2011)

In many cases farmers have low profit margins, however marketing margins obtained by wholesalers are relatively high this affects the lack of information, negotiations conducted under word (without some type of contract) and the resignation of some rural intermediaries due to low margins.

These phenomena occurred similarly in Europe in the sixteenth century that began the process of proto-industrialization as a response to trade associations in urban centers. Ie, this phenomenon start a social revolution based on

innovation as population instrument for their own survival. Today we propose the concept of sustainable consumption communities as part of that innovation focused on the survival of the peasant economy in Colombia.

II. CONCEPT OF SUSTAINABLE CONSUMPTION

Sustainable consumption is the consumption of goods and services that have minimal impact upon the environment, are socially equitable and economically viable whilst meeting the basic human needs (Ministerio Noruego de Medio Ambiente, 1994).

In our analysis, its necessary to expand the term "socially equitable and economically feasible" which goes beyond a definition focused on environmental preservation, which should include culture and welfare. Based on the above, we define "Sustainable Consumption" in terms of food production with rural communities as the process that seeks "to ensure food security for urban and rural areas, while respecting the traditional production processes supporting them in a process of transformation based on social innovation"

III. INFORMATION AS A BASIS TO BUILD COMMUNITY MARKETING PROCESSES

The information in economics is an input to decision making, their absence creates imperfection in the market (Arrow, 1963) which can be used by any of its agents. As discussed above, in the case of crop convergence periods, the information about the competition distorts the price system, opportunity seized by intermediaries to negotiate with the expectations of producers seeking to maximize their utility function.

in the case of sustainable consumption communities, information lets us know the consumer needs and expectations, as well as moments that competitors want to sell their products, which can help us to synchronize and dosing demands, avoiding the speculation on prices.

what information is required to generate efficient market mechanisms in the context of sustainable consumption? First it is necessary to meet the needs of the "host community" is accusing the products, quantities, information on consumption habits, the average price they are willing to pay, delivery times, characteristics of subjective quality and product presentation, degree interest in the processes of farming, food safety, product relationship with a growing community (local ownership) are examples of information that can be taken to plan a delivery process

Second, it is necessary to design and plan the delivery process is the weak point of the supply chain. This includes the times and modes of delivery, the correct quantities to avoid waste that result in economic losses for the producer. this includes the processes calculate low crop

thirdly, in a third step, there is a economic transaction process. In these cases, prevail the relationships of trust mechanisms because they are not applicable payment mechanisms, therefore the information such as location, tradition purchase, payment is essential to ensure sustained transactions

Finally, its necessary information of each agent to ensure their economic viability. For the farmer, it is required to define and implement information related to production costs and sustaining agricultural production unit. For the consumer is required information about their incomes and expenses projected on a family budget available for the purchase of agricultural products and the available supply. Finally for the dealer is required information about the costs of transport and location of clients, offering producers and customer demand specially.

IV. ARCHITECTURE SYSTEMIC OF THE COMMERCIALIZATION PROCESS BASED ON SUSTAINABILITY CONCEPT

Using the Viable System Model concept (Beer, 1994) as a comparison paradigm, it is necessary create an develop a number of systemic functions which are presented below:

a) TASCOI Analysis

Using the TASCOI concept it was possible to establish the identity of the system called "Community Sustainable Consumption" in this way:

T: transformation: food needs of agricultural products in orders delivered to final consumers at the minimum total cost using communication technologies .
A: Actors: Small Farmer, Transportation intermediary, retail broker, final consumer
S: Suppliers: Small Farmers provides agricultural products. Consumer provides money
C: Customers: final consumer
O: Owners: This is a real point of the discussion. In our opinion. The owner is de Small Farmer.
Interveners: Policy System. Local Government

With this concept it is possible define Sustainable Consumption Community as "a social system connected via information technologies which seeks to exchange agricultural products for money equitably to the minimum total cost to society"

b) Unfolding complexity and defining structural systems

For purposes of this article, these two steps were standardized by defining the systems that make the community as follows:

- Operation Systems:

Agricultural production system
Distribution system
Marketing system
paying system and financing

- Coordination Systems:
  Information System in Social Network

- Operational direction System
  Board of the community of sustainable consumption consists of
  Delegate of producers
  Delegate of consumers
  Technical Advisor
  System programming production and deliveries

c) Modeling the distribution of Discretion

- Intelligence: is the ability to anticipate changes in consumer demand and natural fluctuations of production processes in small crops generating constant communication between the actors. This will happen if the following functions:
  Prospecting
  Market Intelligence
  Social Network Management

- Identity: In this function the community should establish its own rules which can be done through collective participation in the social network. However in this case it will strengthen cultural identity based on community and mutual support projection

V. REPLICATION OF THE INFORMATION SYSTEM THROUGH MOBILE APP

Currently, we are designing an application for mobile phone APP for the first set; Agricultural production system and their applications for commercialization process. The App is called "Agro App" and its structure is presented below:

First using reference matrix needs created by Manfred Max Neef, (Max Neef, 1993) it was found that the main requirements are Commodity consumption with health, Support for agricultural producers and food security and New relationships Town - Country customized, Sense of region and nation. (Eat our products) and peasant dignity.

The next step was the next step was analyzed using tools such as the Outcome Expectations and Just to be done (Grupo de Desarrollo Regional del Tecnológico de Monterrey, 2012) and it was found that the new development is to use the cell phone to communicate small family farmers and consumers in large and medium cities to purchase agricultural products of the food basket.

The third step using certain levels of complexity and the required range, the functionalities of the application to be designed which were determined are presented below (Fig 1). To seek investment partners was designed a storyboard that shows the concept of the application and its potential use. (fig 2)

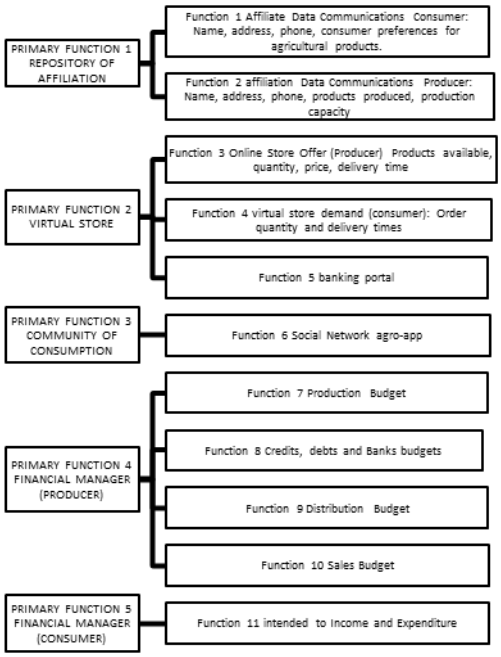

Fig. 1. functionalities of the application.

Problem: I want to buy fresh, clean, organic produce and help farmers in Colombia, in addition to not think so much about the market, because I'm busy. How Do I?

Problem: I want to sell my property and neighbors in the city, but do not know anybody, nobody knows me and so I sell to an intermediary that gets the 40% off sale, I want to meet people from the city to do business How do I?

Agro App is a light Android application that allows 1) to relate family of intermediate customers and large cities, ordering healthy markets for small farmers in province 2) involve farmers in production networks and 3) be a financial manager module producers and consumers of business and household accounts

Agro App connect smallholders to program crops, purchase products, organizing orders, manage cost accounting modules share resources with social networking, accounting and finance

Agro App allows programming a balanced family diet drawn from the origin and affordable with modules Healthy Diet and household economy.

With **Agro App** generate development in the field, healthy culture in cities and sense of patriotism to connect the city to the countryside.

Fig. 2. Storyboard

VI. CONCLUSIONS

Small farmers in Colombia are disappearing in via product of the economic shift to other sources of income. Systemic thinking of the problem, allowing the development of information systems and relationships that reduce the gap between farmers and citizens based on cultural identity can solve the economic problem of information asymmetry and create mechanisms for technical assistance to this vulnerable community preventing its disappearance

ACKNOWLEDGEMENTS

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Modelling the marine environment: Integrating the DPSIR framework with Holling's panarchy theory

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Abstract

This paper is about the management of the marine environment which involves engaging with complex adaptive systems of linked natural, social and designed systems. The complexity of these systems is such that they defy simplistic representation so it is important to recognise that any attempt at modelling will be partial, bringing to light some aspects of the situation under study while at the same time neglecting others. In this paper the design and outcomes of a participatory modelling workshop is discussed which was based on Flamborough Head, a UK marine case study. The workshop involved participants seeking to gain understanding of the dynamics of change through their engagement, in a critically reflective way, with two different modelling approaches: the DPSIR (Drivers – Pressures - State changes – Impacts - Responses) framework and panarchy.

The DPSIR framework, adopted by the European Environment Agency and others, and consistent with the Ecosystem Approach, serves to capture and represent the causes, consequences and responses to change in a systemic way. Although popular the DPSIR framework has been criticised but its points of weakness are well compensated for if used in combination with panarchy. The contribution of this paper is, therefore, focused on how models can be used in a complementary way to increase engagement with and understanding of complex adaptive systems.

Keywords

No more than 5

DPSIR framework; Panarchy theory; Marine environment; Ecosystem Approach

References

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4

Design and Control of Self-organising Systems

Design and simulation of a logistics distribution network applying the Viable System Model (VSM)

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Abstract

Designing viable and integrative distribution networks is challenging for big companies. Researchers often fail to holistically design distribution networks. Thus, the aim of this study is to propose a holistic approach how distribution networks can be designed. Hereby the Viable System Model was applied. Standardized communication channels were able to be defined. In conclusion this proposed approach enables companies to reduce necessary stocks, lead times, manpower allocation and leads to an increase of the service level.

Keywords

Cybernetics, System Dynamics, Viable System Model, Distribution Network

Introduction

Developing organizations capable of coping with the present competitiveness needs is not easy (SCHUH 2013, P. 2). Nowadays, technological development causes lags in systems of implementation, which are not able to manage efficiently the new technological impacts (GOMEZ 1978, P. 1). Achieving sustainable long-term advantages will no longer ensure the competitiveness of companies. Clearly it is essential to focus on successive temporary competitive advantages. This fact also increases the complexity of manufacturing and assembly processes, so that the planning and control of both production and logistics becomes more difficult. This situation results in a significant increase of information which the company has to face.

Actually it can be said that information is the glue in organizations. It is needed for policy, decision-making, control, coordination, etc. Problems with information flows lead to negativ impact in the organization, and if these management problems with the information are not solved, finally it will become harmful to the whole system.

Then apparently it is not easy for management models nowadays to adapt themselves to present needs. To deal with this situation biological sciences can provide more substantial guidance than the economic sciences. The main objective is to make companies more flexible, so that the increased flexibility will help them to deal with problems. Furthermore it will increase their ability to survive in a hostile environment. Thus, the paper will focus on the science called *Cybernetics* (ASHBY 1959, P.1-4). It is originally defined as the science of control and communication in animals, men and

machines (WIENER 1949, P.11). Information, processing and control can be extracted from any context by science. This science extracts what is concerned with information processing and control. The paper will specially focus on one particular Model, the *Viable System Model (VSM)* (ESPEJO 1996, P.105-119). Creating this Viable System Model, the organization is transformed into an autonomous system capable of adapting to constant environment changes (BEER 1959, P. 17). The Viable System Model also exhibits many other features including spontaneous behavior and social harmony within hierarchically ordered relationships. To do this, the powerful weapon (VSM) ought to be really useful.

Distribution refers to every step taken to move and store a product from the supplier stage to a customer stage in the supply chain. Distribution is a key driver of the overall profitability of a firm because it affects both, the supply chain cost and the customer experience directly.

At the FIR (Institute for Industrial Management) at the RWTH Aachen University an approach has been developed to solve the problem of demand and supply distribution planning with the help of the Viable System Model. The aim of the research is to propose a self-regulating approach how to design distribution networks.

Viable System Model

The VSM is built on three main principles: *viability*, *recursivity* and *autonomy*. Viability is a property of every system that is able to react to internal and external perturbations in order to maintain separate existence (BEER 1979, P.115). Thus, the aim of the project is to propose a self-regulating approach how to design distribution networks. For this reason, the VSM is applied for distribution network. The cybernetic model of every viable system consists in a structure with five necessary and sufficient subsystems that are in relation in any organism or organization, that is able to conserve its identity (Figure 1) (ESPEJO 1989, P.21, 22).

System 1 reacts to the development of the relevant operative unit´s environment and it coordinates itself with the other operative units with the objective of own stability and the whole company´s stability (BEER 1972, P.214-217)

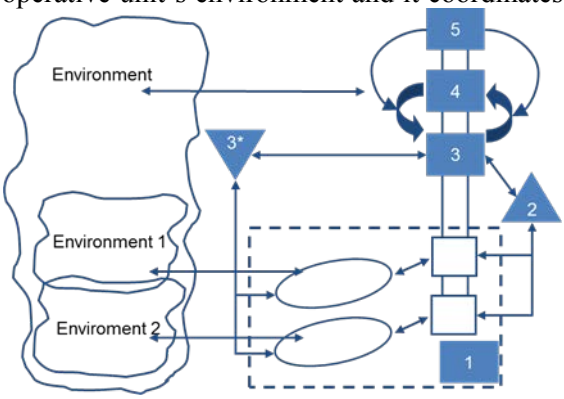

Figure 1: The Viable System Model

System 2 enables the units of System 1 to solve their own problems allowing decentralized decision-making and solve conflicts between those units (ESPEJO 1989, P.287)**.** It also carries out the coordination of the operative units regulatory centres. It is an interface between Systems 1 and 3 (BEER 1972, P.220).

System 3 realizes the control of the orders that are taken in the current operations (ESPEJO 1989, P.281). It checks the strategic activities provided by system 4 and converts them into tactical operations (BROSZE 2011, P.2). Systems One, Two and Three constitute an autonomic system that regulates internal stability and tries to optimize performance within a given structure and criteria (BEER 1972, P.230).

System 4 does an analysis of the external environment and the internal ability to deal with it. It also makes strategic decisions (BROSZE 2011, P.2). The internal stability has only sense if the external factors are considered. Reception, elaboration and transmission of information from the environment are tasks of System Four in order to provide external stability (MALIK 2006, P.90). It is a set of activities, which feeds the highest level of decision making. It must contain a model that

represents the idea of the firm in order to inform the top management about which type of firm they are running (BEER 1972, 233)

System 5 represents the normative level that makes the balance between current operations (System Three) against future´s needs (System Four). When there is no balance, System 5 plays the role of judge (ESPEJO 1989, P.293). System 5 for the firm is the top management and it determines policies and establishes the goals to take decisions (BEER 1972, P.253).

In order to implement the VSM in a distribution network the method of System Dynamics is applied, which is a powerful method to gain useful insight into situations of dynamic complexity. It is increasingly used to design more successful policies in companies and public policy settings (STERMAN 2000, P.39).

System dynamics structure consists of the feedback loops, stocks and flows, and non-linearities created by the interaction of the physical and institutional structure of the system with the decision-making processes of the agents acting within it. (STERMAN 2000, P.107).

Simulation of the logistics distribution network

To sum up, supply chain simulation generates supply chain knowledge by developing and validating improvements using what-if analysis and quantifying benefits supporting decision making at the strategic decision level (CAMPUZANO; MULA 2011, P.4)

To analyze the interaction between parameters, their impact on KPI´s and to quantify the influence of the different models, experiments with random combination of input parameters were conducted. The purpose of the investigation is to compare the answer of the models when dealing with different input demands and to analyse how the variation of the input parameters influences the KPI's.

The VSM simulation model considers all planning tasks of a distribution network. These tasks are allocated in the different systems of the VSM (System 1-5). However the Non-VSM simulation model contains some major differences to the VSM-simulation model. In the Non-VSM simulation model it is not possible to generate demand forecasts (System 4). Even other functions as the switch between different forecast methods or applying different procurement methods (System 3) are not existent.

The initial hypothesis is that the VSM simulation model will be able to meet customer demand with more accuracy than the Non-VSM simulation model with a better allocation of the available resources. It is expected due to its ability to implement measures in order to meet ongoing customer demand.

In Figure 2 the different simulation models can be seen. On the left side the Viable System simulation model and on the right side the Non-VSM simulation models: Economic Order Quantity (EOQ), Reorder Point and Push until Regional Warehouse

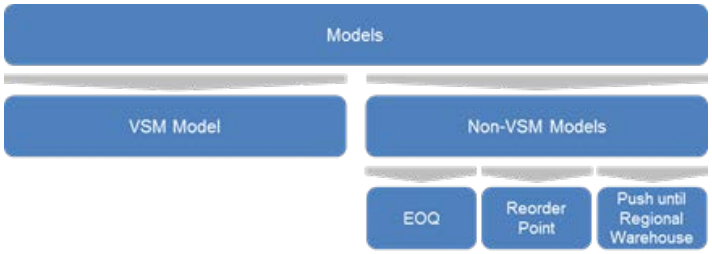

Figure 2: Different simulation models

Structure of the Model

The goal of the research is to study the behavior of different models, the VSM and the Non-VSM models:

The objective is to analyze how these models respond to different input demands. The respond is evaluated according to the following *Key Performance Indicators (KPI)*:

Service level (%)

Quantity delivered on time (%)

Σ

Customer backlog (days)

Utilization ratio of employees (%)

Σ

Σ

To explain how the models works an adapted Ishikawa Diagram of Hypothesis is shown in Figure 3. On the right side the objectives of the simulation can be seen. Point 1 to 8 indicate the conditions of the model.

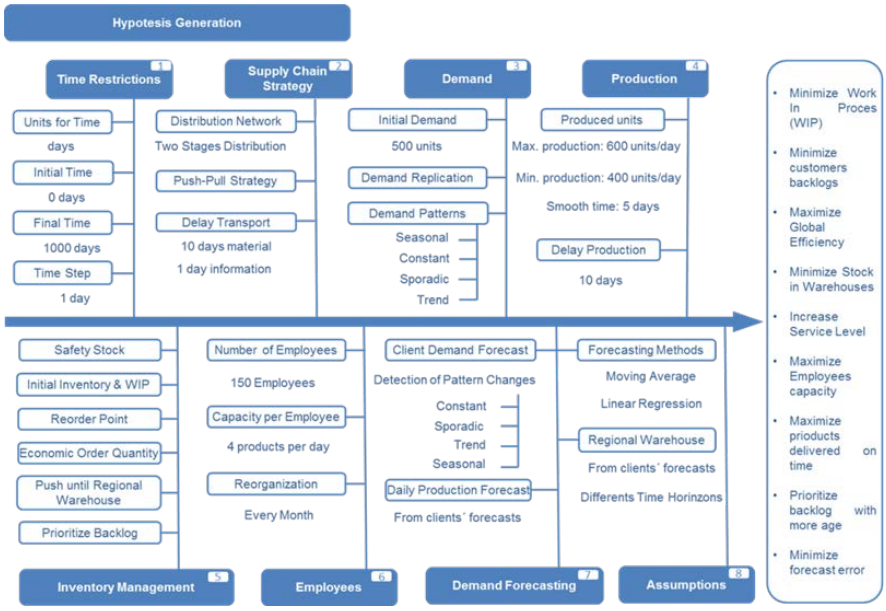

Figure 3: Ishikawa Diagram of Hypothesis

1. Ti me Restrictions

The simulation model will take a time horizon of 4 years. Thus it is possible to evaluate and demonstrate also strategic decisions such as opening a new warehouse or changing the distribution strategy. It is assumed that a month has 22 working days, a year 250 working days and four years have 1000 working days.

2. Supply chain strategy

The structure built is a decentralized distribution network with a hybrid push-pull approach from the production to the end customer. At the beginning of the simulation each warehouse has a certain level of inventory in each warehouse and with some quantity of products in their ongoing transportation between warehouses and customers (WIP). The distribution network (Figure 4)

presents a two stage distribution network with central warehouse. In the initial situation there are 15 customers with 3 regional warehouses opened with 5 customers per warehouse.

The decision to open a new warehouse is taken when a certain backlog is reached (200 products) and this condition is maintained for more than a certain period (10 days). In this situation the decision is made, but there is time needed in order to change the organization. Normally this time is 30 working days.

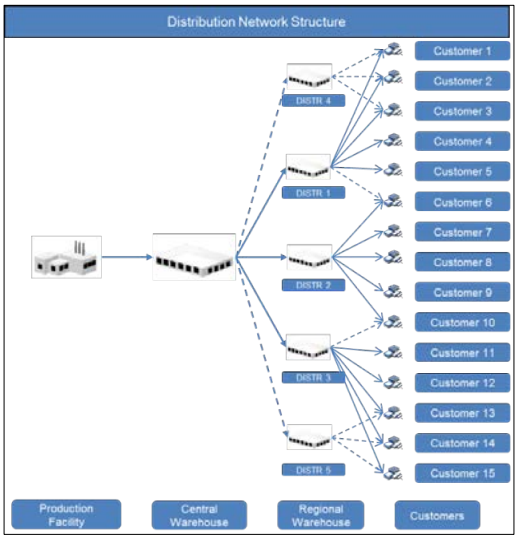

Figure 4: Distribution Network Structure

A. Initial Situation : Distributor one delivers to customers 1 to 5, distributor two to customers 6 to 10 and distributor three to customers 11 to 15. This is the permanent distribution network structure of the Non-VSM models.

B. Distributor four closed and five opened: distributor one delivers to customers 1 to 5, distributor two to customers 6 to 9, distributor three to customers 10 to 12 and distributor five to customers 13 to 15.

C. Distributor four and five opened: every distributor delivers to three customers. In this case customers 1-3, 6, 10, 13-15 are not delivered by the same distributor as initially. Therefore they are described with letter "b".

D. Distributor four opened and five closed: distributor one delivers to customers 4 to 6, distributor two to customers 7 to 10, distributor three to customers 11 to 15 and distributor four to customers 1 to 3.

3. Demand

In all the models the initial demand is a stationary demand, supposed normal distribution with mean and standard deviation equal to 33.3 and 5 respectively. In total the initial demand of all customers is 500 units per day. The customer demands have been created with a data generator in Excel to have exactly the same demand in all the models. The demand patterns, steady, seasonal, trend, sporadic and mixed are introduced as customer demands in the models to show their behaviour when dealing with different demand situations and changes.

4. Production

Production can never be bigger than "600 units/day" or smaller than "400 units/day" even if the demand forecast is out of these limits. In every time period the daily production ordered is the sum of the demand forecast for every single customer with the error that comes from the difference of the total demand and total production until this time period. This adjusting factor allows the system to regulate and to always have enough WIP products.

Σ

After this order is placed the production of this batch is finished after 5 days (smooth time).
Then there is a transport time until central warehouse of 10 days (delay production).

5. Inventory Management

Different methods are used to order material such as the method of Economic Order Quantity (EOQ) or Reorder Point. Moreover the VSM simulation model is able to change between them depending on the variability of the demand, the demand pattern and the current backlog.

6. Employees

There are initially 150 employees divided into 50 employees per warehouse. The Non-VSM simulation models always have the same amount of employees per warehouse while the VSM simulation model redistributes the employees every month according to the forecasted demand, the current backlog and the actual WIP.

7. Demand Forecasting

The Non-VSM simulation model uses one method to forecast customer demand while the VSM simulation model can change between two models of forecasting depending on the pattern of the demand.

In addition the VSM simulation model can change the point of push-pull approach, move employees between warehouses and open new warehouses in order to improve its response to changes in customer demand. Moreover, by using Vensim we compare two different views of distribution networks, a Non-VSM simulation model and a VSM simulation model, which has been built applying the Viable System Model. The main difference between them is the fact that the VSM simulation model can take strategic decisions and observe its environment while the static can´t.

The results were obtained by using Minitab and they show how the VSM-Model is able to meet customer demand and its changes with fewer backlogs than the Non-VSM models. It also allows lower stocks and better allocation of resources.

8. Assumptions of the simulation model

The product is a finished product after the production facility.

There is only one product in the distribution network.

There is no stock limitation in the warehouses.

There is no transport limitation or trucks limitation between the different stages.

Distances between stages are constant.

Steady supply of materials for the production process is given.

Order information along the supply chain is available.

Demand is not known, and historical data for all customers is available one day after the demand.

Customers don´t change the company or order more if the last orders were not fulfilled on time.

Customers can receive one order on different days.

Distances between regional warehouses and customers are always the same and also when new warehouses are opened.

New opened warehouses can be considered as a new physical warehouse or a part of the existing warehouse that takes care of its own customers.

Results

First, we consider the *seasonal demand scenario* which is characterized by an inconstant flow of demand (Figure 5).

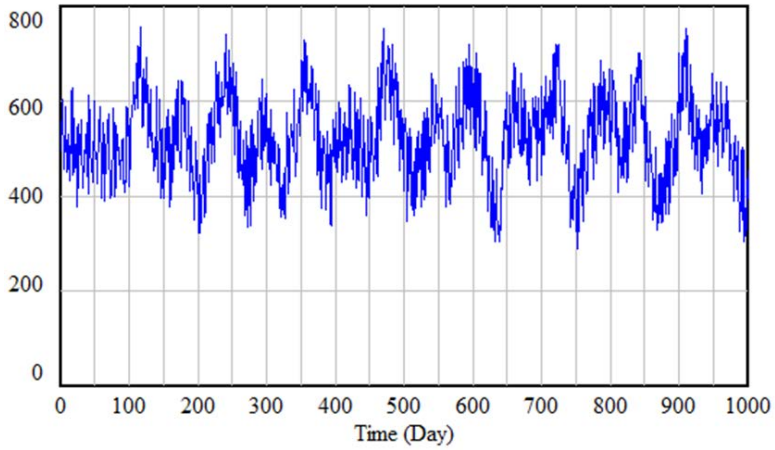

Figure 5: Seasonal demand

The VSM simulation model performed significantly better results than just using EOQ, Reorder Point or Push-Method, due to the fact the VSM is able to change between this different methods (Figure 6). The VSM reached a service level of more than 73%, whereas the Reorder Point-method achieved 62%, the EOQ-method 42% and the Push-method only 17%. The production can meet demand, because on the one hand production can be adjusted flexibly by system 3 (VSM) and on the other hand it is possible to generate an appropriate forecast.

The amount of total customer backlog differs significantly. The number of customer backlogs using the Reorder Point is 8,7 times higher as with the Viable System simulation model. When using the Push-method, the number is even 11,2 times higher. By the targeted allocation in the distribution network, compared with the other models, it is possible to supply customers in a targeted manner.

Backlogs also originate from missing manpower. In that case the total amount of backlogs is much lower by applying the viable system simulation model (25,412), than the amount of the Reorder Point (33,054), the EOQ-method (32,572) or the Push-method (27,839). System 3 of the VSM is able to delegate employees to warehouses were they are needed.

If the developments of backlogs are considered over several days, it can be seen that the long-term backlogs of the Non-VSM simulation models are much higher than the backlogs of the VSM-simulation model. In particular the backlog of three days or more is higher up to 12.3-times (Push-method). The reason is an unbalanced ratio of production to logistics capacities.

The sum of total stocks and shipments (WIP) is also significantly lower if using the VSM simulation model as seen in Figure 6.

	Viable System Model	Reorder Point	EOQ	Push until regional warehouse
Service level (%)	73.81	56.40	56.28	30.50
Quantity delivered on time (%)	92.71	92.53	92.39	84.78
Σ Customer backlog (products)	668,195	5.832 M	5.142 M	7.465 M
Customer backlog t=1000 days (products)	0	11,123	9,472	18,014
Customer backlog (days)	3,932	6,546	6,565	10,435
Σ Backlog caused by missing manpower (products)	25,412	33,054	32,572	27,839
Σ Backlog = 1 day (products)	37,982	38,9	39,631	79,298
Σ Backlog = 2 days (products)	37,462	38,439	39,568	79,292
Σ Backlog ≥ 3 days (products)	592,751	5.755 M	5.063 M	7.306 M
Utilization ratio of employees (%)	86.75	84.60	84.99	83.23
Σ Stocks regional warehouses (products)	4.733 M	6.786 M	10.12 M	14.78 M
Σ Total stocks (products)	8.152 M	11.47 M	10.64 M	14.96 M
Σ WIP (total stocks + shipments) (products)	9.921 M	11.86 M	15.34 M	20.00 M
Σ demand of all customers	520,883	520,883	520,883	520,883

Figure 6: Results Seasonal demand

Similar results were obtained considering the *sporadic demand scenario* (Figure 7). In conclusion we can sum up, the Push-method achieved the worst results, whereas the Reorder Point and the EOQ-method provided average results. The best results were obtained by the VSM simulation model.

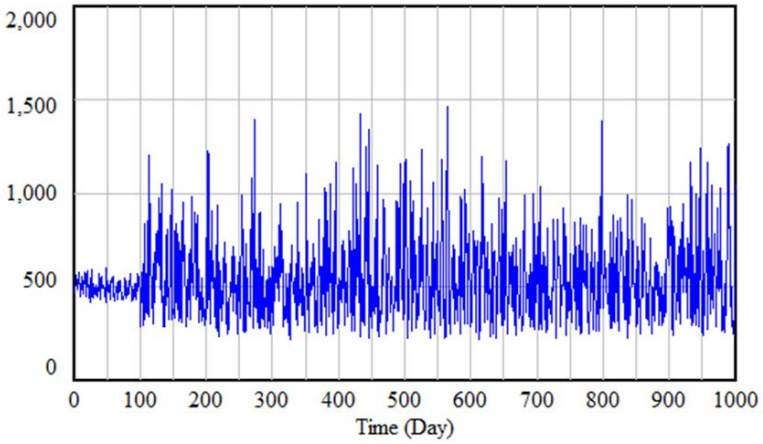

Figure 7: Sporadic demand high

The results of the *sporadic demand scenario* are shown in Figure 8

	Viable System Model	Reorder Point	EOQ	Push until Regional Warehouse
Service level (%)	73.65	62.36	42.84	17.73
Quantity delivered on time (%)	85.42	78.47	67.89	56.26
Σ Customer backlog (products)	515,364	19.91 M	27.34 M	41.77 M
Customer backlog t=1000 days (products)	200	43,68	55,932	95,099
Customer backlog (days)	3,957	5,652	8,583	12,353
Σ Backlog caused by missing manpower (products)	45,679	114,631	149,897	135,088
Σ Backlog = 1 day (products)	78,912	116,516	173,787	236,739
Σ Backlog = 2 days (products)	69,479	110,043	173,586	236,608
Σ Backlog ≥ 3 days (products)	366,973	19.68 M	27.00 M	41.30 M
Utilization ratio of employees (%)	89.68	82.52	80.74	73.79
Σ Stocks regional warehouses (products)	5.108 M	15.64 M	26.58 M	48.87 M
Σ Total stocks (products)	7.569 M	25.21 M	32.67 M	49.06 M
Σ WIP (total stocks + shipments) (products)	10.52 M	21.01 M	31.92 M	54.26 M
Σ demand of all customers	541,27	541,27	541,27	541,27

Figure 8: Results Sporadic demand high

Conclusion

From the results it is clear that in most cases the VSM approach gives us a better response in all KPI terms of delivery performance, stock, WIP, etc.
In the cases where the VSM simulation model doesn´t respond better than all the other three Non-VSM simulation models in all KPI´s are due to the following explanations:

Non-proper demand forecast such as seasonal demand forecast due to a lack of forecast method for this kind of pattern.

Low/Middle Demand with no significant changes: in these cases the response in terms of delivery performance from the Reorder Point (because the VSM change more to EOQ to be costly efficient and it has more chances to fail due its lack of dynamic response. When Push until regional warehouses the response is better due to the allocation of more stock close to the customers in the regional warehouses but involving high WIP & stock levels that lead to high costs.

Therefore the conclusion is not that the VSM has always the best performance because this decision depends on the classical conflict of interest of logistics. In terms of allocation of the available resources this study exposes clearly how the VSM provides the structure to allocate the products efficiently (controlling)
In conclusion this proposed approach can increase the efficiency of distribution networks. Also it shows how a VSM approach is better when dealing with distribution logistics networks, because it allows meeting customer orders with higher delivery service with less stocks and more efficient manpower allocation than an approach with no recursive regulation.
This Viable System Model approach is the key to successful companies with complex distribution networks. The best way to face to the aforementioned problems is to adapt companies to this model. We reckon that would make the company better and even bring it to a new level. Through the analyzed examples and cases, it is clear that such a powerful tool like VSM must be taken advantage of.
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Innovation`s Structure Configuration Based on Network Analysis: A Case of Study

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ABSTRACT

Teams have become, with the passage of time and the demands of the environment, in the first way through which organizations work (Gerard, 1995). Thus, the prevalence of team structures in contemporary organizations has been accompanied by a long stream of theory and empirical application. In hundreds of studies, researchers have sought to understand the factors contributing to the effectiveness in terms of teams. In particular, within this framework, everything related to the study of social networks and the specific way in which the connections between individuals in a team occur is a topic just explored which is of great interest today.

Implicit in this discourse is the idea that the more connected we are, the better the performance. Within this framework this paper examines how the structure of communication networks plus a different set of intragroup informal social network relations has a relationship with performance in 6- members groups on a creative parallel solving task.

Results suggest relations between communication networks and performance are social network dependent. There is an inverted U relation between connectedness and performance only for innovation and total performance measures in relationship groups regardless of privileged or non-privileged positions. However, in linear network always the more connected the group the better. On the other hand, no relationship groups outperform relationships groups. Between relationships groups non-privileged groups perform better but not significantly better

Keywords

Communication networks, intragroup informal social network, Team performance, Group cohesion.

1. INTRODUCTION

The prevalence of team structures in world has been paralleled by a vigorous stream of theory and applied research. In particular, researchers have conducted hundreds of studies to understand the factors contributing to team effectiveness and performance (Sparrowe, Liden, Wayne, & Kraimer, 2001). Within this framework, network structures, or the patterns of formal or informal connections (ties) among individuals, seem to have important implications because they have the potential to facilitate and limit the flow of resources within groups (Leavitt, 1951). However, unresolved empirical questions and theoretical debates persist about whether or not some network features yield to better team outcomes (Balkundi & Harrison, 2006).

Different results seem to turn up from physical (see Sparrowe et al, 2001; Reagans & Zuckerman, 2001;Cummings & Cross, 2003), virtual (see Glückler & Schrott, 2007;Wise, 2014) and agent based networks (see Lazer & Friedman, 2007) researchs. Alike, different results appear from formal and informal networks (see Henttonen, 2010). Even within these two categories consensus doesn´t seem to be clear. For example, while some studies have found that the density of a group´s network of informal social ties is associated with team performance (Reagans & Zuckerman, 2001) others have found opposite results (Sparrowe, Liden, Wayne, & Kraimer, 2001). Similarly, while Boyd & Taylor (1998) found that a leader who is central in a team network of friendship ties have to pay the cost of maintainig realtionships; Levi, Torrance & Pletts`s (1954) research found that central leaders tend to have more productive teams.

Although previous research has demonstrated a relationship between networked communication structure and performance, none of them have explicity examined the link between network structure and creative or idea generation processes with parallel solvers under controlled conditions. Lazer & Friedman (2007) present an agent-based computer simulation model of information sharing with parallel problem solving in which results suggest that when agents are dealing with a complex problem, the more efficient the network at disseminating information, the better the short- run performance. From this starting point and taking into account that any kind of innovation or creative task requires even greater input of tradeoff between exploitation of prior knowledge and exploration for novel ones, solutions which disseminate among individual participants through communication or idea sharing, within formal networks or informal under innovation tasks could become even more relevant than under other conditions.

Moreover, intragroup informal social networks structures have barely related to parallel solving innovation tasks. In relation to that, Jehn and Shah (1997) found that friendship groups

perform (motor task performance, cognitive task performance) better than acquaitance groups. They also found frienship groups share more information, exchange more positive communication and morale-building communication with higher level of commitment than acquaintance groups. This way although there are some results elucidating the relationship between friendship groups and performance, there is still some questions to answer about teams working on creative or innovation task under controlled conditions and the relationship of this performance with information sharing

2. LITERATURE REVIEW

2.1 Parallel Problem Solving

Innovation or creative tasks are by definition a kind of problem with many plausible solutions. Although it is difficult to know, from the beginning, which approaches will yield good results. That's why in many companies and different contexts were innovation is required groups try to take advantage of the different pool of ideas different people working in the same problem have. Thereby, one of the challenges managers and, in general, teams, confront is how to structure the communication among the group. Would it be better to let things just slowly and efficiently diffuse? (Lazer & Friedman,2007). This is an example of what is label as parallel problem solving, in which a set a roughly equivalent agents are all seeking to solve the same problem.

This is clearly ideal, but there are many phenomena in which agents in question are all working with approximately the same problem and are able to learn of each other`s actions. What is of primary interest in understanding parallel problem solving in not only how individuals solve problems by themselves but how individuals solve problem within a collection of subjects. Thereby, we assume that individuals affect collective success through a network of peers.

2.2 Communication to disseminate solutions

Leavitt (1951) investigated the relationship between behavior of small groups and the patterns of communication within which these groups operate. He found that the position which individual occupied in a communication pattern affected the behavior while occupying those positions. Guetzkow and Simon (1955) also found that the communication networks with centralized structure improved the diffusion of information in performing simple task; while decentralized structures delayed the diffusion of information. Later on, Shaw (1954) demonstrated that groups with decentralized communication structure performed complex task in efficient manner compared to centralized communication network.

In relation to that and as a consequence of parallel problem solving, diffusion of information through communication within network structures becomes important. In particular, the assumption that the agents are purposively seeking out for novelty from the enviroment while those ideas are propagating through the network, implies that every participant is engaged in some potentially novel two-way activity within a social enviroment of information sharing. Thus, parallel problem solving can be seen as balancing of exploration and explotation (Lazer & Friedman, 2007). In this paper, we assume that subjects learn directly from each other via network communication.

H1: When dealing with a creative innovation process, there is an inverted –U relation between connectedness (communication network) and performance, in which both poorly and well-connected systems perform better.

2.3 Group cohesion and actor centrality

The concept of group cohesion, i.e., network density, is a structural measure (Wise, 2014). Network density refers to the ratio of actual ties to potential ties. The more ties each member has with other group members, the greater the density. Thus group density reflects the degree of redundancy occurring within a group and acts as a construct representing group cohesion. In fact, density has been the aspect that attracted most attention in all the different kinds of teams investigated in different network researches. Some of them have been found density to affect team performance positively, especially in student teams (Henttonen, 2010). However, there have been fewer studies on the relationship between density and effectiveness in the other types of groups/teams and in either case investigation has produced contradictory results.

For example, Mehra, Dixon, Brass, & Robertson (2006) research suggest that density of friendship relations within an organisational group was positively related to group performance. The centrality of a group leader within the friendship network inside the group was positively related to customer loyalty (a measure of group performance) but not to sales performance (a measure of group performance). The centrality of a group leader in the friendship network among group leaders was positively related to the objective performance of that leader´s group. Nevertheless Kratzer, et al (2008) found that friendship networks had a positive impact on perceptual performance in innovation teams whereas the impact of friendly networks was inversely u-shaped. Peripheral and central positions of team leaders in work –flow and awareness networks impact team creatively negatively. Peripheral positions of team leaders in an information network impact creative positively.

Starting from there, we found it relevant to highlight two different but interrelated sources of variability which seems to mediate the relationship between friendship networks and performance: difference and minority dissent.

From Theory of Difference it is almost evident that diversity is beneficial to innovation. In this way, several approaches can be evaluated simultaneously, while one good idea leads to success for all (Page, 2007). In other words, different perspectives, more probably hold by people who doesn´t have a relation to each other`s, increase the number of solutions that a group of people can find. This in fact, would create new connections between different possible solutions and lead a group to outperform others. From this perspective, and in terms of creativity, which can be a small step for an individual can be a big one for another.

Ultimately, perspectives and heuristics of those who solve problems should be varied. So, more cohesive social networks, and especially networks with popular person in a privileged position, would probably share the same perspective. Thereby, the diversity of perspectives is reduced and also group's ability to find good solutions.

As a result, friendship networks conform to the convenience of sharing the same idea causing them to think about the world in the same way others do. This fact would lead to a significant reduction in minority dissent. Minority dissent not only prevents premature movement to consensus, which is very important for creativity and innovation processes, but also alters the way group members think about, and perceive the situation, including the task to be performed (Carsten, 2002). From this perspective some of the effects of dissent could include (i) conceptual differentiation which leads to recognition of multiple alternatives y (ii) conceptual integration such as the recognition of possible trade-offs among alternatives (both aspects included in the writing and copying action possibilities in our study). In fact, Gruenfeld, Thomas-Hunt and Kim`s (1998) research showed that majorities scored higher on integrative complexity when being confronted with minority dissent. Also, Van Dyne and Saavedra (1996) found that minority dissent enhances creativity and divergent thought in majority members.

H2: No relationship group would outperform relationships groups, between these last two non-privileged group would have better results than privileged ones.

3. RESEARCH DESING

Participants: Subjects in this experiment were sixteen (16) undergraduate and two (2) recently graduated students of Industrial Engineer at Universidad de los Andes – Colombia. The students participate in the task as part of a series of activities assigned to guide the creating process of a business proposal in the framework of "Proyecto Intermedio- Ingenieros sin fronteras" course.

Experiment: The experiment was presented in the form of a game, called "Innovation Challenge", in which six players where tasked to write in a primer as many as possible useful and innovative ideas related to a topic. The players had 3 rounds to frame their ideas, by writing on their own book of answers. On each round after the first, players were allowed to look over, some of their "collaborators" answers according to a communication pattern (See "Communication Network" section). Having seen this new information participants could improve their own ideas, create totally new ones or even ignore this information and continue writing their own new ideas. Subjects were asked to underline any information taken from their group`s peers.

Scores: Players were rewarded in terms of a grade in direct proportion to their group accumulated points. Points were given to each idea, as follows:

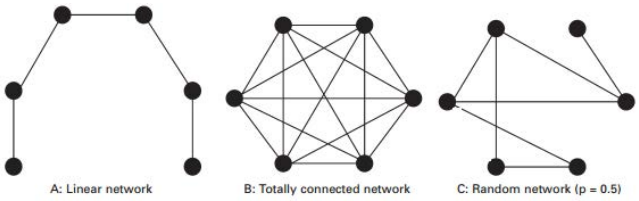
- Two points to each new written idea (to stimulate creative process).
- Each idea was scored in to a 0-3 scale for innovation and a 0-3 for usefulness. These points were added to group ones.
- Additional 12 points were given to the best idea.

Points were given and recounted by two different qualifiers after the exercise.

Complementary Measures: In addition, to the scores mention above, we get some complementary measures related to participants written ideas. Number of ideas based in copy, number of improved ideas, average innovation points and average usefulness points, are some of them.

Description of these measures will be given and explained in the *Results* section.

Communication Networks: One of the central questions we examined was the impact on the performance of the system of changing the network structure, given the aforementioned search behaviors and task. Participants are the nodes of these networks. We limited our focus to networks with a single component (a set of nodes containing some path between every pair of nodes). We examined three archetypical networks: a linear network, a totally connected network and a random (p=0.5) network. We assumed in all of these networks that communication is two way. Figure 1 represents all three types of networks graphically.



Modified form Lazer & Friedman (2007)

Figure 1: Graphic representation of network types.

A linear network, shown in figure 1, A, is a simply set of nodes in which each node, except for two, communicates with two other nodes, and the nodes and their relationships are arrayed linearly (Lazer & Friedman, 2007). A linear network has the minimum number of possible links in a single-component network and produces the maximum degree of separation between an average pair of nodes. A totally connected network (figure 1, B) is one in which every node communicates with every other node. A random network (Erdos & Renyi, 1959) is defined by a stochastic generation process. Each node in the network has a probability p of being connected to each other node. When p is 1, the random networkis identical to the full network; when p is 0, there are no networks ties and all each node constitute a component. As stated above, in this case we use a p=0,5 randomly generated network.

There are many descriptive tools available to describe and compare networks (Wasserman, 1994). This paper focuses on two: density and average path length. Density is the proportion of potential ties that actually exist. Average path lenght is the average number of paths between one node and another.

Social Network: Before the experiment, course students were asked to answer a small questionnaire. In this questionnaire

participants were asked to note if they were friends, acquaintances or they do not know each student in the course. Using this information subjects were assigned to groups of six members according to the following criteria:

Group 1 consisted of participants who don't report having previous relationship; as a consequence they barely know each other.

Group 2 consisted of a set participants which hold some relations but were all connected to a common friend. This common friend was assigned to a privileged (central) position along the communication network patterns.

Group 3 consisted of a set participants which hold some relations but were all connected to a common friend. This common friend was assigned to a privileged (central) position along the communication network patterns.

This way, as told above, one of the central questions we examined here was the impact on the performance of the system of intragroup informal social network of the participants.

Experiments: The core model is then three innovation tasks with variation in the network structure plus a different set of intragroup informal social network relations. (see figure 2)

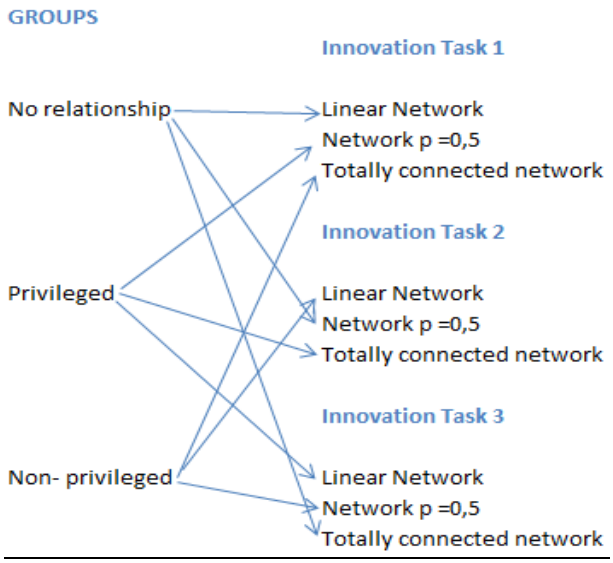


Figure 2: Experiment`s core model

5. RESULTS

5.1 Inter – rate Reliability

As told above, scores for each group and activity where given and recounted, after the experiment, by two different qualifiers. Thus, in order to ensure congruence in scores we get an inter-rater reliability measure based on correlations (see table 1).

Table 1: Inter -rater correlations for Total points by idea

		Correlation Coefficient
Task 1	Group 1	0,689
	Group 2	0,737
	Group 3	0,594
Task 2	Group 1	0,753
	Group 2	0,681
	Group 3	0,607
Task 3	Group 1	0,883
	Group 2	0,646
	Group 3	0,695

Inter- realiability correlation results shows that there was a strong level of consistency between the evaluations of qualifiers. Therefore, given the nature of the task and the amount of ideas revised, correlations obtained were great. Despite Table 1 only shows results for Total points by ideas, inter –rater reliability correlations were also calculated for innovation and utility point separately, these correlations where also, in all cases, high.

5.2 Descriptive Statistics

5.2.1 Number of ideas and total points

First of all, to measure the performance of each group using each one of the communication networks we analyze the total number of new ideas reported by each group and the total accumulate points in each case (see Table 2).

Table 2: Number of ideas (NI) and total points (TP) by group and type of network

		Network Type							
		Linear		p =0,5		Totally connected		Average	
		NI	TP	NI	TP	NI	TP	NI	TP
Groups	No relationship	14	83	17	127	9	84	13,33	98
	Privileged	15	72	23	126	18	96	18,67	98
	Non -privileged	25	121	20	112	19	102	21,33	111,67
	Average	18	92	20	121,7	15,33	94	17,78	

Data obtained from this table shows that, in terms of the numbers of ideas, no relationship group has always the less. Especially in the case of totally connected network, the number of new ideas is at least half of those created by the two other groups. Additionally, it is important to denote that non – privileged network with linear network report more ideas than other combinations.

In terms of total point scores, table 2 shows that for network p=0,5 results are higher than those obtained with other types of network. Only the case of non-privileged group linear network outperforms p=0,5 results, this could be an effect of the fact that, as told before is that combination the one which report having the highest NI.

Although, these results elucidate some important facts, to make results of combination comparable different analysis is needed.

5.2.2 *Performance measure*

A measure of total performance based on the number of ideas in relation to the number of points obtained by each group was calculated to ensure comparability between combinations (see Table 3)

Table 3: Performance measure for Total Points

	Linear	p= 0,5	Totally connected	Average
No relationshi	3,11	3,76	4,67	3,85
Privileged	2,13	2,74	2,67	2,51
Non -privilege	2,48	2,80	2,68	2,65
	2,57	3,10	3,34	

From this table and important result emerges, although we find above that group with no relationships write the less number of ideas, is precisely this group the one which outperform any others group in performance measure. This means that regardless of which communication structure different groups use no relationship group is always better. Additionally, this group results exhibit a linear relationship between connectedness of communication pattern and performance which is not visible in privileged and non-privileged groups. In those groups p= 0,5 network exhibits the higher results.

Similarly subperformance measures were obtained for utility and innovations point separately (see tables 4 and 5)

Table 4: Performance measures for Utility Points

	Linear	p= 0,5	Totally connected	Average
No relationshi	1,607	1,824	2,4444	1,96
Privileged	1,033	1,319	1,3333	1,23
Non -privilege	1,16	1,225	1,3158	1,23
	1,27	1,46	1,70	

Table 5: Performance measures for Innovation Points

	Linear	p= 0,5	Totally connected	Average
No relationshi	1,5	1,941	2,22	1,89
Privileged	1,1	1,423	1,333	1,29
Non -privilege	1,32	1,575	1,3684	1,42
	1,31	1,65	1,64	

Measures for utility points in Table 4 shows that, at least for this measure, increases in connectedness in communication networks are related to increases in performance regardless of each group`s social network. On the other hand, and as with total points, non-relationship group outperforms other groups.

Measures for Innovation points, also shows better performance for non- relationship group. However as shown in total points performance for other groups the higher performance was associated with p=0,5 network.

5.2.2.1 *Analysis of variance for performance measures*

Two factor ANOVA was obtained from the three, aforementioned performance measures. Table 6 shows the results for total performance measure.

Table 6: Two factor Anova for total performance measure

Analysis of Variance	*Sum of Squares*	*Mean Squares*	*F*	*Probabilty*	*Critical Value of F*
Rows (Groups)	3,21	1,61	11,15	0,02	6,94
Columns (Communication Network)	0,92	0,46	3,2	0,15	6,94
Error	0,58	0,14			
Total	4,71				

In concordance with the aforementioned results, two factor anova`s suggest that differences between groups are significant (p=0,02) while communication networks are not. Furthermore, two factor analysis for subperformance measures exhibit same results (groups significance for utility = 0.01, groups significance for innovation = 0.03).

With those results, we make a mean difference analysis. Mean difference analysis suggests there are significant differences between non –relationship groups and privileged and non – privileged group. However, differences between those two last groups are not significant.

5.2.3 *Number of copied ideas*

Table 7: Number of copied ideas

	Linear	p= 0,5	Totally connected	Average
No relationshi	8	4	7	6,33
Privileged	1	21	9	10,33
Non -privilege	3	2	18	7,67
	4,00	9,00	11,33	

Table 7 shows no relationship group is the only one which consistently, use at some similar rate, information from shared ideas. In privileged position group p=0,5 network increases the number of shared ideas. In non-privileged group the totally connected network use the more shared ideas. This last behavior could be seen as a compensation effect of the group for not having the popular person in a privileged position. When the group is totally connected the common friend effect emerges like in p=0,5 network for privileged network

6. DISCUSSION AND CONCLUSION

We found that the effect of social network is significantly related to performance while communication network, at least in this experiment, is not. The explanation of these results laid in H1. H1 predicts an inverted U relation between connectedness and performance. This relation seems to be true only for innovation and total performance relationship groups regardless of privileged or non-privileged positions. However, in linear network always the more connected the group the better. Additionally, and in terms of utility performance points, regardless or the group the more connected the better (linear relationship). As a result, these to different social network dependent behaviors make communication network relationships non-significant in Anova`s analysis.

On the other hand, H2 predicts no relationship group would outperform relationships groups and between these last two non-privileged groups would have better results than privileged ones. We found that regardless of the communication network a group formed by people who does not know each other creates the lower number of ideas. However, in terms of performance, and in some way effectiveness, those groups are the ones who outperform others. Namely, and in concordance with our first finding, no relationship groups are better suited for innovation because the can make the better ideas from the less effort. In fact, those groups are then better in taking advantage of the balance between exploration and exploitation. Information related with copy confirms that this group is the only one which somehow maintains exploration across task and regardless of the communication pattern. In relation to the second part of the hypothesis we found a better but non-significant difference between non-privileged and privileged group. The dominant explanation is that individuals who might discover good ideas are "blocked" by the amount of ideas and the most popular ones, which explains the copying behavior found in our results.

These finding involves that, at least for innovation task, non-relationship groups would be better than relationship groups. As a result, it would be recommendable to form innovation non-relationship groups. However, in taking this advice we also have to consider that what might be an optimal configuration for one group in one situation might be dysfunctional for groups in other situations, depending on what process matter in which scenario. It is plausible, for example, that dense ties among teammates, though negatively associated with collective creativity, is important for team solidarity (Lazer & Friedman, 2007). Additionally derived from our findings, it would be important to note that even if we form a previously non relationship group if that group continues to work together over time, it would, at some point, became into a relationship group which could pay that cost in performance. If this happens, according to our results, the only hope for the group to remain useful is reducing the communication network connectedness. This would lead it to take advantage of an inverted U relationship. However, even though this action will make performance better utility of ideas will be sacrifice (because of the linear relationship) and moreover their performance will not outperform non relationship groups

With this in mind, research results suggest that the power of previous relationships in a social network exceeds the established communication networks within they operate. As a result, it would be important to take into account the social network of a group before giving it an innovation or creative task and a communication network pattern. So, the future challenge lies in the design of the innovative groups that respond to an adaptive system, which through local interactions will actively search for the best configurations. If these groups are designed properly, they could respond properly to the most dynamic and complex problems at rate that the innovative task requires.

7. LIMITATION AND FUTURE DIRECTIONS

As with any non-natural research, our results are limited is some degree to our proposed game rules and convenience sample of participants. Also, as told above, the number of experimental groups and the amount of subjects per group limit our capability to generalize results. There are thus important potential extensions of this study in empirical testing.

Empirical testing: We try to keep the experiment to the minimum complexity necessary to capture some essential aspects of parallel innovation problem solving; there is therefore a wide range of opportunities for extending the model. For example, problem solving innovation could have been measured with different questions or activities which seek it form another point of view e.g., development of new products.

Extending the model: it would be useful to add dimensions to the model that incorporate factors, as environmental changes, which could affect system performance. While we focused on a small group solving stationary innovation problem, one might set a body of variables altering the problem and as consequence the set of possible solutions. "Would one find rapidly converging systems perform better, because they converge on adequate solutions before the environment changes, or do systems that maintain some diversity do better because they contain strategies that might be better adapted to future environments?" (Lazer & Friedman, 2007, pág. 689).

One might also build in assumptions of specialization by subjects. Innovation sometimes involve specialization. That is, there is often a shared conception of the decomposability of a problem into parts that are relatively independent (Simon, 1962). Search in this direction will lead us to a series of experiment similar to Bavelas and Leavitt´s ones (Bavelas, 1948 ;Leavitt, 1951).

It would also be worthwhile to examine a wider array of networks structures. Are there, for example, significant differences between p = 0.5 networks and p= 0.6 random networks? Additionally, changes in systemic rules, as rewarding exploration or limiting copyng, might have significant effects on results. Would results change within different kind of participants or cultures which

Finally, as told above, it would be useful to increase the number of members on each group and the total number of groups under analysis. This could lead to more conclusive and generalizable results.

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Cybernetic Production Management – A Structural Model for Optimized Control Mechanism in Self-Organizing Production Systems

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Abstract

The following paper presents an approach for enabling manufacturing companies to cope with dynamic environment conditions and the increasing planning complexity of present production systems. Cybernetic Production Management (CPM) strives to meet these challenges by applying cybernetic principles to the Production Planning and Control (PPC), and therefore enable organisational structures and processes to be able to react even faster and more flexible to changing internal and external environment by means of decentralised coordination mechanisms.

The presented structure of the CPM is derived from principles of the Viable System Model by Stafford Beer. Based on this the different system elements of the CPM, their functions and their interactions are described.

Keywords

Viable System Model, Cybernetic Production Management, self-organizing production systems, Production Planning and Control

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Introduction

Today, manufacturing companies are increasingly confronted with the influences of a dynamic environment and the ensuing continuously increasing planning complexity (Brosze et al., 2010; Schuh et al. , 2011). Therefore, a successful production management depends beside the process efficiency on high information availability for being able to handle this challenge. In contrast, the lack of standardized interfaces and channels of

information combined with complex processes and a low automation level characterizes the current status in many companies. The consequences are wrong decisions in the planning processes, caused by poor communication, data based on experience and the application of average values, as well as uncertain values of demand, costs and inventory. Conventional planning and control concepts try to tackle these problems by using highly sophisticated and centralized planning methods (Meyer and Wienholdt, 2006). These approaches constrain the ability of companies to react quickly and flexibly on internal and external disturbances. To achieve a higher changeability and a better value-orientation of inter- and inner-company PPC processes, it is necessary to replace the present static arrangement of the central-controlled processes (Beer, 1972; Fleisch et al., 2008).

To maintain logistics efficiency of the production system, the production planning therefore has to adequately consider the uncertainties caused by stochastic disturbances, for example in form of time- and quantity-based plan surcharge values. Both safety lead times and cost-driving quantity surcharges in the form of safety stocks and spare capacities are used to compensate for the uncertainties. The following figure summarizes the relevant causes and effects from planning uncertainties in the production planning for the example of a built-to-stock production (Schuh and Hering, 2013).

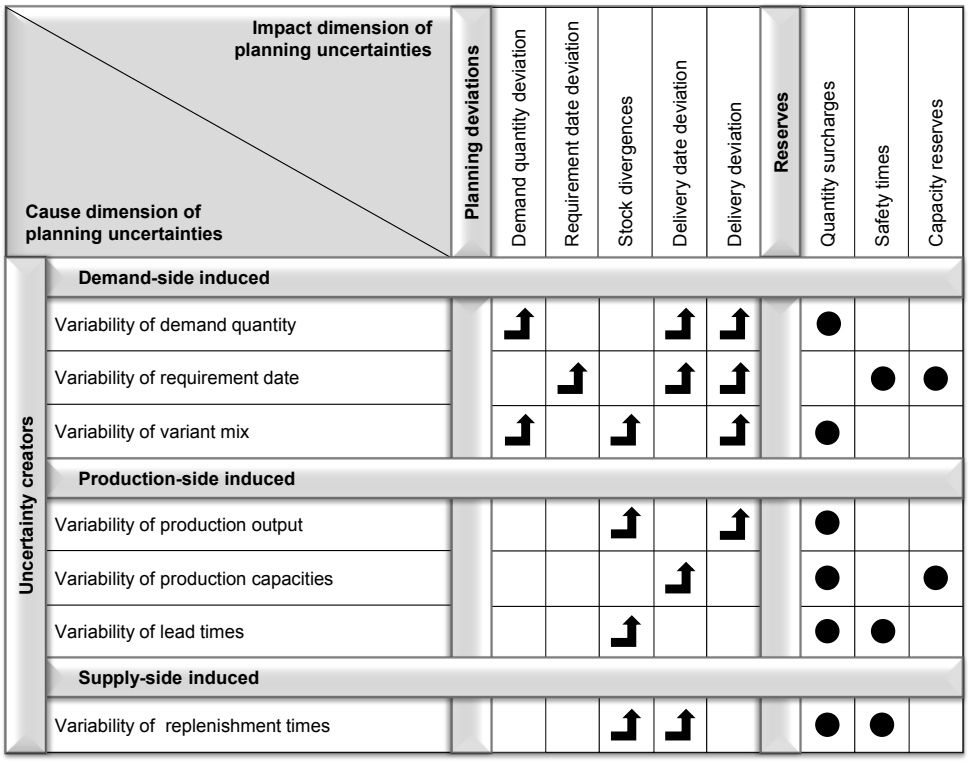

Fig. 1: Cause and effect of uncertainties within production planning in a built-to-stock environment (Schuh and Hering, 2013)

The planning processes underlying information uncertainty can thus be partly due to the result of an inadequate collection and use of relevant and current planning information (deficiencies in information processing) and, on the other hand due to incomplete prediction of future system states by delayed information transfer as well as rigid and inflexible planning systems (deficiencies of information retrieval) (Ouyang, 2007).

Against this backdrop, Cybernetic Production Management (CPM) aim to reduce the planning complexity by applying decentralized, self-optimizing control loops to the Production Planning and Control (PPC). Goal of the decentralized PPC is a higher robustness of the system by distributed handling of complexity and dynamics (Espejo et al., 1996). Changeable organizational structures and processes, a high information transparency, increased capacity flexibility, as well as the continuously synchronization of the engaged planning instances are necessary preconditions to meet nowadays environmental conditions.

Application of Viable System Model to Cybernetic Production Management

The Viable System Model (VSM) is, as stated above, serving as a basis for the organisational structure view. It is conceived in analogy to the human nervous system, which has proven its reliability due to the evolutionary process of billions of years to be the most reliably organised and most adaptable system. The VSM specifies the necessary and sufficient constraints for the viability of complex organisations (Beer, 1972; Espejo and Harnden, 1989). These constraints can be subsumed as completeness and recursivity of the system structure (cp. Beer, 1979). This leads to the requirements of the basic model.

Requirements of the Cybernetic Production Management Model

First, all specified managerial and operative functions must be present and networked in a way that every function has access to the necessary information. Second, every viable system has to be subsystem of a superior viable system and has subordinate viable subsystems itself. Preconditions for this recursive structure are integrated, synchronized target systems, which can be concretized top-down consistently.

The application of the VSM to the production management of manufacturing companies constitutes the structural model for a changeable production system. The structural model is characterised by an explicit process orientation and comprises the operational processes, e.g. order processing, as well as the processes of the PPC (Balve et al., 2001). Within this scope, the model incorporates the organisational view and the process view building up a holistic model.

The system perspective

The VSM-based reference model of production management is characterized by an explicit process orientation and includes the whole order processing from the processing of an offer, to the production and delivery of the finished product (Balve et al., 2001). In contrast to a conventional order processing, the cybernetic approach increases the ability of dealing with internal or external disturbances and ensures a continuous checking for necessary system adaptions.

The PPC processes are embedded in meta-systemic managerial structure, consisting of the operative Process Management and Control, the Process Coordination Center and the Tactical, Strategic and Normative Production Management (see Figure 2). The aim is to provide the operative units with the greatest possible autonomy, which is only limited by the necessity for coherency of the overall system. The extent of autonomy depends on the situational environmental disturbances, thus it is variable over the time. In general case, all tasks of order processing are handled decentralized by the operational units. The meta-

systemic management units are only in charge for sustaining the synchronization of the overall system (Brosze, 2011). For handling these disturbances and dynamic environment conditions it is necessary to specify dynamic reference value corridors, reference values with high granularity and accuracy, as well as to take care for short response-times for every system level.

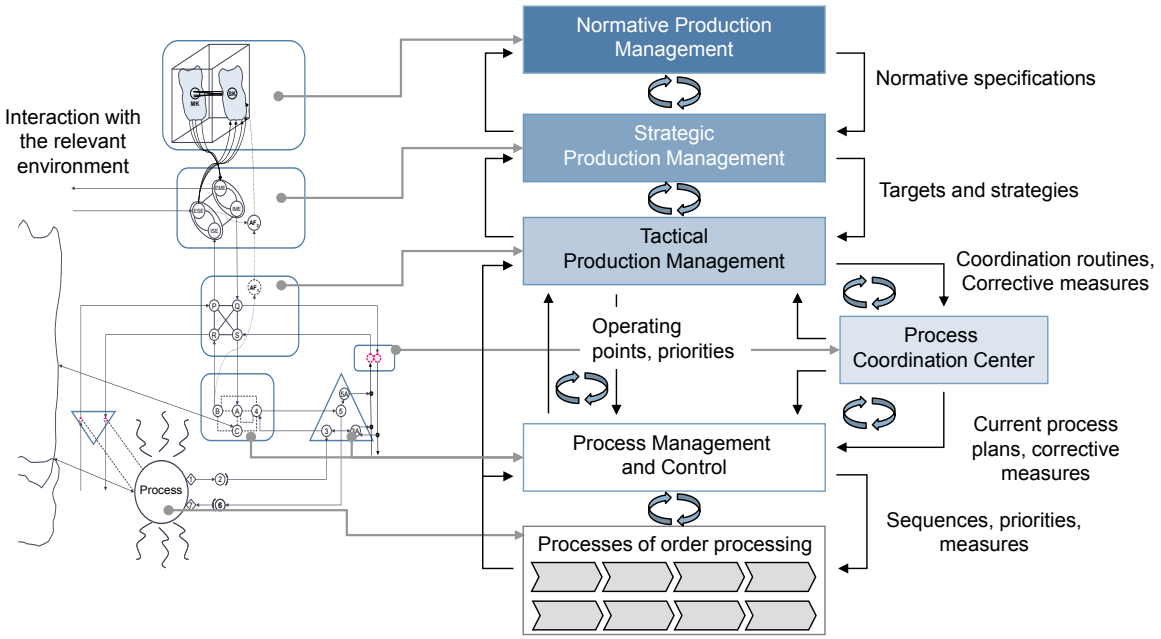

Fig. 2: System structure of the CPM model derived from the VSM

The Autonomous Process Management and Control consists of the local management and control units of the above-mentioned operational processes. The tasks of the local Process Management units consist in the controlling and monitoring of the operative processes. It is responsible for determining the local target systems of the processes in coordination with the Tactical Production Management. The instruction of the higher managerial levels are interpreted and passed as concrete measures to the different processes. Furthermore, the Process Management units are competent to define rules of conduct, routines, sequences and priorities for the processes, as well as developing and optimizing methods and tools to eliminate local disturbances. The local process control units gather and observe defined process indices and share status messages of orders and resources with the control units of the other processes. Beside this, they are in charge for the planning and execution of routines to react on known disturbances, as well as implementing measures of the managerial units.

The stabilization, synchronization and the project controlling of the operative processes is ensured by the Process Coordination Center. In the context of stabilization of the processes, it is responsible for controlling the observance of the operating points, the damping of oscillations between the processes by using standardized measures and the implementing of formal and informal communication channels. Additionally, tasks are the controlling of defined priority rules and the usage of routines for synchronizing the different measures of and between the processes. Tasks of project controlling consist in the monitoring of the order progress and basic dates and the implementing of measures to ensure the order fulfilment, if there is a deviation compared with the plan.

The overall internal stabilization of the operative processes is the guiding principle of the Tactical Production Management. It defines guidelines and scopes of action for the Process Management and Control and the Process Coordination Center. The four primary duties are the process configuration, the process controlling of the internal operative processes at a higher level, the superior process coordination and the monitoring of the operative processes. For accomplishing these duties, it is exemplarily competent to define operating points for the overall system, to specify superior targets, priorities and rules of conduct, to arrange adaptations of the system structure and to optimize the used measures and tools for ensuring the striving for the common target system.

The long-term maintenance and improvement of the companies' competitive advantages by anticipating possible future prospects, adapting the organizational structure to dynamic environmental changes and the consequent alignment of the production system are the key aspects of activity of the Strategic Production Management. Consequent subtasks encompass the monitoring of the environment, the strategic production development and configuration of the production system. The continuous matching between the market-driven requirements and the internal capability to fulfil these is a prerequisite for deriving strategic factors of success and defining priorities and challenges for the production logistics. Within the framework of the production configuration, for example logistical targets and defaults of location planning are defined.

The highest level of the production management system is represented by the Normative Production Management. It accounts for aligning the overall target system with due regard to the companies' identity, values and norms. That leads to the desired condition of the overall production system. Concluding it is important to straighten out that the introduced reference model is not constructed in a classically hierarchical way. The authority results from the different logical capacity of the management units.

To get a more detailed impression of the composition of such a cybernetic based production management model, exemplarily the process and information view are described in the following. The example chosen is the setup of the operative units (systems 1). The operative units comprise of the process itself, a process related regulatory center and a process related directorate (cp. Figure 3).

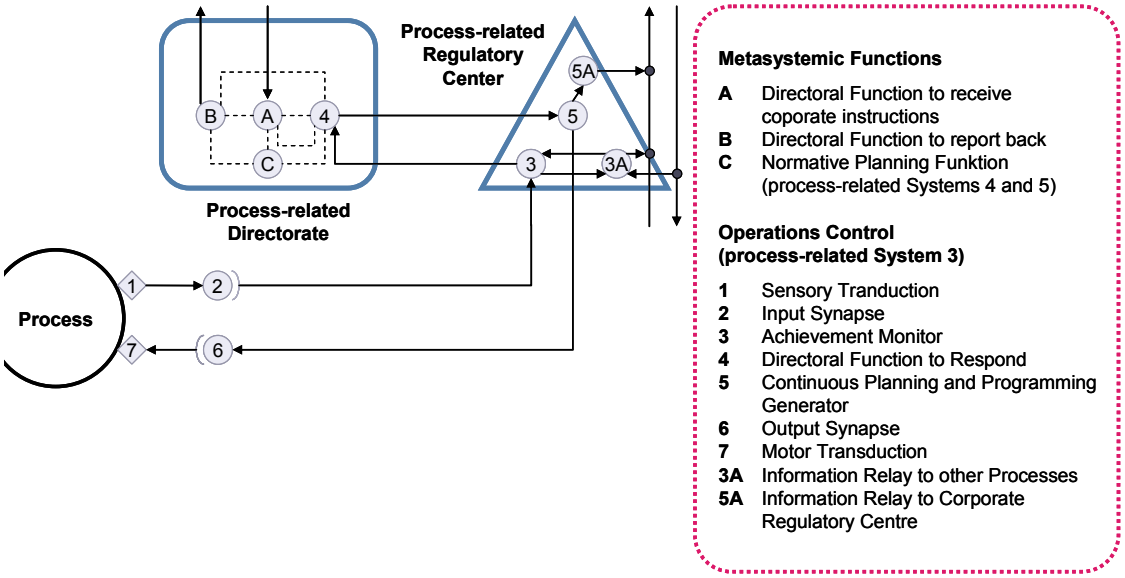

Fig. 3: Organizational structure of process control

The operative unit is designed in a way that under normal conditions (no internal or external disturbances and malfunctions) the process is able to run independently. This is due to the semi-autonomous character of the unit. In those conditions, the process related regulatory center only measures the performance of the process. If the process performance is not meeting the requirements or the process related regulatory center receives information on relevant disturbances from other processes (feed-forward), corrective measures will be initiated by the regulatory center (cp. Figure 3). These countermeasures could consist of changes regarding planning or programming of the process. Namely, adjustments to the parameterisation, adjustments to the target values of the processes or even the change of the whole process can be conducted. Another way to initiate corrective measures is a request from a superordinate system. This could be the systems 3 or 4 in Figure 2. These requests are passed to the process related directorate where they are interpreted, operationalised and forwarded to the regulatory center. The whole information flow within the organisation of process control is visualised in Figure 4. It subsumes on a general and exemplarily concretized level the flow of information which is necessary to assure the required transparency and enable the self-optimisation within the target system.

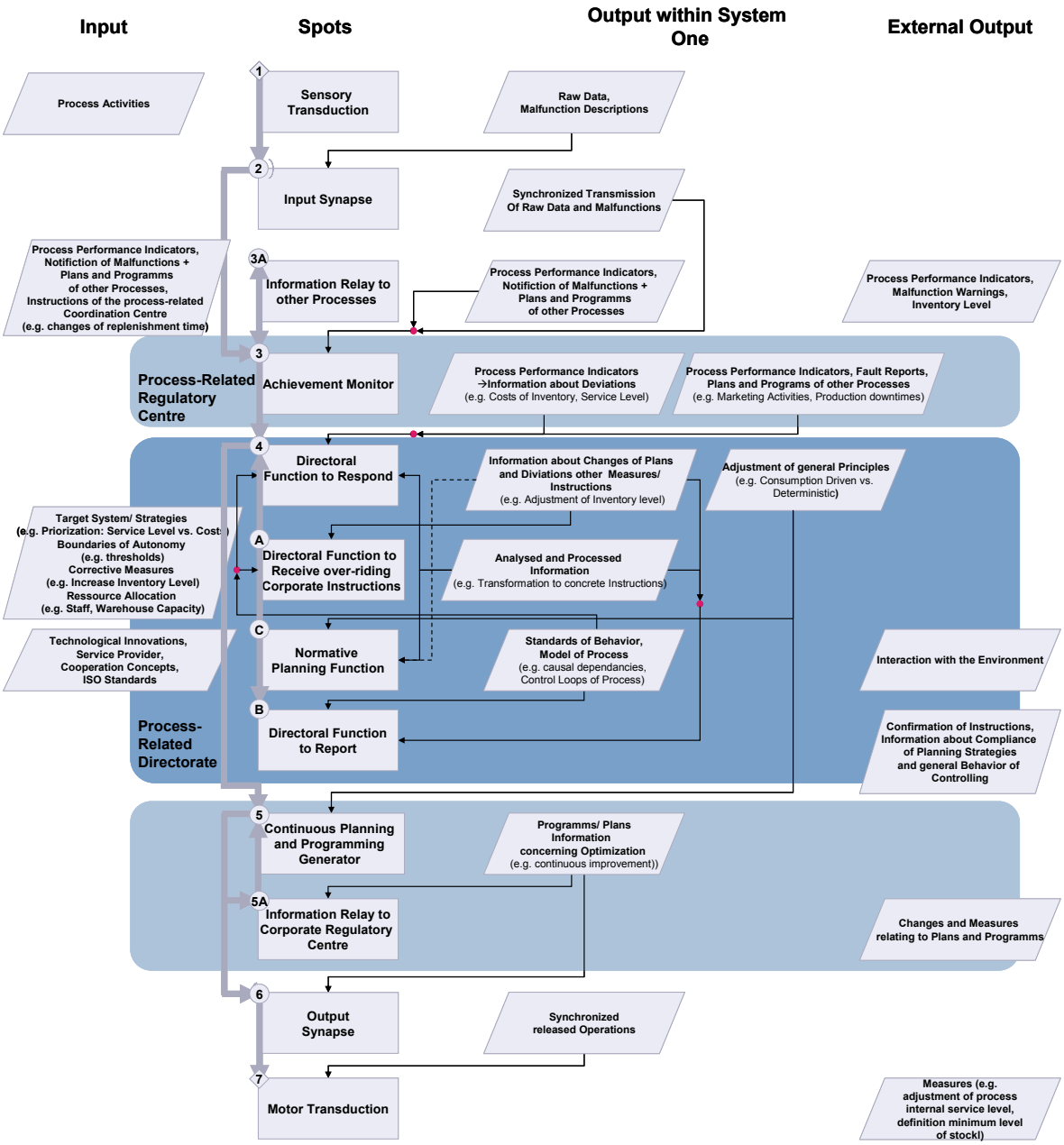

Fig. 4: Information flow within the organisation of process control

The control loop perspective

Ensuring the changeable character of the operative units, they are designed consisting of two elements. First, the previously described organisation for process control allows an adequate process control and management. Second, the process itself must be designed in a way to cope with a certain level of dynamics. The control loop perspective on the one hand provides the framework of a control loop to assure this process characteristic and on the other hand contains a set of different control loops of the same process for different conditions.

Figure 5 illustrates the control loop structure for the case of consumption-driven inventory management.

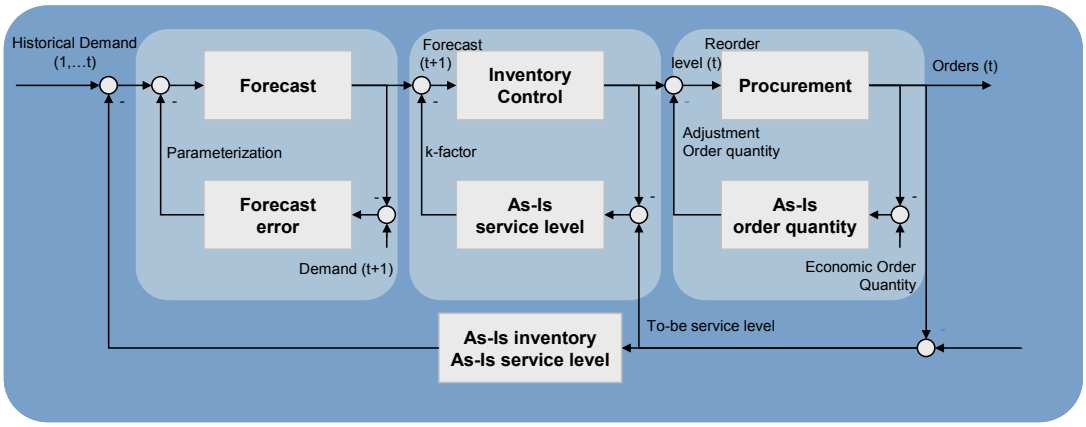

Fig. 5: Control loop for dynamic, consumption-driven inventory management

In this concrete case the control loop consists of the three sub-loops forecasting, inventory control and procurement. The first control loop forecasting minimises the forecasting error by an appropriate parameterisation of the applied forecasting method. The highly accurate forecast enables the inventory control loop to determine a dynamic reorder level taking the replenishment time and the required internal service level into account. Initiated by an inventory level lower than the reorder level the optimal order quantity is calculated and compared to the economic order quantity. Based on this calculation the order is placed (cp. (Stich et al., 2011).

The process internal absorption of dynamics (e.g. variations of replenishment time or shifts in customer demand) avoids an overload within the organisation of process control. In times of normal dynamics the organisation of process control's activities can this way be limited to calculation and monitoring of performance indicators, supplying the process with relevant information as well as forwarding of performance information to other processes. Thus, a cross-process transparency is assured and the process owner (e.g. material planner) is able to focus on critical products that are for example subject to a high level of dynamics.

In those cases when the level of dynamics is exceeding the absorption capability of the process, countermeasures have to be conducted by the regulatory center of the organisation of process control. These countermeasures could go as far as to replace the whole configuration logic of the process by either a control loop already defined in the control loop perspective or a new one. Therefore, different control loops are stored in the control loop view. For the described inventory case, an alternative control loop could for example be a Kanban process.

The decision perspective

The decision perspective is designed to provide substantial support regarding the choice of the right process alternative. It visualises the field of application of the different stored control loops in a way that allows the process owner (the regulatory center in the organizational structure view) to easily evaluate which of the existing process alternatives is adequate under the current conditions. The respective field of application of the single control loops implies that the control loop is capable to balance disturbances within these

boundaries. The visualisation of the fields of application is based on case specific condition indicators, which are capable to characterise the relevant aspects of the process environment. In the described case of inventory management, such indicators are for example the demand volatility, the distribution of the replenishment time as well as the absolute value of the replenishment time. The decision perspective can be designed as a decision tree or characteristic curves. Optimally the decision perspective is derived based on simulations. If this is not possible, it has to be derived heuristically. Like the control loop perspective, the decision perspective is concretised for every operative unit (system 1) separately.

The cause and action perspective

The cause and action perspective is, in contrast to the control loop and decision perspective, a perspective on system level, not on the operative unit level. It is meant to identify the adequate leverages to react or act proactively due to low performance on company level or changes in the macroeconomic environment. This perspective should furthermore support the maintenance of a consistent target system in horizontal as well as vertical direction. Namely, subordinate units have to contribute to the targets of the superordinate system and systems on the same level should not create idle power by acting contrary to each other.

In order to fulfil the formulated requirements, the cause and action perspective will be designed as a relationship model describing the connections between the targets on the different levels of the system.

Findings and practical implications

In order to assure the practical relevance of CPM several workshops with industrial partners have been accomplished. Within these workshops, branch-specific problems have been derived and are further analysed within use cases. The use cases as well as best practices of the participating companies will be used to successively concretise the CPM approach. As one example, implications for the process and process control of inventory management have been derived by applying the introduced framework. Configuring the process and its control according to the principles of the framework leads to a better handling of dynamics and thereby higher process stability and efficiency. Furthermore, the definition of escalation levels stops the continuous firefighting within the organisation of process control. In practice the process owner, e.g. material planner, is enabled to use the saved time to deal with critical issues and the continuous improvement of the operative unit. The establishment of the flow of relevant information between the processes improves the planning quality and enables process control to take anticipatory measures. Both aspects improve the long-term facet of changeability.

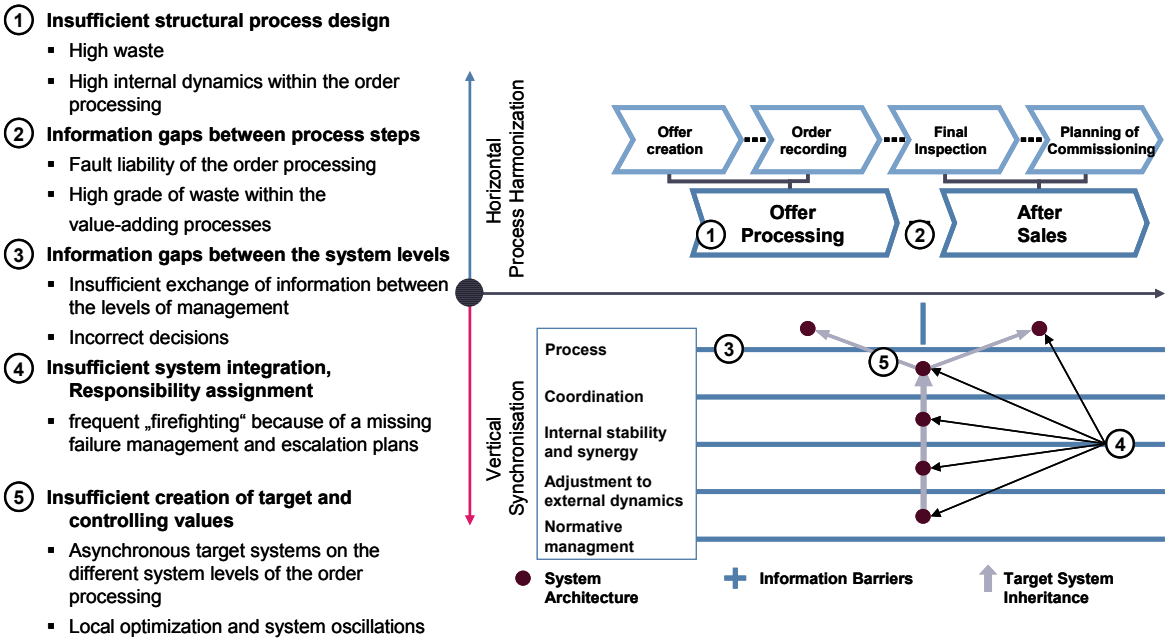

Fig. 6: Solution competences of the reference model for a Cybernetic Production System

Figure 6 systematises the solution competences of the CPM framework to horizontal process harmonisation and vertical synchronisation. Widely spread practical problems are related to these two dimensions and thus can be solved by benchmarking with the proposed framework. While the horizontal process harmonisation is mainly enabled by adaptive processes and cross-process in-formation transparency, the key factors to improve the vertical synchronisation are synchronised target systems. A methodology to synchronise target systems in decentralised organizations is currently under development to complete the organisational structure view as well as the cause and effect view.

Conclusion

In this paper, the application of Stafford Beer's Viable System Model (VSM) on the order process has been discussed. It has been used as a basis to build up a holistic framework for a changeable production management system. After introducing the preconditions of the model, we have derived the structural framework of the CPM from the Viable System Model and specified the functions of the system elements and their interactions.

For enabling the implementation of the model, practical implications have been carried out. Further research is needed to substantiate the presented solution principles for the different tasks of PPC in order to verify and validate the model's ability to support the design of control loops. Thereby a specific focus should be dedicated to the determination of the granularity and accuracy of the individual reference values, the specific response-time behavior and the corresponding dynamic reference value corridor.

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Cybernetic analysis for defining indicators: an approach oriented to Organizational Control and Technical Document Structures

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Abstract

Purpose—in this paper we aim to contribute to organizational control by analyzing how indicators are currently defined and proposing a structure of technical document that meet the organizational needs. We suggest the performance of management control by using a cybernetic approach.

Design/methodology/approach—we start by reviewing some proposals in order to define indicators, then we identified the possible features a document called *Indicator Reference Sheet* can have. Subsequently, a structure for this type of document is proposed and analyzed in terms of its contribution to the organizational learning.

Findings—no standardized structure of technical documents has been proposed to define indicators; the organizational needs and the knowledge of those who define the indicators are the main reasons for such a structure. Indicators should be as dynamic as the organization itself; they should evolve with it and enables learning from past experiences. We proposed a structural pattern for the document called *Indicator Reference Sheet* by using elements of the cybernetic approach, such as communication, learning, feedback, viability, and variety.

Originality/value—some work has been done in defining performance indicators, *e.g.,* efficiency, effectiveness, environment, and economic development, among others. However, scarce research projects for defining indicators under a cybernetic approach have been conducted. This work is a contribution to the standardization of the document *Indicator Reference Sheet* as an important element of the management processes.

Key Words: Organizational cybernetics, organizational controls, indicators, Indicator Reference Sheet.

Article Classification: technology and science research

Introduction

Indicators are common measurements most organizations world-wide use, due to the need for monitoring and controlling the progress when planning projects, strategies, and processes, among others. According to Kast *et al.* (1993), management process comprises fundamental activities such as planning, organization, and control. Control is

the activity for regulating the system behavior, regarding the plans established by using the measurements of the indicators. This is a cybernetic approach to organizational control which enables organizational learning as a result of such measurements.

The definition of indicators is a topic of global interest for academic, business, and government communities in Latin America, because several problems related to many countries are based on indicators. Such an interest comes from the need to control critical variables for achieving goals in some areas—*e.g.,* economy, environment, sustainable development, and organizations. In recent years, some countries funded organizations like RICyT[1], CEPAL [2][2], OECD [3][3], among others, where international experts from different sectors reached agreement about approaches to measure innovation, management, and performance (Martinez, 2009; Bahamón, 2006, Neely *et al*, 1997;.del-Rey-Chamorro *et al,* 2003;. Rojas, 2008; DNP, 2009). Some manuals were subscribed such as the Oslo Manual (OECD, 2005, 1996), the Fracasti manual (OECD, 2002), the Bogotá Manual (Jaramillo *et al*., 2000; Gutti *et al.,* 2007), and the Santiago Manual (Sebastian, 2007).

Indicators are usually defined by using a technical document called *Indicator Reference Sheet*, which comprises the attributes required for measuring variables to be controlled in an organization. In this work we review the structure defined by some authors for defining an indicator. Based on such a review, we analyze how the Organizational Cybernetics (OC) can help to improve such definitions, looking for indicators to change or adapt the static definition into a dynamic tool considering the organizational changes.

The rest of this paper is organized as follows: first, we define a Theoretical Framework about indicators and Organizational Cybernetics. Then, an analysis of several proposals found in the state of the art regarding structures used to define indicators is conducted. Next, the structure and attributes of the indicator reference sheet are proposed and an analysis by using the OC approach is conducted. Finally, conclusions and future work are discussed.

Theoretical Framework

Indicator

In the state of the art we can find several definitions for indicator and most of them come from the Statistics discipline. Some of those definitions are summarized as follows. According to Kohler (1996) an indicator is the result of the behavior of a qualitative or quantitative variable during a specific period. Martínez (2009) states indicators are statistical elements which are chosen due to their ability to explain an important phenomenon. They can be outputs from the statistical processing in order to show the state, evolution, and tendency of a phenomenon under monitoring. Indicators are designed and produced for tracking and monitoring phenomena as a set of dynamic processes requiring some type of intervention. Therefore, indicators have a purpose and require a careful calculation process with several criteria (*e.g.*, information availability and quality), a relevance indicator, and a contribution to the indicator system, among others. Indicators often appear in context, usually together with an explanation which tells users what the

[1] RICyT: Latin American Network on Science and Technology. http://www.ricyt.org

2 ECLAC: Economic Commission for Latin America and the Caribbean. United Nations.http://www.cepal.org

3 OECD: Organization for Cooperation and economic Development. http://www.oecd.org/

indicator shows, their importance and implication. Indicators are presented in a clear and friendly manner (using infographics, graphs, and maps) and generally they are published in indicator systems (either in paper or in digital media) in order to experts easily access their contents.

Technical Document
A technical document is a structured document used in organizations to specify processes, procedures, or manuals. Mostly, it is used for specifying the attributes of document records. Some examples of technical documents are quality manuals, procedure manuals, user manuals, and indicator reference sheets. According to Zapata and Manrique (2013), technical documents are currently under study and their use for extracting knowledge from an organization is proposed.

Indicator Reference Sheet (IRS)
IRS refers to a technical document describing the attributes composing the definition of an indicator. This document contains data and information related to the calculation, calculation frequency, manner in which the results are presented, origin of the values needed for the calculation, etc. Some proposals for IRS are: *indicator factsheet*, *methodological factsheet of the indicator*, and *performance measure factsheet*.

Organizational Cybernetics (OC)
OC is defined as the *science of effective organization*. Also, OC is the *information, communication, and control science*. Cybernetics can lead to organizational self-learning as a result of control, since it is based on the following five principles (Morgan, 1998):

- Systems should be able to sense, control, and explore significant aspects of their surroundings.
- They should be able to relay this information to the operating norms that guide the system behavior.
- Similarly, they should be capable of detecting significant deviations from the norms.
- In addition, systems should be able to initiate corrective actions upon detecting discrepancies.
- The capacity of a system with a self-regulated behavior will depend on the information exchange processes, including feedback.

According to Pérez Ríos (2008a), this is one of the systemic approaches that, deriving from Wiener's (1948) Cybernetics, applies the principles characterizing organizations related to Communication and Control.

The following paragraphs define the essential components of OC. Such components were adapted from Pérez Ríos *et al*. (2008) referencing the following concepts: viability (Beer, 1985); variety (Ashby, 1956); Ashby law (Ashby, 1956); Conant-Ashby theorem (Conant & Ashby, 1970), and the Viable Systems Model (Beer, 1985).

- *Viability.* The ability of an organism, system or organization to continue existing, regardless of the changes that may take place in its surrounding environment throughout time—even though they were not foreseen when the system was designed. To this extent, the organism, system, or organization must have the ability to self- regulate, learn, adapt, and evolve.
- *Variety.* This concept refers to the degree of complexity of a system—*e.g.,* organization, company, etc. Also, it is the number of possible current or potential states and behaviors that can occur in a given situation or problem. The job of the

managers and, in general, the difficulty of the job of the organizational decision makers depends on the complexity (variety) they face.

- *Conant-Ashby Theorem.* It refers to the models used by the decision makers when they find a problem to solve. The theorem states: "*Every good regulator of a system must be a model of that system.*"
- *The Model of Viable Systems.* This model establishes the necessary and sufficient conditions for an organization to be viable. Its compliance involves the existence of certain functions or subsystems in the organization which the MSV identifies as essential, and which Beer (1985) calls System 1, System 2, System 3, System 4, and System 5. Each of such systems corresponds to the Implementation, Coordination, integration, Intelligence, and Policy functions. For our purposes, we add System 3* (*i.e.,* Auditing) as a complement to System 3.

Background and State-of-the-Art Review

Structures used to define indicators
Martínez (2009) proposes a methodological guide for developing environmental and sustainable development indicators. The process comprises three stages:

1) *Preparation stage* aims to form a group of experts in the field for defining indicators; with the enlightenment they are able to propose viable indicators.
2) *Design indicator stage* begins with a proposed list of indicators, which are verified searching for the information available for their future calculation. We proceed with the specs of method sheet for each indicator, we separate expert teams by subjects and then we select the final indicators. The proposed structure for the indicators is the following:

- Name of the Indicator
- Short Description of the Indicator
- Relevance of the Indicator
- Graphical representation
- Trends and Challenges
- Directionality
- Scope (which measures the indicator)
- Limitations (which does not measure indicator)
- Formula of the indicator calculation
- Definition of the variables involved by the indicator
- Coverage or the indicator scale
- Source of Data
- Method of survey or data capture
- Availability of data (qualitative)
- Frequency of Data
- Period of time series currently available
- Frequency indicator updating
- Relation of the indicator with Objectives of the Policy, Standard or Environmental Goals or DS in LAC countries
- Link with regional or global initiatives
- Data chart

Even though the above structure is quite complete, it cannot be used unless adaptations in different fields to environmental control and sustainable development

are made, because it is oriented to the standard environmental goals still not considered within standard.

3) *Institutionalization and updating stage* aims to encourage indicator for using culture constantly.

Bahamón (2006) proposes the construction of management indicators on a systems approach, setting out the identification of the indicators nature. So, we need to state if the indicators are related to efficiency or performance, in order to establish which parameters to measure. The proposal is related to goals and strategies, in such a way that critical success factors will be identified, linked to indicators and associated with mechanisms for monitoring and controlling the process. The next step is establishing acceptable ranges for values yielding the measurement, to set the desired value and current value. Finally, for the calculation of each indicator is necessary to determine the information sources, the frequency of measurement of the different variables, the form of tabulation, analysis, and presentation of information.

As a summary, a structure for the indicator reference sheet is not formally established. In this sense, in this proposal—and according to the reviewed approaches—we infer the following elements to a structure for resuming an indicator:

- Name of the indicator
- Nature of the indicator
- Objectives and Strategies
- Critical Success Factors (associated with objective or strategy)
- Acceptable range
- State (recent indicator value)
- Optimal value desired
- Source of information
- Measurement Frequency (for each variable)
- Format of information

The above structure provides an approach to build and calculate indicators, which can be useful for going from simplicity to complexity in the process of building indicators. However, the structure of fields that could be inferred is limited when we compare with the proposal of Martinez (2009).

Neely *et al.* (1997) propose a framework called *Performance Measurement Recording Sheet*, which is similar to the information of an IRS. This proposal results from a detailed state-of-the-art review on theories proposed to measure performance, where a list of recommendations is identified for the fields in Figure 1.

Details
Title
Purpose
Relates to
Target
Formula
Frequency of measurement
Frequency of review
Who measures?
Source of data
Who owns the measure?
What do they do?
Who acts on the data?
What do they do?
Notes and comments

Table IX.
Modified performance measure record sheet

Figure 1 performance measure Recording Sheet.
Source: Neely *et al,* 1997

This proposal is specifically focused on performance measures instead of indicators in general. However, several fields of this proposal are similar to the Martinez (2009) and Bahamón (2006) proposals. Additionally, the authors discuss a table of field recommendations to be considered when defining a different approach to the structure of the document of indicator reference sheet.

Rojas (2005) presents a proposal aimed at management control. The control arises from cycles by adapting a cybernetic approach and by using indicators and indexes. This proposal is based on the stages of the Cybersyn method illustrated in Figure 2.

PHASES		**TOOLS**
1. Identity statement	→	1 List systems and Tascoi
2 Splitting of complexity	→	2. Structural models
3 Relevant aspects	→	3. Critical success factors
4 Building indicators	→	4. Indicator reference

			sheet
5	Calculate index	⟶	5. Cyberfilter
6	Develop practices	⟶	6. Control cycles

Figure 2. Cybersyn method stages
Translated from Rojas (2005)

The fourth step on the Figure 2—"Building indicators"—is associated with the indicIRS which is defined as the tool to display everything about the indicator under study. However, in this work the indicators were defined only in terms of the characterization of effectiveness, efficiency, and effectiveness, but they were never built to specify and detail the calculation of indicators. One advantage of this methodology is the direct assessment of the compliance of the indicators with the planning related to an organizational area, group, or department.

Carvajal *et al.* (2009) present a similar case of application of the Cybersyn method for assessing active learning in an engineering course. The methodology and the steps followed are similar to the previous one, except that the structure dealt with IRS, as we present in Figure 3:

Goal	*An ability to communicate effectively*				
Strategic factors	Oral presentations				
Indicator	Clarity in defining objectives				
Category	Eficacia	Range	[1, 5]	Units of measure	Rating scale according to evaluation matrix
Calculation Formula	$\sum_{i=1}^{\text{Number of groups in the course}} \frac{\text{Qualification obtained by the group } i}{\text{Number of groups in the course}}$				
Method of data collection	Information supplied by the team of teachers				
Interpretation	Grado promedio of clarity in the definition of objectives according to the evaluation matrix				

Figure 3. Indicator Reference Sheet.
Translated from Carvajal *et al.* (2009)

IRS in Figure 3 is simple and it lacks important elements to specify presentation of results, frequency of calculation, indicator updating, indicator range, relationship to other indicators, and variables. An important aspect to highlight among the items inside the structure in question is the range in which the efficiency varies is specified, detailed effectiveness within the element "category".

Del-Rey-Chamorro *et al.* (2003) propose a framework for defining key performance indicators for knowledge management. In this work, a case study is done where the template of Figure 4 is used to describe the model of a key performance indicator (KPI):

Table VI KPI model template (Case study)

KPI model	*KPI description*
KPI	Time reduced in trials due to the reutilization of previous components/number of new products launched
Measurable action (MA)	Reutilization of previous knowledge in the product development department
Competitive dimension	Quality
Inputs	Reutilization of previous knowledge about formulation and physical properties from previous trials
Activity description	Measurement of improvement of quality of ideas in the product development department because of more time in thinking due to the reutilization of previous knowledge
Agents	Project A team
Outputs	To measure the improvement of quality of the ideas generation phase

Figure 4. Model template for KPI.
Source: del-Rey-Chamorro et al. (2003).

Although the framework proposed is useful for knowledge management, the template for IRS lacks some elements as formula, frequency, and source of input data.

The National Planning Department (DNP) of the Republic of Colombia published in 2009 the document "*Methodological Guide for indicators evolvement,*" in which they try to answer how an indicator is formulated by following 5 steps:

1. Identifying the Target to verify
2. Defining the indicator typology
3. Drafting the indicator
4. Selecting clear, relevant, economic, adequate and measurable indicators
5. Developing IRS with identifying, scheduling, and monitoring information

In Figure 5, the proposed, simplified structure for the indicator reference sheet is displayed as it is used in the methodological guide:

Name	**Description**	**Measure unit**	**Formula**	**Variables**	**Periodicity**	**Typology**	**Creation Date**

Figure 5 Indicator reference sheet.
Adapted from: DNP (2009)

In this state-of-the-art review, control theory from different approaches, some control-oriented management, some focused on variable measurements including effectiveness, efficiency, and effectiveness. Key performance indicators and the evaluation of target compliance to the plans and critical success factors within an organization is also the focus of some work. Also, sustainable, environmental, and economic development variables are also considered. Whatever the approach, a lack of alignment and standardization between the structure and IRS technical document is identified. All proposals differ in several elements, although they share some similarities, which support the need for a document

structure for IRS, incorporating the relevant elements required according to the defined standard acceptance criteria and trying to ensure its usability for organizational control.

Cybernetic analysis and proposed structure

After reviewing the previous structures of IRS, we identify common elements, even though the focus of every structure differs from the scope. We found some structures for indicators such as: environmental, economic, sustainable development, management, performance, etc. In this section we focus on establishing a structure for using in organizational control, based on the attributes found in the review and considering the cybernetic approach.

In the following paragraphs, we present the cybernetic approach which is considered for defining the structure should have an organization for "learning" during the execution of its control processes. The purpose of create, define, measure, and evaluate an indicator is directly related to the need for controlling the behavior of important variables to achieve a goal. This can be done in two stages:

1. Throughout the implementation of the plan to achieve that objective
2. When the plan is finalized and we wish to assess the level of compliance

In this paper, we analyze the cybernetic approach of the indicators definition, so the analysis focuses on the first option. We are interested in presenting a technical document of IRS considering some of the approaches of OC of Morgan (1998) and Pérez Ríos *et al.* (2008). According to each author, the approaches selected for the proposed IRS structure, are as follows:

According to Morgan (1998), indicators should allow for:

- Check and explore significant aspects of their environment and communicate this information to the operating norms guiding the behavior of the system
- Detect significant deviations from standards
- Initiate corrective action when discrepancies are detected
- Provide information exchange processes and feedback to lead to a self-regulated behavior.

According to Pérez Ríos (2008), the principles of viability and variety are selected in order to say the indicators should allow for:

- Regulation, Learning, Adaptation, and Evolution. In other words, indicators should contribute to the objectives, plans, processes, or strategies which are being controlled by them, as a way to maintain their existence, regardless of the changes
- To consider all possible and feasible variables to be evaluated in order to address the complexity of the decisions under uncertainty in organizations.

Considering the above, in Table 1 we propose the next attributes, for each approach:

Approach	**Candidate attributes**
Check and explore significant aspects of their environment and communicate this information to the operating norms that guide the behavior of the system	Related indicators dependencies processes related standards, communication guidelines
Detect significant deviations from standards	Limit values for each standard
Initiate corrective action when discrepancies are detected	Action Plan / Contingency Source of alert / notification
Provide information exchange processes and feedback to lead to a self-regulated behavior	Data output, Data input, Communication channel, Receiver Issuer
Regulate, Learn, Adapt and Evolution. In other words, indicators should contribute to the objectives, plans, processes or strategies that are being controlled by them, to maintain their existence, regardless of the changes they encounter	Previous measurement, trend Future Measurement necessary to maintain compliance with the plan/goal, Variables to improve in the next measurement
Consider all possible and feasible variables to be evaluated in order to address the complexity of the decisions under uncertainty in organizations	Universe of variables Process to get data Plan of action to follow when there is not data availability

Table 1. Candidate attributes for each approach

Structure of the 'Indicator Reference Sheet'

The structure of the indicator reference sheet should consider the following attributes, which were inferred from the state-of-the art review of the above structures and defined according to the cybernetic control:

- Name of the indicator
- Description of the indicator
- Purpose of the indicator
- Calculation Formula
- Variables involved
- Source of data for each variable and its responsible
- Unit of Measure / Scale each variable
- Frequency of consultation of each variable
- Acceptable range

- Optimal Expected Value
- Frequency of indicator
- Frequency of review
- Responsible for measuring and presenting results of the indicator
- Interpretation and presentation of results
- Related Indicators
- Dependent processes
- Rules related
- Communication Guidelines
- Limit values for standard related to the indicator
- Action Plan / Contingency
- Source of Alert / Notification
- Data Entry
- Data outpt
- Communication Channel
- Receiver
- Issuer
- Previous Measurement
- Trend
- Measurement future necessary to maintain compliance with the plan / goal
- Variables to improve in the next measurement.
- Universe of variables
- Process to get data
- Plan of action to follow when there is not data availability

This proposal has a high level of complexity compared to the revised structures, but also constitutes an initial approach for the indicators to be viewed from a perspective derived from the Organizational Cybernetics. By manually using this approach, filling out templates (as happens today in many organizations) would be meaningless, but taking computational tools that support this analysis, it could contribute significantly to the organizational control that many managers have dreamed of someday.

Conclusions

A good definition of indicators can significantly contribute to organizational control. Currently, many organizations are somewhat empirical in defining the indicators. In fact they lack methods and standardized structures of technical documents for their correct definition. The revised structure proposed in this work contribute to improve the definition of indicators for specific topics, but can not be conceived as structures to promote the application of the theory of Organizational Cybernetics when exercising control by using indicators.

In this paper, we proposed a structure of the technical document called *'indicator reference sheet,'* considering, for indicators, approaches to the Organizational Cybernetics presented by Morgan (1998) and Pérez Ríos (2008) for systems. This proposal is an initial approximation for thinking in future works, where is considered, with the help of

computational tools, to do organizational control in real-time, about of compliance of objectives, plans, strategies, etc

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Construction of Complexity: What is Allowed from the Evolutionary Point of View

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Abstract

The modern theory of complexity is one of the most promising tools to comprehend an uncertain, full of sudden changes, and complex world we live in. Due to the rapid development of this theory, considerable changes occur in the whole conceptual net, with the help of which we understand the world and build our own managerial activity. Complexity as a concept is closely connected with the notions of non-linearity, instability and meta-stability, transformation (integration and decay) of structures, evolutionary holism, emergence, innovation, cycles of evolution, etc. The effective risk management and forecasting activities should be based on our understanding what is feasible in dissipative media, how a complex system can be constructed and how to maintain its meta-stable state and its sustainable development. Our efforts have to correspond to own, inner trends of evolution of natural and social media, i.e. to what is allowed and what might be constructed in them from the evolutionary point of view.

***Key words*:** alternative futures, co-evolution, complexity, constructivism, emergence, nonlinearity, management, self-organization, space and time, tempo-worlds.

Challenges of the Complex World

A task of paramount importance nowadays is to learn how to construct a complex system, how to control its emergent properties and how to predict alternatives of its future development. The modern theory of complex adaptive systems (CAS) allows us to assert that properties of a complex system, be it a natural entity, a human personality or a group of them as a social actor, and a medium in which it functions determine each other. Complexity, emergence and activity of a complex system and of its medium are mutual properties which are being under permanent construction in their interactive coupling. The system is formed by its medium and builds its own medium which, it its turn, exerts a reverse influence on the system and transforms it. Methods of control over innovations in complex systems and appearance of holistic features in them are of great significance as well. They include skills of management of complex irreversible time and of controlling emergent properties of hierarchically organized systems and their media. In order to be effective, governing influences should be diversified, situational and constructive.

There are *general laws* and *rules* of development of complex systems. They show rather *trends* which are observed sufficiently often and with high probability under fixed conditions, but are not obligatory. They help us to gain an understanding of complex phenomena and processes and give them a profound scientific explanation. They allow us to make foresights and to reveal vectors of further development of complex systems. Of course, it is impossible to make accurate forecasts; however, such general laws allow us to make certain general conclusions concerting, for example, the strengthening of instability of development and the increase of probability of decay of a complex system, the amplification of the process of concentration of resources, the reinforcement of stratification in society, etc. They help us to elaborate reasonable managerial solutions. Management of the future, construction of sustainable and dynamically developing complex organizations, control over emergence and risk management are topical technologies of management of the modern time.

When trying to reveal general laws of evolution and self-organization of complex systems and to elaborate some patterns of complex nonlinear thinking, I rest upon unique and little known (for the Western scientific community) results of computational experiments and mathematical modeling of course of processes in complex dissipative systems, of situations of instability and of scenarios of passing though a crisis, which are obtained during last decades by the Moscow scientific school of complex systems research with the center at the Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences (RAS) (Knyazeva & Kurdyumov 2001).

Complexity as a Natural Phenomenon

The general laws of self-organization and evolution of complex systems look like laws of evolutionary prohibitions (Haken and Knyazeva 2000). When constructing a complex system, it is allowed everything what is not prohibited. What are general characteristics of complex systems?

- complexity is a multitude of elements which are connected by non-trivial, original bounds with each other. Complexity is a dynamical net of elements (elements are connected according to a certain rules);
- complex systems are unique and inimitable ones. There are no two identical men, cities, biological individuals, organs and even stars or typhoons;

- complex systems are regulated by loops of feedback: *negative feedback* which secure the recovery of an equilibrium, the return to a former state and *positive feedback* which is responsible for a fast, avalanche-like growth, in the course of which complexity blossoms;

- each complex system has its own *characteristic scales of time and space*. The scale of time is determined by speed of a main process connecting elements into a whole, while the scale of space depends on a radius of interactions within the system. Space and time within the system are connected with each other. In the process of evolution, the acceleration of the course of system time is observed. This is expressed in the reduction of characteristic time intervals in which global system events occur, for instance, the duration of cycles is reduced;

- a complex system doesn't possess a property of *ergodicity* and never demonstrates all its properties on the observed trajectory. From this it follows *weak predictability* of behavior of the system. Because of complex hierarchical functional and topological organization, nested structure of complex systems, permanent change of a given system under the influences of external medium, it is in principle impossible to determine all the functions of complex system and to predict its behavior in the future. The future of a complex system is open; there are only horizons of vision of the future (Prigogine 1997);

- at the certain stages of evolution, a complex system can demonstrate a *butterfly effect*, i.e. strong sensitivity to small, insignificant perturbations those consequences tell upon the trajectory of development of the system in the future. A complex system is poised on the edge of chaos. As a rule, such behavior is observed close to points of bifurcation or in the area of turbulence of a strange attractor. A horizon of vision of the future is extremely small here; behavior of a given system is practically unpredictable;

Huge material concerning the study of complex systems is accumulated by now. When generalizing it and basing on my own experience of exploration of complex systems, I would emphasize the following main laws of self-organization of complex systems which should be understood as characteristic trends of their evolution and principles of their construction and design.

a) In the process of evolution, the complication of structure and organization of a system occurs, the complication of interactions within it and with environment takes place. All the structural and functional complexity appears as a result of the processes of competition.

b) Evolution occurs on the boundary of order and chaos, succession and changeability, regularity and chance.

c) The process of evolution often runs in the regime of blow-up and is characterized by compression of spatial and temporal scales. The regime of blow-up describes a main trend.

d) Evolution of complex system has cyclical character. The periods of stormy development alternate with periods of decline, crisis. In the next cycle of evolution, new leaders appear, new more complex organized (in aspects of architecture and function) structures are observed; thereby complexity increases in a discrete steps, with jumps.

f) Cycles are not equivalent; they have a tendency to reduction and occur around the main trend growing in explosive regime. This gives a notion of evolution as development on ascending spiral, and cycles are convolutions.

g) In the process of evolution, the spatial discontinuity increases, the processes of concentration are reinforced; a bigger and bigger exfoliation of system occurs.

h) Significant stages of evolution are finished by critical points, points of singularity; when passing through such points, a system enters a qualitatively new phase of evolution.

Laws of Construction of a Complex Evolutionary Whole from Parts

The path of evolution in nonliving and living nature is a path of increase of complexity. How can more and more complex structures emerge from separate parts which may be in fact complex structures themselves? What are general laws of integration of structures in the course of evolution of nature and mankind? To put it in other words, what are laws of co-evolution? The modern theory of complexity has managed to discover such laws.

The theory shows that complexity of a structure is connected with its coherence. By coherence, we understand the concordance of tempos of life of structures by means of diffusive (dissipate) processes that are a macroscopic manifestation of chaos. In order to build a complex organization, it is necessary to coherently joint subsystems within it, to synchronize tempos of their evolution. As a result of the unification, structures fall into one tempo-world, so they acquire one and the same moment of peaking; they start to co-exist in the same tempo-world.

Complexity of a structure is connected with its coherence. By coherence, we understand the concordance of tempos of life of structures by means of diffusive, dissipate processes that are a macroscopic manifestation of chaos. In order to build a complex organization, it is necessary to coherently joint subsystems within it, to synchronize tempos of their evolution. As a result of the unification, structures fall into one tempo-world, so they acquire one and the same moment of peaking; they start to co-exist in the same tempo-world (Knyazeva & Kurdyumov 2001).

To construct a complex structure, it is necessary to know how to unify structures “of different ages”, i.e. structures of different stages of evolution and having different rates (tempos) of evolution. It is necessary to know how to include the elements of “memory”, the biological memory, DNA, or the memory of culture, cultural traditions. Inasmuch as the structure-attractors, which characterize the developed, steady evolutionary stages of structures in the nonlinear world, are described by the invariant-group solutions, the spatial and temporal properties of structure-processes turn to be tightly bound. The dynamics of development of a complex structure needs a coordinated (with one and the same moment of peaking) development of substructures of “different ages” within it, this leads generally to the breakdown of spatial symmetry. The insertion of “memory” (of elements of the past) signifies the symmetry breakdown in space.

Different but not arbitrary structures can be unified. The degree of connection of structures, which are to be integrated, and the stages of their development are not arbitrary as well. There are various but not arbitrary ways of unification of structures into integral ones. There is a restricted set of integration ways, ways of construction of a complex co-evolutionary whole.

The selectivity (the quantum character) of ways of integration of parts into a whole is connected with the imposed requirement of existence in one and the same tempo-world, i.e. of development of all parts with one and the same moment of peaking. This is the physical basis of quantification by integration of complex evolutionary structures. If

joinable structures have even slightly different from each other moments of peaking, then, near the moment of peaking (the singularity), they will become incomparable in intensity.

Thus, the synthesis of relatively simple evolutionary structures in an entire complex structure occurs by the establishment of a common tempo of evolution in all unified parts (fragments, simple structures). The intensity of processes in various fragments of the complex structure (for example, for the social medium – a level of economic development, quality of life, provision with information, etc. in different countries) can be diverse. The fact of integration signifies that structures becoming parts of a whole acquire a common rate development.

An integrated complex structure arises only if there is a certain degree of overlapping of simple structures. There must be a certain topology, "architecture" of overlapping. A constructive "sense of proportion" must be observed. If the area of overlapping is not sufficient, then the structures will develop independently, they will not feel each other, they will live in different tempo-worlds. However, if the overlapping is too wide, then the structures will flow together very fast, they will straight away "degenerate" in one rapidly developing structure.

One may attempt to formulate rules of symmetry breakdown, when uniting structures of "different ages" into a whole and to indicate an optimum degree of connection (of overlapping of areas of localization) of substructures within a complex structure, a proper topology of their location, laws of switching of regimes and other factors, ensuring sustainable concordant development in one and the same tempo-world.

When integrating structures, a magnitude of maxima of intensity of processes occurring in them must be in an appropriate way matched with their distance from a center. Three structures having equal maxima of intensity (levels of development), when integrating, settle themselves in apexes of an equilateral triangle. If one of these structures is more developed, the equilateral triangle turns into an isosceles one: bigger intensity of burning is "compensated" by its bigger distance from a center of symmetry. But there is no continuity in such a mechanism of "compensation", i.e. a majority of intermediate states is unstable and only selected, definite configurations of structures are metastable. The compensation of a magnitude of a maximum by its bigger distance from the center of symmetry of a complex structure "works" in a discrete, quantized field of possibilities of integration.

When maxima of intensity increase, a distance between them decreases ((the model of "converging waves of burning" is developed and studied by our scientific school), and, on the contrary, when they decrease, the distance increases. One can integrate structures with different powers of intensity by arranging them at different distances from the center and by observing certain forms of organization.

The factor of unification of parts into a whole structure is chaos, dissipation, fluctuations or – for social structures – their analogue (exchange processes of various kinds). Chaos plays a constructive role not only in the moments of choosing a further evolutionary path, but also in the processes of assembling a complex evolutionary whole. Chaos leads to the establishment of coherence of development in all parts (substructures). To put it figuratively, chaos serves as a "glue" that binds parts into a united whole.

If a complex structure is constructed from more simple ones in a right topological way (that is, if there are a certain degree of interaction and overlapping of substructures and a certain symmetry of "architecture" of an emerging united structure), the united structure finds itself on a higher level of hierarchical organization, i.e. a step towards a super-

organization is taken. Thereby, the rate of development of structures, which are integrated into a complex one, is being picked up. The rapidly developing structures "pull to themselves" by their tempo of life the slowly developing structures. In case of right unification, a ratio of maxima of more developed structures to maxima of less developed ones remain constant, i.e. small, underdeveloped structures don't fall out into another tempo-world, they don't become a simple background for development of structures with bigger maxima, there is no decay of tempo-worlds.

Besides, if an evolutionary whole is organized in a right topological way, the whole begins to develop at a rapid pace, which is higher than there was a pace of the most rapid developing structure before the unification.

The path of unity and of integration of different parts into entire structures is not steady, permanent and monodirectoral. The evolutionary ascent towards more are more complex forms and structures passes through a number of cycles of decay and integration, of tearing off from the whole and inclusion in it, the slowdown of the processes and their acceleration.

From the theory of self-organization, it follows that any open systems with strong nonlinearity are most likely to pulse. They have natural cycles of development: the stages of differentiation of parts alternate with the stages of their integration, scattering alternates with rapprochement, the weakening of bonds changes into their strengthening. The world seems to go towards a universal unity, a super organism. But it moves forward not monotonously but through certain fluctuations and pulsation. The stages of decay, even if partial, are followed by stages of more and more powerful unifications of structures. This modern scientific notion of complexity reminds us of the eastern images of "rhythms of life" that are peculiar to our world, first of all, of the Chinese symbol Yin-Yang.

The cycles of increase and decrease of the intensity of processes, of decay and unifications of parts indicate regularity of nonlinear processes; the cycles are determined by the very nature of nonlinear processes. Any complex structures at the moment of maximum of accretion, or at the culmination of development (at the moment of peaking of processes), are subjected to the inner instability with respect to small perturbations, they are under the threat of decay.

The history of humankind testifies that the world empires increased in size and became stronger to the maximum extent and in the end they came asunder, sometimes disappeared completely without leaving a trace. But if the beginning of decay of some geopolitical system is observed, it is reasonable, from the point of view of the theory of complexity, to put a question: is the nonlinearity of the system sufficient to turn the evolutionary processes back, to switch them to another regime of the renewal of bonds, the attenuation of processes in the central domain and their stirring at the periphery of the structure? If the nonlinearity is not sufficient, then the former intensive processes may simply be extinguished and come to naught.

Thus, the fundamental principle of behavior of complex nonlinear systems is the periodical alternation of stages of evolution and involution, the unrolling and the rolling, the explosion of activity, the increase of intensity of processes and their fading, weakening, the converging to the center, the integration and the disintegration, at least the partial decay. There are profound analogies here to the historical testimonies of the downfall of civilizations and the break-up of great world empires, to the cycles of Nikolai D. Kondratiev, the oscillatory regimes of John K. Galbraith, the ethnogenetic rhythms of Lev N. Gumilyov.

At the initial stage of formation of a complex structure, its right topological organization is of great importance. When the process of integration occurs, the structures are not simply put together; they do not simply become parts of the whole in an unaltered, undistorted form. They become somehow transformed; they form strata on each other and intersect, and at the same time some of their parts fall out. As the physicists say in such a case, there exists an overlapping with the energy loss. This signifies that the unification leads to the economy of energy, to the diminution of material expenses and human efforts.

The topologically proper organization of structures in an entire evolutionary structure results in an approach to the moment of peaking, the moment of maximum development. The whole develops faster than its integral parts. It is more profitable to develop together, since the joint, co-evolutionary development is connected with a saving of material (in particular, energetic), spiritual and other resources. Every new way of the topologically proper integration of structures, the appearance of successive layers (with bigger exponent of nonlinearity) of hierarchical organization picks up speed of development of the whole as well as its integral parts. Therefore, the evolutionary path to the building of more and more complex organizations of structures in the world is to a certain extent pre-determined. We should lend our ears to Eliot's advice:

"We must be still and still moving
Into another intensity
For a further union, a deeper communication".

Construction of Complexity in the Process of Co-evolution

Co-evolution is *per se* "the art to live together". To follow the rules of co-evolutions signifies to construct a preferable and sustainable future. An important task can be set: to define order parameters of evolution of states that determine a corridor of their sustainable co-evolution. General rules of co-evolution of complex social, economic and geopolitical structures on national, international and global scales, which arise from the methodological analysis of mathematical models, can be summarized in a form of the following key notions:

a) it is *a common tempo* of development that is a key indicator of connection of complex structures into a single whole;

b) *non-uniqueness and involuntariness* of ways of assembling of a whole from parts;

c) structures-parts enter the whole not in an invariable form, they *are transformed and became deformed* in a certain way in accordance with the peculiarities of an emerging evolutionary whole;

d) for assemblage of a new complex structure, for re-crystallization of a medium, one need to create situation *"at the edge of chaos"* when small fluctuations are able to initiate a phase transition, to throw down the system in another state, and to set another course to the process of morphogenesis, another way of assembling of the complex whole. "The very nature of co-evolution is to attain the edge of chaos";

e) to make a dynamically evolving integral structure, a *proper topology* of combination of structures is of great importance;

f) in case of right, resonant unification of complex structures into the whole, a united super complex structure begins to develop at a higher rate ("it is profitable to live and to develop together").

Co-evolution is not simply a process of adjustment of parts to each other by formatting a complex whole, of their resonant positional relationship and of synchronization of tempos of development, but it is enactive cognition of the world by a human being, synergism of cognizing and constructing subject and of a medium surrounding him. This is also an interactive connection between human organizations and single individuals, the universal collaboration, complicity and solidarity, concerted efforts in construction and rebuilding of the world, and thereby of one's own mentality. This is disclosure of universal affinity of all with everything and of mysterious connection between the past, the present and the future.

Constructing of a Desirable Future

Effective management of complexity should be: a) soft and non-linear, b) strategic (i.e. oriented to attain remote ends and to actively construct the preferable future), c) should include social and economic risk management (diagnostics of social risks, estimation and justification of allowable risks, prognostication of consequences of venturesome decisions).

The following notions are considered as core ones in the modern forecasting (futures studies): a) the image of the future, b) alternative possible futures, c) creating the future rather than predicting it. The vision of the world, which is future-oriented, in based on solidarity with the future. We should not wait for gifts from the future, we rather should create, construct a desirable and preferable future. This attitude towards creation of the future is an intermediate interpretation of constructivism in futures studies.

In relatively simple mathematical and computational models, a result of fundamental importance has been obtained: a continuous nonlinear medium potentially contains in itself different kinds of localization processes (different kinds of structures). Medium is a united source that acts as a carrier of different forms of future organization and as a field of different evolutionary paths. In other words, there are discrete sets of evolutionary paths of complex systems into the future (Knyazeva 1999).

The future states of complex systems escape our control and prediction. The future is open, not unequivocal. But at the same time, there is a definite spectrum of "purposes" or "aims" of development available in any given open nonlinear medium. If we choose an arbitrary path of evolution, we have to be aware that this particular path may not be feasible in a given medium. Only a definite set of evolutionary pathways are open, only certain kinds of structures can emerge.

The principles of strategic management based the theory of complexity show how it is possible to multiply reduce the required time and the necessary efforts and to generate by means of a resonant influence the desirable and – what is no less important – feasible structures in a given complex system, i.e. certain structures from a discrete spectrum of potentially possible structure-attractors. Besides, they demonstrate how it is possible to achieve the proper and persistent unification of relatively simple evolutionary structures into more complex entities and to accelerate in that way the tempo of their evolution.

The world we live in is non-linear and open. The world is creative. An unexpected and often charming new appears in it. The future is multiple and uncertain in our non-linear world; it is a fuzzy future. The non-linear world often gives surprises to us. In such a world, the probability of fulfilment of even improbable events increases. The science of complexity is an optimistic attempt to cope with nonlinear situations and to make use of the methods of effective nonlinear management of complex systems in their states of

instability. This is the way of attainment of a desirable and at the same time feasible future, the future that is coordinated with the own properties of complex systems.

In order to succeed in constructive and management activity in the modern complex and globalized world and to build oneself properly in co-evolutionary processes, one should:

a) know how to take robust decisions under the conditions of deep uncertainty which is determined by the increasing complexity of social processes. And for that an intellectual alliance (intellectual synergy) between prediction, production of innovations and entrepreneurial (management) activity is necessary;

b) know how to think globally and to act actively and interactively, in a way that is adequate to a situation (the principle of situatedness of action);

c) to be in synergism with a medium, with an organization or enterprise which is under our management control (the principle of non-linear feedbacks which is being established between a subject and a medium if his/her activity);

d) to create a coherent and mutually concordant world fitting not only his/her own cognitive and constructive possibilities, but also inner latent tendencies of a medium (attitude towards not only desirable but also feasible future).

The Construction of Complex Structures is Connected with Time Management

Complexity is the unity of plural and diverse elements. According to E. Morin, who argues the problem in the true philosophical context, complexity is “unitas multiplex”. i.e. both “unity of diversity” and “unity in diversity” (Morin 1977, p. 147).

According to the models of non-linear dynamics and evolution of open dissipative structures elaborated by the Moscow school, complexity of structures and of their behavior is conditioned, first of all, by their *tempos of evolution*. The tempo, or the rate of evolution of open nonlinear systems, is a key characteristic in exploring complexity.

The thesis can be explained by a few ideas that are more concrete:

a) there are very fast, avalanche-like processes, the blow-up regimes, which are of great importance. An effect of localization, i.e. the structure formation, and the appearance of extremely complicated structures may be observed in these very regimes;

b) periodical alternation of various evolutionary regimes may take place. The change of tempo of evolution as well as of general character of the occurring processes is a basis for self-maintenance of complex structures in the world;

c) it is the tempo of evolution that serves as indicator of integration of structures developing with different speeds in a whole complex structure;

d) synchronization of tempos of evolution of different complex structures is a way of co-evolution and sustainable development in the world.

To manage time, to put it more precisely to master time, is to know how to unify complex structures in a resonant way, i.e. to create a common tempo-world which is able to accelerate development of a produced whole and its constituent parts. The path of co-evolution is a mutually beneficial path into the future.

Co-evolution of complex systems is “the art to live in one tempo-world”, when not curtailing diversity but maintaining and developing it on the levels of elements and separate subsystems. Then, in a self-organizing society, it is necessary to cultivate a feeling of

responsibility of each state structure and of each individual for the whole in a plural and united world.

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A complexity science approach to resilience in the operation of networked infrastructure systems

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Abstract

Modern societies rely on goods and services provided by lifeline systems that are increasingly interconnected, interdependent and affected by global politics, economy, and climate change. The performance of lifeline infrastructure networks is, thus, the result of the interaction of natural, technical, and social systems. A complex systems approach referred to as the CoDAN framework was introduced by the authors (Gomez et al, 2014a) which accounts for complexity and the socio-technical nature of infrastructure systems in the context of risk assessment and management in the presence of natural hazards.

CoDAN stands for Complex Distributed Agent Network and recognizes infrastructure performance as emergent behaviour that results from decentralized decision-making units (i.e., agents that represent operators and institutions) and distributed physical processes (i.e., gradual deterioration, disasters, and maintenance actions). These local processes (both physical and social) add up in a non-linear dynamics that depends on how elements are connected to each other (i.e., on topology), hence, the appearance of the terms *'complex'* and *'distributed agent network'*.

Several types of analysis are enabled by the CoDAN framework. At the level of agents, the analyst may consider the evaluation of regulation policies for operating agents, cooperation vs. competition schemes, or decentralization strategies. At the network level, flows can be estimated as well as the probabilities of exceeding minimum flow thresholds, which allows for risk analysis regarding expected values of unmet demand (e.g., in electricity or water supply), as well as the design of strategies of maintenance and disaster-preparedness. At the level of components, several deterioration and disaster models can be used to account for different atmospheric conditions and relevant hazards.

Previous efforts in the development of CoDAN aimed at providing modules of network modelling, risk assessment, and optimal intervention of infrastructure networks. However, little has been done regarding coordination policies for agents and the effect of local decisions and interactions on global performance indices. This paper studies the effect of regulation policies for distributed operation of sub-networks, and its dependence on adequate strategies of inspection. In order to enforce regulation, it is necessary to assess performance, and while technically exhaustive inspection of infrastructure performance is costly, public perception alone is not fully reliable due to biases and lack of expertise. A combination of both is explored as a means to enhance accountability in infrastructure operation, which in turn improves governance from a cybernetic perspective.

Existing CoDAN modules include: supervised and unsupervised clustering methods to detect relevant sub-systems within infrastructure networks; multi-scale optimal resource allocation strategies to identify valuable sub-units for autonomous decision-making (Gomez et al, 2014b); state-of-the-art algorithms for the computation of network flows and reliability; and exact and heuristic optimization method to support decisions about preventive and corrective maintenance. The contribution of this paper is the development and adjustment of an agent-based model in which the relevant actors of the problem are accounted for and allowed to use these modules to pursue resilience of infrastructure networks.

Illustrative examples are presented in which agents face the problem of infrastructure operation, responding to uncertain growing demand and deterioration, and performing effective recovery and assistance after major disasters. Adequate decentralization schemes provide the flexibility to recover quickly in the context of emergencies in which communications and coordination from the central level are limited. During normal operation, however, the performance at the system level can benefit from investing in coordination and inspection to overcome unaligned interests at the agent level.

Keywords

Infrastructure networks; risk management; agent-based model; socio-technical modelling; decision-making.

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About the Authors

Mr. Gómez's main area of research is decision support in socio-technical systems,

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Professor Dueñas-Osorio's research focuses on computational and theoretical models for structure and infrastructure system reliability and risk assessment in the context of natural hazards, deterioration, and complex operation. Applications include the quantification of interdependencies across critical infrastructures systems, assessment of smart grid resilience, development of robust topologies for networked systems, design of lifeline systems using reliability-based methods, and evaluation of bridge system and bridge network reliability.

P2P Societies: The impact of Decentralization and Heterogeneity in Complex Systems

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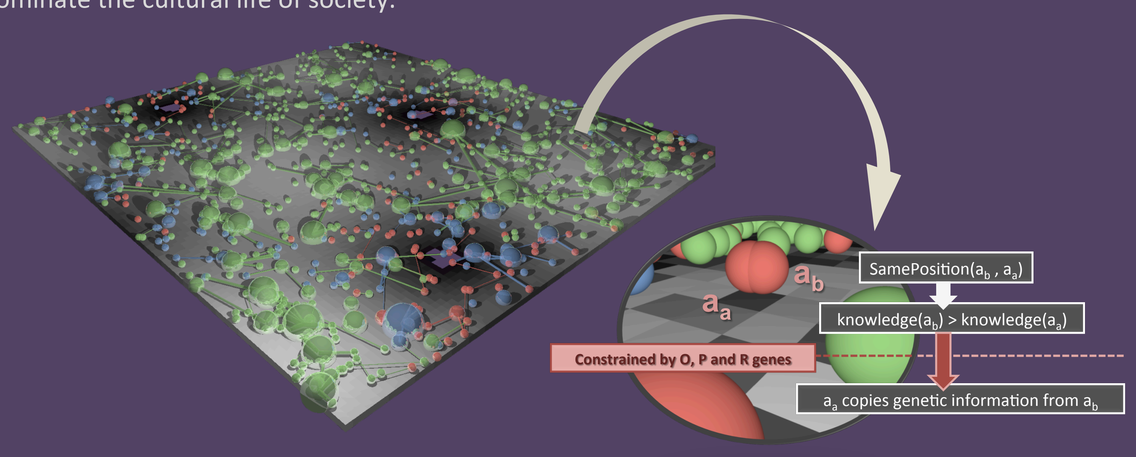
INTRODUCTION

Bacteria have demonstrated an amazing capacity to overcome environmental changes by collective adaptation through genetic exchanges. By using a distributed communication system called *conjugation*, bacteria propagate innovations that allow them to survive in different scenarios. We have developed a proof-of-concept inspired by conjugation that to test how, in artificial societies based on interactions among agents with bounded rationality, optimal results emerge by incrementing heterogeneity levels and decentralizing communication structures, leading to 'P2P Societies'.

BASIC MODEL

In this model, we have a set A with N agents (a_i). Each agent owns a genome that contains a specific strategy (s_i) to optimize a function. Depending on an agent's strategy, its knowledge level will be greater or lower. Then if an agent is able to optimize a given function in order to get a result with 70% of accuracy by using its own strategy, its knowledge level will be set to 70 and so on. Knowledge levels determine an agent's position in the social structure. So agents with a more successful genome will dominate the cultural life of society.



During simulation agents move randomly through a bi-dimensional grid. When two agents reach the same coordinates (x,y) they compare their knowledge levels. After that, the one with a lower knowledge (a_a) tries to get a copy of genome from the more successful (a_b). If the owner of the best strategy (a_b) does not share its strategic knowledge we will say that conjugative machinery to send plasmids is inhibited. Otherwise a_b will offer a plasmid with a copy of its genome to agents in the same coordinates and lower knowledge. Even though if the owner (a_b) allows the other agent (a_a) to get a copy of its genome and then improve its strategic knowledge, a_b can impose two restriction policies to that copy:

- *Inhibit reproduction:* The receiver of a plasmid (a_a) is allowed to use the strategy that is contained in the copy but it does not own the intellectual property of that strategy. Then plasmid cannot be sent to others once it is received. In this case the first owner (a_b) is the only one with reproduction rights on that strategy.

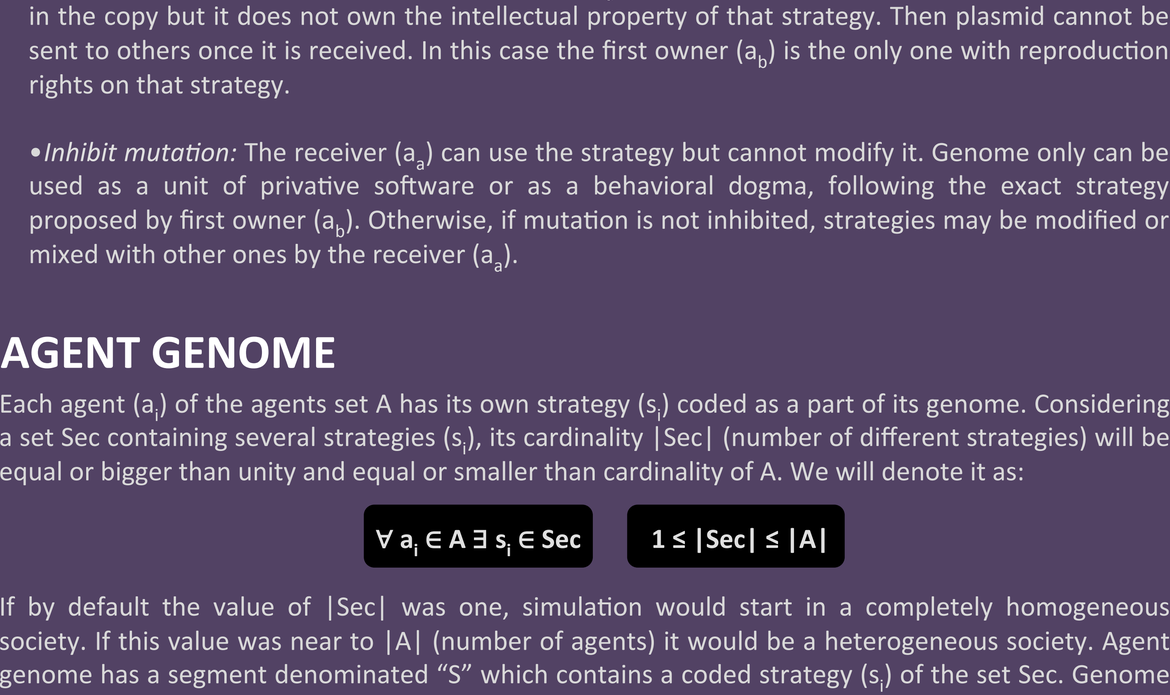
- *Inhibit mutation:* The receiver (a_a) can use the strategy but cannot modify it. Genome only can be used as a unit of privative software or as a behavioral dogma, following the exact strategy proposed by first owner (a_b). Otherwise, if mutation is not inhibited, strategies may be modified or mixed with other ones by the receiver (a_a).

AGENT GENOME

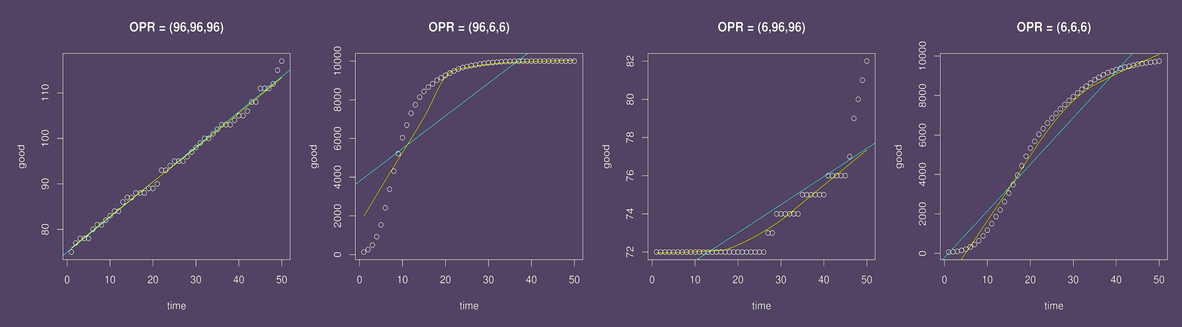
Each agent (a_i) of the agents set A has its own strategy (s_i) coded as a part of its genome. Considering a set Sec containing several strategies (s_i), its cardinality |Sec| (number of different strategies) will be equal or bigger than unity and equal or smaller than cardinality of A. We will denote it as:

$$\forall\, a_i \in A\ \exists\, s_i \in Sec \qquad 1 \le |Sec| \le |A|$$

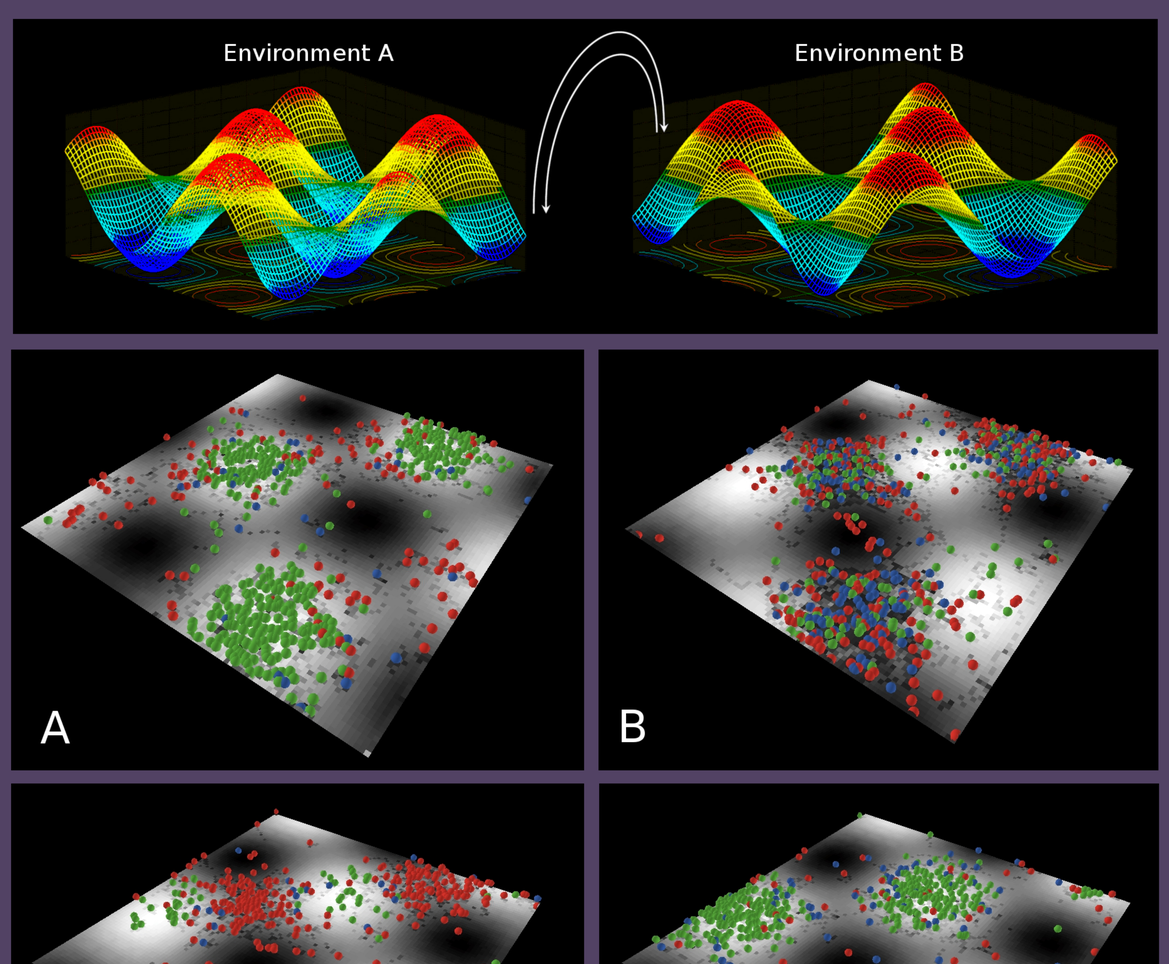
If by default the value of |Sec| was one, simulation would start in a completely homogeneous society. If this value was near to |A| (number of agents) it would be a heterogeneous society. Agent genome has a segment denominated "S" which contains a coded strategy (s_i) of the set Sec. Genome also can include another three sequences (P, R and O) which are related to the three constraints that we have described: inhibit **mutation (O)**, inhibit **original plasmid conjugation (P)** and inhibit **copy reproduction (R)**. The expression probability of these genes (OPR = O-Prob, P-Prob, R-Prob) will change the structure of the system.



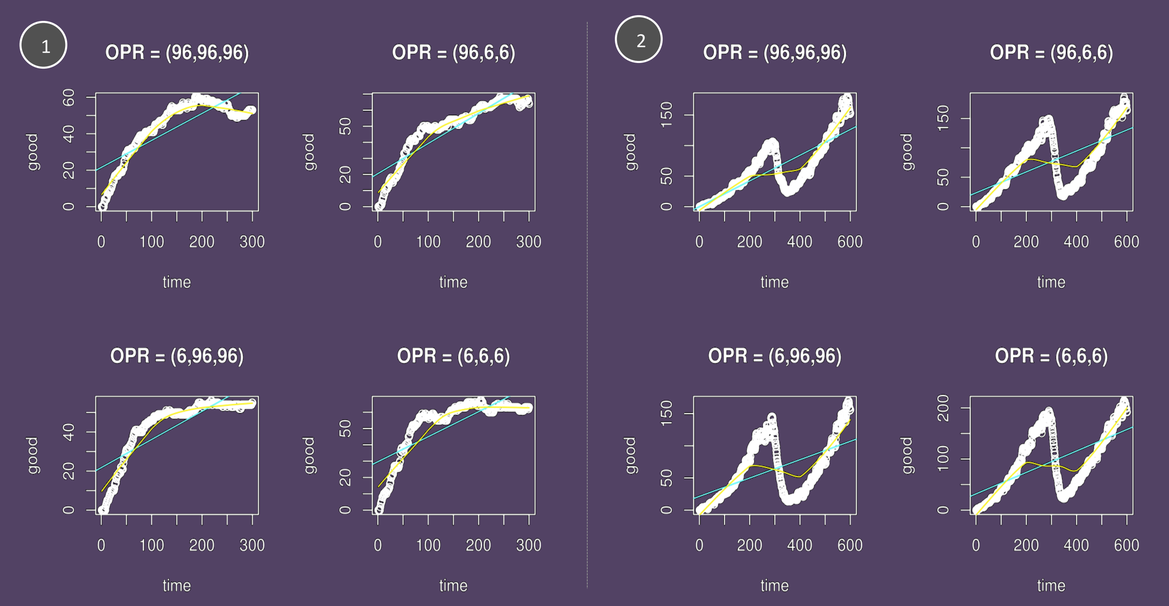
SIMULATION RESULTS



Basic model applied to optimize a function: Impact of OPR on production of knowledge. Plot of strategies with accuracy higher than 0.7 in four simulations of 10^4 agents during 50 iterations.



Extended model: Artificial life in a sugarscape-like scenario with dynamic distribution of resources. In this model, strategic genome (S) codifies motor behavior. Low O-Prob leads to heterogeneity of strategies and therefore to a resilient behavior. The (A,B,C,D) screenshots show the evolution of the system after the change from *Environment A* to *Environment B*. White levels represent resources concentration. Agent colors represent its energy: green means higher than 70 units, blue means between 50 and 70 units and red lower than 50 units. Decentralized systems perform better because they allow horizontal gene transference, that is, horizontal learning. Heterogeneity produces more innovative solutions preserving *nomadism* in *sedentary* communities.



Extended model: Impact of OPR on adaptation to a dynamic environment with a swift change from *Env. A* to *Env. B* at time = $3 \cdot 10^2$. Plot of strategies with accuracy higher than 0.7 in several simulations of 10^2 agents during $3 \cdot 10^2$ iterations (1) and $6 \cdot 10^2$ iterations (2).

CONCLUSIONS

With this model we wanted to show a proof-of-concept of bacterial-based algorithms. Furthermore, we pretended to use them to study CAS performance. We conclude that, in our model, centralized and homogeneous CAS perform worse in knowledge production than distributed and heterogeneous ones. We have tested this hypothesis by comparing bacterial-based societies with different configurations and observing how inhibiting plasmid conjugation, reproduction or mutation modifies the global fitness. It seems that a in "P2P Society", by sharing individual information among agents without communication constraints, optimal strategies and social development are achieved faster than in centralized and homogeneous ones. These differences can be better observed in dynamic environments such as the extended model in which bacteria adapt their motor behavior dynamically.

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The Paradox Closure-Openness in Organizations

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Keywords

Paradox, learning, organizational systems, TESO, meaning

Abstract

Systemic officials that have to deal with cybernetics because all systems need regulation, sometimes face ourselves with the paradox that Maturana and Varela (1972) used to call the closure of the nervous system with which they purported to portray the regulating apparatus of a living system (a closed system) which regulated the body (an open system).

We want to give an example on how our work group faced this issue when we worked with the Colombian government agency Colciencias which is in charge of managing and developing public policy regarding the Colombian science and knowledge production system. Our approach is intended to help develop flexible organizations, but State agencies have by their very nature, a tendency to be rigid. As our case is exceptional, given that Colciencias is in charge of coordinating the science, technology and innovation system of the country, it seems that what we call a paradox arises as a consequence of several factors that influence the agency's outcomes.

Introduction

Within the research program of our group at Universidad de Los Andes, we have been doing research for several years focusing on the development of theory and methods to

intervene in Colombian organizations regarding particularities of Colombian culture, as will be explained later in more detail.

We portend to show, with the help of one example, the state of the art we had achieved when we designed and put to work a project of organizational change as social design. We have developed a systemic approach called TESO (Lleras, 1997), which is a way to do participative design of organizations with technology. As a way of conclusion, we show certain achievements and paradoxes that emerged as outcomes of the process. In other papers we also show the follow up done 4 years later of what has happened in time with the intervention (Lleras et. al. forthcoming), and the software innovations we produced (Lleras and Ibagón, forthcoming).

Interventions are context dependent. We will use Colciencias, a State organization, as an example of a test for the use of TESO methodology as a way to design a flexible organizations in the improbable case of a State Agency, given the rigidity that pervades these agencies by way of legislation and organizational structure.

Colciencias was created in 1968 following the mandate of multilateral international agencies such as OAS and BID, and USAID, a United States agency. It was supposed to support the development of science and technology in line with post World War II ideology. It proposed that science and technology were strategic for third world development as they had been for the reconstruction of Europe and Japan after the war. The model proposed an articulation between the State and the scientific community (Dagnino and Thomas, 1966). The strategy proposed to create an infrastructure to support the transference of science and technology from the central countries to the periphery.

Between 1960 and 1970 Latin American research demonstrated that this model didn't operate in this part of the planet (Herrera, 1970, Sábato and Botana, 1970, Varsavsky, 1994, Vacarezza, 2011) because poverty, social unrest and cultural traits were not addressed from this perspective.

The creation of Colciencias went hand in hand with the improvement of research institutes and research public universities. The bulk of efforts in this line were focused on science for supporting the improvement of productivity (Ocampo et al., 1987) in contrast with the model that proposed to give more support to basic science. One of the moves Government made in that line of thought was the transfer of Colciencias from the Ministry of Education to the National Planning Office (DNP), and the creation of the National System of Science and Technology (SNCT) and national system for the promotion of innovation separated from the former.

In 2008 Colciencias hired us because they were planning to transform the agency into an autonomous Administrative Department (equivalent to a ministry in terms of power), and to give it the mandate to assume the management of the recently created System for Science Technology and Innovation (SNCTI). New resources were injected to it, and High Government declared it in charge of the "National Knowledge System".

The new stakeholders of the SNCTI to be considered were the regions with their varied knowledge producing agencies, the productive sector (businesses), universities, research centers, and others. They were supposed to be integrated by Colciencias via strategies

and policies. Compatible research and development agendas from different sources were supposed to integrate in order to create synergies to insert the country in a global world (Law 1286, 2009).

An ingredient, new for the country, was incorporated into the law. It was intended to support "social innovation". It was supposed to go hand in hand with "productive innovation."

Within this context we arrived for our intervention. It was part of a bigger strategy to "modernize" Colciencias. We worked using the TESO approach (Lleras 1997, 2007). Our version was tailored for Colciencias given the context particularities that we have tried to show above.

Methodology of intervention

The TESO approach is framed within three traditions: the emancipatory Latin American tradition which comes from the pedagogical approaches of Paulo Freire (1972,1975,1977), the Participatory Action Research (PAR) tradition (Fals Borda, 1988, Stringer, 1996, Salazar, 1992) and the Systems and Cybernetics tradition (Checkland, 1981, Beer, 1979, 1985, Espejo & Harnden, 1987, Espejo & Schwaninger, 1993) (For an extended bibliography cfr. Lleras, 1995).

The development of TESO was intended to be a response to the cultural conditions of Colombian enterprises (Weiss, 1992, Sicard, 1982, Lleras, 2007). The paternalistic and authoritarian colonial heritage contributes to the development of non-autonomic non-responsible persons. Jackson (1991) addresses these types of behaviors when he talks about coercive structures in organizations.

This condition is an opportunity to work with persons and teams to awaken their creativity and their initiative. Persons psychologically autonomous feel they can manage their own lives and act accordingly in their work if they perceive it to have meaning (Robinson, 2014, Maslow, 1998). These are what we call "emancipatory environments" or "habitats". A person feels comfortable in her habitat and relate to others accordingly. We postulate that the individual, and the groups as well, can be organized reinterpreting organizational cybernetics from the point of view of the actors within the organization as "enterprises within enterprises". This is a vision from within, in contrast with traditional organizational cybernetics approaches that visualize the structure from the outside (cfr. also Ulrich, 1994)

We understand a community as a social setting structured in such a way as to achieve goals. The notion of community also implies that every person has a "situated" relationship with the others, and that they can build consciously relationships of cooperation, trust, solidarity and meaning.

The work

Our intervention began in 2007, when the law was conceived, and ended in 2009. As said above, the reason for the intervention was the intention to "modernize" Colciencias. The law obliged it to coordinate the different participants in the NSCTI.

We intended to promote a participative design for this renewed organization. The main strategy we proposed was the building of work teams as "enterprises within enterprises", which were also "communities of learning" (Lleras, 2003). A "community of learning" is a habitat and an enterprise at the same time. As habitat, is a space that members build themselves (make world). This means that they construct, reflect, give meaning and produce their world permanently in an ongoing cycle. That leads them to belong.

The first challenge we had (and "we" are them and us) was to set up the conditions for the communities of learning to emerge. The notion of enterprise was easier since it has an intuitive meaning imbedded in everyday practices, whereas the community "emerges" after certain emotional moods appear such as attitudes, commitments, and practices oriented towards working with others.

The second challenge was to find out the form in which the officials in the organization, public servants, incorporated their new roles as co-managers of the SNCTI. They had a responsibility in the coordination of the knowledge-producing actors in the country.

The first step in our methodology was to go directly to each actor in the organization to make interviews structured in such a fashion as to develop a "dialogical mood" (Buber, 1965, Bohm, 1975). We then ask about which are the aspects of their work that give meaning to their lives. We also tried to create a reflective atmosphere for them to contemplate their own talents and those practices that give them pleasure.

We also worked with the top management of the agency for the setting up of dialogical spaces. Those spaces were specific times for reflecting together about the identity of the organization, the identity of the work teams, and the articulation between different practices.

The declaration of identity that emerged and was explicit had to do with the role of coordinating, supporting and orienting the country´s "Knowledge System" through the articulation of the different actors of the SNCTI and the enhancement of preferred types of relationships. We also suggested it was necessary to change from an obeying organization (provider of work orders) to an organization that makes possible the flourishing of initiatives and have autonomous yet coordinated practices.

We set up a diagnostic as well: First, something that happened to be very self- assuring for the officials, we found that the officials were well prepared and eager to go along with the experiment. There were identified certain barriers that prevented good performance in certain areas.

Second, they had to understand better what the SNCTI was. In particular, they had to devise the way to develop forms of monitoring and evaluating the implementation of public policies regarding the SNCTI, as well as how to coordinate the relationships between regions.

Third, they had to design and put to work a nationwide information system. They also had to design carefully a portfolio of services from Colciencias to the rest of the actors.

Fourth and last, they were a very fragmented organization both horizontally and vertically.

From the reflection spaces there emerged a proposal for a flexible organization that could deal with the several innovative proposals that came from different parts of the country. From universities, research centers, enterprises, government, communities, native dwellers reserves, youngsters associations, and so on and so forth. Here we found the first obstacle we call "paradox": the rules for accepting what was considered to be science were too rigid to account for all the variety of proposals produced in the country.

The flexible organization proposed was based on spaces for dialogue for understanding (Bohm, 1975), deliberation (Lleras, 2007, Brunning and Foster, 1997) and *ad hoc* teams for dealing with specific situations. Permanent and *ad hoc* teams were proposed to follow the notion of habitat as said before. Work tools were also designed *ad hoc* with the help of "lego boxes" of resources (Lleras, Ibagón, forthcoming).

The basic unit of action was called a "practice", which we define as an action with meaning.

We hope it is by now transparent that the main thrust of the approach is based on the person and the teams giving and experiencing meaning in their work and in their lives.

Enterprises within enterprises

Communication as tool for the coordination of actions (deliberation) was based on the notion of "speech acts" (Echeverría, 1996, Searle, 1969).

A person manages her workflow (Flores, 1972) and the importance of coordinating her "product relations" (Lleras, 1995, 1999). Each person and team has to develop her ability to "negotiate" and to be accountable. All these features are supported with the toolbox provided by the system and designed by the persons and teams.

In figure 1, we try to summarize how we devised the ways for the organization to build meaning systems through practices that lead to results, and how we designed in a participative way the support with information and communication technologies (TIC).

The organization as community of learning is a pedagogic space as well. We devised ways develop in officials the ability to observe relationships. We emphasized relations of power (power-over, power-with); communication (speech acts); and production

(indexes for quality, opportunity, pertinence, effectivity and aesthetics), with regard to products.

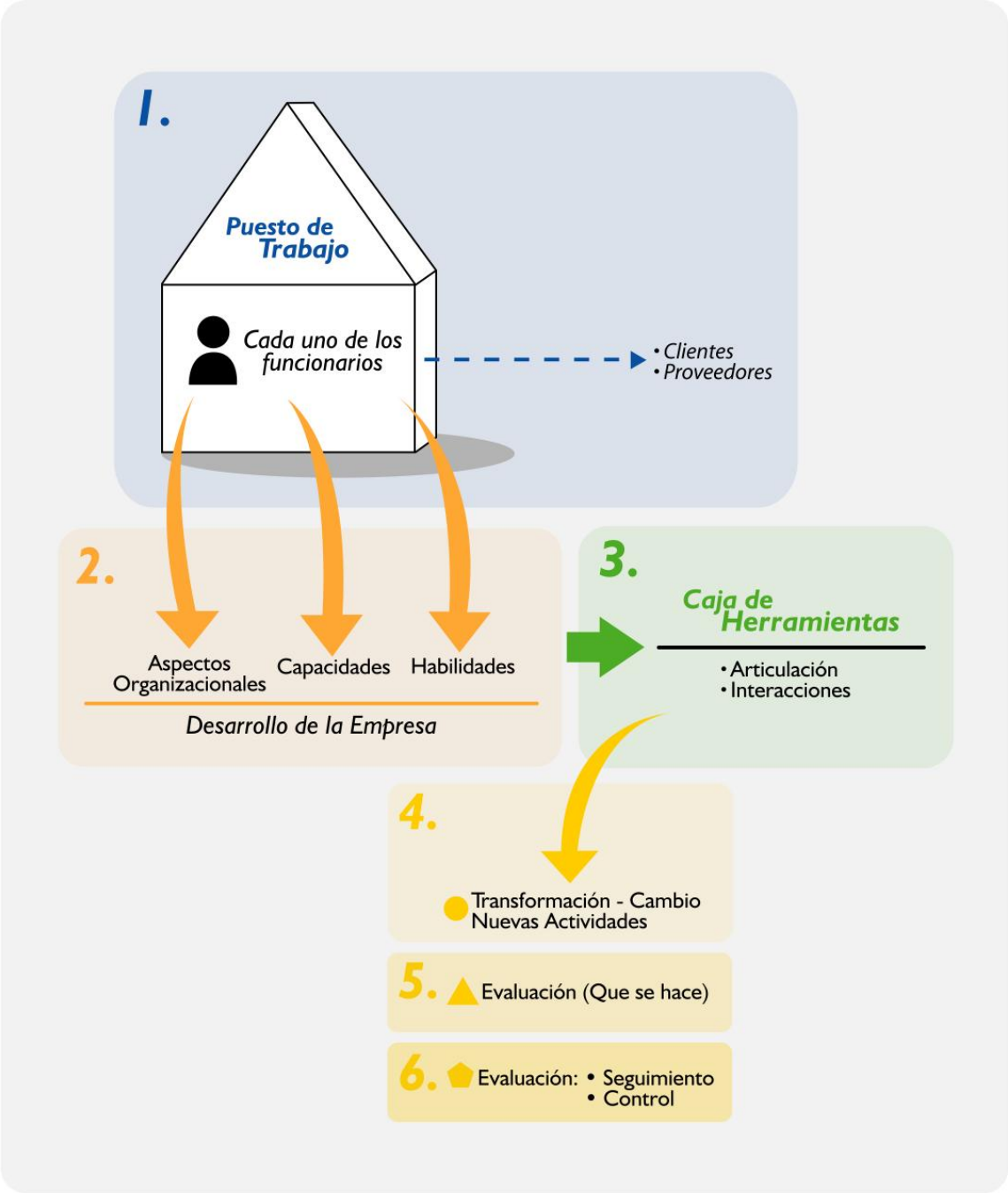

Figure 1 Devising the ways for the organization to build meaning systems through practices.

Tools for observing were the "log book" (bitácora), the "fact sheet" or "work notebook" (cartilla) provided by the organization but actualized by officials according to new events in everyday practices.

Elements for effective and flexible organizational teams are modeled after the enterprise model provided by organizational cybernetics (Beer, 1985, Espejo and Schwaninger, 1993, Espejo and Harnden, 1987), but they are adapted in a flexible way by means of

the developed capacities for observing relations, realizing moments of "truth" (realization of realization), and spaces for dialogue.

Layers

As a way to understand organizational complexity we also proposed a layer schema for helping to see different aspects. They are sketched in Figure 2.

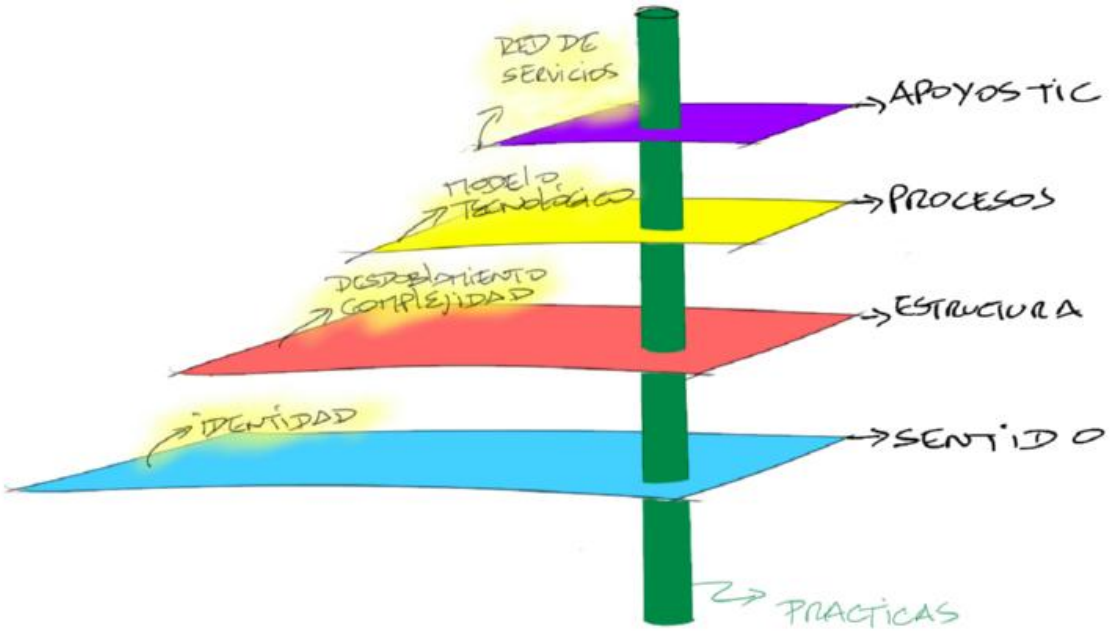

Figure 2 Layers schema.

The basic layer is that of meaning based on identity, but also on what we could call identity "in use", which is a way to approach what is and also what should be. Upon it one can visualize the organizational structure, that is, the primary activities and the different relationships between them, the process structure, how practices interact, and the information infrastructure, basically the data and the ways to retrieve and use them.

This method presupposed that they could change their practices according to exigencies of the environment, and accordingly adapt new structures and processes. However, to change practices is impossible if they are to follow the rules that come from the laws. It is also impossible to change processes and structures that are set up by decrees and ordinances

The layers schema allows a fast overview of the whole system for any person to reflect upon the possibilities to change it. But in practice, it was also too ambitious to expect that officials, used to follow rules in static environments, would adopt this new way of

behavior. That is, they would be reflecting not only on outcomes of the system, but on a second order way of thinking they would also be expected to reflect about.

Final Reflections

This was a consulting and experimental project in which we were expected to redesign and test in a participative manner this State Agency. They were actually in need of our support since they were in the process of transforming the organization from a mere financing agency to a "knowledge management" department at the level of a ministry.

Our way to intervene an organization is also paradoxical. It does not intend to impose *a priori* models but depart from a proposed model. We propose to develop jointly different layers of organizational structure. This process of co-construction generates new organizational forms, new practices and new communication schemes, but we found that it takes more time than we had proposed.

This is a process of learning in two terrains: the terrain of the research-consultancy and the terrain of the organization. And we call these aspects terrains because the epistemic bases as well as the learning constitutive interests are different in both cases. The research-consultants want to refine their ability to understand systems and its capacity to generate new practices.

First paradox: we tried to build up, joining them a flexible organization to enhance the creative potential of the country. But we didn't count on the belonging of Colciencias to the State bureaucracy. This fact prevents Colciencias from being flexible.

Second paradox: the State agency rules prevent the success of the new attitudes and reflective behaviors that we intended to make emerge in the community. This shows that it is necessary to work in more depth at higher levels of the State organization, and to introduce institutions to reflect on the results of public policy implementation.

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5

Systems Democracy, Citizenship and Civil Society Self-organisation

Colombia: diseñar democracia local para la ciudadanía activa

German Bula

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Abstract

La democracia colombiana es la más antigua de América latina, su calidad actual es baja y tiende a deteriorarse, a más de enfrentar una singular coyuntura proveniente de las conversaciones de paz con las FARC. El *back and forth* colombiano en materia de partidos políticos expresa un claro "dilema del control". Aún actores progresistas so pretexto de fortalecer los partidos políticos sufren de ceguera sobre el rol de la democracia local al no ver de manera sistémica y recursiva al Estado. Es urgente e indispensable introducir reformas específicas que liberen de trabas a la participación política electoral local. Esta expresa otro arquetipo: la carencia de autonomía y la ausencia de clausura; los partidos políticos del nivel de recursión del Estado-Nación someten a la ciudadanía y el impiden jugar su rol como sistema cinco a nivel local.

Introducción.-

Cómo intervenir en las reglas de juego de la democracia para que sea más inclusiva? Stafford Beer en "Diseñando libertad"[1] (el propio título es, como se sabe, un oxímoron) plantea: *"On the electoral side we lose the freedom we have, when our variety is attenuated, because we are not asked how the attenuation should be done"*. En Corea del Norte, ejemplo extremo, la complejidad es dramáticamente reducida en tanto el voto es binario: SÍ o NO se elige al candidato único del partido único. La debatible pero existente democracia de Colombia (gobernada por presidentes constitucionales durante 174 años, y por líderes de facto durante solo ocho años -el 4.4% del tiempo) permitirían ver en acción el poder de la aplicación de las *techniques of cybernetics* -la ciencia de la organización efectiva-, para diagnosticar y diseñar ingeniería de variedad. Como señala Beer *"The aims of society are of course a set of variety attenuators"*, pero cuáles y cómo diseñarlos, he ahí la cuestión. El *back and forth* colombiano en materia de partidos políticos semeja en el nivel de recursión del Estado Nación lo que Espejo ha denominado "dilema del control"[2]. La ausencia de criterios científicos en el diseño de reguladores de la democracia afecta discursos progresistas que poseen logros y potencial para profundizarla, como el "neoconstitucionalismo"[3]. Más allá del amplio debate dentro de y en relación con la

[1] Beer, Stafford, (1993). Designing Freedom. House of Anansi, Ontario

[2] Espejo, Raúl, http://www.syncho.com/

[3] El reconocido profesor español Manuel Atienza, en conferencia pronunciada en el aula Máxima de la Universidad del Rosario en la celebración de los cien años del Consejo de Estado de Colombia, descalificó el término de "neoconstitucionalismo" al que considera innecesario; reconoció que había tenido éxito en el escenario latinoamericano y se arriesgó a especular que podría tratarse de un particular gusto regional por las palabras largas y compuestas. Bogotá septiembre de 2014.

corriente del constitucionalismo mundial, aquí se hace referencia en sentido lato al positivo papel que vienen jugando las Altas Cortes en Colombia, y en particular la Corte Constitucional, en la promoción activa del Estado Social de Derecho con base en la Carta de 1991, y al mismo tiempo a la deficiencia del enfoque que esta última ha utilizado en relación con el tema específico de los partidos políticos en el cual pareciera que no hubiese atendido las mínimas reflexiones hechas por Ferrajoli para un enfoque sobre el asunto que merezca ser considerado como de corte "constitucional"[4]. El no ver de manera sistémica y recursiva al Estado lleva a la ceguera sobre el rol de la democracia local. Se puede sostener que, sin perjuicio de la necesidad de emprender un ejercicio de ingeniería de variedad integral sobre el sistema político, es plausible la hipótesis del rol muy positivo –diríase indispensable- de estructurar reformas específicas que apalanquen dinámicas ampliadas de cambio en la cultura y la estructura políticas. Resulta claro en Colombia, y urgente, liberar de trabas a la participación política electoral local.

1. **Una democracia persistente en proceso de degradación y sometida a amenazas de corto plazo.-**

La última dictadura y "la violencia" que enfrentó a los dos partidos terminaron con un acuerdo entre estos en 1957, el llamado "Frente Nacional" que consagró el bipartidismo excluyente hasta 1974. Los dos "partidos tradicionales", el liberal y el conservador, acordaron alternarse en el poder y repartir la burocracia del Estado entre ellos por partes iguales. Una breve descripción de la relación entre esos acuerdos y la emergencia de la violencia reciente puede ser planteada así:

> El Frente Nacional bipartidista sirvió para poner fin a la violencia partidista, pero dio pie a la emergencia de una nueva violencia guerrillera de izquierda. El origen de las FARC está ligado a los reductos guerrilleros de la violencia anterior, como es harto conocido. Ese es el hilo histórico que liga ambas violencias y al que subyacen factores que aún no se han resuelto.
>
> Un segundo hilo que confluye al trenzado de la nueva violencia es el arriba mencionado cierre de espacios a los partidos políticos diferentes de las colectividades tradicionales liberal y conservadora, el cual permitió la aparición fundamentada de un discurso político rupturista que planteaba el agotamiento de las vías legales, por mera sustracción de materia. Era elemental sostener que los dos grandes partidos habían monopolizado el poder y que por tanto los movimientos y partidos políticos de los obreros y campesinos y el anti imperialismo no tenían otra salida que la lucha armada. No obstante, los dos hilos mencionados –reductos de guerrilla y justificación por exclusión política-, no tenían capacidad para trenzarse solos.
>
> Un tercer hilo juega la función trenzadora: se trata de los movimientos y partidos de izquierda influidos por los acontecimientos en el movimiento socialista mundial que acaecen precisamente por la época en que comienza el Frente Nacional: La revolución cubana de 1959 sobre cuya influencia en América Latina no es menester recabar, y la división del comunismo mundial en 1962 entre las líneas maoísta y soviética. Estos hechos internacionales influyeron sobre las formaciones políticas de izquierda en Colombia de manera que sus múltiples divisiones giraron alrededor de validar o no la lucha armada y la participación electoral –a más del punto de "honor" de a cuáles teóricos mundiales seguir-. Lo que aquí interesa señalar es cómo la alianza en forma de cerrojo entre liberales y conservadores concitó una respuesta de desafío armado. El discurso revolucionario de la

[4] Ferrajoli, Luigi, 2011, Poderes Salvajes, Minima Trotta, Madrid.

época enfilaba baterías, en lo político, específicamente contra estos dos partidos y su conducta excluyente de conducción monopólica conjunta, alternación en el poder y reparto de la burocracia del estado.[5]

Posteriormente acaecieron hechos trascendentales de signo diverso con guerrillas, narcotráfico y corrupción política; el asesinato del líder Luis Carlos Galán terminó por desencadenar la indignación nacional y el clamor por una Asamblea Constituyente. Galán había acertado en la caracterización de la crisis colombiana como una "crisis de transición"; su muerte significó un hito en ese proceso que aún no termina. Contraponía crisis de transición a crisis de madurez, esta última de posible ocurrencia en países desarrollados. En Colombia se trataba de transiciones demográficas, económicas y sociales hacia la modernidad a las que había que acompañar con un proyecto político que las pudiera albergar. Así, pues, la Asamblea Constituyente fue mirada en esos tiempos como herramienta clave en frente a los desafíos de impulsar la dinámica de las diferentes transiciones, de la crisis de transición.

La nueva Constitución (1991) abrió puertas para superar el Frente Nacional pactado entre los dos partidos. Para 1998 el número de partidos había aumentado a 64!!. En términos de regulación se pasó de un periodo de democracia que se restringía a dos partidos, a uno de desregulación cuyos resultados constituyeron una *unintended consequence*: ahora se criticaba la balcanización política y la proliferación de microempresas electorales. Las mayorías parlamentarias aprovecharon la situación y reformaron la Constitución en 2003 y 2009 en dirección restrictiva otra vez. Para 2010 los partidos se habían reducido a 9.

Este regreso a las restricciones se cobija bajo el discurso de que la democracia necesita contar con "partidos políticos fuertes", y restringir su proliferación -vía regulación- para elevar la calidad de la democracia.

En lo que sigue se sostiene que esas restricciones, aplicadas sobre la participación política local, castran la democracia en vez de profundizarla o fortalecerla. La visión lineal hacia un propósito consistente en una entidad inerte -partidos fuertes-, desconoce la dinámica de la participación política ciudadana y el rol real de los partidos. La persistencia de la democracia colombiana no parece estar en juego en términos coyunturales, pero las posibilidades de que el país salga de la crisis de transición están comprometidas por la mala calidad de la democracia, a la cual han contribuido las reformas políticas restrictivas a que se ha hecho referencia.

Sin perjuicio de lo anterior deben reconocerse nubarrones provenientes de lo que podría ser una desafortunada combinación de factores estructurales, culturales, tendenciales y coyunturales, alrededor de los resultados que pueda arrojar el proceso de diálogos de paz que se adelanta en la Habana con representantes del las FARC. En efecto, se está frente a una democracia estructuralmente comprometida como consecuencia de la degradación de la compraventa de votos que ha terminado por generar una cultura popular del tipo que practicaba el campesinado ruso en el siglo XIX, "cada uno por sí y Dios por todos", y es evidente una tendencia al agravamiento de esta situación (el costo reportado de las campañas políticas crece en pesos constantes en cada elección y ha alcanzado montos que solo se explican en clave de una dinámica que fuerza a que los aspirantes entren a saco en el erario para cubrir su inversión, obtener ganancias y apertrecharse para la próxima

[5] Esta reflexión, con algunos ajustes, en Bula, Germán, "LIMITACIONES DE LA CONSTITUCIONALIZACIÓN EN LA PROFUNDIZACIÓN DE LA DEMOCRACIA COLOMBIANA: ATENCIÓN A LA POBLACIÓN DESPLAZADA, UN ESTUDIO DE CASO". Tesis de Maestría. IAEE. Bogotá, 2013.

elección). Resta por ver lo que acontecerá a esa frágil democracia con la entrada en la escena política de los miembros desmovilizados de las FARC. Al respecto no parece plausible la hipótesis de adelantar nada diferente de especulaciones que van desde ver a la izquierda desarmada como un grupo con poder económico suficiente para entrar en el juego de la democracia plutocrática de forma que el andar errático y decadente de la democracia colombiana no cambiaría, hasta concebir a esa misma izquierda como una alternativa de limpieza política que por tal condición estaría en capacidad de superar entre las masas a las cansadas propuestas de la corrupción política electoral y hacerse al poder con un discurso populista que derivaría al final en un desastre de corrupción y desgreño a nombre del socialismo como en Venezuela, pasando por escenarios más optimistas consistentes en la aparición de nuevas fuerzas políticas y tendencias en el seno de las organizaciones existentes que emergerían desde la democracia local y la ciudadanía, y pondrían una impronta de buena política al conjunto de la democracia. En todo caso aquí se postula la necesidad de ciudadanía activa como clave para la viabilidad y fortalecimiento de la democracia colombiana en medio de la coyuntura de diálogos de paz.

2. **El recurrente debate sobre reforma política y la cuestión de la ciudadanía activa.**

El país ha vivido permanentes debates y cambios en relación con su nueva Constitución de 1991, en particular en materia política. En la actualidad se viven intensas discusiones en torno a un proyecto gubernamental de reforma constitucional al que se ha denominado de "equilibrio de poderes"[6], nombre que originalmente le viene en realidad de solo uno de sus componentes, a saber la eliminación de la reelección presidencial, que no fue parte de la Constitución original de 1991 sino producto de una de sus modificaciones, y cuyos resultados han sido desafortunados. Como es natural en este tipo de debates parlamentarios cada día trae un afán y una noticia distintos, a medida que las distintas líneas políticas van logrando introducir sus puntos e intereses. Véase cómo registra el prestigioso blog "La silla vacía" dicho fenómeno a fines del mes de septiembre:

> "La discusión sobre el proyecto de equilibrio de poderes continúa y a medida que avanza, se vuelve más una amalgama de reforma política y judicial.
> Los nuevos cambios aprobados, en la primera de ocho instancias ayer, incluyen que las listas al Congreso sean cerradas y con forma de cremallera (es decir, hombre-mujer-hombre-mujer), la prohibición de que se reelijan los encargados de las ías (Contraloría, Defensoría, Fiscalía y Procuraduría) y -por enésima vez- la muerte del Consejo Superior de la Judicatura. Habrá que ver lo que el nuevo día de debates traerá a la mesa."[7]

De los temas políticos en discusión, además de la eliminación de la reelección que es el único que tiene amplio consenso, hay otros tres que interesan a la reflexión de este artículo: la eliminación del voto preferente y la consecuente implantación de la lista "cerrada" (para pasar a votar solo por la lista ordenada del partido y no por cualquier nombre de la lista a elección del elector como se hace actualmente). Modificar la elección nacional de senadores para consagrar una fórmula mixta que incluya senadores por reparticiones territoriales. La circunscripción uninominal por distritos electorales en el caso de la Cámara baja (de Representantes) con el propósito de fortalecer la relación entre electores y

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[6] "PROYECTO DE ACTO LEGISLATIVO No 018 de 2014"

[7] La Silla Vacía. En otros medios. 26 de septiembre 2014. http://lasillavacia.com/content/las-cuatro-patas-de-la-silla-xxx-48665

elegidos. Estas regulaciones podrían beneficiarse de la aplicación de las técnicas de la cibernética.
No obstante, el clima que preside el debate actual no ofrece perspectivas halagüeñas. Más allá de su nombre pomposo ("equilibrio de poderes"), y a pesar de que juiciosos columnistas sugirieron separar ordenadamente los temas políticos de los que atañen a la Justicia, el poder ejecutivo optó por presentar un paquete no sistemático que ha generado reacción en la Rama Judicial. Se afirma por los críticos que el proyecto se inició como una alianza entre el gobierno y un sector parlamentario, al que ahora no puede controlar, que amenaza con aprovechar la iniciativa para auto dispensarse privilegios y garantías, las cuales intentan pasar bajo la mampara de una reforma a la justicia. Con independencia de que la maniobra use como parapeto a la Justicia (explotando un justo anhelo reformista que se respira en la opinión en cuanto a la Rama Judicial), lo que es incontrovertible es que el Congreso y el Ejecutivo no muestran preocupación alguna por la solución de un problema basal de la democracia colombiana, a saber la corrupción electoral que se expresa en la masiva compraventa de votos y el consecuente resultado de "oclocracia" (gobierno de los peores) en la mayoría de las administraciones locales.
Una de las preguntas que preside los debates apunta a la estructuras de pesos y contrapesos y en general a cómo diseñar mecanismos y sistemas de control que garanticen la prevalencia del Estado de Derecho en relación con todos los poderes. Desde las discusiones de la Constituyente de 1991 hasta la fecha se han diseñado variados en ingeniosos esquemas que van desde conservar la actual Comisión de Acusaciones del Congreso –a la que se ha llamado "de absoluciones" porque no disciplinó a nadie en décadas de existencia miserable e inocua-, hasta la creación de una nueva supercorte, un altísimo tribunal disciplinario a cuyo cargo estaría juzgar a los más altos dignatarios del Estado, los magistrados de las Altas Cortes, los parlamentarios, el Fiscal, el procurador General y el Contralor. Como es de esperarse siempre surge la pregunta de quién nombra a la supercorte y, más clásico aún, quien controla a la vez a sus integrantes. La llamada "clase política" constituida centralmente por los parlamentarios activos quiere elegir ella a la supercorte, y controlarla, en un bizarro ejercicio de "yo te controlo, tú me controlas", una especie de ouroboros, una culebra que se come su propia cola. De allí que muchos críticos hayan señalado que no se trata de "equilibrio" sino de un mayor desequilibrio de poderes a favor del Congreso y en contra de la Justicia en particular.
La degradación de la política ha traído consigo el abandono de fundamentos democráticos elementales en los enfoques de quienes ostentan la condición de líderes políticos contemporáneos en Colombia. No es de extrañar entonces que la cuestión crucial de la ciudadanía activa, única capaz de responder por un ***control*** que sea un auténtico "sistema cinco", no merezca la menor atención en los tiempos que corren.

3. **Visiones "desde arriba" y "desde abajo".-**

Ni la nueva Constitución ni las sucesivas reformas políticas han logrado mejorar la calidad de la democracia política. Como Tántalo y Sísifo la Nación colombiana no logra salir del estado de corrupción política que a finales de los años ochenta la llevaron a cambiar la Constitución para ver de superarlo. El desprestigio de las instituciones crece al mismo tiempo que la ciudadanía no da muestras de estar dispuesta a superar sus pésimas costumbres electorales que han llevado a que el conjunto del edificio político se asiente sobre una base espuria. Desde lo local la compraventa del voto infecta las alcaldías y concejos municipales, las gobernaciones y asambleas departamentales, los partidos

políticos en sus reparticiones de base, etc. De ahí surge un Congreso que tiene la capacidad de extender la infección antidemocrática a otras instancias como los entes de control y la Justicia, sin que la gente advierta por qué canales llega a estas la corrupción. El Ejecutivo somete parte de su acción a la presión parlamentaria por la vía del conocido "pork barrel", y el resultado final es un monumental desperdicio de recursos comprometidos en corrupción y los consecuentes escándalos que estallan en todas partes y que, de cara a la opinión pública, comprometen a la institucionalidad en su conjunto.

Para algunos pareciera que se está a punto de lograr la transición hacia "una democracia consolidada con una gobernabilidad democrática eficaz", y se liga este paso a la consolidación de una izquierda democrática[8]. Esta visión ideológica de lo que sería un diseño idealizado de democracia pone foco en si la izquierda tiene presencia en la vida política nacional, de manera que reproduce viejos paradigmas de dilemas inclusión-exclusión propios de la historia latinoamericana que a estas alturas ya no resuelven la cuestión de la profundización de la democracia: son condición necesaria pero en manera alguna suficiente.

Es un estereotipo proveniente de la ciencia política centrada en el Estado-Nación el no considerar los distintos niveles de recursión; por ende, las propuestas de reforma se muestran negligentes con lo local. Los cambios constitucionales (1985-1991) pretendían enrumbar al país hacia la democracia local con la elección popular de alcaldes y gobernadores. Las nuevas instituciones produjeron olas de entusiasmo ciudadano en forma de movimientos cívicos locales que con mayor o menor éxito desafiaron a las viejas castas dominantes en las municipalidades. Sin embargo esa apuesta por la autonomía local no tuvo apoyo ni seguimiento y antes bien lo que se evidencia es un retroceso hacia el centralismo, asociado al predominio de los partidos que a su vez operan como centralizadores de un poder que se suma al peso del Estado sobre el ciudadano.

Los partidos mayoritarios han hecho cambios –restrictivos- que benefician su monopolio de poder, y solo miran el sistema político "por arriba". Mientras, abajo, la opinión se aterra con la captura de los municipios en manos de una corrupción "integral" en la que la corrupción electoral opera como gran dinamo del resto de las conductas depredadoras. El entusiasmo cívico por la democracia local casi desapareció bajo el peso de las restricciones a la participación política ciudadana impuesta por los partidos en su beneficio.

Una corriente de pensamiento jurídico, la Constitucionalización del Estado y el Derecho, viene tomando fuerza en América Latina y se erige como una alternativa de profundización democrática en la medida en que implica el compromiso del Juez con los derechos de la ciudadanía consagrados en la Constitución, en una tesitura que se aleja del tradicional rol judicial más bien pasivo. Esta posibilidad ya ha dado sus primeros frutos en Colombia en bien de la democracia y los derechos ciudadanos, pero podría frustrase y producir una reacción lamentable si no se cuidan las relaciones entre las nuevas capacidades jurisdiccionales y las variables principales -no jurídicas- que codeterminan las posibilidades de efectividad de aquellas. No hay ciudadanía sin democracia ni democracia sin ciudadanía.

La democracia inclusiva requiere de un proceso "de abajo hacia arriba". La Corte Constitucional en relación con los Partidos va en contravía del Estado constitucional: favorece que estos sean instituciones que aumentan las asimetrías de poder entre el establecimiento y la ciudadanía y no mecanismos de regulación y de absorción de variedad. Así las cosas no se vislumbran fuerzas en los estamentos dirigentes que tengan la claridad y

[8]Cepeda, Fernando, Uniandes, 2012.

la voluntad para introducir reformas que apunten a remozar la democracia local y a generar espacios para la emergencia de ciudadanía activa. Los tres grandes poderes –ejecutivo, legislativo y judicial- conjugan sus esfuerzos para mantener el actual estado de cosas, de manera que la situación, como ya se mencionó, tiende a agravarse.

4. Autonomía local versus partidos políticos nacionales: un arquetipo[9].

El arquetipo de la realidad política del municipio colombiano lo muestra, en general y cuenta tenida de la existencia de un porcentaje de voto de opinión aún existente, como un sistema organizacional sin clausura y por ende sin autonomía. Su sistema cinco[10] ha sido despojado de su capacidad de decisión política, subrogada por el sometimiento de la masa a la degradación de la compraventa del voto. Como es de esperarse aparecen brotes de feed back negativo cuya operación tendría la virtud de corregir las desviaciones del sistema, resultado que fue evidente en las primeras elecciones populares de alcaldes, antes de que los partidos en el Congreso impusieran restricciones a la democracia local. Esas regulaciones provenientes del nivel de recursión del Estado-Nación desestimulan la acción ciudadana para subvertir el orden de cosas corrupto ganando alcaldías en muchos lugares. De paso desestimulan la participación ciudadana en general: el sentido de identidad ligado a la clausura del sistema organizacional no aparece con espacio suficiente, y la ciudadanía ve su suerte librada al rumbo de los acontecimientos en el orden nacional, y no se observa a sí misma como con libertad para crear significados en la vida política. En tales circunstancias se dificulta el empoderamiento ciudadano y se perpetúan las nefastas castas locales con todas sus consecuencias adversas a las posibilidades del desarrollo humano.

La ley es producto del Congreso y los partidos políticos son dueños de este. En consecuencia no hay nada de extraño en que esos partidos dicten leyes que refuercen su monopolio del poder político. El ejecutivo entrega al legislativo esos espacios como parte de su negociación por gobernabilidad y las Altas Cortes se equivocan de plano al apoyar a los anteriores so pretexto del fortalecimiento de los partidos. Todas las anteriores son estructuras institucionales que pertenecen al nivel de recursión del Estado-Nación, en tanto que las municipalidades son subsistemas y por tanto niveles de recursión obviamente inferiores. Desde el punto de vista de la geografía política entre el municipio y la Nación existen los llamados Departamentos cuya pertinencia se discute todo el tiempo desde 1991 en clara muestra de su escasa importancia; no serán tomados en cuenta en esta reflexión, entonces, en la medida en que no afectan en absoluto la cuestión que aquí se debate.

Se ha venido hablando en este documento de restricciones a la participación política local, ¿de qué se trata? La regulación sobre el ejercicio de los derechos electorales de la ciudadanía obliga a que cualquier aspiración a un cargo de elección popular deba contar

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[9] Raúl espejo ha desarrollado una treintena de arquetipos de disfunciones organizacionales con base en el modelo de sistema viable (VSM) y el método VIPLAN. Se pueden consultar sus trabajos en http://www.syncho.com/ . Por ejemplo: Espejo, R. (2008), „Observing organisations: the use of identity and structural archetypes"

[10] Con base en la misma http://www.syncho.com/ es interesante volver sobre la experiencia de Cybersyn a este respecto, desde la mirada de Raúl Espejo: "One of Beer"s preoccupations as the project evolved was the inclusion of the people in policy-making processes. This was a concern for an inclusive democracy, giving policy-makers the chance to align their purposes with those of the people. This concern was articulated in an off-shoot of Cybersyn; the project Cyberfolk. Presidente Allende"s utterance "at last the people" as Beer explained to him the VSM was its origin. Cyberfolk was a technology aimed at including the people in policy processes; it was an attempt for a real-time response of the people to politicians as they discussed a policy in a public space". Cybernetics of Governance: The Cybersyn Project Chile 1971-1973

con un aval de una organización política reconocida, vale decir una que cuente con personería jurídica. Si grupos ciudadanos quisieran apartarse de la estructuras políticas existentes tienen que conseguir firmas y otorgar garantías bancarias lo que los coloca en franca desventaja; se trata de desincentivos que buscan obligar a la ciudadanía a alinearse en los partidos políticos so pena de que prácticamente desaparezcan sus derechos políticos. Ya se explicó el *corsi e ricorsi* del enfoque sobre los partidos que llevó a plantear una gran apertura en la CP del 91 y luego condujo a reformas constitucionales restrictivas en 2003 y 2009. En ese ir y venir quedó restringida la posibilidad de aspirar a la alcaldía y al concejo municipales en tanto y en cuanto cualquier ciudadana que desee hacerlo está obligada a conseguir un aval político como se indicó. Lo anterior equivale a que el nivel de recursión municipal está sometido al nivel de recursión nacional, y por tanto se constituye en un arquetipo de falta de autonomía.

En términos de narrativa es fácil imaginar la situación de un grupo de ciudadanos que estuviesen indignados con la grave corruptela local. Con suerte lograrían entusiasmar a unas y unos valientes para colocarse en la posición de aspirantes a la alcaldía y al concejo municipal –a sabiendas de las escasas posibilidades de superar con un discurso renovador de dignidad y esperanza etc., al poder del dinero dispensado a chorros para comprar votos de la masa desmoralizada en medio de una mísera democracia local secuestrada-. ¿Cuál sería el paso siguiente? Conseguir un aval político; pero la "causa" se vería de inmediato afectada por el uso de un tal aval de cualquiera de los grupos políticos, y la ciudadanía no vería una alternativa sino algo así como "los mismos con las mismas". En tales circunstancias los movimientos cívicos que quieren representar el cambio de las costumbres políticas se ven obligados a recoger firmas de la ciudadanía y otorgar pólizas de garantía bancaria, en fin, a trasegar caminos difíciles en franca desigualdad.

Una salida digna pero inefectiva es el voto en blanco que ha forzado la repetición de dos elecciones[11]. La revista Semana registra como de importancia el que por firmas se hayan ganado 3 alcaldías capitales y 7 gobernaciones[12], dato cuya lectura puede hacerse también en negativo, no solo por cuanto cualitativamente no en todos los casos se trata de auténticos movimientos ciudadanos (los hay que detentan el poder y usan la recolección de firmas como una pre-campaña), sino que en otros (en Bogotá D.C., por ejemplo) deben su victoria a la división de las otras fuerzas pero no alcanzan la mayoría absoluta. Esa misma revista recoge el rol crucial que juegan las coaliciones, aunque olvida mencionar el hecho de que en todos los casos –con independencia de si el candidato se inscribe a nombre de un partido específico o de una coalición-, son agrupamientos coyunturales los que se disputan las alcaldías. Una buena descripción de esa dinámica se puede leer en "Desde abajo"[13]

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[11] En el Departamento del Cesar y en el Municipio de Bello (Antioquia).

[12] Revista Semana, POLÍTICA | 2011/10/30, ¿Cómo les fue a los partidos políticos? Dos fenómenos dejaron las elecciones: a la vez que se impusieron las coaliciones entre partidos, también fue un auténtico palo la victoria de muchos candidatos por firmas. Sin embargo, el Partido Liberal fue el de mejores números, y el Polo Democrático perdió su fuerza electoral.
http://www.semana.com/politica/articulo/como-partidos-politicos/248662-3

[13] En "Desde abajo" 19/11/2011 -, Alfredo de León Monsalvo escribe: "Coaliciones al mejor postor. A ver quién da más: Más que ideas de cambio, o lo que algunos analistas pudieran llamar "visión del mundo", lo que estaba en juego en las recientes elecciones municipales eran formas de control del presupuesto municipal en la mayoría de los municipios colombianos. No en vano, cuando un partido político percibía que no contaba con candidato apto para ganar o, lo que es peor, no disponía de recursos suficientes para imponer su maquinaría, se arrimaba al sol que más alumbrara." http://www.desdeabajo.info/ediciones/item/18586-coaliciones-al-mejor-postor-a-ver-qui%C3%A9n-da-m%C3%A1s.html

La ciudadanía no se apropiará de la Constitución mientras la política local siga capturada, ni incrementará de manera sustancial su grado de participación. La elección popular de alcaldes es escenario insoslayable para construir democracia inclusiva; requiere empoderamiento de la ciudadanía activa y liberación de las barreras legales. Facilitar que grupos ciudadanos inconformes desafíen a los que capturan el municipio, redundaría en el entusiasmo participativo y deliberativo en general (factor subjetivo), y en la suficiencia de canales y mecanismos operacionales de participación y deliberación (factor objetivo). La democracia "sistémica" da cuenta de las interrelaciones entre elegir, deliberar y participar, desde y para la inclusión.

Keywords

Systemic democracy, systemic constitutionalism, levels of recursion, archetypes, autonomy, operational closure, people as system five.

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El Desarrollo Integral Territorial: La Propuesta de la Fundación Social en Ibagué

Presentación

La Fundación Social es una organización sin ánimo de lucro y de utilidad común, constituida el 1 de enero de 1911**.** A través de sus Proyectos Sociales Directos trabaja con las comunidades pobres y con otros actores del territorio, para construir condiciones que permitan a los más excluidos participar con iniciativa y poder en proyectos de desarrollo que mejoren su calidad de vida, y tejer relaciones de paz y convivencia en sus comunidades y en la sociedad.

Los Proyectos Sociales Directos se dirigen a fomentar el desarrollo en territorios localizados, con un claro enfoque promocional que construye sujetos sociales, con un acercamiento integral a la vida de los pobres y en una perspectiva de mediano y largo plazo. Los proyectos y procesos pertenecen a la comunidad, cuyos habitantes se apropian de las actividades y resultados. El rol transitorio de la Fundación Social consiste en promover, acompañar, enriquecer y potenciar lo que las comunidades acuerdan de forma colectiva. Las personas se convierten en multiplicadoras de los aprendizajes dentro de la comunidad, y de este modo el "saber hacer" queda en manos de esta.

El Desarrollo Integral Territorial

La promoción de procesos de Desarrollo Integral Territorial que puede tener un ámbito local, intermedio y regional se soporta en la promoción de procesos de planeación y gestión participativa del desarrollo que busca generar unos resultados en unas Dinámicas Integrales referidas a la Gobernabilidad Democrática; Competitividad Territorial; Solidaridad, identidad y pertenencia; y, Sostenibilidad Ambiental.

Estas Dinámicas Integrales expresan la finalidad o el objetivo superior de esta propuesta y es donde se refleja el mejoramiento de la calidad de vida de los habitantes de un territorio; sin embargo, existen unas Condiciones Básicas del Desarrollo que es dónde la Fundación Social ha venido haciendo mayor énfasis en toda su intervención, porque considera que son aquellos resultados mínimos fundamentales necesarios y suficientes para desencadenar procesos de desarrollo territorial.

Estas Condiciones Básicas del Desarrollo son la Construcción de lo Público (fin colectivo); Capital Social (actores articulados); Competencias Humanas (actores capaces); Capital Institucional (normas, entidades y escenarios); y, por último, Inserción a Mercados (empleabilidad y empresarialidad).

La Experiencia en Ibagué

Soportado en este modelo, la Fundación Social emprendió en 2004 la promoción de un proceso de Desarrollo Integral Territorial en un ámbito local, la comuna 6, con 58.000 habitantes en la ciudad de Ibagué. Un territorio donde convergen personas de todos los estratos socioeconómicos y que conjuga una compleja problemática socioeconómica y ambiental.

En este proceso se trabajó con todos los actores presentes en la comuna y que tenían ingerencia en ella, valga decir: las organizaciones sociales y comunitarias, los empresarios, la academia, las congregaciones religiosas, las ONG´s promotoras del desarrollo, el Estado y los partidos políticos.

Durante siete años distribuidos en varias fases, se trabajó alrededor de unos ejes de actuación como son la Investigación, Formación, Comunicación, Organización y Gestión que permitió colocar a esta comuna como un referente de participación democrática y de construcción de un propósito colectivo.

La formulación, gestión y ejecución de un plan estratégico de desarrollo construido participativamente es el hito más importante que se debe destacar, pues este se constituyó en la hoja de ruta del desarrollo de esta comuna que recogía los intereses y sueños de esta colectividad tan heterogénea.

El proceso de planeación permitió la apropiación de las comunidades de estos conceptos poniéndose de presente que también las personas que habitan los territorios pueden participar en la construcción de los sueños y del dibujo de la ciudad cuando éstas formulan propuestas de programas, proyectos y también de ideas de desarrollo y ordenamiento territorial.

La planeación participativa promovida por la Fundación Social en la comuna 6, despertó el anhelo de réplica en otros territorios que en el

pasado tuvieron alguna experiencia en esta materia, generándose así la condición desde 2008, de trascender de una escala local (una comuna) a uno intermedio (tres comunas), con casi 200.000 habitantes (el 40% de la población de Ibagué).

Desde 2008, se actualizaron los planes de desarrollo en las comunas 6, 7 y 8 de Ibagué y entre 2009 y 2010 se empezó a trabajar en una iniciativa inédita hasta el momento y fue la formulación participativa de una Agenda de Desarrollo Intercomunal que recoge propuestas de otra escala territorial que le apuntan al mejoramiento de la calidad de vida de estos espacios urbanos considerando la íntima imbricación de estos con el espacio rural.

Existen como resultado evidente de este proceso de Desarrollo Integral Territorial unas apuestas colectivas que le apuntan a la construcción de lo público en cada una de las tres comunas y en su apuesta interterritorial con los planes comunales y la agenda intercomunal; unos actores comunitarios e institucionales que se articulan alrededor de estas propuestas para hacer realidad la ejecución de los proyectos; unos actores sociales capaces no solo de construir planes sino de hacer incidencia ante los decisores para la ejecución de los mismos; y, un proceso inicial de dinamizar económicamente el territorio alrededor del turismo.

Ha sido tan potente este proceso de Desarrollo Integral Territorial, que fruto del mismo, la planeación participativa hoy no solamente se practica en estas comunas referidas, sino que por iniciativa de las mismas se promovió una política pública que hoy ha hecho posible que a lo largo y ancho del municipio, en las comunas urbanas y en los corregimientos rurales existan planes de desarrollo que se articulan alrededor de un Sistema Municipal de Planeación y Presupuesto Participativo.

El proceso ha sido arduo y retador, sin embargo la experiencia pone de presente que el Desarrollo Integral Territorial es una importante propuesta para generar inclusión social, mejorar calidad de vida y fortalecer la democracia local; que las comunidades avanzan en su organización y articulación; que movilizan actores institucionales en pro de su propuesta colectiva y que de esta manera nos acercamos a la construcción de una sociedad más democrática, productiva, en convivencia pacífica donde la vida digna, bella y buena sea posible para todos.

Juventud y Ciudadanía: ciudadanía de la desconfianza y clientelismo en Ibagué

Lilian Andrea Castro

John Jairo Uribe

> "Una forma distinta de asumir el ser joven es participar (…) los jóvenes han venido ejerciendo su ciudadanía quizás no a través del voto, ni en la conformación de partidos tradicionales, es decir, han diseñado diversas formas de ejercer la ciudadanía desde sus culturas y su arte" (Lina Bonilla Pava – Taller Ibagué Imagina Joven)

Presentación

La presente ponencia tiene como objetivo discutir las tensiones propias de la construcción de la ciudadanía[1] en un contexto clientelista, a partir del modo como los jóvenes de la ciudad de Ibagué entienden y practican la política. Puede decirse que esta comprensión se caracteriza por cuatro elementos interrelacionados: 1) La ciudadanía de la desconfianza[2] frente a la política (Rosanvallon, 2007). 2) La idea de que la política es un "mal necesario" porque se convierte en un medio para alcanzar fines personales. 3) La noción particularista del liderazgo social, entendido como un ejercicio que busca lograr proyectos para una comunidad específica y no para discutir el destino colectivo, en este caso el de la ciudad y 4) La noción de que la participación, se constituye en una nueva forma de construcción de la juventud. Los tres primeros elementos generan una "trampa" en tanto, la crítica a la política como un medio para lograr fines personales, termina reproduciendo el mal al que quiere oponerse (al clientelismo, a la corrupción, etc.) en la medida en la que los jóvenes se alejan de las instituciones políticas tradicionales, tal y como se lee en el epígrafe. Debe decirse que existen organizaciones juveniles interesadas en desplegar esa "reinvención" de la juventud a partir de su participación en la construcción colectiva del municipio, reconstrucción que se hace necesaria en la medida en la que la "trampa" a la que hemos aludido, está puesta.

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[1] Tradicionalmente se entiende la ciudadanía como el vínculo entre el disfrute de los derechos y el ejercicio de los deberes, especialmente en la relación entre los sujetos y el Estado y la constitución de las comunidades políticas (Kimlimca, 2002). Aquí se hace referencia al modo como los jóvenes entienden su ciudadanía a partir del ejercicio político.

[2] La ciudadanía de la desconfianza se presenta como un fenómeno generalizado que responde al hecho de que la política se entiende menos como la co-construcción del mundo y más como un ejercicio de control sobre lo público. De un lado, la política se desarrolla como un proceso que debe mantener la situación presente (y de sus tendencias) y no como una apuesta por la transformación de la sociedad. De otro lado, la actividad pública se ha especializado de tal suerte que es imposible contar con una visión de conjunto. Estos fenómenos se traducen en una actitud de desconfianza hacia la política que conduce a posturas populistas y personalistas.

La presente ponencia reconfigura los hallazgos de dos procesos: la investigación "Concejo al Día" (2012) en el que se analizaron las dinámicas de comunicación entre Concejales y ciudadanos a través de entrevistas y grupos focales, y el desarrollo de la primera fase del proyecto "Ibagué Imagina Joven" (2012-2013), en el que se desarrolló un conjunto de talleres en los que se discutieron temas relacionados con la ciudadanía, la participación y la juventud. Estos talleres se desarrollaron con una red de organizaciones juveniles (Red Arquitectos del Desarrollo) y con estudiantes de varios colegios de la ciudad y de la Universidad de Ibagué. Este abundante material, permite desarrollar un análisis de la ciudadanía desde los jóvenes ibaguereños en el contexto clientelista local desde un ángulo que puede ser interesante, esto es, como una trampa en el que la crítica y la implicación política de los jóvenes, termina alimentando la ampliación de las prácticas tradicionales a las que dicen oponerse.

Ahora bien, la apatía puede evidenciarse a partir de algunos datos de la Encuesta de Percepción Ciudadana Ibagué Cómo Vamos 2013[3] en la cual el 68% de los entrevistados manifestaron no pertenecer a una organización social, de los cuales el 73% correspondió a encuestados entre los 18 y los 25 años de edad, adicionalmente, el 43% de los encuestados manifestaron no realizar acciones para apoyar a otras personas, ideas o hechos, de los cuales un 41% se encontraban entre los 18 y los 25 años.

Un ejemplo de cómo ven la política los jóvenes en Ibagué, se lee en el testimonio de una joven frente a este interrogante: "*La política está asociada al gobierno, a la forma de guiar una Nación, no obstante, la política también está asociada al poder y esto ha hecho que los jóvenes dejen de ver al gobierno como algo que guía y por el contrario que domina, domina el dinero, las decisiones, la educación…el gobierno no busca el bienestar común sino el bienestar individual"* (Entrevista taller Ibagué Imagina Joven, 2012). Dicha apatía, se suma a que la población entre los 15 y 29 años (población joven) en Ibagué según proyecciones del DANE al 2012 alcanzaba el 26% de la población total de la ciudad.

Por su parte, la política como un "mal necesario" y como un medio para alcanzar fines personales o particularistas, se puede reflejar en el siguiente testimonio que responde a la pregunta: ¿Ha votado a cambio de un puesto de trabajo? *"Es que uno a veces ve que la relación es directa entre el dirigente y el trabajo, porque ellos manejan los proyectos, por las mismas roscas, entonces, dirigente igual a trabajo"* (Grupo Focal Jóvenes, 2012)

La construcción de la ciudadanía desde los jóvenes de Ibagué, se encuentra tensionada por el clientelismo, específicamente por el modo como éste organiza las relaciones políticas. En primer lugar, vale la pena plantear que esta es una práctica universal que no solo atiende a realidades como las latinoamericanas, según Fernando Cepeda Ulloa (1979, citado por Rubio, 2003) el clientelismo político es aquella relación en la que un patrón otorga favores a cambio de lealtad política y otros servicios que presta a su clientes, pero en algunos países del mundo esas relaciones son formales en la medida en que están

[3] El programa Ibagué Cómo Vamos realiza desde 2010 una encuesta de percepción ciudadana sobre la calidad de vida que se aplica a más de 1000 personas y que tiene un margen de error de 3%.

consagradas en documentos que tienen valor contractual mientras en otras partes este fenómeno responde a prácticas más flexibles y menos formales.

En segundo lugar, es preciso aclarar que el clientelismo político ha estado asociado a la desigualdad socioeconómica como terreno fértil para que se desarrolle esta práctica, esto es, que el clientelismo político se presenta con más frecuencia en contextos donde los recursos son limitados o prevalece la escasez. No obstante hay posiciones que interpelan lo anterior, argumentando la compatibilidad que puede tener el clientelismo con instituciones modernas. Es decir que la desigualdad no define siempre las prácticas clientelistas en la medida en que desde esta perspectiva el clientelismo puede colaborar a la consolidación de ciertas destrezas ciudadanas que definen la participación política (Rubio, 2003). De otro lado, el clientelismo no es un fenómeno homogéneo y existen procesos de transición que van de uno de tipo tradicional a uno moderno, paralelo al desarrollo del mercado, el sistema o régimen político y la burocracia.

En síntesis, la noción de que la política es un mal necesario (para obtener empleo, por ejemplo), la desconfianza hacia los políticos y el particularismo constituyen una actitud "antipolítica" que reproduce los intercambios de favores necesarios para mantener las relaciones de poder. Las páginas que siguen presentan el contexto político municipal como el escenario en el que se inscribe la construcción de la ciudadanía juvenil, para luego discutir los indicios que apuntan hacia esa actitud antipolítica mencionada y luego confrontar los indicios que apuntan hacia la reinvención de lo juvenil en clave de nuevas formas de participación artística y cultural.

El contexto: Participación y panorama político local a partir de las elecciones a alcaldía y concejo municipal de octubre de 2011

Sin duda alguna, el comportamiento de los partidos políticos en el ámbito nacional y local, no es el mismo de hace décadas, pues procesos como la Constitución Política de 1991 en Colombia, transformaron el sistema de partidos. Los partidos tradicionales que predominaron en el contexto político, Conservador y Liberal, juegan hoy por hoy un rol distinto desde la perspectiva electoral, dada la aparición y consolidación de terceras fuerzas partidistas. Pizarro León Gómez (2002) describe este fenómeno como "faccionalismo personalista" concepto que implica las microempresas electorales, el declive del bipartidismo y un ascenso creciente y extremadamente fragmentado de terceras fuerzas que alcanzan espacios de representación en los cuerpos colegiados (Pizarro y Pachano, 2002)

El faccionalismo se refiere a las subunidades o subpartidos que se configuran al interior de un partido político, producto de la presencia de diversos actores internos que se encuentran en tensión y conflicto, la característica central de este tipo de fragmentación es que las facciones, asumidas como grupos de poder de un partido político, carecen de organización, son muy coyunturales y dependen plenamente de liderazgos personalistas (Sartori 1976, citado en Duque, 2006). Estas divisiones ocurren en todos los niveles, insertos en contextos de fuerte tradición clientelar.

La ciudad de Ibagué alberga por lo menos dos fenómenos; primero, el faccionalismo descrito anteriormente, lo que da lugar a que no haya una fuerza política dominante en la ciudad y segundo, un bajo nivel de participación ciudadana que se traduce electoralmente en un alto abstencionismo, pero también en bajos niveles de participación e incidencia. Entonces, de un lado los partidos políticos tradicionales sobreviven con votaciones importantes, frente otras fuerzas partidistas que se han consolidado electoralmente en el contexto nacional[4] y de otro lado estas fuerzas luchan por conquistar al electorado y sobreponerse al abstencionismo que asciende casi al 50% del total de sufragantes potenciales. Esto puede verse mejor cuando se analiza la situación de las distintas fuerzas electorales en el contexto local a partir de las últimas elecciones a la Alcaldía y al Concejo llevadas a cabo el 30 de octubre del 2011.

[4] Estas fuerzas son el producto de la fragmentación de los partidos tradicionales, como por ejemplo el Partido de Unidad Nacional y el Partido Cambio Radical, de origen Liberal y conformado por disidentes de este partido.

Según datos de la Registradora Nacional del Estado Civil, para las últimas elecciones al Concejo en Ibagué, sólo el 54% del potencial de sufragantes votaron, es decir, casi la mitad de la población apta para votar no lo hizo, lo que evidencia la existencia de un importante abstencionismo electoral en la ciudad.

De otro lado, es posible ver que la política de la ciudad está mediada por la presencia de distintas fuerzas que se disputan los poderes locales y nacionales. Las elecciones del 2011 al Concejo[5] muestran que la fuerza política que mayor votación obtuvo las pasadas elecciones fue el Partido Liberal Colombiano con 28,259 votos, lo que se tradujo en 4 curules de las 19 que le corresponden a una ciudad como Ibagué. Por su parte, el Partido Social de Unidad Nacional constituyó la segunda fuerza electoral en el ámbito local, con un total de 24.109 votos, con lo que obtuvo 4 curules. Seguido por el partido Cambio Radical y el Partido Conservador con 17,228 y 17,062 votos respectivamente, alcanzando cada uno dos curules. Sin embargo, otros partidos y movimientos, aunque con una representatividad menor, alcanzaron una fuerza electoral importante que les posibilitó conseguir una curul en este órgano, estos son: el Partido de Integración Nacional (PIN), el Movimiento Social Primero Ibagué, el movimiento MIRA, el Partido Verde, Progresistas, el Polo Democrático Alternativo y el Movimiento Inclusión Social Independiente (Ver gráfica: Porcentaje de votación del total de votos por partido político). Sin embargo hay que mencionar que del total de votos que recibieron los partidos políticos en las pasadas elecciones al Concejo (158,515), tan solo 32,526 llegaron a constituir curules en este órgano, esto es, un poco más del 20% de la votación percibida por los partidos y movimientos políticos se tradujo realmente en curules en el Concejo[6]. En esta dirección, debe destacarse que los partidos y movimientos presentan listas con voto preferente, es decir, el elector vota por el candidato de su preferencia[7] en el partido al que se encuentra inscrito, lo que refleja la votación específicamente hacia los candidatos. Así que los partidos tienen la tarea de superar el umbral (para obtener un cierto número de curules) y los candidatos deben competir entre sí para acceder al cargo: si un partido obtiene 4 curules, las ocuparán los candidatos que hayan obtenido las 4 mayores votaciones. Esta lógica incentiva las rivalidades entre los candidatos de un partido y contribuye a profundizar el faccionalismo del que ya se ha hablado.

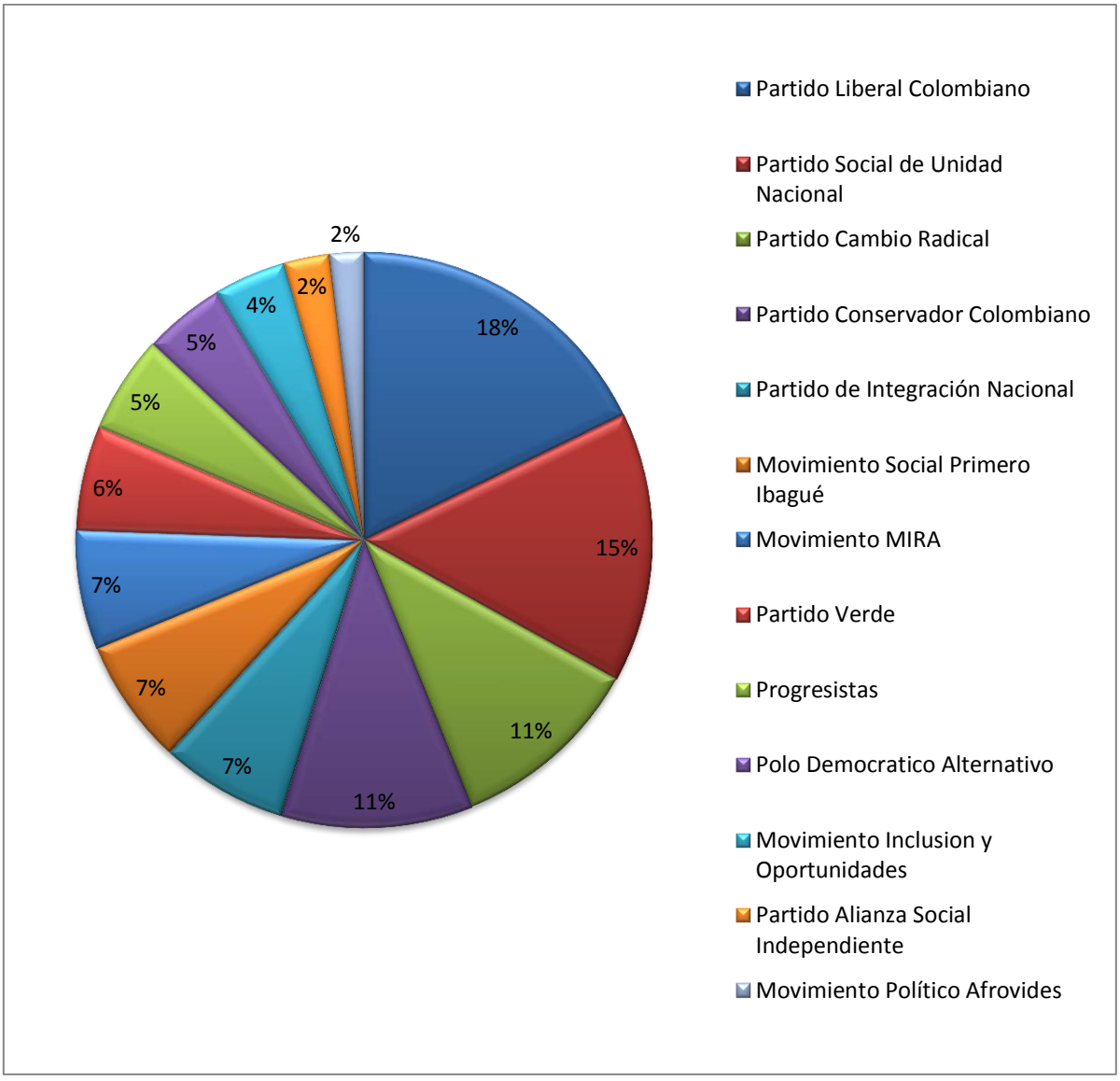
[5] Según Robledo Silva, el concejo es un "un órgano colegiado de los entidades territoriales en los que se encuentran representadas las distintas fuerzas del municipio" (Robledo Silva, 2010, pag. 281)

[6] Aquí es importante aclarar que para que un partido pueda entrar a la repartición de las curules, debe alcanzar un umbral.

[7] Existe la posibilidad de que los partidos confecciones listas cerradas, en las que se vota por el partido. Las curules obtenidas se reparten de acuerdo al orden en el que se confeccionó esa lista por el partido.

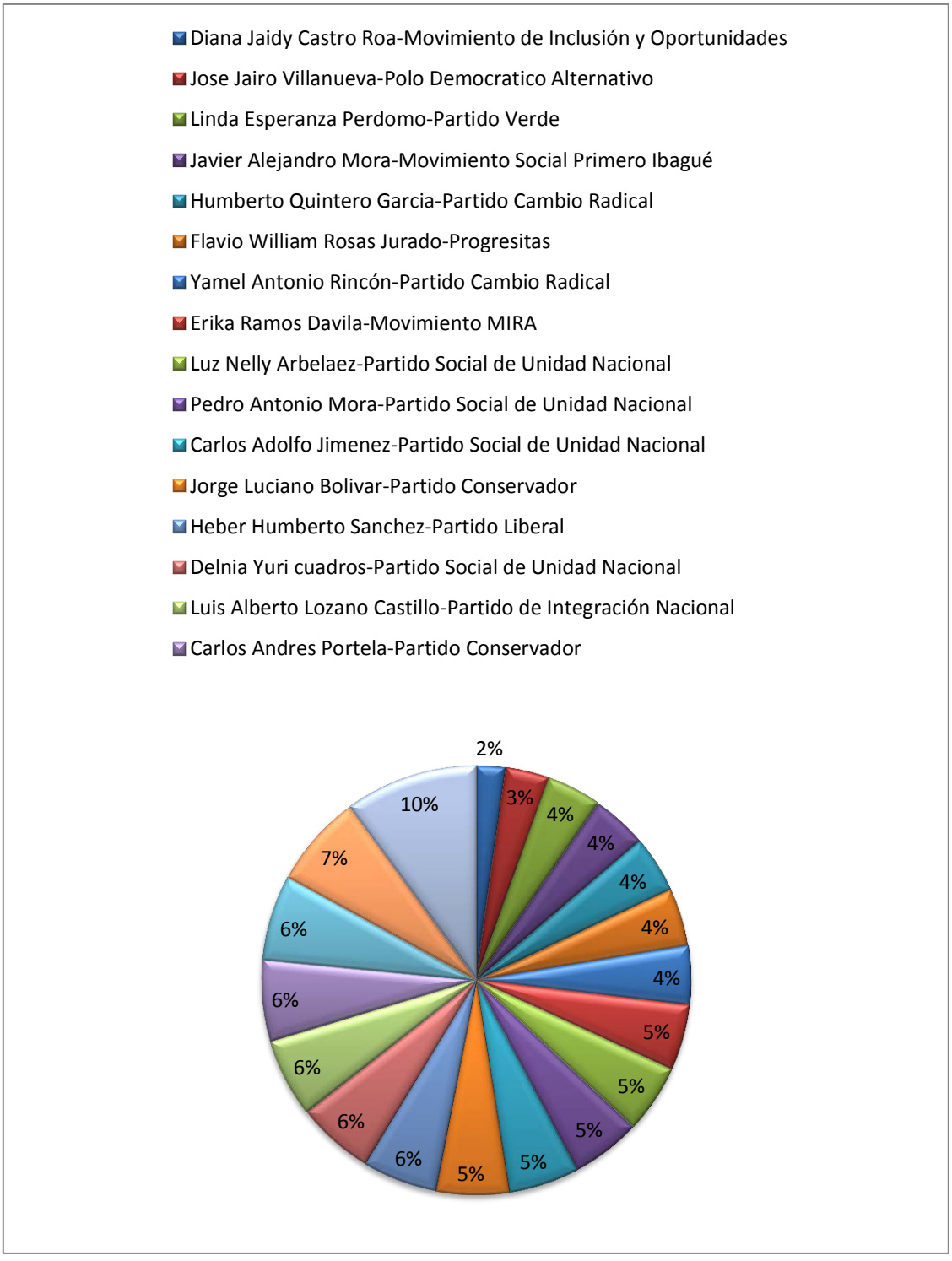
Para ampliar lo anterior, cabe decir que existen grandes brechas entre los candidatos que percibieron la mayor y la menor votación y obtuvieron curul para el Concejo, por ejemplo la candidata con la menor votación del total de votos obtenidos por los concejales electos, fue Diana Jaidy Castro Roa, quien con 715 votos, solo representó el 2% de esta votación, frente a Camilo Delgado Herrera, candidato que con 3.528 votos obtuvo la mayor votación, con el 10% del total de votos de los concejales electos (Ver gráfica: porcentaje de votos obtenidos por concejal electo frente a la votación total obtenida por los concejales)

Gráfico 1. Porcentaje de votación del total votos por partido político al Concejo de Ibagué 2012-2015



Fuente: Elaboración propia con base a información de la Registraduría Nacional del Estado Civil. Base: 158.515 votos.

Gráfico 2.Porcentaje de votos obtenidos por concejal electo frente a la votación obtenida por los concejales.

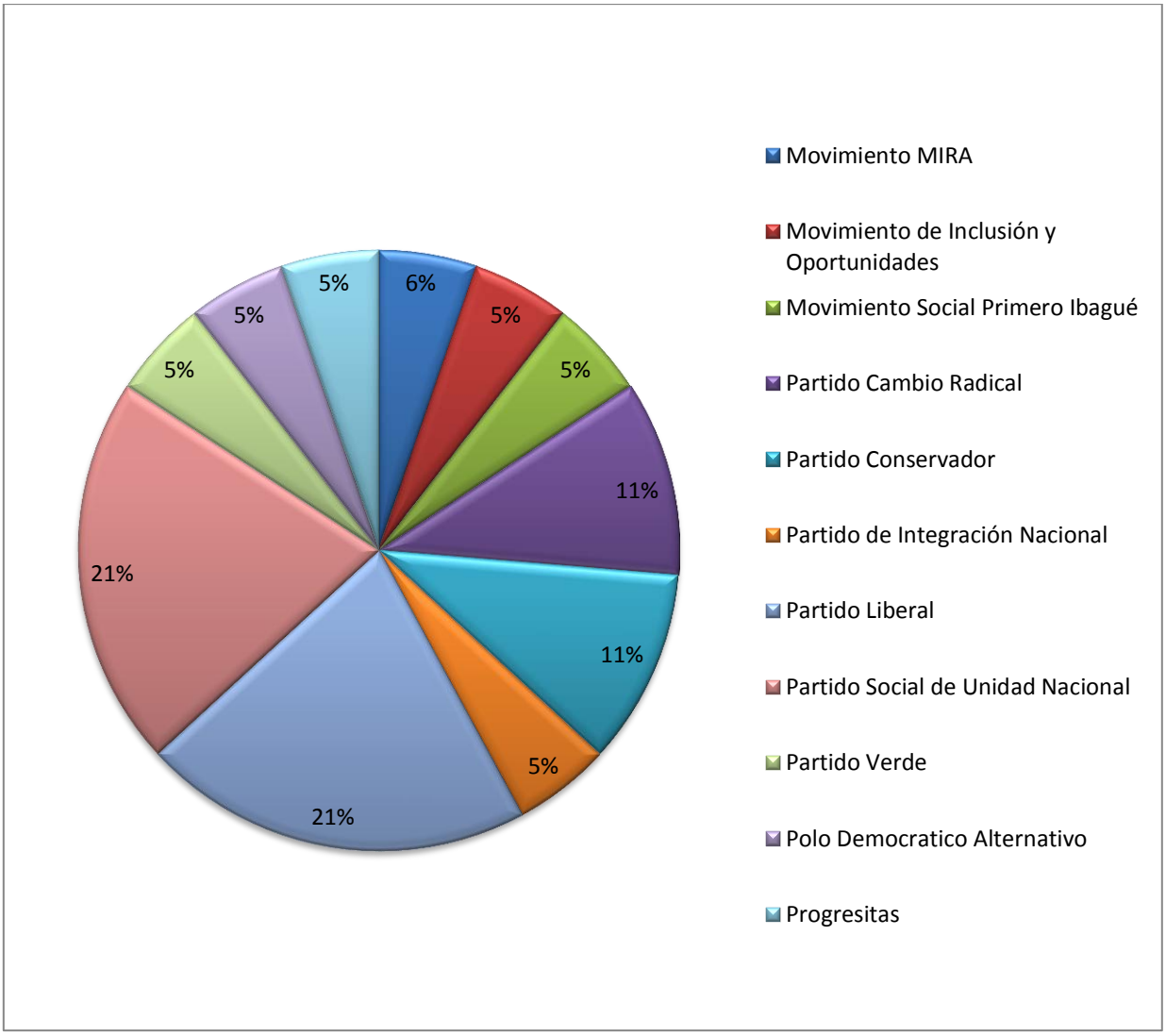


Fuente: Elaboración propia con base en información de la Registraduría Nacional del Estado Civil. Base: 32.526 votos.

Entonces, 11 fuerzas políticas en una ciudad de medio millón de habitantes lograron una curul en el concejo municipal, de tal modo que el 42% de esta corporación quedó

constituida por el partido Liberal y el Partido de Unidad Nacional, el 22% lo componen las fuerzas del partido Conservador y Cambio Radical, mientras el 36% restante se distribuyó entre 7 partidos y movimientos políticos (el partido de Integración Nacional, el Movimiento Social Primero Ibagué, el movimiento MIRA, Partido Verde, Progresistas, Polo Democrático Alternativo y el Movimiento Inclusión Social Independiente)

Gráfico 3.Composición del Concejo de Ibagué por partidos y movimientos políticos 2012-2015



Fuente: Elaboración propia con base en información de la Registraduría Nacional del Estado Civil. Base: 19 curules.

Por otro lado, al estudiar el comportamiento de las elecciones a la alcaldía, hay que mencionar primero, que 5 candidatos se disputaron este cargo en el 2011: Luis H. Rodríguez, avalado por el Partido Liberal y quien por tercera vez aspiraba a la alcaldía; Ricardo Alfonso Ferro, representante del partido Social de Unidad Nacional; Carlos Andrés

Ramírez por el movimiento MIRA; Luis Alberto Bejarano, candidato del Polo Democrático Alternativo y Fidel Humberto Pinilla por el Partido Alianza Social Independiente.

Es de resaltar nuevamente que el abstencionismo siguió predominando en esta elección, pues del potencial de sufragantes (349,124), el 54.7% votó para alcalde en el 2011, lo que reitera que casi la mitad del electorado no participó en estos comicios. Así, del total de votos para los candidatos[8] (163,872), el candidato del Partido Liberal Colombiano obtuvo la victoria con el 48% de la votación. Por su parte, el 40% de los votos los obtuvo el candidato del Partido Social de Unidad Nacional; el 9% de la votación la logró el candidato del movimiento politico MIRA y el 3% restante se distribuyó entre los candidatos del Polo Democratico Alternativo y de la Alianza Social Independiente[9].(Ver gráfico Porcentaje de votos por candidato a la alcaldía según movimiento o partido político)

Finalmente cabe decir que, si bien no es posible demostrar estadisticamente con los datos disponibles que el faccionalismo presente en Ibagué es esencialmente personalista, vale la pena mencionar algunos nombres que representan fuerzas electorales importantes y que constituyen liderezgos personalistas dentro de las colectividades partidistas, por ejemplo por el partido Conservador, se han hecho visibles nombres como Luis Humberto Gomez Gallo[10] (el gomezgamillismo) y últimamente la familia Barreto[11] (barretismo); por el partido Liberal, durante mucho tiempo se hizo visible el nombre de Alberto Santofimio Botero (santofimismo)[12] y adicionalmente la familia Jaramillo (jaramillismo)[13]. De otra parte, en las facciones disidentes del liberalismo en la región, el liderazgo de partidos

[8] Es de mencionar que para la elección de cargos unipersonales, la votación del candidato es equivalente a la votación del partido político que avala su candidatura.

[9] Cabe decir que, son comunes las alianzas partidistas en estas elecciones, en este caso el alcalde a pesar de representar a una colectividad que le dá su aval, requirió del impulso de otras fuerzas políticas para vencer electoralmente, consecuentemente, la coalición electoral se hizo presente para favorecer al candidato vencedor, de tal modo que partidos como Cambio Radical, Partido Verde y una parte del partido Conservador, apoyaron su candidatura.

[10] Fue senador en los periodos de 1994-1998, 1998-2002, 2002-2006 y 2006-2010. Además fue presidente del Senado de la República de Colombia. En 2011 fue condenado por vínculos con grupos paramilitares. Falleció en diciembre de 2013.

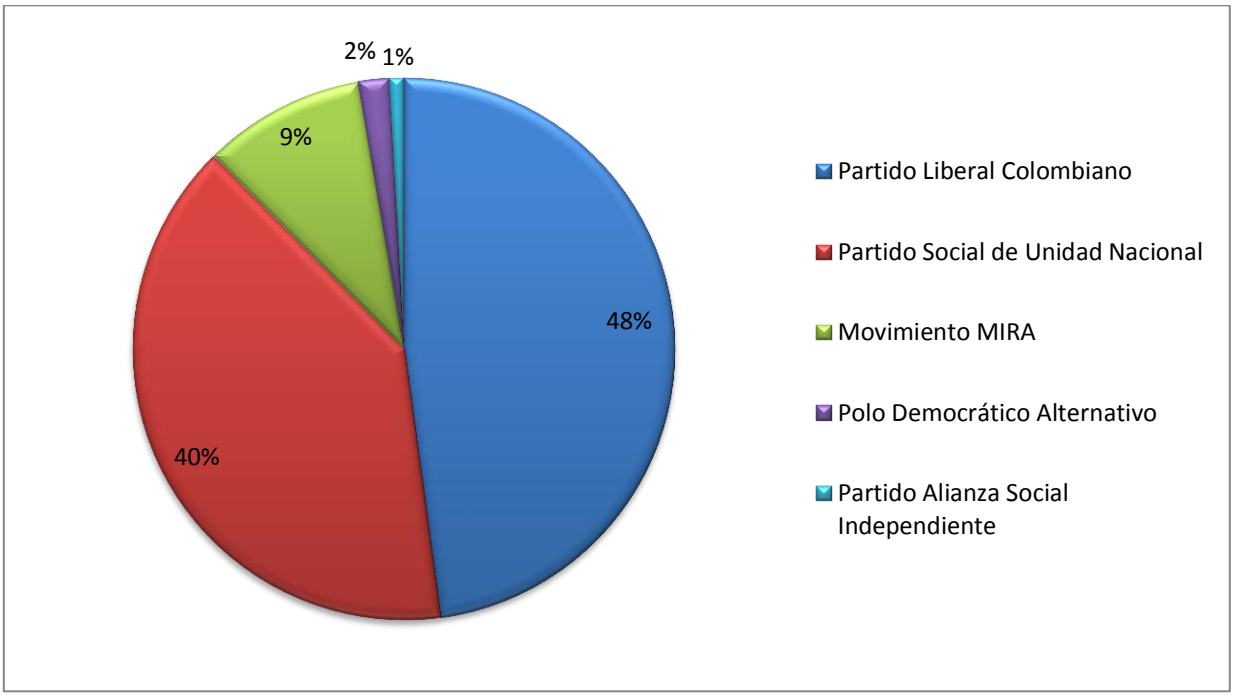
[11] Jaime Barreto Quiroga fue gobernador del Tolima en 2008-2011, actualmente se encuentra inhabilitado para ejercer cargos públicos. Su hermano, Jaime Barreto apoyó la campaña del primer periodo del Presidente Juan Manuel Santos y en las elecciones del 2014 apoyó al candidato Oscar Iván Zuluaga del partido Centro Democrático, oponente electoral del candidato presidente Juan Manuel Santos. Tenía aspiraciones a la gobernación del Tolima para las elecciones del año 2015 pero falleció en 2014.

[12] Fue Ministro de Justicia en los años 70, dos veces candidato presidencial y senador. Actualmente paga una condena por la coautoría intelectual del asesinato del líder liberal Luis Carlos Galán.

[13] Mauricio Jaramillo Martínez, ha sido Senador de la República en varias oportunidades, de otro lado su hermano, Guillermo Alfonso Jaramillo, fue concejal del municipio de Armero (Tolima) diputado de la Asamblea del Tolima y Gobernador del mismo departamento, además fue Senador de la República y respecto a su desempeño reciente vale decir que estuvo vinculado con la Administración del alcalde Gustavo Petro en Bogotá como Secretario de Salud y Secretario de Gobierno. Guillermo Alfonso ha militado en varios partidos políticos como el Liberal, el Polo Democrático y el Progresista. El padre de los hermanos Jaramillo fue Ministro de Salud y gobernador del Tolima y su madre fue congresista.

como Cambio Radical ha estado en cabeza de los hermanos Emilio y Rosmery Martinez[14] y colectividades de origen mas reciente como el Partido de la Unidad Nacional y el Centro Democrático han pasado por el liderazgo de los García (Padre e hijo)[15].

Gráfico 4.Porcentaje de votos por candidato a la alcaldía según movimiento o partido político.



Fuente: Elaboración propia con base en información de la Registraduría Nacional del Estado Civil. Base: 163.872 votos

A partir de este escenario continuamos con el análisis de la construcción de la ciudadanía juvenil que hemos enunciado.

Jóvenes[16], ciudadanía y política

Al hablar de la ciudadanía, y más de la ciudadanía en los jóvenes son necesarios dos apuntes claves: en primer lugar, la relevancia que adquiere el vínculo entre jóvenes y ciudadanía, en tanto que tradicionalmente no se ha considerado que los jóvenes fueran ciudadanos dado que no han llegado a su edad adulta, al tiempo de ser ciudadanos (Morán y Benedicto, 2003). En segundo lugar, que el ejercicio ciudadano no se puede

[14] Emilio Martínez Rosales, fue concejal del municipio de Espinal-Tolima, diputado a la Asamblea y ex Representante a la Cámara en las legislaturas 1994-1998 y 1998-2002, en la última legislatura perdió su investidura. Su hermana Rosemary Martínez, fue Representante a la Cámara por varios periodos y actualmente es Senadora de la República.
[15] Carlos García Orjuela fue miembro del Partido de Unidad Nacional a través del cual llego a ser Senador de la República. En la actualidad su hijo Pierre García es Representante a la Cámara por el partido Centro Democrático.
[16] Según el Estatuto de Ciudadanía Juvenil, el rango de juventud en Colombia es de las 14 a los 28 años de edad.

entender desarticulado de la política; pues dado que esta última se refiere a la gestión de los conflictos sociales (Valles, 2000), la ciudadanía se refiere a la manera como los individuos son capaces de gestionar dichos conflictos o de incidir en su gestión, en este sentido como lo menciona Kymilicka y Norman (2002) la calidad y extensión de este ejercicio (la ciudadanía) depende de la participación en la comunidad a la cual se pertenece.

Ahora, frente al panorama de la relación entre juventud, ciudadanía y política en Ibagué, vale la pena mencionar que la población entre los 15 y 29 años en la ciudad según proyecciones del DANE[17] al 2012 alcanzaba el 26% de la población total de la ciudad, porcentaje importante si se relaciona con decisiones de política pública, con la concentración de algunas problemáticas puntuales[18] y con la incidencia que podrían llegar a tener en decisiones que los afecten a ellos, a sus comunidades y a la ciudad. Sin embargo, podría decirse que la población joven en Ibagué se caracteriza por una apatía hacia los procesos colectivos, tal y como se ha evidenciado en la introducción y como retomaremos más adelante.

En Ibagué como en otras ciudades de Colombia, los jóvenes están representados formalmente a través de esquemas como los Consejos de Juventud; estos fueron producto de la Ley 375 de 1997, también conocida como Ley de la Juventud, y se refieren a espacios legítimos y legales desde donde se representa a la organización juvenil de base y en general a los jóvenes, no obstante en el imaginario juvenil este órgano no es un referente significativo y en la mayoría de los casos es desconocido (Hoyos, 2003).

De este modo el ejercicio de la política y la ciudadanía en los jóvenes está atravesado por la presencia de distintas fuerzas políticas que promueven liderazgos personalistas. A pesar de los múltiples espacios que se han formalizado para el ejercicio de la ciudadanía, esta se ha limitado, a la elección de gobernantes a través del voto. Lo anterior, se suma a la apatía por los asuntos colectivos, la deficiente participación ciudadana, al hecho de no sentirse representados por los órganos que en teoría deberían hacerlo y finalmente a un ejercicio de la política considerado conflictivo y transgresor pero necesario para alcanzar fines de personales. Antes de revisar las construcciones juveniles, es necesario detenerse en la ciudadanía de la desconfianza.

Política como consumo: ciudadanía de la desconfianza

Pierre Rosanvallon (2006) entiende que la política ha dejado de ser "el pegante" de la sociedad, que ésta ha dejado de ser el eje articulador de lo social, tal y como se venía

[17] Departamento Nacional de Estadística.

[1818] La falta de oportunidades de empleo es una de las principales problemáticas por las que atraviesa la población joven de Ibagué; al 2013 la tasa de desempleo juvenil en Ibagué, ascendió al 22%, siendo esta mucho más alta que la tasa de desempleo del total de la población económicamente activa.

estructurando desde el proyecto moderno. Se trata de lo que él denomina como la disolución de lo político. Esta disolución es resultado, a su vez, de la separación entre la sociedad civil y la esfera política: lo político se ha convertido en una esfera exterior a la sociedad. De este modo, el ciudadano se convierte en consumidor político, no es más co-productor del mundo común, tal y como se esperaba en la modernidad. Así, se degrada la actividad política: "La era del *consumismo político* está marcada, por el contrario, por fuertes expectativas y grandes exigencias dirigidas a las instituciones políticas. Todo el problema viene del modo de manifestarse de esas demandas que conduce a deslegitimar los poderes a los cuales se dirigen. De ahí procede el desencanto democrático contemporáneo: la decepción es allí el producto casi mecánico de una ciudadanía de desconfianza" (Rosanvallon, 2006. Pp.: 248).

El desencanto por la política no obedece sólo a la incapacidad del Estado por cumplir lo que promete, sino porque las expectativas ciudadanas han aumentado desmesuradamente, de tal suerte que es imposible satisfacerlas.

De otro lado, la disolución de lo político obedece a su segmentación. Si por una parte, esta segmentación responde a la expectativa de mayor control sobre las actividades públicas (se supone que es más fácil vigilar pequeños fragmentos de la administración), por la otra, esta fragmentación contribuye a que nadie pueda leer el conjunto. En este escenario, los políticos se preocupan menos por promover grandes reformas que por padecer las consecuencias de un escándalo: la tarea del político no es proponer, sino evadir la mala prensa. Los electores, por su parte son más sensibles a los riesgos de ver degradada su situación actual (piden estabilidad y seguridad) que a asumir los posibles logros que resultarían de grandes proyectos de transformación social.

Estos elementos (consumismo político, aumento de las expectativas sobre la acción estatal, fragmentación de lo público, apuesta por la estabilidad) constituyen el escenario de degradación de lo político como esfera a través de la cual, la sociedad se da forma a sí misma. La política, reducida a la lógica del espectáculo, se ha separado de la sociedad. Esto quiere decir que las sociedades son moldeadas, formadas, transformadas, dirigidas, desde otras esferas: las corporaciones transnacionales parecen constituirse en ejes centrales del poder en el mundo contemporáneo. De ser esto cierto, cabe preguntar por el papel que juegan las dinámicas políticas locales: ¿es posible que los ciudadanos construyan estrategias de acción que superen los límites contemporáneos de la política y disputen el poder en sus propios terrenos?

Para Rosanvallon el populismo es una expresión clave de la contra-política. Más que una ideología, éste es una inversión de los ideales y procedimientos democráticos. "El populismo se comprende en primer lugar en su relación con las tensiones estructurales de la representación. Pretender resolver la dificultad de representar el pueblo resucitando su unidad y su homogeneidad de un mundo imaginario, en una toma de distancia radical con aquello a lo que se supone que se le opone: el extranjero, el enemigo, la oligarquía, las élites" (Rosanvallon, 2006. Pp.: 258). El populista se encarga de afirmar la unidad constituyendo un enemigo y por supuesto, prometiendo seguridad. Pero el populista se

hace posible en ese universo que degrada lo político y reduce la actividad ciudadana al consumo. El clientelismo, podemos decir, no se presenta necesariamente como una condición que facilite o que por el contrario restrinja la emergencia del populismo, de modo que su relación es compleja. Para el caso que estamos revisando aquí, la desconfianza ciudadana frente a la política, en el marco de una crítica hacia el quehacer de quienes la ejercen, se encuentra vinculada al clientelismo y al liderazgo particularista.

Desde los jóvenes: Ciudadanía de la desconfianza

> *"Después de terminar mi carrera especializarme y poder irme del país" (Camilo Torres – Taller Ibagué Imagina Joven)*

Hemos sugerido que los jóvenes han construido un discurso crítico sobre la política, acusando a quienes la ejercen por incumplir sus promesas y por el modo como obtienen beneficios:

> *"Lo que yo entiendo [por política] es que es algo más negativo, es algo de intereses propios. Después que suben se olvidan de los que les dieron apoyo, o el votico. Cuando están en campaña van a los barrios a prometer y preguntar bueno ustedes qué es lo que necesitan pero luego se les olvida" (Grupo focal Jóvenes)*

La política articula grupos de amigos que colaboran para obtener beneficios:

> *"yo entiendo la política como rosca, porque un pobre nunca va a tener la oportunidad de sentarse a la mesa con un senador, el pobre no tiene oportunidad, solo los que tienen poder. Esa politiquería son todos lo que hablan cháchara y no hacen nada y no le dan oportunidad a los de bajos recursos" (Grupo focal Jóvenes)*

Así que el ejercicio de la política se encuentra, a los ojos de los jóvenes consultados, "amarrado":

Imagen No. 1. Taller Ibagué Imagina Joven

De modo que el político le apuesta a la obtención de dinero:

Imagen No. 2. Taller Ibagué Imagina Joven

Como resultado, la política hace daño:

> *"La política daña mucha gente, el poder daña a la gente porque vea: voté por otro compañero, se veía bien pero necesitaba plata para llegar allá, entonces el que lo va a manejar, es el que le dio la plata, entonces eso es un pantallazo. Uno ve que la política daña a la gente porque dejó el pueblo en quiebra y se fue para España" (Grupo focal jóvenes)*

En este escenario, la construcción de la ciudadanía, se orienta hacia la obtención de posiciones ventajosas que les permitan acceder a fuentes de recursos y el voto termina constituyéndose en un recurso para la negociación entre ciudadanos y candidatos.

> *Entrevistadores: ¿Les gusta la política?*
>
> *Hombre joven: la verdad sí me gusta, no me gusta es el manejo. Si fuera de otra manera, para el equilibrio, para mejorar el bienestar de nuestro país. Somos un país muy rico pero mal manejado*
>
> *Mujer joven: es muy importante pero desde que no se sepa manejar. Se supone que la política se basa en ética. Debe ser organizada para que haya unión, para que el Estado prevalezca. No estoy de acuerdo con la forma como ahora se está manejando al país y ninguno de los que ha subido ha funcionado, todos los regalan o dejan al país a un lado (Grupo focal jóvenes)*

Como puede leerse, este tipo de percepciones sobre la política, hablan de la ciudadanía de la desconfianza que ha caracterizado Rosanvallon (2006):

Imagen No. 3. Taller Ibagué Imagina Joven

Y como sugiere la imagen que antecede, el rechazo a la política, se traduce en descontento cívico. De este modo el círculo se cierra: el ejercicio político, degradado, se

expresa en una ciudadanía de la frustración que tiene pocas opciones, bien escapar de la ciudad (como lo plantea el epígrafe anterior), bien sumarse al negocio, bien rechazar aceptar el orden. Sin embargo, como se verá más adelante, la participación ciudadana se erige en una posibilidad de acción que algunos jóvenes vienen explorando.

> *"El común denominador en la población el desconocimiento de los derechos y deberes que como ciudadanos poseemos, el tipo normal de concepción frente a la participación se cierra a las Juntas de Acción Comunal, pero si bien se conoce el escenario, no se reconoce como un espacio de importante participación ciudadana" (Alejandra Rodríguez – Taller Ibagué Imagina Joven)*

Así que, los espacios de participación directa también se empobrecen en la medida en la que los jóvenes consideran que han sido contagiados por las prácticas clientelares de la política tradicional. A partir de estas apreciaciones, no sorprende que la política se convierta en un "mal necesario".

Desde los jóvenes: la política un mal necesario

Entrevistador: ¿Te han ofrecido algo a cambio de un voto?

Hombre joven: Sí a mí me han ofrecido hasta cincuenta mil pesos (Grupo focal jóvenes)

Formalmente, la política se ha entendido como el escenario en el que los ciudadanos contribuyen a la construcción colectiva de su sociedad, esto es, su proyecto común, los mecanismos que se emplean para tratar con los conflictos, los principios y procedimientos que establecen la autoridad (Rosanvallon, 2006). Pero en este universo de la desconfianza, una de las "salidas" (de las formas que asume la ciudadanía), es precisamente la de sumarse al juego:

> *"Pues digamos que en mi caso, las primeras veces que voté, mi mama me decía [por quién votar] porque yo no sabía mucho. En estos últimos años […] mi prima estaba con Osorio y ella nos dijo <<vote por tal porque nos ayuda con trabajo>>" (Grupo Focal Jóvenes)*

Y entonces, cabe la pregunta:

> *Entrevistador: ¿A ti alguna vez te ha funcionado esto, de votar por alguien a cambio de un puesto?*
>
> *Hombre joven: pues sí, estuve nueve meses trabajando en la gobernación, en el archivo y dos años que estuve trabajando en el Bienestar Familiar por cuestión de palanca (Grupo Focal Jóvenes)*

Así que la conclusión no puede ser otra:

"Es que uno a veces ve que la relación es directa entre dirigente y trabajo, por los proyectos, por las mismas roscas, dirigente igual a trabajo. Ellos dicen cómo está el país, porque ellos son los que destinan los recursos en las diferentes instancias como trabajo, salud, educación, y ahora que uno pues ve difícil conseguir trabajo, entonces no queda otra" (Grupo Focal Jóvenes)

Ahora bien, desde la orilla de los políticos electos, la atención a las solicitudes de empleo, o de cualquier otro tipo de favores, se constituye en una de sus labores cotidianas:

"Bueno realmente nuestra actividad se compone de dos escenarios, primero cumplir la funciones que emanan de la constitución política y la ley 136 del 1994 que entre otras son aprobar y desaprobar acuerdos municipales, analizar las iniciativas, velar por el patrimonio ecológico ambiental, aprobar presupuesto, dar la escala salarial para los trabajadores del municipio, dar autorización al señor alcalde, pero también tenemos otras disposiciones que es la atención periódica continua a nuestros electores. Creemos que esa es una búsqueda continua en la cual está reflejada que la comunidad siempre busca su concejal amigo, su amigo representado en el concejo, para que le haga un favor, para que le colabore a diligenciar, a agilizar, a buscar una alternativa o solución a lo que pasa en este municipio con necesidades tan sentidas" (Grupo Focal Concejales)

Así que la democracia se restringe a la dinámica de los favores y del negocio:

Imagen No. 4. Taller Ibagué Imagina Joven

Así que el vínculo entre unos y otros, se alimenta de esta dinámica que dibujan los jóvenes: intercambio de favores, todo ello a pesar de los esfuerzos de los Concejales.

"Yo creo que a pesar que el vínculo más común que se presenta es el personal, a través de favores a individuos y a comunidades que de una manera u otra respaldaron a los concejales […] hemos tratado de trascender la gestión personal y tratar de buscar la socialización y difusión y sobre todo publicitar los temas gruesos que hacen parte de la función propia del Concejo Municipal como las discusiones de presupuestos, planes territoriales de desarrollo y cambios de suelos, políticas

públicas, en fin dar una pedagogía al ciudadano de lo que realmente trasciende dentro del Concejo Municipal de Ibagué y las funciones que los concejales tiene que desarrollar" (Grupo Focal Concejales)

Entonces el voto pierde su sentido formal:

Imagen No. 5. Taller Ibagué Imagina Joven

Entonces, desde la perspectiva de los jóvenes entrevistados y de los participantes en los talleres, la actividad política se traduce en un liderazgo "particularista", esto es, que apunta a la satisfacción de necesidades individuales o grupales.

Liderazgo como particularismo

La participación política se orienta hacia la obtención de bienes, al logro de favores:

"Si he trabajado en una campaña, pero ni conocía al candidato, todavía tengo la camiseta […] yo repartí volantes y me contrataron para eso porque necesitaba la plata" (Grupo focal jóvenes)

Desde esta perspectiva, la actividad política no es ajena a los hombres y mujeres jóvenes:

"Mi papá también se lanzó para Concejal del Espinal, él estuvo o fue diputado en Espinal y se lanzó para la Asamblea, yo fui y todo el cuento, aunque no vivo con él ni comparto el partido al que pertenece, pero sí fui a ayudarlo en su campaña" (Grupo focal jóvenes)

Entonces, muchos jóvenes y sus familias se esfuerzan por hacer parte de las "roscas" de quienes se benefician de los favores:

"Ahora que nombran gobernador, el político más cercano a mi familia es el actual es Peñón porque él trabajó mucho tiempo en TELECOM y mi papá era el técnico de Ibagué y él era su jefe inmediato en la ciudad y la mayoría de las personas que votaron por él fueron pensionados y de TELECOM" (Grupo focal jóvenes)

En este escenario, no es de extrañar que los sueños juveniles apunten hacia el logro de metas personales y que en pocas ocasiones apuesten a la construcción de país, o de región. Por ejemplo:

"Además casarme y tener un excelente hogar, teniendo todos los recursos económicos necesarios para poder sobrevivir" (David Girón – Taller Ibagué Imagina Joven)

"Casarme, tener hijos" (Jessica Ortegón – Taller Ibagué Imagina Joven)

"En mis sueños estaría el poder regalarle una casa a mi mamá y que mi mamá pudiera abrir su microempresa en todo el país […] poder ser ayuda para mis padres y mi hermano" (Angie Fandiño – Taller Ibagué Imagina Joven)

"Ayudarle a mi familia en lo que más pueda" (Jorge Estrada – Taller Ibagué Imagina Joven)

Debe decirse, en todo caso, que la noción de comunidad o de servicio comunitario, aparece ligada a perspectivas religiosas:

"Deseo servir y agradar a Dios con toda mi familia, para de esa manera mostrarle mi agradecimiento por todo lo que nos da a diario. Es por eso que ese sueño desde hoy lo comienzo a realizar" (Tatiana Sastoque – Taller Ibagué Imagina Joven)

"Servir a la iglesia y a la comunidad" (Cristian Nonato – Taller Ibagué Imagina Joven)

"Servir a Dios en espíritu y en verdad" (Jessica Hernández – Taller Ibagué Imagina Joven)

Quedará por discutir el sentido de este tipo de perspectiva religiosa sobre a comunidad. Pero puede decirse que el liderazgo particularista, la ciudadanía de la desconfianza y la idea de que la política es un mal necesario, al parecer dejan un vacío de sentido y de pertenencia que algunos jóvenes sacian en las aguas de los espacios religiosos.

Y sin embargo, los jóvenes que reinventan a la juventud desde la participación

"Los jóvenes somos actores protagónicos para el desarrollo" (María Camila Lozano Jiménez – Taller Ibagué Imagina Joven)

Como se ha mencionado, algunos jóvenes vienen impulsando procesos de participación desde los cuales no sólo apuntan a transformar prácticas políticas, sino que insisten en la transformación de sí mismos, es decir, en la re-invención de la juventud ibaguereña.

> *"Cuando hicimos campaña a Mockus, que ni nos pagaron, fue por convicción…eso fue porque me gustó la propuesta de la educación" (Grupo focal jóvenes)*

Los jóvenes cuentan con experiencias no clientelistas de participación en las campañas políticas, como se acaba de leer. En esta dirección, apuntan hacia una noción de ciudadanía centrada en el ejercicio de derechos y deberes:

> *"La incidencia en lo político, social, ambiental y cultural se estipula como la llave para abrir las puertas de la justicia, la tranquilidad y la paz" (Alejandra Rodríguez – Taller Ibagué Imagina Joven)*

O por ejemplo:

> *"El sólo hecho de vivir en la sociedad nos permite sentirla, criticarla, cuestionarla, pero también influir positivamente en ella" (Alejandra Rodríguez)*

Otro ejemplo:

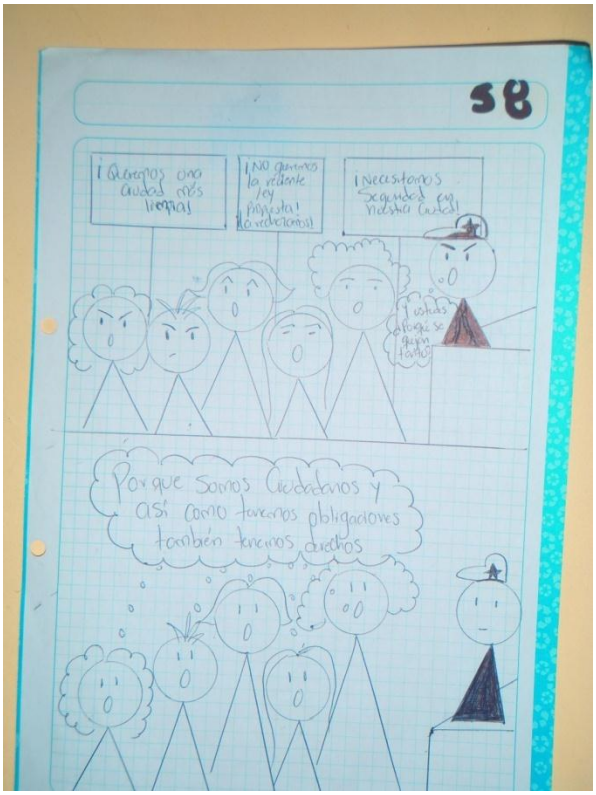


Imagen No. 6. Taller Ibagué Imagina Joven

En esta dirección, el reconocimiento del otro y el trabajo sobre sí mismo (la reconstrucción de la juventud), se articulan:

> *"Hacer cambiar nuestra ciudadanía empezando siempre por nosotros" (Lina Bonilla – Taller Ibagué Imagina Joven)*

Además:

> *"Contribuir a que no haya discriminación por condición sexual ni por la condición de discapacidad" (Daniela Salinas – Taller Ibagué Imagina Joven)*

Esta perspectiva se constituye en una invitación para la acción:

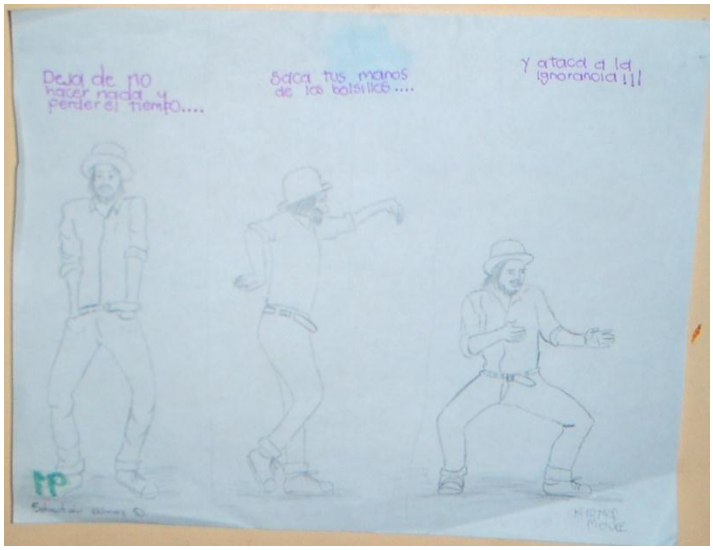


Imagen No. 7. Taller Ibagué Imagina Joven

Y esta acción, se articula a una noción de libertad y de participación:

> *"Libertad, es tener la conciencia y el criterio de lo que se piensa y de cómo se actúa" (Laura Camila Rubio – Taller Ibagué Imagina Joven)*

> *"Unos espacios para ejercer la ciudadanía son los parques y escenarios deportivos para integrar la comunidad y hacer tener una mejor convivencia (…) lo interesante es que la oferta participativa no se cierra allí [en los espacios formales], desde el arte, la música, el juego, las redes sociales, la danza, la actuación o la recreación también es posible construir escenarios de convivencia, estos campos son de nuestro dominio" (Alejandra Rodríguez – Taller Ibagué Imagina Joven)*

Participación que apunta hacia la invención de otra forma de ser joven:

"La participación es condición esencial para que los jóvenes sean actores de su proceso de desarrollo, para que ejerzan la convivencia, el dialogo y la solidaridad… los jóvenes tenemos derecho a participar en temas importantes en la sociedad" (María Juliana Rodríguez – Taller Ibagué Imagina Joven)

Los jóvenes como protagonistas del desarrollo:

"[…] que los jóvenes actúen como agente central de su propio desarrollo y así de los demás […] contribución a proyectos sociales para ser ente de cambio […] una forma distinta de asumir el ser joven: promover la participación" (Juan Carlos Neira – Taller Ibagué Imagina Joven)

Protagonismo que supone la resignificación de lo público y del conflicto:

Imagen No. 8. Taller Ibagué Imagina Joven

Y además:

"Es imprescindible re-significar el término conflicto, su ausencia genera orden, no estrictamente buena convivencia. Bajo esta premisa se deriva la responsabilidad que cae sobre los ciudadanos: empezar la construcción de un entorno donde se viva bien con los demás" (Alejandra Rodríguez – Taller Ibagué Imagina Joven)

Como se lee, esta reinvención de lo juvenil al tenor de la participación, contribuye a transformar la práctica ciudadana en dos niveles: otra forma de construcción de lo colectivo y otra forma de entender la convivencia, y por tanto la paz.

Imagen No. 9. Taller Ibagué Imagina Joven

En síntesis, si bien la mayor parte de los jóvenes entrevistados y encuestados[19] se articulan a la órbita de la ciudadanía de la desconfianza, al liderazgo particularista y a la noción del a política como un mal necesario, sin embargo, diversos grupos juveniles, apuestan por la reinvención de sí mismos en clave de participación ciudadana desde espacios alternativos (parques, expresiones artísticas, entre otros)

> *"Esté en cada uno de nosotros asumir el papel de la juventud: los retos, la incertidumbre por el futuro, los obstáculos sociales y en medio de este gris panorama decidir la acción en lugar de la pereza. Sumarnos a grupos sociales, culturales, políticos, ambientales, que visualicen una sociedad más tranquila, justa y en paz" (Alejandra Rodríguez – Taller Ibagué Imagina Joven)*

Y estos cambios apelan al humor, a la creatividad, a la búsqueda de nuevos lenguajes:

[19] Como se anotó, el programa Ibagué Cómo Vamos aporta importantes datos sobre la apatía juvenil, a partir de su encuesta de percepción de la calidad de vida.

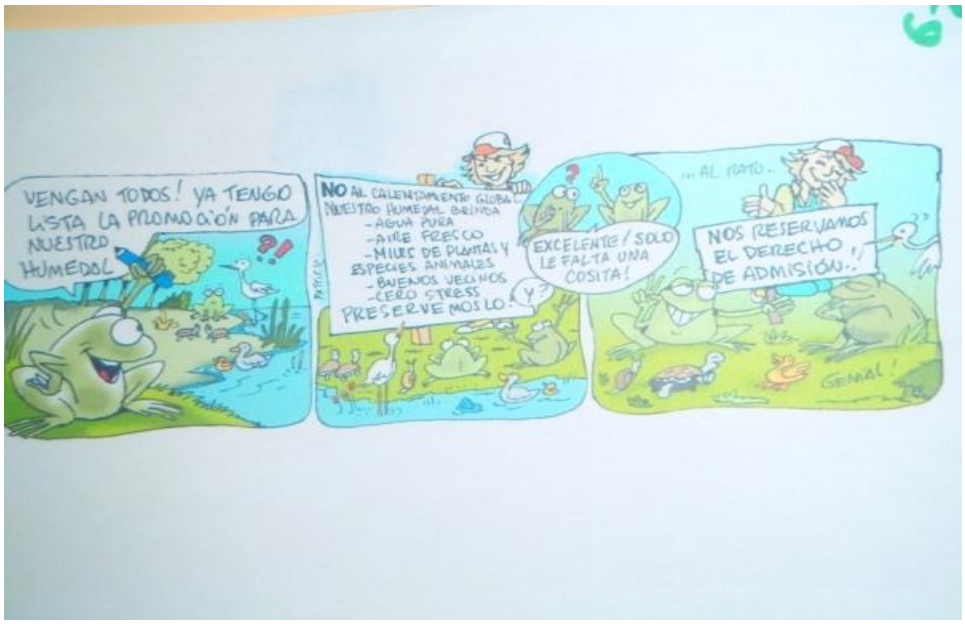


Imagen No. 9. Taller Ibagué Imagina Joven

Queda por analizar cómo se articulan y tensionan estas dos dinámicas juveniles y qué cambios pueden producirse en el entramado clientelista local.

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Towards a Non-trivializing Education

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Abstract

This paper posits that the transformations that humanity currently requires needs a non-reproductive education that produces non-trivial machines capable of changing the way society operates. Whereas reproductive education attempts to make students similar to a pre-existing model, and performance is evaluated in terms of achieved similarity to said model, a non-reproductive education would be based on a model of evaluation centered on a genuine, qualitative, self-evaluation and a restricted role of central command in terms of prescribing and guaranteeing only essential features of the system. This would also mean combating our current obsession with rankings and quantitative measures. Throughout the paper I point out some relationships between the ideas of Stafford Beer and Heinz von Foerster with the philosophies of J.S Mill, Spinoza and Heidegger.

Key words: education, Heinz von Foerster, variety management, evaluation, freedom

Introduction

If the current ills of humanity are a product of our social system rather than of its failure, a feature and not a bug, it would be pointless to attempt to fix them by perpetuating and intensifying said system. What is needed is not to do things better or more, but differently. Our social systems need to be able to adapt to unforeseen changes; that is, to become ultrastable (*cfr* Beer, 1994).

Educational institutions, as autopoietic systems, work towards reproducing themselves, irrespective of social changes (Boom, 2009, 168) whereas they should be geared towards producing difference. (see Beer, 1994, 97). Educational institutions are producers of sameness in two different ways: 1) like all bureaucracies, they are self-reproducing systems which tend to seek their own preservation rather than produce the effects they were designed for (Beer, 1994, 75-78); and 2) they reproduce certain

models of the world, certain epistemologies, which guide the way we act (see Von Foerster, 1996).

Educational institutions, like all institutions, operate with a model of the raw material they work with: students are seen perhaps as "untamed savages" or "sons of paying costumers". But they also operate with a model of the final product, a certain idea of what their graduates should look like (official school documents attempt to make this idea explicit, with statements like "X school graduates are respectful of the law and of others"). For example, the theory of *human capital* sees education as education for the jobs marketplace (Ossenbach & Boom, 2011, 679-680). With a model at each end, the process of schooling can be seen as the transformation of raw material into a specified product: the degree to which actual graduates diverge from product specifications is the degree to which the educational institution has failed. In this way, sameness is produced: this might not be a bad idea if our society was working well; since it is not, difference is a better *desideratum*. Of course, a viable adaptive system does not aim to be *wholly* different from what it is: a system is able to persist over time if it can maintain certain critical outputs steady (e.g, peace for a society; or blood-sugar levels for a human being) while certain non-essential features of the system are changed (Beer, 1994, 77).

In his famous essay *On Liberty*, John Stuart Mill (1997) praised individual freedom because divergent lives are experiments in living, which can help us fallible human beings find better ways to live (the argument, of course, works at other levels of recursion: weird institutions are just as valuable as weird persons). In times of societal crises, experimentation ought to be encouraged: the variety of a system is a source from which a system can develop new responses (*cfr*. Espejo & Reyes, 2011, 46). In what follows I present some ideas for non-reproductive education with regards to both pedagogy and institutional frameworks.

1. Perception

An important factor in facing the challenges of the future is the ability to recognize them. The problem of climate change denialism (see Dunlap & McWright, 2011) shows how relevant this factor is. The model that our brains can make of the environment is necessarily less complex than the environment itself: we must therefore filter out parts

of the environment that we consider irrelevant. It is crucial to our getting along well in the world that we only filter out what is irrelevant when we make our models: picture, for example, a parent whose model of how well his son is doing in life is derived exclusively from the child's school report card and not, for instance, the child's mood. To ignore crucial features of the environment is a recipe for disaster. However, the overwhelming complexity and sheer awfulness of our world today leads us to do just that (*cfr.* Beer, 1994, 94). A few months ago, while the coal mining company Drummond was illegally pouring tons of mining waste into Colombian oceans, one of the leading stories in national news was that a homeless person had mistreated his dog– the Drummond story was dutifully ignored. This is compounded by what Diamond (2011, 425) calls "creeping normalcy", our tendency to see as normal negative changes that occur slowly, so that what would have been scandalous fifty or twenty years ago is now considered ordinary. Finally, inadequate low-variety models can be self-confirming because "they cannot accept the very data that which would modify them" (Beer, 1983, 803).

At a deeper level, our epistemology, based on the imperative of objectivity (that is, that the properties of the observer ought not to enter the description of observations), makes us blind to its own failings. Since the epistemology of objectivity ignores the fact that we make models of the world that filter out some of its features, it makes it impossible for us to correct our filtering processes when they go wrong; this is a second-order deficiency (Von Foerster, 1996). If this diagnosis is correct, our crisis is chiefly one of perception (see Capra, 1996). Therefore, the problem of education is not one among many, but rather a strategic determinant of humanity's failure or success. I do not propose the inclusion of second order cybernetics in school curricula (which would be imposing an epistemology), but rather an education geared towards producing non-trivial machines.

2. Triviality

Paulo Freire uses the term "banking education" for what we call reproductive education. In banking education, pre-existing knowledge is "deposited" in students by a teacher in a one-directional, non-dialogical, non-creative relationship (1977, 72-73). Rather than being taught to transform the world, students are made to adjust to the existing world, as

springs and sprockets adjusted to a given machine; therefore banking education reveals a necrophilic hatred for the spontaneity of life (Freire, 1977, 74-82).

Banking education can be conceived in terms of cybernetics as the production of trivial machines. A machine is a formal function with an input, a transforming function, and an output. In a trivial machine, the transforming function is always the same, therefore the relationship between the input and the output is invariant: the behavior of wholly trivial machines is predictable and independent of their history (Von Foerster, 1996, 148-150). For example: a lamp that invariably turns on when a switch is moved, a well functioning calculator, a well-trained dog or a well-trained soldier responding to commands. At least in certain contexts, trivial machines are convenient and desirable. Reproductive or banking education is education geared towards producing certain given responses to specific questions: two times two must be four, and only four (this tendency is made more acute with the current fever of standardized testing with multiple-choice type questions; but even essay questions are generally a measure of trivialization since certain answers are expected). This approach may be adequate when teaching multiplication tables or the capital cities of the world, but is surely at fault when the subject is democracy, religion, or anything meaningful.

Non-trivial machines have an input, a transforming function and an output; but the function changes in relation to the machines' internal state which, in turn, changes in relation to the input. The first couple of times one plays peek-a-boo with a baby, the baby will be surprised and delighted. If the child were a trivial machine, this would be its response perpetually; however, previous inputs will change the baby's internal state, and it will get bored with the game. A history of inputs has changed her internal state, and therefore the output has changed from joy to boredom. The amount of possible outputs for a given input will be a function of the amount of possible internal states of the machine, which are determined by the individual machine's history (Von Foerster, 1996, 150-152). A sufficiently complex non-trivial machine, by the sheer amount of possible outputs, will be unpredictable to an outside observer (Von Foerster, 1996, 152-153) and therefore, for practical purposes, can be considered free. Non-triviality can be used as a measure of freedom.

Consider Adolf Eichmann, a rather trivial machine as to obedience to orders. In his famous Jerusalem trial, he stated that he would have been more ashamed of disobeying orders than he was of sending jewish captives to their deaths. Had Eichmann's superiors given him better orders, he would not be a reviled historical figure, but perhaps even a beloved hero. Trivial machines work well within a correctly designed system, but are more than worthless when the larger system they are in needs to be changed.

Since trivial machines in an autopoietic system cannot purposefully cause it to change, the only way our society can become a non-trivial machine capable of change is if its components (both people and institutions) become non-trivial machines. Change presupposes the production of *difference* (see Bateson, 1993). As Diamond (2011, 523-524) has pointed out in his study of the collapse of civilizations, societies that can survive crises are the ones that are capable of transforming their values; that is, societies that are capable of difference.

It's important to point out that there are two independent arguments in favor of a non-trivializing education: the argument we are making here is that society as a whole is currently in need of transforming agents. But a second and important argument, is that non-trivial machines have a richer life experience. Indeed, human ideas and perceptions are internal states; the more complex a human system is, the more varied its internal states, the more varied are its perceptions and ideas. Therefore there is a relationship between non-triviality and richness of experience. This does not mean that non-trivial humans are necessarily happier but it does mean that their lives are more interesting: "it is better to be a human being dissatisfied than a pig satisfied; better to be Socrates dissatisfied than a fool satisfied" (Mill, 1972, 9). Therefore, a non-trivializing education is called for not only for the sake of society but for the sake of the students themselves.

3. Control

I will argue that producing non-trivial machines is not merely a "letting be" of human spontaneity. Heinz von Foerster speaks of "leaving the door open" for agents of change (1996, 199), a matter of not burning heretics, but this is not enough: freedom ought to be a product of our social system, rather than a side-effect of its inaction.

Against certain libertarian positions that stress negative liberty[1] (freedom *from* State action) Martha Nussbaum argues that since freedom is always freedom to *do* or to *be* something, liberties are always positive; rights exist merely on paper if they cannot be effectively exercised, independently of whether the barrier to effective exercise is state action or some other cause; therefore it is the job of the state to positively guarantee rights (2012, 86-87; of course this includes, but is not limited to, curtailing state actions which harm people's rights).

The key distinction to be made is whether freedom is conceived as the *output* of a system or as the amount of operational constraint in it. How free is a neglected child whose parents let him do whatever he wants? How much actual freedom is there in stateless, tax-free, Somalia (which has been praised by libertarians, see Doherty, 2006)? A social system that *produced* liberty would not be an entity "characterized by more or less constraint, but a dynamic viable system that has liberty as its output" (Beer, 1994, 35).

In order to regulate a system, its variety must be absorbed. "Variety" is the number of possible states of a system; the mode of organization of a system is the way in which it absorbs variety. How? "Variety absorbs variety" (Beer, 1994, 24); regulatory variety must be equal to the systemic variety being regulated. Picture an adult taking a small child out to the city park; now picture him taking three children. The situation is quite different; in the first case, in soccer terms, we have man-to-man marking; in the second, we have zone marking. The adult may have to ask the children to hold hands while they cross the street, or to play in the same area of the park. Whereas regulatory variety remains the same (there is still only one adult), systemic variety has increased dramatically. In order to cope with this extra variety, it must be attenuated by rules and regulations. The other way in which variety can be balanced is by amplifying regulatory variety, which could mean an extra adult in the park, or a more creative one who organizes a structured game for the kids[2]; or, and this is the essence of democracy,

1 Isaiah Berlin (1969) distinguished between negative liberty (the absence of coercion) and positive liberty (self-mastery and the exercise of political rights). While he denounced the rhetorical abuses of positive freedom (where people are oppressed "for their own good"), he recognized that both types of liberty are desirable in society. The idea that negative liberty is the only kind of liberty is a crude caricature of Berlin's liberalism.

2 For the sake of brevity, I have omitted Espejo & Reyes' (2011) distinction between *diversity* (the number of *possible* states of a system) and *complexity* (the number of *behavioural distinctions* of an

teaching the children to look after themselves. In any case, variety must be absorbed by a regulatory system, some way or another.

If we manage to increase regulatory variety rather than attenuate systemic variety, we have preserved some measure of freedom (Beer, 1994, 25); this can be achieved by transferring regulatory functions to the periphery of the system. What is needed is to figure out what ought to be controlled by the central function of the system and what by peripheral functions.

For any system of appreciable complexity (like an educational system, a school or a family), it is quite impossible for the central command to regulate all of the systemic variety. The truth is that persons and organizations have a finite amount of regulatory variety that is generally quite less than the systemic variety they need to handle. Attempts to assume complete control end up in overload and failure. Colciencias (the chief educational and research institution in Colombia) demands huge amounts of information from researchers and institutions in order to evaluate and rank them; so much, in fact, that its website is usually overloaded and there is no real control on whether the information being uploaded is true or false. Is the answer, then, to increase the staff of Colciencias? This is quite impracticable; you would need an evaluator for every researcher. What is needed is a better delimitation of the role of central command (see Beer, 1994, 71-75).

If a system is to remain viable, it must preserve a certain identity: the job of the central command is to decide on and preserve it, guaranteeing cohesion between its components. The function of the central command is the preservation of the system's essence. Everything else can be handled autonomously by decentralized functions.

The problem of central and decentralized control in education, at every level of recursion, is about finding what is essential in a system and what can and ought to be left to peripheral control. I will give examples of how *not* to go about things, at different levels of recursion:

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observer in relation to a system). However the example of a creative adult is a good illustration of how increasing *individual complexity*(the repertoire of behaviours an observer can have towards a system) can balance the variety equation by increasing regulatory variety.

- Colciencias measures and ranks research groups according to an online system that records the academic production of the groups. Among the metrics used is one called "group cohesion"; groups score higher in Colciencias if their members are often co-authors of academic papers, rather than publishing as single authors. If what is essential is to evaluate the quality of academic production, is it necessary that good research papers be written collectively by members of a research group? Of course not. "But– it may be replied– academic work is improved by collaboration". Perhaps, but that should be up to the researchers to decide (for example, this may be a good idea for biology but not for philosophy). What this metric is causing is that many people in academia are starting to cheat and trade favors, by including each other as co-authors in singly-authored research papers, which was surely not the intended effect.
- Let's agree that the essential purpose of a given school lesson is to gain mastery of a certain mathematical operation (say, long division). Usually, the teacher recommends a single method for reaching said mastery: rote repetition, say fifty exercises of increasing difficulty. But maybe some students can gain mastery with just a couple of exercises, or by skipping to the hardest exercise and taking it on as a challenge, or by inventing new exercises for themselves. Why should students who understand the operation but fail to complete the fifty exercises be penalized? (see Von Foerster, 1996, 130) Again, a response to this sort of imposition is widespread cheating.[3]

If the central function were to give autonomy and responsibility to the periphery, it would relieve itself of systemic variety and make its own job easier by turining systemic variety into regulatory variety[4] (*cfr*. Espejo & Reyes, 2011, 47).

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3 These sorts of mistakes can be related to certain discourses on development that originated in the middle of the twentieth century which had a profound effect on educational planning (Ossenbach & Martínez, 2011). In Latin America, between 1950 and 1970, "(...) the new bureaucratic structures created (…) to undertake planning for education were set up for the production and circulation of discourses (...) that were generalised on a worldwide scale. In large part, they displaced the traditional places where expert knowledge regarding education was legitimised (the academic culture)" (Ossenbach & Martinez, 2011, 699-700). The philosophy of planning circulated by these discourses included the idea that development implies detailed planning, that "(...) improvisation and governmental spontaneity had to be eliminated at any cost" (Ossenbach & Martínez, 2011, 686). In systemic terms, this means an imperative to eliminate peripheral control in favor of central planning.

4 Sugata Mitra's (2010) experiments with "hole in the wall" computers (that is, computers accesible to children mounted on public spaces for free use) have shown that a rich environment can cause self-organising learning systems to form (in which, for example, some children unpromptedly take on the

It must be noted that self organizing parts of a system only work to balance the variety equation when it is aligned with the purposes of the larger system; otherwise it is a source of disturbance *(*cfr. Espejo & Reyes, 2011, 59). Universities should promote independent initiatives from students and teachers *that further the broad goals of the institution*; whereas initiatives that are orthogonal or at odds with those goals will add to the systemic variety that is to be regulated. Central command should enforce these broad guidelines, but it should also abstain from backseat driving[5].

A non-reproductive educational system should, at a minimum, limit central control to the bare essentials. But this is not enough. In the next section I will explore Heinz von Foerster's idea that non-trivial machines could be produced by an education that asked legitimate questions.

4. Questions

The biggest problem with education is that it is generally understood as the transmission of knowledge, where knowledge is a thing that is possessed by the teacher and not the student. Education is, rather, a dynamic relationship, a mutual structural coupling where teacher and students *both* learn and teach (see Von Foerster, 1996, 129); knowledge is not transmitted as a thing but rather activated as a process. Seen this way, to teach is not to transmit knowledge but to operate on a dynamic person.

A reified understanding of knowledge leads to an education guided by illegitimate questions. These are questions to which there already exists an answer (Von Foerster, 1996, 198). The job of the teacher is to get the student to give specific answers to specific questions. A legitimate question, on the other hand, is a question to which the answer is unknown: to allow the asking of legitimate questions in the classroom is to activate autonomous research.

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role of teachers) that can produce results comparable to those of formal schooling. This is a perfect example of putting a systems self organising capabilities to work.

5 Christoph Wulf (2013) has called for peace, cultural diversity and sustainable development to be goals of education. In the same article, he calls for curricula to include peace studies, heterological thinking and studies on sustainability. It is important to distinguish between the two calls: one is about *where* we should go, the other is about *how* we should get there. The *where* should be decided by central command, the *how* is a matter for self-organizing peripheral systems.

The difference between the two types of questions can be illustrated by the role played by language and by the teacher in each case. In answering illegitimate questions, students learn pre-existing categories that guide their thinking (see Von Foerster, 1996, 190); whereas in answering a legitimate question, students must *create* their own categories (see Von Foerster, 1996, 167). The teacher that asks illegitimate questions is the possessor of the answers and is therefore in a position of power over the students; whereas in answering a legitimate questions the teacher (as well as the library, the internet, or other people in the community) becomes a *resource* for the student, an aid in solving a problem, that can be called upon if necessary (*cfr* Beer, 1994, 61).

¿Can school students do original research? Yes: recently, an artificial intelligence program for detecting breast cancer (see Kuchment, 2012). But more importantly, there needs to be a distinction between *original* and *authentic* research. Original research comes up with theories or innovations that are new for the academic community as a whole; authentic research is research that tackles autonomously formulated questions that are significant to the person or group that formulates them. A rural community might take on the task of solving some of its problems regarding drinking water and come up with solutions that are quite similar to others already known elsewhere in the world: their research will not be original, but it will be authentic. Picture a sixteen year old who is having doubts about which career to pursue: she might look for information about the nature of certain professions on the internet; interact with people in her community, etc. What she finds out will not be new for humanity, but it will be new and important for her, and she will be empowered by the experience.

5. Measurement

Reproductive education has an easy time of the necessary task of measuring the success of students, teachers and institutions. Given a pre-specified model of expected results, the task of measuring success is simply that of comparing actual results to required ones. But what if success in education means producing the unexpected? How should we rank a school where the students have created a club for designing videogames as compared to one where the kids have decided to use some of their school time to build houses for the underprivileged?

I will tackle the problem of measurement in the context of what has elsewhere been called *Gorgia's disease* (Bula, 2012). In Plato's Gorgias (1983), Socrates states that philosophy is to sophistry like gymnastics is to cosmetics. Gymnastics produces true beauty while cosmetics produces its superficial appearance; in the same way, philosophy produces truth, whereas sophistry produces the appearance of truth; in both cases, the search for the superficial and apparent is harmful for the search of the true. The term "Gorgia's disease" refers to the current ubiquitous tendency on the part of institutions to seek to do well on official measurements while disregarding the goods these measurements are designed to measure: schools focus on doing well on standardized tests rather than on providing a good education; researches focus more on publishing plenty of articles than they do on quality research; countries focus on increasing GDP rather than improving the actual lives of their citizens. Remember what I mentioned about cheating on silly policies emanating from central command, like Colciencias' group-cohesion metric.

This disease has to do with a disproportionate focus on quantitative measures; for instance, universities are evaluated more on bibliographical production than they are on extension work towards the community simply because the first is more easily quantified (De Sousa Santos, 2011, 68). Part of the problem is that we tend to trust the bureaucracy of formal models and procedures more than we do people, which is quite stupid: people are capable of morality, intelligence and flexibility; bureaucratic models and procedures are not (see Beer, 1994, 81).

A common answer to the insanity of measurements is to propose new instruments for measuring success (for examples, alternatives to the GDP for measuring the success of countries, see Nussbaum 2012; Leonard, 2010). This is a good idea, but a question that should be asked is who should be measuring what. Remember our limited role for central command: whatever is essential to the system should be guaranteed by central command, whatever is not should be left to the autonomy of the periphery. In education, this is how self-evaluation and evaluation by a command center should be assigned.

Before I proceed, I should note that what is usually called self-evaluation is really other-evaluation that is outsourced to the people being evaluated: the evaluator chooses the criteria for evaluation, and gives the "evaluees" part the task of performing the

evaluation, according to criteria that they did not select. This has nothing to do with educational autonomy, but rather with creating the superficial appearance of it, and maybe saving evaluators a little work. Self-evaluation is only genuine when the self-evaluator gets to choose the criteria with which he is to be evaluated. At my university, as part of my "self-evaluation", I am asked whether I try to use new technologies in the classroom: I actually think that is quite irrelevant to my classes (and I should know, I teach them).

So what should be measured by central command, what should be left to (genuine) self-evaluation? Central command should guarantee minimal, essential standards and leave whatever goes beyond that to auto-evaluation. For example, the government should figure out what are the minimal qualifications for someone to be a licensed doctor and test the different Schools of Medicine on that; and teachers should think what is minimally required from each assignment and make sure that students reach it. The idea would not be to rank schools or students, but just to certify that they comply with minimal standards; you either pass (with, say, a 95% grade or higher) or you don't. Ranking would not be a function of evaluators; this would greatly help to alleviate Gorgia's disease: educational institutions would not be compared by ranking but rather (as they were for many centuries) in the court of public opinion, so there would be no stimulus to cook the books or beef up the numbers.

What about what goes beyond the bare minimum, everything that is creative, transformative, interesting? This should be the province of self-evaluation: each institution, as well as each student, should be able to select the criteria for evaluation. Since each institution or student will select different criteria, ranking is out of the question, as it would be akin to comparing apples and oranges.

Often, debates on education lead to discussions about essences: "What is a school? What is the true nature of a University?" If educational policy matters are decided in this way, individual institutions are robbed of the proper flexibility to experiment with different ways of understanding education in our changing social landscape; that is, society is robbed of the variety it needs to transform itself. Should we do away with essences entirely? This seems unwise as well; viable systems need to preserve their identity, for which they need an idea of what that is. Spinoza's (1999a) framework

seems useful: he speaks of individual essences; there is no such thing as the essence of Man or Dog, but there is the essence of Keith or Pluto. This individual essence is the autopoietic network that produces and gives identity to a certain system (see Bula, 2008). On an epistemological level, this means understanding each educational institution in its own terms; on a policy level, this means that it is the members of each institution, not some distant board of head honchos, who are tasked with figuring out what the essence of their institution is.

Spinoza (1988, 166-172), in a letter to critic Willen van Blijenbergh on the problem of evil, lays out the idea of what can be called an immanent ethics. For Spinoza, there is no such thing as evil; "evil" being, rather, the name we give to a things' imperfection in comparison to what we think they should be. We compare Peter or Paul to a certain idea we have of what a Man should be, instead of looking at Peter or Paul in their own terms. This, in a nutshell, is transcendent morality: judgment using a pre-existing criterion external to the object. In contrast to this morality, Spinoza posits that God's ethical laws ought not to be understood as the commands of a judge or a king but rather as corollaries of natural laws, as simply the best way to behave given the way the world works: it is not that coveting thy neighbor's wife displeases an angry God, but rather that, given the natural laws that govern human interactions and emotions, this tends to lead, causally, naturalistically, to bad consequences (see Spinoza, 1999b; Deleuze, 2009). Ethics is therefore immanent to a thing's causal operation and connection to its environment. As a corollary, ethics can change with a situation: in a specific set of circumstances, it can be a good idea to covet thy neighbor's wife; this is something you have to figure out for thyself.

Beer's aphorism: "the purpose of a system is what a system does" (2008, 99) is an invitation to examine a system in its immanent operation: look at the way a school works, not at its mission statement. Educational systems are not images or representations, but rather causally interrelated elements (*cfr*. Martínez, 2009, 168).

An increased role for genuine self-evaluation would make for more autonomous institutions and persons that would have to make genuine decisions. This means that institutions and persons would have to take more responsibility for their actions: the Eichmann excuse goes out the window. The call for greater autonomy at every level of

recursion of the educational system has to do with actually being able to absorb the systemic variety that needs to be regulated. But it also has to do with personal autonomy; which is something that ought to be pursued for its own sake.

6. Autonomy

I recommend minimal hetero-evaluation and genuine self-evaluation at every level of recursion in the educational system: Institutions in relation to the government, teachers in relation to the institutions, students in relations to teachers. There is one final, crucial, level of recursion: the evaluation of students by themselves. Students should be their *own* variety attenuators. This is personal autonomy.

Since human beings are finite and live in a finite environment, they must necessarily operate within variety constraints (Beer, 1994, 82). Freedom cannot mean freedom from constraints: rather it means freedom of control over one's own variety attenuators (Beer, 1994, 83). Would the main news item in a free Colombian society be the mistreatment of a dog while Drummond pollutes Santa Marta's oceans?

The world we perceive is necessarily the product of variety attenuation: to understand this is necessary if we are to regain control of the attenuation process (Beer, 1994; Von Foerster, 1996). Heidegger (2001) has conceptualized freedom in a very similar manner. For Heidegger, the essence of technology is ontological; it is a way of disclosing the world, of revealing reality. The essence of techonology is its way of disclosing the world in a technological manner, where things appear as resources to be put to work. The danger of technology is that this particular way of uncovering the world (as opposed, for example, to ancient Greek or medieval ways of disclosing) may become dominant and exclude all other possibilities of uncovering, thereby robbing man of his essence as capable of disclosing worlds. But man regains his freedom if he realizes that he is a discloser (Heidegger, 2001, 29; see also Spinosa, Flores, Dreyfus, 1997).

The freedom that comes from taking charge of the construction of one's own reality comes with a corresponding responsibility. To say "my hands are tied, such is the nature of reality" is no longer an excuse, because such a reality was a product of construction (see Von Foerster, 1994, 92). Against the drift that makes certain choices and positions seem inevitable (see Martinez, 2009, 175), to disclose that we are disclosers, to gain

control of our variety attenuation, is to be able to ask, like Socrates, 'how are we to live'?

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Scenarios of transformation of political parties in Colombia in the context of power and the global reconfiguration of the modern state

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Keywords: Power, Global Reconfiguration, Scenarios, Marketing Clientelism, Citizens Self-government, Soclab

What is the role of the political parties today, particularly when we are witnessing a complex transformation of power and the modern state? This is the question we are set to answer in the present paper. We will argue that as the result of these transformations, old institutions are being dissolved or reconfigured and new institutions and forms of citizen organization are emerging. Of special interest in Latin America are phenomena such as the restructuring of society in new forms of communal and citizens non-governmental organizations; changes of the traditional clientelistic modes of operation of political parties and inchoate forms of deliberative and participatory democracy. This paper will undertake first the task of outlining a theory of the transformation of power and the Modern State based on the works of Michel Foucault and Manuel Castell.

Next, based on the above conceptual framework, we will proceed to interpret the current role of political parties in the Department of Tolima in Colombia and their relationship with citizens at various levels, particularly the communal level of organization. The underlying rationale of Tolima´s political parties is to make use both of so-called "market clientelism" and mechanisms of informal negotiations between families and political groups, in order to take control of local public institutions. How can we interpret such behavior in the light of the theories mentioned above?

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Making use of various studies on market clientelism (Programa Ciencias Políticas, UNIBAGUE), community organizations (Fundación Social de Ibagué), and emergent citizens self-government in Colombia (Murillo, 2014), we will draw at least two scenarios of politics and the transformation of political parties in the Tolima region. The first scenario, a reference projection, will be driven by the question: If the strategies and behaviors of the political parties do not show any basic change in the next few years, what is the fate of market clientelism and the power dynamics which characterize it. The second one is focused on the possibility that the political parties begin to change their strategy and look to nest themselves within emerging forms of citizen self-government. The paper ends with a discussion about the possibility of using computer platforms as Soclab to reflect more deeply on the dynamics of the aforementioned scenarios. SocLab (Sociology Laboratory) is a theoretical and methodological framework for the study of the structure and dynamics of social systems, through computer-based multi-agent simulation. It´s main goal is to study the organizational dynamics and the forms of regulation of social systems.

INTRODUCCION

En el presente artículo se discute el modo como el *clientelismo*[5] se ha venido reconfigurando al tenor de los nuevos escenarios político sociales relacionados con el fenómeno de la transformación del estado moderno. Dicha transformación se manifiesta de diversas formas, tanto a niveles globales como locales. Una de ellas es lo que llamaremos en el presente artículo el fenómeno de la "monetarización" de la vida y la emergencia de *la sociedad endeudada*. A nivel local, y en relación con el clientelismo, se puede hablar de una "monetarización" de la relación entre votantes y candidatos que profundiza la actual separación entre el poder y la política, esto es, que aleja a los electores, pero también (incluso) a los elegidos, de la participación en la toma de decisiones estratégicas en torno a los destinos nacionales, regionales y globales. A nivel global este el fenómeno puede interpretarse en términos de ~~se~~ la *lógica del poder pastoral*, concepto foucaultiano (Foucault, 1998, 2006a, 2000 y 2007) que usaremos en nuestro estudio para estructurar el campo histórico del presente como una "producción" de sujetos que asumen la tarea de gestionarse a sí mismos, esto es, de personas que se conciben a la vez como *empresarios de sí* y como "*sujetos endeudados*", vale decir, sujetos que construyen sus vidas alrededor de la gestión de los pagos, y no desde el reclamo de sus derechos[6]

En la primera parte de nuestro artículo armaremos nuestra estructura conceptual con base a dos pilares y un contrapeso. Por una parte tendremos una columna inspirada en la lógica del poder pastoral. Por otra parte, Lazzarato (2013) nos proveerá de una segunda columna con su concepto de "*la sociedad del hombre endeudado".* El contrapeso lo proveerá Castells (2010) con su teoría acerca de la desaparición del Estado Soberano. El contrapeso a las columnas mas de corte foucaultiano nos permitirá comprender mejor dichas teorías respecto a la transformación del estado moderno y la globalización como parte de un nuevo mecanismo de poder transnacional que está rompiendo los esquemas de nación,

[5] El *Clientelismo* se entiende como un proceso de relación entre candidatos y electores en el que se intercambian favores. Se trata de una relación desigual en la que se ponen en juego diversas estrategias de acceso a la actividad estatal (Ver Rubio, 2003). Como se verá más adelante, este tipo de acuerdos se ha venido transformando en un escenario en el que las entidades públicas se reducen y las decisiones de inversión se centralizan, lo que ha abierto un escenario para la compra de votos.

[6] Lazzarato (2013) ha argumentado que las actuales crisis en Europa (así como las que ocurrieron en América Latina para finales de los años 1990) han convertido los subsidios al desempleo (así como muchas otras garantías en salud y seguridad social) en mecanismos de ahorro personal y de deuda pública (que terminan pagando todos). Los sujetos se vienen gestionando como personas "endeudadas", que apuestan su forma de vida a la obtención de préstamos y al pago, con lo que esto trae de presión (culpa, responsabilidades, etc.).

gobierno nacional y local, así como los esquemas de lo publico, lo común, lo político y lo colectivo.

En la segunda parte nuestro investigación, apoyada en las columnas y contrapeso antes mencionados, centrará su foco a nivel local y regional para preguntarse *¿Cuál es el lugar y el papel de los partidos políticos hoy, cuando asistimos a una compleja transformación del poder y por ende del Estado y de la política desde las perspectivas ya anotados*?" A este nivel podremos entonces observar la "monetarización" de la política. En efecto, a través de una serie de entrevistas con activistas políticos que ocupan diferentes lugares y roles en el entramado político regional colombiano[7] ---por ejemplo como líderes que canalizan votos para un candidato (quien a su vez, facilita votos para otros jefes políticos), o como líderes elegidos para corporaciones públicas locales (Concejo) y regionales (Asamblea)--- podremos mostrar el potencial de nuestro marco conceptual interpretativo para comenzar a entender la transformación del *clientelismo* en nuestra región.

Expliquemos con mayor detalle. Dado que nuestro interés radica en poder examinar cómo la transformación del estado moderno está incidiendo en la reconfiguración de los partidos políticos, en la primera parte miraremos esa relación a nivel general ~~se~~ señalando tres elementos problemáticos: de un lado, los efectos que la globalización trae respecto al orden tradicional, esto es, la reconfiguración de la soberanía; de otro lado, la creciente intromisión de las políticas públicas en todos los órdenes sociales; y por último, lo que Bauman (2007) ha denominado como la separación entre poder y política. A la luz de estos aspectos se discutirá el modo como todos los fenómenos señalados se articulan con la lógica de poder en el mundo contemporáneo: la llamada sociedad disciplinaria y la emergencia de la sociedad del Control (Deleuze, 2006 y Deleuze y Guattari, 2002), la gubernamentalización de la vida cotidiana, y finalmente el *poder pastoral* (Foucault, 1998, 2006a, 2000 y 2007) y *la sociedad del hombre endeudado* (Lazzarato, 2013).

En la segunda parte usaremos el marco conceptual para abordar aspectos problemáticos de la dinámica de los partidos tales como su des-corporalización y

[7] Estas entrevistas se contrastaron con los archivos de dos investigaciones previas y con los resultados de un proceso de seguimiento a la gestión pública local hecho desde el programa de Ciencia Política de la Universidad de Ibagué. Las investigaciones fueron "Concejo al Día" y "Gestión Social del Territorio" respectivamente. Concejo al Día analizó las estrategias de comunicación desplegadas por el Concejo Municipal, así como por los Concejales. En este contexto se estructuraron una serie de grupos focales para conversar en torno a la manera como los ciudadanos se relacionan con el Concejo, así como un conjunto de entrevistas para discutir con éstos su interacción con los ciudadanos. Además se analizó el modo como la prensa local informa (y construye noticias) sobre esta corporación. Gestión Social del Territorio, por su parte, analizó las dinámicas de construcción social del territorio para los municipios del norte del Tolima (Ambalema, Mariquita y Honda). Desde este proyecto se hizo un seguimiento a la dinámica electoral de la región. Todo este material se discutió a la luz de los resultados electorales de 2010 y 2014 para el Congreso de la República de Colombia. El análisis se condujo desde el Observatorio al Concejo de Ibagué, haciendo un seguimiento a la actividad de esta corporación por espacio de un año.

de su des-ideologización. El escenario de la discusión se problematizará a partir de la lógica política regional Tolimense, la cual gira en derredor de lo que podemos denominar *clientelismo monetarizado* y en la pervivencia de las negociaciones informales entre familias y grupos políticos para capturar y administrar al Estado local. Esta problematización final alimenta el debate en dos vías: la discusión sobre los partidos, y la relectura del poder local a la luz de las tensiones globales.

PRIMERA PARTE: MARCO TEORICO PARA COMPRENDER LA TRANSFORMACION DEL ESTADO Y EL IMPACTO DE DICHA TRANSFORMACIÓN EN EL "CLIENTELISMO"

LA TRANFORMACION DEL ESTADO

La globalización económica ha re-localizado la cuestión de la *soberanía*, elemento esencial de los Estados Modernos. En efecto, la movilidad global del capital ha generado una dificultad en los Estados para controlar el flujo de la inversión y por tanto el desarrollo de proyectos a largo plazo. La globalización del capital ha determinado que la sobrevivencia económica de las regiones dependa entonces más de su capacidad para *adaptarse a entornos cambiantes*, que de un aseguramiento de la estabilidad de las actividades económicas. En este sentido, las corporaciones han ganado una capacidad de negociación y de agencia globales muy importante. Por su parte, los inversionistas han cambiado su lógica. Según Sennett (2008), su apuesta por los rendimientos de sus inversiones se ha orientado más a lograr ganancias de la compraventa de acciones (o de títulos de este tipo), que a obtener los rendimientos de las empresas en las que invierten. *Éste énfasis en la especulación global*, *reorganiza la relación entre los Estados, las Corporaciones y los inversores*: el control que los primeros pueden ejercer sobre los demás, disminuye. Sin embargo, la política institucionalizada (la que tiene que ver con los partidos, los parlamentos y los gobiernos) sigue desarrollándose localmente, de tal suerte que el poder (entendido como la capacidad de afectar las posibilidades de vida de los demás) y la política, *terminan por alejarse*. Esto implica que la mayoría de los ciudadanos ahora deben enfrentar los efectos de las decisiones tomadas en otras latitudes, mientras que los Estados buscan crear confianza en los inversionistas, compitiendo con otros en esta carrera por hacerse atractivos para la inversión.

A este escenario le viene bien la des-ideologización y a la des-corporativización de los partidos (de la cual hablaremos más adelante), en tanto que sus promesas se inscriben en las posibilidades de un orden global limitado al desarrollo de habilidades y capacidades (personales y sociales) que hagan de la región un lugar atractivo para el flujo de dinero y que canalicen algunos recursos para resolver necesidades básicas.

En este escenario, Foucault (xxxx) plantea que el neoliberalismo supone una racionalidad del poder, que busca una sujeción de los individuos a partir de una

modulación no necesariamente de sus conductas sino de su ambiente. Por su parte, Castro (2010) citando a Deleuze (2006) expone que el neoliberalismo parte de la idea de que cualquier individuo tiene la capacidad de incrementar su "capital humano" mediante la creación, innovación y emprendimiento, lo que requiere necesariamente un medio ambiente de libertad frente a las vigilancias estatales. Esto permite que los sujetos hagan *marketing* de sí mismos y que adquieran nuevas competencias inmateriales. De este modo, un diagnóstico del presente, desde la perspectiva foucaultiana de la "analítica de la gubernamentalidad" es el de una sociedad donde la forma "empresa" domina sobre la forma "Estado". Por ende es más una sociedad compuesta principalmente de mercados que de individuos y colectividades. En ella el control se desterritorializa y al mismo tiempo se molecullariza (Castro, 2010). Vista en estos términos, la reorganización del clientelismo (en el caso específico tolimense) ~~que~~ puede leerse desde la lógica empresarial y de marketing propia del neoliberalismo. A este punto se volverá en la segunda parte.

Desde otra perspectiva teórica (la que hemos llamado de *contrapeso* a la foucaultiana), Castells (2010) analiza el fenómeno de la transformación del estado Moderno aclarando que se debe entender que existe una política nueva en el mundo globalizado, en la cual las relaciones de poder existentes en distintas estructuras sociales que regularmente se constituyen a partir de formaciones espacio-temporales, ya no sólo son locales, sino locales y globales al mismo tiempo. El territorio, considerado como uno de los elementos constitutivos del Estado, se ha redefinido con la globalización, de modo que se han reorganizado los límites territoriales del ejercicio del poder (Beck en Castells, 2009) lo que ha llevado a plantear la cuestión de si el Estado como institución soberana puede desaparecer en la medida en la que otras instituciones han ganado protagonismo y agencia. En todo caso, hay una resignificación de los límites nacionales de las relaciones de poder: *el estado no desaparece, pero cambia de papel, de estructura y de funciones, evolucionando hacia una forma nueva y diferente (Castells, 2009) que posiblemente se vuelve más útil a las dinámicas de la globalización.*

Vale la pena anotar que Foucault y Castells tienen en común cierta preocupación por la reconfiguración del territorio, del estado y de las relaciones de poder; Foucault con la desterritorialización y molecularización del control y Castells con la resignificación de los límites nacionales de las relaciones. Podemos agregar que esta reconfiguración se hace evidente por lo menos en dos sentidos: hacia adentro y hacia afuera. Hacia adentro se descentraliza para responder a las demandas de autonomía de los territorios subnacionales (Moncayo, 2002); hacia afuera se consolida la supranacionalización para proveer esquemas de regulación requeridos en la globalización.

En el primer sentido, los territorios subnacionales cobran un papel importante basado en altas cuotas de autonomía[8]. En el segundo sentido se consolida la supranacionalización debido a que gran parte de las políticas públicas que decidía el Estado central, ahora provienen de las directrices de los organismos multilaterales y supranacionales (World Bank, 2002; Shah, 2007). De este modo, globalización y *localización* se vuelven dos caras de la misma moneda. Las regiones, progresivamente empiezan a preocuparse por diseñar las estrategias que le permitan su concierto dentro del contexto global. Un ejemplo de ello es la paradiplomacia o política "interméstica", a través de la cual una función natural del Estado, como las relaciones exteriores, es apropiada por los territorios subnacionales para promover iniciativas de tipo político, social, económico, cultural, etc. La paradiplomacia podría entenderse como las iniciativas exteriores de los territorios subnacionales, realizadas a través de una diplomacia que se aleja del centralismo estatal y que es regulada y sostenida por las colectividades territoriales que proclaman y despliegan una capacidad de actuación propia (Torrijos, 2000, págs. 20-21, citado por Moncayo, 2002).

Así mismo, en el segundo sentido, el Estado se reconfigura en múltiples alianzas y nuevas estructuras comandadas por organismos multilaterales, supranacionales (como la OMC, el Banco Mundial, el FMI, entre otros (Castells, 2010)), bloques regionales, empresas multinacionales y transnacionales que cobran fuerza en el ámbito internacional y hacen que el papel tradicional del Estado pierda importancia. Sin duda alguna lo que se evidencia es una transformación del Estado-nación como entidad soberana. Y comenzamos a presenciar Estados respondiendo a la globalización conformando redes de Estados, algunas con múltiples objetivos, Estados compartiendo soberanía con otros Estados o estableciéndose de manera informal para gestionar estrategias mundiales conforme a los intereses de los Estados miembros participantes.

LA TRANSFORMACION DE LA CIUDADANIA

Ante estas transformaciones cabe preguntarse cómo ha respondido el ciudadano, particularmente sintiendo el vacío que dejan las estructuras del Estado Moderno tradicional que ya no están más en existencia. Comienza a aparecer una nueva noción de ciudadanía que supera los límites del Estado, *la ciudadanía global*. Según Hopenhayn (2001), de la División de Desarrollo Social de la CEPAL, el impacto de la globalización en la ciudadanía se manifiesta por lo menos en dos niveles; el primero es el político y cultural que se traduce en la difusión a escala planetaria de una cierta sensibilidad proclive a los valores democráticos y al respeto a los derechos humanos. En otro nivel, el comercial y financiero, los ciudadanos se asocian globalmente con organizaciones que se movilizan e impactan la opinión pública para defenderse de los efectos de la globalización. Adelantándonos a la segunda parte del artículo, diremos que

[8] Para el caso colombiano, puede decirse que el proceso de descentralización se ha debilitado en la medida en la que desde Bogotá se definen lineamientos, se concentra la contratación y se recorta el presupuesto local.

para el caso del Tolima las redes clientelares conectan la participación política con el intercambio de favores y ubican la gestión pública desde esta lógica, de modo tal que el acceso a servicios o a bienes provistos por el Estado pasa por la correlación de fuerzas de los grupos políticos que controlan las entidades públicas. En este escenario *la ciudadanía*, como ejercicio de participación en la construcción del universo colectivo, *se aleja de la política local, regional, e incluso nacional*, esto es, la "política" regional se despolitiza al reducirse a la competencia entre grupos por controlar los recursos requeridos para reproducir sus curules, mientras que las decisiones estratégicas se toman por fuera del Estado: los lineamientos de las políticas públicas se definen en otras esferas. Así, el Estado garantiza que se socialice la deuda[9], al tiempo que se desarrolla una intensa para-diplomacia "por encima" y "por debajo" de los Estados nacionales. Por tanto podemos decir que en el plano de la política local y regional, el Estado aparece menos como un escenario de construcción de lo público y más como un mercado de recursos en el que diferentes empresarios políticos acuden en una encarnizada competencia. Desde esta perspectiva la ciudadanía asume las características antes mencionadas: el ciudadano es un sujeto que se "autogestiona", que se hace empresario de sí mismo, accediendo a la política local como *otro emprendedor más en procura del control de los escasos recursos.*

En suma, el Estado se ve constantemente socavado por el nuevo orden global. De hecho como menciona Bauman (2003) "*los castigos impuestos por violar la nueva ley global son rápidos y despiadados. La negativa a jugar la partida según las nuevas reglas globales es el delito más duramente castigado, un crimen que los poderes estatales, atados al suelo por su propia soberanía definida territorialmente deben evitar cometer a cualquier precio".*

GUBERNAMENTALIZACIÓN DE LA VIDA COTIDIANA Y PODER PASTORAL: HACIA EL HOMBRE ENDEUDADO

Si bien es cierto que el poder político y el poder gubernamental se separan y el ciudadano queda entonces desprotegido en varios frentes tradicionales manejados por el Estado (salud, educación, empleo….), por otra parte y paradójicamente las políticas públicas abordan un conjunto cada vez más amplio de problemas ciudadanos, políticas que abordan desde el control de la vida pública (transporte, seguridad, medios de comunicación), hasta el disciplinamiento de la intimidad (educación sexual, control del tiempo libre, políticas que regulan la dieta y la actividad física, etc.). *La gestión (producción) del sujeto como empresario de sí mismo*, se desarrolla a través del llamado *capital humano* (capacidad para producir

[9] Nos referimos a que las crisis financieras, la dificultad que han tenido los bancos para recuperar su deuda, ha sido asumida por los estados (quienes obtienen sus recursos de los ciudadanos). Si otrora el estado de bienestar procuraba "corregir" los desequilibrios del capital, hoy, los estados garantizan que toda la sociedad pague por los fracasos en la gestión de dicho capital, al punto de que estas crisis, se convierten en un buen negocio para muchos sectores financieros (Ver Lazzarato, 2013). Sobre este punto volveremos más adelante.

bienes y servicios de alto valor) y capital social (la capacidad para establecer y mantener acuerdos, confianza, y por esta vía, reducir los costos de transacción). Todo ello se conjuga con el aumento de las demandas sociales de intervención pública que se encuentra en el medio de una emergente l ciudadanía de la desconfianza.

Este aumento de las políticas públicas se desarrolla como un ejercicio de gobierno de la vida, esto es, como un proceso de gestión de cada una de las esferas que la componen, de producción de lo bueno, lo deseable, y de constitución de las fuerzas individuales al tenor de las necesidades de cierta organización social.

Foucault ha definido al *poder* como una acción sobre las acciones posibles de los demás. En este sentido, el poder requiere de la libertad, de una cierta capacidad de elección de los sujetos. No hay poder sin libertad, al punto que los sujetos pueden ejercer esta libertad, incluso en contra del poder mismo. Ahora bien, como producto de la capacidad de afectar la vida de los otros y de ser afectados por estos (en últimas, de la construcción de una trama de relaciones estratégicas), se producen formas globales del ejercicio del poder, en estructuras de dominación. Una de estas formas generales del ejercicio del poder ha sido denominada por Foucault como "gubernamentalización" (2006a), refiriéndose a un poder que procura el "buen gobierno" de todas las cosas: se trata de "llevar" (guiar) cada asunto a un desenlace deseado. A diferencia de éste, el poder soberano se ejerce como un castigo (la respuesta del soberano a cualquier amenaza en su contra) y como una "extracción" (obtener de los súbditos sus bienes o servicios). La *gubernamentalidad* apunta a la administración de todos los temas y problemas y supone el conocimiento de la "naturaleza" de cada uno de estos asuntos, con lo que, el vínculo entre poder y saber se complejiza: se conoce para administrar mejor.

El poder pastoral alude a esa lógica en la que el poder se esfuerza no sólo por administrar las fuerzas del rebaño, sino también por aumentarlas: un pastor no sólo sanciona o castiga (poder soberano) sino que conoce a sus ovejas, las conduce por territorios propicios, las fortalece, pues sabe que su éxito depende del bienestar del rebaño.

Se entiende que estas lógicas del poder son esenciales en la ampliación del capitalismo, pues se trata de "lograr" individuos y poblaciones capaces de producir en entornos económicos precisos (a la vez disciplinados y creativos) y de consumir (de dejarse llevar por impulsos, de comprender que en la satisfacción de "gustos" se encuentra la realización personal, etc.).

Estas ideas ayudan a comprender la paradójica multiplicación de las políticas públicas (una de las expresiones de la gubernamentalización) en el escenario del distanciamiento entre el poder global y las políticas nacionales y regionales: el esfuerzo de unos y otros por mejorar los capitales humano y social adquiere

sentido en el escenario de re-localización de la soberanía, de lucha por hacerse "atractivos" a la inversión. Pero aquí cabe la pregunta, ¿por qué es que las relaciones políticas locales prestan poca importancia a esta abundancia de posibilidades que abriría la superproducción de políticas públicas? ¿Por qué esas redes clientelares poco discuten el sentido y las formas que esas políticas adquieren? La primera idea es que el interés de estos grupos se articula a una cuestión básica, a saber, cómo canalizar votos, es decir, las políticas públicas se convierten en asuntos de la gestión de las redes clientelares en la medida en la que puedan ser una fuente de recursos para responder a los favores: servicios, puestos, subsidios, etc. De este modo los gobiernos locales contarán con cierta libertad (aparente) para actuar en la medida en la que su quehacer no interfiera con las pirámides de favores clientelistas. Sin embargo, esa "libertad" es modulada por los lineamientos nacionales e internacionales, como se ha puesto de manifiesto ya: el modelo de salud, de educación, el sentido de políticas de juventud, de mujer o de género, incluso los alcances y estrategias de participación se encuentran ancladas a redes de discurso transnacionales de las entidades financiadoras, que se concentran en la ampliación de las oportunidades y capacidades de los sujetos que toma bajo su cargo, lo que, desde nuestro punto de vista, apunta hacia la gestión de sujetos productivos, de empresarios de sí mismos.

Ahora bien, Deleuze (2006) ha apuntado hacia nuevas formas generales del poder: las sociedades del control. De acuerdo con él, Foucault había analizado las sociedades disciplinarias, en las que los poderes operan en a través de los encierros: la escuela, la fábrica, la escuela, el hospital, produciendo cuerpos y poblaciones "dóciles", con capacidades y cualidades en sintonía con ciertos saberes y exigencias sociales. Deleuze argumenta que esas sociedades del encierro han dado paso al control al aire libre, control que opera digitalmente, modulando los deseos y permitiendo el acceso a un mundo social mediado a través de las tarjetas de identificación: el carnet, las claves de acceso, las tarjetas de crédito. Todas ellas orientan el universo de lo posible para los sujetos y se constituyen en un modo de organización institucional. En este universo, las resistencias operan siguiendo la lógica de los virus, infiltrándose, infectando. Aquí, Deleuze formula la forma general de este nuevo tipo de relaciones de poder: *no estamos encerrados, estamos endeudados*.

Lazzarato (2013) entiende, a partir de este planteamiento, que la deuda no es sólo un compromiso personal o institucional, *sino que se constituye en el eje articulador de las relaciones de poder del mundo contemporáneo*, es una relación que garantiza cierta sujeción del deudor frente al acreedor. De un lado, la deuda demanda cierto trabajo sobre sí mismo, una cierta subjetividad: el deudor no sólo es un empresario de sí mismo, sino que debe demostrar que es confiable y estar dispuesto a comprometer sus esfuerzos futuros en favor del acreedor. De otro lado, la deuda compromete el futuro, le da forma: ya no se trata del tiempo de lo indeterminado, en el que las capacidades humanas se implican, sino que se constituye en un

arreglo que contribuye a mantener la lógica capitalista, pues la deuda reproduce la forma como se produce y se distribuye la riqueza, prolongando las relaciones de poder propias del presente.

Vale decir, el capitalismo contemporáneo no apunta a la rentabilidad de las empresas, *sino a la ganancia de las acciones*. *Se busca lograr que el dinero haga dinero*. Como lo plantea Senett (2008), no son los gerentes quienes concentran las decisiones empresariales, ellos pierden protagonismo frente a los inversionistas, siempre dispuestos a trasladar su dinero hacia actividades más rentables. Pero este tipo de relaciones no sólo impacta a las empresas, sino que condiciona a los territorios en la medida en la que estos se enfrentan a la necesidad de ofrecer las condiciones de mayor rentabilidad posible, lo que incluso puede deteriorar la calidad de vida de muchos de sus habitantes.

Ahora bien en este escenario la deuda, como eje de las relaciones de poder, garantiza la lógica del dinero que hace más dinero, pues los individuos, las empresas, los fondos de pensiones, los sistemas de salud, los gobiernos locales, regionales y nacionales, acuden a la financiación de su presente y la hipoteca de su futuro, ajustándose a las exigencias crecientes de los acreedores. Así, las calificadoras de riesgo terminan constituyéndose en centros de saber-poder que condicionan las posibilidades de acción de grupos sociales enteros: una calificación de mayor riesgo supone un mayor condicionamiento del "sujeto" calificado. Toda esta dinámica organiza no sólo el trabajo, sino también el trabajo de sí: empresarios de nosotros mismos, somos también sujetos endeudados, disciplinados para producir y para consumir.

En la actualidad, la eurozona presenta un fenómeno particular que permite profundizar en lo que hemos llamado "sociedad de la deuda" (basados en Lazzarato 2013). Los PIGS (Portugal, Grecia, Italia y España-Spain en inglés) son países que presentan condiciones de particular importancia para nuestros propósitos, pues se evidencia en ellos una de las características cruciales: *la socialización de la deuda*. En primer lugar, debe notarse que estos países tienen la carga fiscal más baja de la Unión Europea. Mientras al principio de la crisis del 2007 el promedio de esta carga para la Eurozona alcanzaba el 41.1%, en cambio en Irlanda ésta era de 31.1%, Grecia de 34.2%, España de 34.0% y Portugal de 36.5%. Todos ellos, pues, con una carga fiscal más baja que el promedio de la UE-15 (Fuente Eurostat).

Estos relativamente bajos ingresos para el estado significan gastos públicos sobre el PIB también bajos, y un bajo nivel de gasto público en protección social. Mientras el promedio de la UE-15 en este ámbito es de 27%, en Irlanda es de 18.9%, en Grecia 24.4%, en España 21% y Portugal 24.8%. Una situación semejante ocurre con el empleo público. Mientras que el porcentaje de la población adulta que trabaja en el sector público es del 15% para la Unión

Europea, en Irlanda es de un 12%, en Grecia un 14%, en España 9% y en Portugal sólo de un 7%.

Los bajos impuestos, aunado a un sector público pequeño, un estado de bienestar poco desarrollado (en comparación con el resto de la UE-15) y poco redistributivo, contribuye a que estos países tengan los mayores niveles de concentración de la riqueza, mientras que el promedio de la UE-15 era 0.28 en 2007, en España era 0.31, en Irlanda era 0.31, en Grecia era 0.34 y en Portugal era 0.36 (Fuente Eurostat). En este escenario, el papel del Estado se transforma: El Estado no es ya el que garantiza la operación libre del mercado, sino que por el contrario se constituye en garante de las deudas privadas, pues se erige en garante de su pago, bien por la coacción sobre los deudores, bien porque coloca sus recursos como garantía de pago, bien porque asume directamente su gestión.

> "La coordinación de deudas privadas exige siempre la intervención de la trascendencia del Estado. No es el mercado sino la deuda soberana, en el fondo, la que garantiza y hace posible la circulación de las deudas privadas. Así, la privatización de la moneda[10] desemboca necesariamente en lo que horroriza, según dicen, a los liberales: la intervención del poder del Estado. Esto es lo que revela la crisis actual: la emisión privada de moneda-crédito no puede sino exigir la intervención del Estado, porque las deudas privadas son incapaces de una coordinación inmanente (autorregulación del mercado). Se produce entonces algo sorprendente, que permite dimensionar la <<locura>> del capitalismo: la deuda soberana es, a su vez, objeto y oportunidad de especulación y explotación por los acreedores y sus representantes, que se empeñan en destruir de manera sistemática la mano muy visible que los ha salvado" (Lazzarato, 2013: 145)

En este escenario, los Estados garantizan el pago de las deudas impagables, como ocurre en Grecia y en España. Recordemos brevemente cómo ocurrió este "fenomeno anti-libre mercado". Los problemas que originaron la crisis fueron acumulándose durante los años anteriores al 2007, cuando la reducción de la masa salarial creó el problema del endeudamiento de las familias, de modo que el bienestar se venía "resolviendo", al menos temporalmente con base en el crédito, el cual creció generando una expansión del sector financiero. Este sector conseguía el dinero de las bancas alemanas y francesas en el caso de Grecia y España, y de la británica en el caso de Irlanda. Lo anterior fue *el inicio de la deuda privada*. Dicha

[10] Se refiere a una medida macroeconómica que restringe la emisión de dinero por los Estados~~, que restringe esta alternativa~~ para su financiación. Como alternativa, los Estados deben financiarse a través de deuda. De otro lado, es necesario destacar que la financiación de la seguridad social y de los seguros de desempleo, dependen cada vez más de la capacidad de endeudamiento de los Fondos (públicos o privados) y del ahorro individual. Como se ha planteado, esta multitud de procesos y sistemas de endeudamiento, requieren que el Estado actúe como garante de pago, *al punto que puede inyectar recursos propios para cubrir las pérdidas del sector financiero*, *incluso cuando éstas se deban a sus propios errores* (Ver Lazzarato, 2013)

deuda podía ser sostenida pues el aval de la misma era la vivienda. Sin embargo dicha garantía colapsó, debido a la explosión de la burbuja inmobiliaria.

En efecto, el enorme crecimiento de las rentas del capital y la poca rentabilidad de la economía productiva, aumentó la inversión especulativa en el sector financiero. Así, en Irlanda y España la unión entre el sector bancario, inmobiliario y la industria de la construcción impulsaron el llamado "milagro español e irlandés". *Milagro que se conseguía con base en un enorme endeudamiento.*

Adicional a lo anterior, la baja carga impositiva y los escasos recursos del estado, determinaron que este tuviera la necesidad de endeudarse, para poder financiar el escaso estado de bienestar. Además de esto, el sistemático descenso de los impuestos de las rentas superiores ahondó el déficit estructural del estado, el cual se acentuó con la crisis y la recesión. Esto condujo a que en el año 2009 Irlanda alcanzara un déficit del 14%, Grecia del 15%, España del 11% y Portugal del 9%.

Con base en este panorama, podemos evidenciar cómo el capital financiero está ejerciendo el poder sobre las políticas de los países, mediante medidas impuestas por el FMI y la UE, medidas tales como reducir las prestaciones sociales, disminuir los sueldos de los empleados públicos hasta en un 20%, reducir el salario mínimo y una mayor desregulación del mercado de trabajo, empeorando así aún más las brechas de desigualdad en estos países y demostrando cómo las grandes plataformas financieras empiezan a ejercer el poder sobre los estados a través del endeudamiento perpetuo y las deudas impagables.

SEGUNDA PARTE: INTERPRETACIÓN DEL "CLIENTELISMO" CON BASE AL ESQUEMA TEORICO DE LA PRIMERA PARTE

Des-corporalización y des-ideologización de la política: a propósito de los partidos

Con base en el marco conceptual anteriormente dibujado, una primera ojeada al panorama político nos revela que la política se ha despolitizado, mientras que la vida cotidiana se re politiza. Evidencia de lo dicho es la denominada personalización de la política: las campañas presidenciales giran cada vez más sobre la figura del candidato y menos sobre las opciones ideológicas del partido al cual éste pertenece. Es decir hay una des-ideologización de la política. En esta línea, vale la pena recordar que en las calles de muchos lugares del mundo, los ciudadanos suelen mencionar que "todos los políticos son iguales". Rosanvallon (2006) ha definido este fenómeno como "ciudadanía de la desconfianza": los ciudadanos ejercen su papel desde la frustración, pues el aumento de las expectativas y exigencias va de la mano con el crecimiento del miedo y la desazón. Al mismo tiempo, la complejidad de las lógicas burocráticas, centradas en la híper-vigilancia de los funcionarios, ha terminado por hacer ilegible el quehacer estatal en su conjunto. Como resultado, los ciudadanos están menos dispuestos a correr

riesgos y prefieren que las estructuras sociales básicas se mantengan (con la esperanza de lograr mejorías en algunos aspectos), en vez de realizar apuestas por la transformación de los modelos económicos, culturales o políticos. En este escenario, las apuestas partidistas tienden a parecerse (sin que por ello desaparezcan diferencias importantes) con el propósito de captar el nicho electoral que los lleve al control del legislativo y del ejecutivo.

Puede decirse entonces que los partidos, en este escenario mundial, tienden a poner en un segundo plano la construcción de agendas ideológicamente elaboradas (que apuesten por la reconstrucción del orden social) y terminan respondiendo a las peticiones de los electores en una suerte de "mercadeo electoral", esto es, en un juego de oferta y demanda orientado a "satisfacer" las preferencias de los electores, medidas por encuestas (a la manera como se mide el rating de programas de televisión). Así mismo, las campañas electorales, se enfocan en la presentación y promoción de candidatos, como un producto del marketing: se enfocan en su imagen, en su aceptación, en sus actividades cotidianas y relegan a un segundo plano, sus disputas ideológicas. Esta "marketización" de la política, y por ende a la des-corporatización de la misma (el elector ya no se identifica con una corporación política determinada sino con un producto que está siendo bien o mal mercadeado) contribuye a su "espectacularización" (Edelman, 1991), a su transformación en productos mediáticos. ¿Pero a dónde apunta todo esto? En la primera parte veíamos que una de las direcciones es hacia permitir una reconfiguración del espacio para hacerlo más atractivo a la inversión y el capital globalizado. Y el marketing se hace posible gracias a la intervención del padrinazgo, es decir, familias y grupos políticos que invierten en un candidato y lo mercadean no solamente para capturar y administrar al Estado local ---y lo que ello implica en términos de poder---- sino también para poder ir abriendo camino a alianzas estratégicas de capital regional y global. Ejemplo de ello lo vemos en el caso del Tolima con el negocio minero y las alianzas políticas y de familias adineradas de la región que invierten en candidatos al congreso que favorezcan inversiones de empresas mineras extranjeras. En efecto, en los estudios llevados a cabo en la región del Tolima (xxxx) se pudo observar cómo los elegidos a las corporaciones públicas gestionan los proyectos, las ordenanzas o las leyes (según el caso), en los que se pone en juego el destino de los territorios, en muchos casos trascendiendo los niveles de soberanía del país. Pero debido a la marketizacion de la política el elegido debe también responder a los que votaron por el y sostienen su base electoral. Para ello debe atender a las solicitudes de las comunidades, como el apoyo en la formulación de proyectos, la gestión de recomendaciones para favorecer hojas de vida (apoyo en la búsqueda de empleo), el apoyo para el acceso a servicios públicos, etc.

Por otra parte el comportamiento del votante se ajusta a estas dinámicas. Líderes comunitarios deciden jugar el juego del mercadeo político y la monetarización de la política pues de otro modo el logro de soluciones a problemas personales o

colectivos, se hace improbable: *"es que uno a veces ve que la relación es directa entre dirigente y trabajo, por los proyectos, por las mismas roscas: dirigente igual a trabajo …"* (Grupo Focal Jóvenes, 2012)[11]:

> ***Marco Tulio (líder comunal)***: Entonces ese concepto de partido, de ideas concretas, de ideas políticas, como que todas esas fronteras se perdieron, ya no existen. Entonces yo creo que eso es lo que provoca que haya tanto surgimiento de candidatos, que no tienen propuestas políticas, sino sencillamente el trabajo de un grupo, trabajan más en consideración de grupos y de poderes, que de conceptos políticos.

De otro lado, una práctica tradicional de la política colombiana, el clientelismo, se reedita como mecanismo de gestión de recursos públicos para las comunidades: los líderes comunitarios y sociales, enfilan sus esfuerzos para establecer alianzas con políticos exitosos, "relacionándose" en lo que se ha denominado "clientelismo de mercado", es decir, en una dinámica de selección del mejor postor[12].

Como hemos mencionado ya, el clientelismo se ha venido monetarizando, lo que hemos interpretado como un fenómeno que se suma a la sociedad de control contemporánea que hemos descrito a través de tres características claves: separación entre el poder y la política, la constitución de sujetos como empresarios de sí mismos y la sociedad de la deuda. La dinámica clientelar apunta de forma compleja en estas mismas direcciones, pues aleja a la política local de las decisiones estratégicas (como el manejo de la deuda, o el papel que juegan las regiones en el concierto global) y contribuye a profundizar la gestión individualizada de la vida, a la gestión de sí según la búsqueda de beneficios personales, de la política como un negocio de sujetos que compiten entre sí.

Concluiremos intentando mostrar que todos estos fenómenos leidos desde el marco conceptual de la prieraparte apunta en nuestra región hacia la constitución de la sociedad de la deuda: se trata, finamente de comprender este tipo de gestión política, como un elemento que se reconfigura bajo la lógica de la gestión de sí en el marco de la lógica mercantil.

FALTA desarrollar esta interpretación!!!

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[11] Este tipo de expresiones se han expresado en talleres con líderes locales en la ciudad de Ibagué, con quienes se ha discutido la participación política y las estrategias electorales. Uno de estos talleres se desarrolló el pasado 20 de febrero de 2014 en el marco de la construcción de preguntas para un debate entre candidatos a la Cámara de Representantes por el Departamento del Tolima.

[12] Vale decir que el clientelismo tradicional no ofrece esta posibilidad, de modo que el Patrón aparece como un benefactor que cuenta con una base clientelar más estable.

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Citizen training and university. The experience "Paz y Region" Program

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Introduction

The paper provides a holistic analysis of the relationship between University and Community based on the experience of implementing the "Peace and Region" Program as a scenario of community formation, developed at the University of Ibague, Tolima, Colombia. The analysis provides reflections for the integration of formative processes that links the actions of the University with the civil society and intends to integrate teaching, research and social projection to contribute to local development.

Institutions of higher education are faced with different challenges. One of them is to respond to the needs and demands of the society, especially from its immediate surroundings. The World Conference on Higher Education (2009) called for universities to assume a more leading role in social change and development. One of the most important challenges of higher education, today, one of the challenges is the formation of people; not only within the different scientific disciplines, but also within the citizen competencies, the ethical principles and the contribution to peace. Currently, the discussion focuses on whether the university is forming or not such people, and if it does, how is it doing it (Martínez, 2006; Unesco, 2009).

University Social Responsibility is assumed as the capability that the University has to respond to the demands and tensions emerging from the societyin which the school is immersed in, with actions leading to common benefits (Vallaeys, 2000). Writers like Villar, addressed the issue of University social responsibility as a new paradigm for a humanizing and liberating education of individuals and societies. Meanwhile, Xarur (2008) mentions that the University has the ability to lead changes and progress in society and for this reason, should be significantly involved in the formation of democratic and critical citizens.

Martínez (2006) proposes that the University's role has changed, and now, in addition to assuming the formation of professionals within various academic disciplines, it also faces various challenges in the attempt to provide a coherent response to social needs as part of its responsibility with society. In this sense, it is assumed that a University can

promote the formation of civic responsibility from the involvement of future professionals in public problems (Kymlicka and Norman, 2002).

Diverse experiences of universities show that it is possible to take leadership from the institutions of higher education to meet the challenges and stresses of the modern world. Some of these experiences are: *The Community College,* the *Service Learning,* "Communal work" in Costa Rica, "Young commitment" in Argentina, "Peace and Competitiveness" in Colombia. In addition to this, some research on the role of University and formation for civism (Henao, Ocampo, Robledo, and Lozano, 2008; Pérez and Sarrate, 2013; Toledo and Kings, 2010) state that forming citizens in the University has special importance to the contribution of cultural, social and political change.

The Peace and Region Program is a strategy from the University of Ibague, created with the purpose of offering a comprehensive formation scenario to students from different academic programs; includes the creation and installation of interdisciplinary teams of students at different municipalities, so during an academic semester, they engaged in long term local development projects that are articulated to the plans of local development. The implementation of the Peace and Region Programwants to promote the strengthening of public and private organizations, stimulate the vital functions of the University and articulate local institutions and participants who work toward the sustainable development of the region.

This paper contains a systemic analysis of the experience of the Peace and Region Program in Tolima (Espejo y Rejes, 2011). The Program is viewed as a system that analyzes the interrelationships shaping its operation, between the different components of the implementation and the context surrounding it. It is expected to identify key variables involving the results within the different scenarios and learned lessons. The objective is to present holistically, how it hasbeen the dynamics of thefunction of the Program and the benefits it generates, both to the University and the participants involved, from the analysis of primary and secondary sources. Consequently, the accomplishments, barriers and challenges expected by its implementation are identified.

Methodology

The research is conducted from a systemic approach, from a qualitative perspectiveenclosed in an interpretative tradition viewpoint. The perspective of research allows you to collect information on the experience of the Program as a dynamic process and that is still under construction. The research presents a methodological challenge underlying the proposal to study a Program that is under a construction process. In this sense, there are partial results of whatthe development of the strategy involves. To facilitate the process of analysis a scheme was build. (See table 1).

Table 1. Scheme of analysis

Dimensions	Variables
Inputs	
Program design and preparation	– Organization of task force – Programdesignprocess – Process of Program visibility and dissemination – Operation of the Program's task force
Processes and direct results	
Program implementation at the University	– Expectations from the community from the Semester – Strategies for the dissemination of the approach and responses from the University community – Extent and form of participation of the different University's members and dependencies. – Characteristics of the process of education provided to the students during the Program – Perception and evaluation of those involved with the development of the Program
Implementation of the Peace and Region Program in the municipalities	– Entrence to themunicipalities – Expectations from the Program by local members – Projects' planning characteristics – Characterization of projects, types, and products driven from them. – Integration of the local participants in the developed activities – Roles of advisors, students and partners – Process of accompaniment, follow-up and advice – Major conflicts and ways in which they are resolved – Characteristics of the dynamics of interaction between the different participants – Participants perception and evaluation on the implementation
Learning and/or changes involved from participation in the program on the different participants involved from the municipalities and the University	– Changes and/or learnings from the personal growth perspective - Changes and/or learnings from the professional development perspective
Citizenship	– Contributions to the regional and municipalities development and – Contributions to the education of citizens – Contributions to the institutions linked to the Program – Challenges of the University against the promotion of citizenship at the University and in the municipalities

Sustainability and impact	
ProgramArticulation	–Appropriation of Peace and Region in the University: teachers, programs, students. –University micro and macro curriculum articulation
Program Continuation	–Demands for sustainability of the Program in the State –Positioning of the Program in the city and the state.
Partnerships operations	–Pacts and/or agreements with local governments
Impact on Public Policies	–Actions to influence public policies
Communication and dissemination	–Employedstrategies and –Media

Sources of information

The methodology for the management of information was qualitative supported by quantitative research techniques.

The analysis components were:

- Teachers participating in the Program
- Associated students
- Parents
- The institutions participating in the Program
- Partners
- Regional membersworking in the focus of the Program
- Local and regional authorities

The data collection process was done transversely to the process, in this sense, interviewing students, teachers and parents who have gone thru the experience.

With regards to the sources, they were of primary and secondary character. The primary was collected by the team. And the secondary, corresponds to the documents that were drafted by the team, such as reports, didactic and communicative materials, documents and information available thru virtual access by the involved members.

Depending to the systematization activity or the time of evaluation, the most appropriate technique will be implemented. Then, other techniques may be used for reading and reviewing documents, semi-structured or in depth interviews, surveys, focus groups and observations.

Techniques for reading and reviewing documents: Program's planning documents, information about the way in which the Semester develops, team work documents, activities reports, outreach materials, news reports.

Semi structuredand/or in depth interviewsto key informants such as teachers, managers, partners, among others.

Qualitative observation:all discussions, meetings, follow-up and accompaniment activities had been recorded as they occurred, without any interpretation or judgments.

Focus groups: with this technique we sought to promote the interaction among the participants to obtain information from their own knowledge and experience.
Lessons learned meeting:whit this technique a participatory workshop was generated, where h students and other participantsshare their learningswithin the process, in regards to the pedagogical, operational and development projects.

Results

This section presents the main results on three axes: The Peace and Region Program operative dynamics, the benefits perceived by the community and the benefits observed by the University.

Peace and Region Program operative

A relevant precedent in the implementation of the Program is that it is considered as a strategy of a comprehensive education, which is already included on the curriculum plan of all academic programs at the University. In this respect, the University generated rules to position the Program and to ensure the registry of the students, initially as a degree option, and later, as a requirement.

For the implementation of the Program, the University signs an agreement with each city and commits to support the identification of local needs; also, to generate projects with local participantsthat communicateswith the Community Development Plan, and to form interdisciplinary teams of students on their last semester from programs required for the proper development of these projects. Each entity provides necessary resources for housing and living expenses of these young students; in return, each semester, under the terms of the agreement, a new group of students supportsand continues the work based on the results left by the former teams.

For the operation of the Program a work team has been formed integrated by the director of the Program; the Project Coordinator, the Academic Coordinator and the Regional Advisors. It also is integrated by theAcademic Program Advisors and Partners assigned by the institutionsin which the projects are developed and that lead the students through the process.

The project coordination leads the union between the University and the municipalities and manages the processes that are conducted to ensure that Peace and Region will be a stage of learning in these locations. Together with the regional Project Advisers they planthe projects to be developed and work in conjunction with various public and private institutions that support the implementation of projects that contribute to the

local development and allow the University to come into contact with the needs and problems of the region.

The Academic Coordination generates the strategies to guide the students' learning process and the training, methodology, assessment, and monitoring objectives to coordinate the work of the educational advisors that join this experience.

The training process includes three stages: context, experience in the municipality and closing. During the first stage, students participate in an induction process, effectuate project and municipalities integration, and adjusted the plan of action. In the second stage, they execute the plan of action in relation to the projects; and by during the third phase, they deliver reports and products, introduce the results to the municipal participants and/or institutions, and presentthe experience to their academic programs. Athwart, this is a process of monitoring and evaluation, and a place to promote critical thinking activities.

The work of the students is organized from the components of understanding the environment and participation in projects. The component of understanding the environment is a process of discovery and inquiry that leads students to get interested in knowing and understanding a social context. Based on this, the students conduct an analysis about social reality that involves the recognition of dimensions that characterize the municipality, for example, the historical, socio-cultural, economic, environmental and political dimension.

By participating in projects students from interdisciplinary teams should develop a plan of action that is consistent with local needs and the development plans of the municipalities. These projects have been considered for a long term and each team of students improvesits performance each semester. In addition, they are develop according to an agreed framework of action between the University and the institutions involved, and respond to some areas of work that have been defined in the framework of the Semester: institutional strengthening, the strengthening of the health and educational sector, and the social and economic development.

Is important to highlight that, projects within the framework of the Semester:

- Are linked to the municipalities' development plan
- Are administered in the municipalities
- Are related to regional problems
- Interpretthe objectivesof the Peace and Region Semester
- Are conceived for a long term
- Are developed from plans of action each semester and are carried out by students with participation of local members and institutions
- Call for interdisciplinary work
- Promote peace, development and the implementation of civism
- Are relevant, feasible and sustainable.

The work in the municipalities promotes an environment of training that encourages the participation of local members and students in the formulation, implementation and evaluation of projects that respond to local needs, in the framework of the philosophy of the Peace and Region Semester. Thus, semiannual plans of actions are built with local

members, contributing to the implementation of long-term projects that are led by students.

From the implementation of these projects the local members are moved and enlighten about the nature of the Peace and Region Semester as a platform of comprehensive formation and contribution to regional development. In parallel, it promotes the participation of local members in developing projects, encouraging actions that generate fit capacity and strengthening the social capital of the municipalities, from actions that allow the sustainability of the already generated processes.

The Semester's team guarantees the monitoringand technical assistance to the relevant development projects, according to the plan of action formulated; and supervises a timely delivery and quality of the product as agreed each semester, as stablished to the plan of action.
In this regards, the main activities developed in the municipality to implement the projects are:

- Meetings for recruitment of local members and signing of agreement.
- Definition of projects and stages
- Construction of the plan of action
- Monitoring and follow-up visits
- Construction of reports and products
- Days of delivery of results per semester

Strategies for comprehensive training

In the process of starting the Semester, a framework has been built gradually to promote the integral education of the students and this has entailed the mobilization of various instances and members of the University and the municipalities. *Peace and Region* has achieved results both in the development of projects, and in the process of edification of the students. After almost three years of work, it is possible to register some important results on the contribution of the Semester as place for the citizen training at the University.

First, as a semester of foundation, *Peace and Region* implies a different relationship with knowledge, especially because it gives priority to the solution of real problems and encourages an active role of the students in the course of their learning. Also with this initiative, the University promotes that knowledge is constructed from scenarios that include a high level of participation of society. In addition, it contributes to citizenship construction from reflection, involvement, and connecting students to the everyday reality; the component of social commitment is observed from the ethical reflection and awareness of social needs and the problems experienced by the population of the municipalities.

The reflective component on*doing* is one of the essential tools of the process. In this regard, there emerge different questions.How to achieve a critical approach to reality? How to help students get concerned for the common well and to engage with the fate of their region? This process gets promoted through strategies such as the following: on the one hand, the Semester leads students to think about the project in which they are involved and the benefits that it will provide for the community. It also promotes the strengthening of an attitude aimed towards understanding the experiences and the

importance of critical thinking and the modification of his work. In third place, it motivates action and certifies the work that students develop during the performance of these projects.

Benefits for the community

The direct benefits to the community are identified through the type of projects that run on the counties. They are mostly intendedfor an institutional strengthening of local administrations, health institutions and educational organizations. Institutional strengthening is conceived as the effect that produces a series of actions aimed to promote the formation of a collective knowledge (appropriation), which implies not only the internal development of the institution, but, its articulation with the environment. From the perspective of *Peace and Region,* projects that are part of this cluster, have as primary objective contribute to the modernization and optimization of the institutional capacity of the public or private municipal organizations.
One of the main goals identified by the team is the immersion that has gradually made the Program into the counties; this has been possible thanks to an institutional support of organizations like the Local Government in Tolima, especially, the State Secretary of Planning in Tolima. This institutional support allowed Peace and Region get closer for the first time with local participants as well as to obtain credibility and recognition.

During the implementation, it has been identified that *Peace and Region*:

- Contributes to the institutional strengthening and the health and education organizations, as well as to the social and economic development of the counties.
- Contributes to identification of problems among the municipalities with the participation of local members.
- Promotes the aggrupation of local members who work in the development of the region
- Advises the population from the municipalities in developing projects that allow them to improve performance, municipal development in addition to strengthen public and private organizations.
- Promotes the development of research and systematization processes to generate local knowledge.
- Generates processes of knowledge transfer and appropriation by local participants, in relation to the projects that are developed and the lessons that are learned.

Set the stage of participation for students in the municipalities has been a challenge; in addition of promoting a context of learning, it is important to guarantee good housing and living conditions that allow students to participate in these projects and in the municipal everyday life. Therefore, a process and methodology that allows working in these municipalities has been identified, which has involved identifying participants, places, times, knowing the dynamics of the municipalities to be able to develop a job as the one performed by*Peace and Region*.

Finally, local members of the community have expressed that the work done by students has been valuable. Mainly, they have contributed to improving management in the municipalities. In addition, a significant contribution to regional development is the training that students are receiving,who have become more sensitive about the role they

can play as professionals, in regional or local territories, some have visualized those towns as business scenarios, and few have been hired by the institutions where they developed their experience after graduation.

Benefits to the University

Based on the analysis it was identified that the Program has been related to all categories of the University; its operating functioning has been strengthen as well as it pedagogical level. In general, from the analysis of the whole experience, it was driven, first, that the operations of *Peace and Region* has involved four fronts of work; first the joint of the University, second the administration of projects and cooperativewith the municipalities, third, participating in networks and research, and fourth, the follow-up and supplement processes. Each work front allows stating that based on the implementation of the Program a framework has been built to promote the integral education of the students and this has entailed the mobilization of various frames and members of the University.

On the training of students

Students benefiting from the Program, not just they applywhat they learned throughout their time at school, studying and resolving problems; but they learn to work together as a team with people from other disciplines, that surely address the problem from their own perspectives. The experience has given them a stage so that they understand the complexity of the work in interdisciplinary teams. At the end of the semester, the students prepared a written report about their experience; in which is made explicit the conceptual framework from which they approached the problem, describe the methodology they followed to stablish a possible solution and critically analyzed the resolution proposed.

In general based on an analysis of interviews done with students who have participated in this experience, it was identified that the Program encourages students to address real needs of the municipalities from a planned exercise, through the implementation of projects. This experience generates learning from doing and improves the understanding of social, political and municipal problems, at the same time, it impacts on the formation their values and development of their critical thinking.

Based on the description of the experience from the perceptions of students it was found that the Program:

- Manages to be a meaningful experience for students affecting their personal and professional development
- Promotes the participation of the students in a project that generates teamwork with other members in the group
- It has a high reflective component that allows to become more aware about the experience
- Are able to obtain project results in which they participate, receiving recognition for their work in the community in which they are involved
- Questions students about their role in civic engagement and well-being of the community

It is important to notice that students have recognized that these projects are designed to contribute to local development and that this work enrich their personal and professional growth. In addition, they have identified the importance of qualify their capabilities,

skills and knowledge and therefore, value the progress achieved in their career and the training process provided by the Program, such as the training previously received, the supervision of the advisors, the follow-up from the academic coordination, the project coordination and the regional advisors; as well as the contribution of the participants.

Conclusions and recommendations

Framed from this analysis, it is concluded that this type of comprehensive development initiatives promotes, from an operation stand point, the University substantive functions integration of teaching, research and social outreach in coherence with the realities and demands of the context in which they are found. By implementingthese strategies in different local contexts, it has been identified that the University achieved a stronger institutional presence in the territory.

The operation of the Peace and Region Program is an example of how a University introducesin its curriculumin a very strong way, topics of civil context. The structure of the work encourages students to address real municipal's needs as a planned exercise, through the implementation of projects. This experience generates learning from the doing stand point and improves the understanding of social, political and civic issues for the educational community. At the same time, these experiences generate questions in those involved, about their role in civic engagement and well-being of the community.

With the implementation of P*eace and Region*it has been found that the experiencesthe students live in the municipalities, offers an opportunity improve their in values and personal growth; in addition, it was identified that the design of the strategy affects critical thinking on social reality and the student's role as professionals and has become an opportunity that students value and appreciate, considering that they will be better professionals because of this experience. In this regards, prof is found that this kind of Programs promote a critical attitude toward the social reality, beyond the information provided by the media and other influential organizations. The commitment of these strategies expands the role of students as active citizens, being the development of critical thinking, one of the most influential variables.
The participation of the University students in a project leads, as well as its intervention in processes of cooperation among the members of the work force, the implementation of a reflective process that allows them to become aware about the experiences they lived, its contribution to the development of the community in which they are involved, and most importantly, constitutes a clear experience about the role they are designed to play in the transformation of society.

In the framework of such Programs, it is identified that the territory is an extension of the grounds and there meet other ways of teaching and learning, which allow, on the one hand, concrete training based on the values of students, and on the other hand, make them more aware about the necessary synergy that must exist between the professional work and responsible citizens.

Alternatively, it was identified that within the communities some expectations and tensions are generated playing a role of facilitators or barriers to the development of projects; being important for such programs to intervene through strategies that allow reducing those obstacles. In this regard, it is necessary to build strategies that generate partnerships, evaluate the quality of the processes together with the participation of the

community. Additionally,it is important to work on representations the communities have about the disciplines and their understanding about the interdisciplinary teams, achieving a better understanding and action on social reality.

Finally, it is identified that such initiatives point to a transition of Universities as "cloister" to a more open, complex University that promotes not only interdisciplinary work, but it also bet in the formation of citizens so that graduates are able to consciously use their knowledge to their own advantage and that of the communities.

There are various administrative, pedagogical and logistical challenges proposed by such initiatives. An important element is that these bidscan have the institutional backing and to gradually achieve sustainability from networking with public and private organizations that ensure the presence in the territory. Therefore, it is important to consider other aspects such as: cooperative design of projects, work network, level of strategy organization and commitment to perform an accurate and attainable action with the community.

Keywords
Citizenship, citizenship training, university social responsibility, university, civil society.

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Community-based Research: enabling civil society's self-organisation

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Key words: community-based learning, active citizenship learning, university-community partnership, civil society self-organisation.

Introduction

This paper explores the contribution of community-based research to the self-organisation of Civil Society (CS), using the UK Take Part programme as a reference. Today, there are many opportunities for exploring innovative and inclusive approaches to empower communities in democratic and peaceful coexistence, as well as challenges. Community empowerment is focused on building community capacity to influence decision-making, governance and policy development at the local and global levels, and community-based research helps enable this, by providing a transformative space for citizenship engagement in democratic processes (Mayo and Annette, 2010).

Citizens, through Civil Society organisations, are struggling to understand and extend their boundaries of power in the operational domain of their interactions with policy-makers, and how to move strategically to produce democratic transformations, at all levels of decision-making. The organisation and practice of citizenship learning should lie in robust conceptual approaches, and its applicability to local efforts. The challenge for researchers is to be able to coproduce knowledge with communities, using approaches that enable communities to map needs, barriers and opportunities, and to produce evidence of their impact in public policy. (Mayo et al 2013, p237-8). Community-based research has been used to strengthen self-organisation, develop evidence of good practices and evaluation tools and facilitate reflective practice.

Education for more empowering forms of civil and civic activism needs to include learning about how to challenge unequal power relations, and how to work collectively to promote agendas of social justice (Westheimer and Kahne, 2004, Mayo and Rooke, 2006).

Social systems and active citizenship is a key transdisciplinary area of research. It involves a great debate about participation theory, but also the need to produce evidence on how effective participation requires the formation and facilitation of self-constructed action spaces. An even distribution of power in the self-organisation of local communities cannot be taken for granted. Those with knowledge and organisation will be able to better understand the structures and processes of power involved in influencing decision-making and promoting social justice agendas. More studies are needed to understand relationships in social systems, to develop stronger links to active citizenship policies. (Espejo and Mendiwelso-Bendek, 2011)

Active citizenship and Civil Society

Civil Society is a long-standing and contested concept, increasingly popular with governments, international organisations, academics and practitioners. It refers to those spaces where people can debate and demand social transformation and despite different developments, the concept "maintains the essence to inspire successive generations in their struggles for a better life" (Edwards M. 2011). It also has an intimate connection with a better democratic society, as civil societies are spaces occupied by the voluntary and community sector and neighbourhoods, home to charities, faith based organisations, human rights campaigners, housing associations and

sports clubs etc. In other words, a set of not for profit associations, which promote democracy and social justice, distinct from the state and the market, with the self-determination and capacity to engage actively in society (Young 2000).

Citizens' participation has great potential in democratic societies, but there is also a risk of it being hijacked by minorities, who over-influence the direction and quality of outcomes. Those with the resources, power and knowledge to shape discourses and practices can do it to their advantage, increasing power inequalities at the expense of the weakest (Gaventa 2011). The citizens able to participate are often the ones who know how the 'system works', so they can use power structures pursuing their own interests. It is a fact that these groups are more able to obtain this help and this is, in most cases, owing to their organisational competence. Therefore, it is essential to help improve the organisational competence of disadvantaged people, to enable them to participate. However, it is not enough in Civil Society to simply say ´organise yourselves and go out to work'. Civil Society's associations, groups and organisations need help to protect the interests of the weakest (Walzer 2002). Civil Society can articulate citizens' participation in these places, but it requires the formation of self-constructed action spaces. (Espejo 1996, 2002).

Civil Society is a natural self-organising space, where citizens define their rights and expectations and create new forms of democratic transformation. They learn and as a result, adapt their interactions and relationships with local authorities and policy-makers, and make alliances and networks with agents in local, national and global spaces to break down inequalities. Self-organisation is driven by citizens' need to enhance shared values, particularly around social justice. For this purpose, self-organisation should help citizens develop collective inner strengths, so they have a platform from which to work together, become outward looking and promote social justice. But self-organisation, underpinned by heterarchical relationships, is often chaotic and fails to produce strong participatory platforms. In spite of this, perhaps there is something in the "genetic code of human beings that resists attempts to bureaucratise the self-organising principle of civil society" (Eduard 2011). Citizens struggle for a voice to increase their influence in public decision-making, so the challenge for Civil Society is to enable learning that helps citizens pursue shared values, in non-coercive contexts. Only a comparatively small number of associations, groups and organisations have the capacity to overcome the obstacles preventing them from producing socially shared values. Helping Civil Society learn how to reach inclusion and cohesion for particular issues has been one of the purposes of the Take Part Programme in the UK.[1]. Organising and organisations are needed to support a more pluralistic understanding of 'identity', in all its different forms, as well as citizens' issues, expectations and opportunities, as these are the catalysts for the self-organising collectives and groups of Civil Society.

Social systems

The relationship between power, citizenship and democracy has become a key topic of research and activism. Researchers are producing more and more holistic research evidence on how to increase effective civil society self-organisation, and how governments can improve their capacity to engage in a non-hierarchical relationship with citizens.

Of central significance is the organisational structure for citizens learning through actions, taking account of the circularity between observation and reflection with conversations shaping knowledge, practice and theory-in-use. (Mendiwelso-Bendek 2002)

Identification of local systemic effects, through the critical reflection of those involved, has also been seen as key to effective active citizenship (Mayo, Mendiwelso-Bendek and Packham, 2013, p237-8)

[1] www.takepart.org

Increasingly, populations throughout the world are fighting more aggressively for changes that give substance to their rights and effective action enabling the social change they want to see. Citizens are spreading and limiting the edges of power and are growing more concerned with understanding the structures and processes that enable them to participate effectively in decision-making processes.

Civil Society is strengthened when it is recognised by the state and the momentum is making visible the need for a holistic and systemic response to these questions, in order to find innovative roads to reach an inclusive, participatory and deliberative democracy.

The relationship between citizens and the state requires programmes of community engagement, in which civil society offers a natural space for self-organisation. This is a space where citizens engage with each other in non-hierarchical communications and collective action, but it is also a space where power structures exclude those lacking skills and organisation, excluding the most vulnerable in our societies. The purpose of this contribution is to discuss how to facilitate civil society's self-organisation processes, with the aim of speeding up inclusion and cohesion.

The role for higher education institutions (HEIs) in the relationship between active citizenship and democracy lies in generating new challenges. HEIs are striving to articulate and produce rigorous evidence of practices that produce positive social integration and protection of the most vulnerable, challenges which are widely incorporated into the aspirations of the European Union Horizon 2020 program, which seeks, among other things, to support research and social innovation1.

Take Part Programme

Learning partnerships to support learning to take part in civil society as an active citizen has been a topical policy commitment. The previous New Labour government launched two consecutive initiatives, following a consultation by the Home Office on adult citizenship learning in 2002. Firstly, 'Active Learning for Active Citizenship'(ALAC) (2004-2006) which was introduced by the then Home Secretary and subsequently moved to the Department for Communities and Local Government. Learning programmes were delivered via third sector organisations based in seven regional hubs, working in partnership with local voluntary and community sector organisations and academic partners with relevant experience of community-based learning in their regions. The hubs also developed good practice guides, which became two freely available National Learning Frameworks, launched in 2006 and revised in 2011. Secondly, the Take Part Programme (2008-2011), which consisted of two components, the 'Pathfinders', who were to take the learning from ALAC forward more widely, to improve citizens' knowledge, skills and confidence and the Take Part Champions, supported by a national support programme, designed to engage organisations beyond the Pathfinders and Champions, enabling them to run Take Part activities for themselves. There were 18 Pathfinders and nine Champions and the programme involved several local authorities as well as third sector organisations and universities.

Lincoln university research entered the policy process by proactively responding to the Home Office's 2002 consultation. Ever since then,through active engagement in policy processes, Take Part research has produced a sustained change in governmental and third sector approaches to citizenship education.,A learning partnership of third sector organisations and universities (including the researchers) ran a number of successful pilot projects, translating and refining citizenship concepts. The evaluation of the first part of the Take Part programme identified that nationally, 1,373 people had been engaged, including refugees and asylum seekers, black and ethnic minority women, carers and faith communities. It also found participation had many

benefits, such as access to education and employment, increased volunteering and self-creation of voluntary groups. (Mayo and Rooke, 2006).This led to the inclusion of the Take Part concept in three government White Papers. Pathways to impact were two National Learning Frameworks, a Take Part national programme (2009-2011) and ESRC capacity building cluster (2008-2013). The evaluation of these pathways revealed that Take Part has reached over 18,000 people nationally, helping them become more effectively involved in local democracy.

Take Part research demonstrated effective community-based process using active learning pedagogy (Paulo Freire) and contributed new knowledge to make the concepts workable. For example, it helped to articulate and define the context and the forms of relationship in the learning process. This research has helped to make changes to policy development and practice in the area of public participation in democratic processes, especially in terms of community engagement and community empowerment. Enabling people to feel able to influence the decisions that affect them, in their local area and beyond.

The formulation of practices from the research became formalised in (i) a national framework to guide practice and (ii) a national Take Part Network to share good practices. The Take Part 'learning for active citizens' approach played a key role in forming elements of the government's strategy for empowering communities. Whilst Take Part research evidence and provision made a direct contribution to the evidence base underpinning three government White Papers. 'Strong and prosperous communities' in 2006 (CMD 6939, section 2.60), 'An Action Plan for Community Empowerment: Building on Success' in 2007 (page 9) and 'Communities in control: Real people, real power' in 2008 (CMD 7427, see p3, para 14; p39, para 2.22; p133), which included the implementation of the Take Part Local Pathfinder Programme and committed funding to a Take Part Pathfinder Programme to promote citizenship learning, building on the existing Take Part network.

The Take Part programme involved two main pathways to impact, using the existing National Learning Framework, a Pathfinder Programme to apply the learning from Take Part more widely and the national support programme, which engaged organisations beyond the Pathfinders, enabling them to run their own Take Part activities. 19 Pathfinders were established nationally through local strategic partnerships. The national support programme established regional champions, promoted activities, trained trainers, produced guides and materials and managed an online resource. This data is given in the evaluation of Take Part by the Community Development Foundation (Miller and Hatamian, 2011), which found "The programme had an extensive reach, with thousands benefiting from accredited and non-accredited learning programmes, community leadership courses, workshops, one-off sessions, Pathfinder events and local 'train the trainers' courses, delivered through 19 Pathfinders and 36 projects, administered in all UK regions. 6,569 people benefited from the Pathfinders' work in 2009/10, 11,616 people benefited in 2010/11 and 967 learning opportunities were created by 'Train the Take Part Trainers' activities, across the duration of the programme." (p30).

The evaluation found that Take Part helped thousands of people gain confidence, knowledge and skills to become more actively involved in their communities (Miller and Hatamian, 2011 p5). Beneficiaries increased their civic and civil activity and became more effective in their involvement. People were more able to influence decision-making and take action in their community. Many also took up further learning opportunities (p30). Public agencies reflected on their own practice, making them more open to citizen and community influence (p5). Networks and partnerships were established as a result. (p30). Citizenship activities amongst the groups involved included voting for the first time, organising a petition, liaising with a local council, becoming school governors and trustees and applying to become magistrates and special constables (p35). A national evaluation of the 'Train the Take Part Trainers' programme, delivered by the Workers' Educational Association (WEA) and the National Association for Voluntary and Community Action (NAVCA) (Land, 2011) states that 1,083 people, a significant

number of which were from ‘disadvantaged postcode areas’, participated in 63 courses. The results included improved knowledge and awareness of political processes and greater confidence to lead in communities and partnership working (p3-4).

In the East Midlands, Lincoln created impact by leading a Pathfinder programme in partnership with the Lincolnshire Assembly, every local authority and a range of communities and voluntary organisations. The ‘constructed conversations’ approach used reflected the practical application of the (now developed) 1996/2002 research. Lincoln also extended their local reach through a Regional Champions programme (Take Part in the East Midlands), in partnership with the WEA and supported by five district councils. Lincoln’s Take Part project with sports volunteers was recognised with an Inspire Award, as part of the London 2012 Summer Olympics’ legacy.

The next phase of research development was undertaken in 2008-2013, through a national research and capacity building programme, funded by the Economic and Social Research Council (ESRC) and led by three HEIs, (hosted by Lincoln). The Take Part ESRC Capacity Building Cluster has led to the formation of university and community Partnerships; which are undertaking new research within and beyond the Take Part programme.

The Cluster set out to increase research capacity within the third sector, by focusing on building a critical mass of third sector research, in relation to active citizenship and community empowerment. It did this by developing partnerships with a range of third sector partners, at a local, regional, national and international level, from large organisations to smaller voluntary and community groups.

This contributed to the development of ‘research mindedness’, as third sector organisations began to develop an enhanced awareness of the value of research more generally. For example, the Cluster’s work included helping third sector organisations understand how to undertake research for themselves, commission research most effectively and identify relevant research methodologies and tools, as well as ways of identifying, evaluating and then applying research findings.

The programme also demonstrated the value of university and community Partnerships for Universities themselves. Early career researchers developed relevant expertise and a commitment to developing theoretically-robust research, with and for the third sector, with the potential to make significant impacts in policy and practice.

Overall, the Cluster has helped to develop innovative approaches to community engagement and empowerment, issues of central importance to the third sector, as well as the public and private sectors.

The substantial impact of this programme on the organisation and practice of citizenship learning lies in its conceptual robustness and its direct applicability to local efforts. It included a sustained strategy of maintaining a link with the programme from research to practice. As one participant has said: “this research is a good example of the direct benefits realised by linking academic research and expertise specifically to a policy, as it moves from design, through to implementation.”

Constructed Conversations

Civil Society groups construct their identities in the process of extending the boundaries of power (i.e. issues, expectations and opportunities). This construction is the outcome of communication

processes among citizens. Identities emerge from the way in which citizens relate to one another in their moment-to-moment communications. Citizenship is understood as a stable construction-property that emerges from these interactions (Mendiwelso-Bendek 2002). Citizens are producing the contexts they belong to, at the same time as being defined by these contexts (Espejo 2000). Take Part has facilitated the recognition of possibilities and diversity through constructed conversations. These conversations are designed to help participants in Civil Society to be systemic observers of their own internal processes as they extend the boundaries of power, and also to observe from the outside, as external observers. The systemic observer is inside and outside the action. From this perspective they simultaneously observe themselves as actors and observers in a circular causality (von Foerster, 1982).

Constructed conversations in Civil Society need structures that at the same time as harnessing the interactions of groups operating under non-coercive rules and, as yet, undefined purposes, also enable inclusion of all people and openness of expression for all viewpoints. These should be facilitated conversations which steer groups towards shared issues, maintaining their course through on-going feedback (cf. Beer, 1994).

This research combines ideas of 'self-construction' and understanding power relationships by taking a knowledge co-production approach, working with communities and envisaging community research as part of the community development process. Take Part has focused on active citizenship learning tools for third sector organisations, community-based research, training for trainers and forms to strengthen university and community partnerships. Recently published results (Mayo, Mendiwelso-Bendek and Packham, 2013, p237-8) indicate that the approach enables communities themselves to "map needs", "explore the impact of public policy", "strengthen self-organisation", develop evaluation tools" and "facilitate reflective practice". The research also identifies that the assumption of 'self-organising' in local communities cannot be taken for granted and needs further studies and elaboration. Identification of local systemic effects, through critical reflection by the actors involved, has also been seen as key to effective active citizenship.

The emphases of these programmes were upon learning collectively, as well as individually, and learning experientially, through engaging as volunteers and participants in structures of governance. Through increasing their knowledge and their critical understanding, learners could also be empowered to take collective action in the pursuit of the values of equality and social justice (Mayo, 2010).

Conversations about what matters to us: There is a need for spaces to reflect on those things that are really important in a democratic society, like social justice, equality, education and health; that means spaces to reflect about democratic citizenship (Sandel 2012). The academic world can sometimes be far away from daily narratives and the challenge for HEIs is to support reflection and articulations of their local narratives, in a process of coproduction of knowledge. There is a worldwide need to increase the knowledge, skills and confidence of citizens to expand and develop civil society capacity, and at the same time to have a systemic perspective that includes structures, processes and attitudes that allow effective participation.

The research findings from the Take Part programmes identified that active learning for active citizenship requires SPACE (Social and Political Active Citizenship Education) for sustainability (see Mayo and Rooke, 2006 in Sec. 5). This finding reflects the significance of 'self-constructed action spaces', explored throughout the whole research process. The projects have tested approaches and also identified the critical need to understand power relations in the 'space' of active citizenship. The research also enabled a more complete framework of relationships in organisational systems to be developed and linked to wider policy on active citizenship. (Espejo and Mendiwelso-Bendek, 2011)

At a more global level, the state is responsible for enabling effective processes of self-organisation in Civil Society. As Civil Society becomes stronger its demands on the state and the economy will increase, and in particular, the state will have to strengthen its organisational ability in order to respond. This is likely to produce a relationship where the circularity will increase mutual demands and opportunities. The self-organisation of Civil Society needs a social context that respects justice and freedom. Social justice is a key element of civil society and involves not only self-determination, but also self-development. Self-development means being able to actively engage in the world and grow, which requires state intervention, its own activities and those of the economy and Civil Society.

This paper offers research findings from the Research Cluster, in line with other researchers' understanding of concepts and practices for partnership learning between universities and Civil Society. Thus, it reflects upon programmes to promote community-based learning for active citizenship in the UK (2002-2014) and the lessons emerging from researching these.

Research findings:

The self-organisation of Civil Society in the UK is facing major challenges in the current social, political and economic context, whatever policy-makers suggest to the contrary, particularly in terms of the potential opportunities to be grasped. Community-based research to support Civil Society, community empowerment and engagement needs a conceptual rigour, yet policy-makers are articulating or misarticulating Freire and Alinsky's conceptual model in very different ways, to justify approaches to active citizenship, Civil Society and third sector learning. Successive governments concerned with learning about the impact of individual community development programmes are favouring narrow project evaluations, instead of research. Researchers should be given more opportunities to focus their research and help community groups learn more about their own strengths and weaknesses as a participative exercise, rather than simply collecting data to respond to funders. There is a need to learn to bridge 'languages' in use, by developing a dynamic process of co-production learning processes. In addition, third sector organisations need to strengthen their own capacities to undertake research and evaluation for themselves, in order to demonstrate the value of their outcomes to potential funders. There are pressures to make the most effective use of resources, by thinking strategically and building alliances with organisations with similar values, working towards transformative goals for the longer term. University and community-based research partnerships can make a vital contribution to those goals.

Take Part's community based research has made visible the need to define the criteria used to measure the impact of the shared experiences emerging from ALAC and Take Part, which brought civil society organisations together with university partners, regionally. Take Part has been based, amongst other influences, upon Freirian principles for participatory learning for social justice and equalities. The approach has been to enable citizens and communities to make effective use of the spaces offered by government programmes from above, whilst continuing to strengthen Civil Society's capacity for progressive, autonomous action from below, with particular emphasis upon self-organising amongst women, black and ethnic minority communities and other groups suffering from discrimination and oppression. We are part of a national programme to strengthen research capacity in the third sector - focussing upon participatory action research into active citizenship learning and action. Current initiatives include projects to evaluate the lessons learnt from government programmes to promote active citizenship, as well as projects to enable Civil Society organisations (including multi-faith organisations and refugee and migrant worker organisations) to research the impact of initiatives to strengthen democracy and promote solidarity, rather than competition and conflict within and between disadvantaged communities.

Finally, we have the same open question: to what extent have these programmes been contributing to wider processes of change? How effective have community-based approaches

been in engaging people as active citizens, including the most excluded people? To what extent have university and community learning partnerships actually been prepared to facilitate this learning for active citizenship?

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The heuristic use of TASCOI in training programs with leaders of associations of small rural producers

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Abstract

This article presents a pedagogical reflection on the heuristic use of Viable System Model - VSM - specifically from the TASCOI tool for the analysis of organizations, in the processes of formation of transversal competencies with small rural producers, to improve their management capacity, made in the framework of the "Pilot Program of Management of the formation of small producers of the movement Another Villa, another product" GOVOP, carried out by the University of Ibagué - Colombia, with the collaboration of the Institute of the Southeast Regional Innovation of Tolima - Innovar - of Purificación and the financial support of the Administrative Department of Science, Technology and Innovation - Colciencias.

1. *Context:* The University of Ibagué, located in Ibagué capital of the Department of Tolima, between the years 2,010 and 2013, designed and implemented a pilot training program for small rural producers to support the training of management capabilities of their business and their associations, and to achieve better living conditions for families and the community.

Overcoming the conditions of poverty in the rural sector is one of the major challenges of the Colombian society to the stage of post-conflict, any time that, according to José Antonio Ocampo, Director of the Rural Mission to Colombia[1] to observe what has happened in Colombia in the last 20-25 years highlights the growth of "the rural-urban gap."

In the Department of Tolima, according to the census population in 2.005 of a total of 469.247 people, the 34.37 % of the population lives in rural areas and, according to the current Development Plan of Tolima (2012: 256): " the majority of them is linked to the peasant economy and the greater part of their holdings, represent barely subsistence economies. The main challenge … is that these producers through the associativity, accompaniment and the technology transfer, will become small-scale entrepreneurs with profitable farms and linked efficiently to markets"

2. Challenges for the design of the training program: at the start of the project the GOVOP team was faced with several challenges:

2.1 . Count with a theoretical and methodological framework for understanding the organizational situation of small-scale rural producers and contribute to its improvement process for shaping effective organizations.

To address this work was adopted a systemic approach because it offers a perspective of analysis of society and its organizations as a whole, at the same time that considers each of its parts and their relationship with the environment. Specifically it was chosen the cybernetic approach by its ability to help interpret and analyze complex social situations as they are in this case the construction processes and organizational change in rural communities of peasant economy. In

[1] The Rural Mission, was created by the Colombian Government to formulate guidelines Rural Policy for the next 20 years.

particular the Viable System Model and the TASCOI tool that enables us to make a diagnosis of the organizational issues basis necessary for the design of effective organizations.

Well same adopted the concept of organizational change of Michel Crozier and Erhard Friedberg (1990: 3) as a "collective creation process through which the members of a collectivity learn together, it means, invent and determine new ways to play the social game of cooperation and conflict and acquire the cognitive capabilities and organizational relationship that are necessary"

2.2 . Take an educational approach that would adapt to the situation of adults groups population with low level of schooling and with little interest in the academic activity.

The pedagogical model that was adopted was the constructivist supported with the action research methodology.

2.3 . Combining the previous two approaches in the design of a product that would be the pedagogical training program.

To achieve this there were several exercises one of which is the object of this document.

3. Pilot experience of implementation of the TASCOI to the analysis of the situation in two groups of small rural producers.

The associations that participated are located in different municipalities one in the north and the other in the south of the Department of Tolima. One is from producers of blackberry and another of coffee- producers. Both were involved in change processes consistent to make the move from being totally independent producers to organized producers to process and sell their products collectively.

The experience development during several working sessions and in each one of them participated around 25 producers.

The main results of these experiences were:

- The participants expressed in their own language which means the process in which they are involved as well as the responsibilities and challenges.
- The analysis of agents, its contribution and importance in the process served as a gateway to the knowledge of various aspects of the organization.
- The TASCOI proved to be a simple and friendly tool that serves as a tool for building a shared vision of the organization identify strategic objectives and the basis for defining the strategic plan of the same.
- The TASCOI as a teaching tool to help organizations understand and find alternatives to improve its effectiveness, it is a point of strong support for the empowerment of small producers as members of an association and local development actors.
- This experience is replicable for groups of maximum 30 small urban or rural producers belonging to maximum 5 organizations (6 by association).
- The results served as a basis for defining the content of training courses for GOVOP proyect multipliers of the Program.

Keywords

Empowerment, community capacity, training of transversal competencies, organizational change.

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Building inter-sectorial bridges to overcome obstacles in inter-organizational learning: The case of partnerships between a group of small restaurants and a crafts school

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Abstract

This article presents how cross-sector partnerships between small businesses and non-profits can be a way to develop learning in organizations. The case of one partnership serves to illustrate the manner as the learning obstacles were overcame and how inter-sectorial partnerships can be an instrument for learning. The research is developed in Colombia, and it involves a non-profit crafts school and its for-profit partners.

Keywords

Organizational learning, cross-sector interactions, small businesses, third sector organizations.

Introduction

Cross-sector partnerships can be an instrument for learning (SEKN, 2006). Partnerships between for-profits and non-profits do that the persons that conform those organizations face new issues. When a partnership is established, the common goal is which guides the actions of the partners. The common purposes help to overcome some differences and problematic situations (Aldana & Reyes, 2004), and also to make agreements when the differences persist (Searle, 1969).

The capacity of listen to the other and the possibility of develop a conjoint project can be the base of learning. When a cross-sector partnership is established some boundaries are blurred but that is the result of a better understanding of the other person point of view through the everyday practices (Spinosa, Flores and Dreyfus, 1997). In that sense the rationalities for-profit and non-profit can share common aspects and learn about the difficulties faced by the partner and the benefits that he/she can obtain of this association.

The purpose of this paper is to contribute to the understanding, through a case study, of the relationship between the establishment of cross-sector partnerships and the learning on it. This research is focused on inter-sectorial partnerships between small business and non-profit organizations.

The establishment of the partnerships involves variety of issues derived from the mixed nature of the partners. The necessity of manage those issues makes that the persons to learn. When the persons learn together give place to conjoint learning actions.

Based on the study of the formation of the partnership between the small restaurants and the crafts school, the research question that is addressed in this enquiry is: Which are the reasons why some small businesses, can overcome a sort of obstacles, and can to start an interaction and learning with third sector organizations whereas others do not?

Theoretical Basis

In an interview for the research, a former owner-manager of a small business, now leading a unit to raise funds in a non-profit organization, said that small business conceives the cross-sector alliances in a different way than large ones.

She said that the structure of the large enterprise makes difficult that the social intentions can permeate the several hierarchical levels on it, making blurry the connection between the contribution to social issues and the benefits of those contributions for the enterprise. According to her experience, the partnerships as a tool for learning are better valued in small enterprises, due to the align between the interests of social impact of the owner-manager with those of his/her own enterprise (Madden, Scaife and Crissman, 2006).

This study frames on organizational change theory, organizational learning and the field of inter-organizational relationships which studies the origin, characteristics and patterns of those links (Cropper, Ebers, Huxham, & Smith-Ring, 2008). When a small business establishes a partnership needs to be more efficient, because need deal with the new demands at the same time that fulfill its own survival purposes (Pawolowsky, 2000). Change implies acquisition of new abilities and knowledge, for that reason, the partnerships between small businesses and non-profits are environments for the inter-organizational learning.

In order to develop a definitional basis for this research, the terms to be employed are presented here.

The learning emerges when a person changes his/her practices facing of a problem (Lleras, 2003). The interchange between a learner active and interested and a propitious environment favors learning with sense. This approach to learning is closer to

pedagogical approach centred in the relationship between the apprentice and the school (Not & Baez, 1983), not in the approaches centred on apprentice or those centred on teacher or school.

The construct of organizational learning has been proposed to describe how the organizations acquire knowledge (Garrat, 1987 and Garvin, 1993 en Ingram (2005); Espejo, Schuhmann, Schwaninger, and Bilello, (1996); Schwaninger (2001). That understanding of learning includes norms and values that are learned by the organization which involves processes at the levels: individual, units and organizational (Volberda & Lewin, 2003).

The inter-organizational learning also has been studied, this last form of learning happens when some change is produced in an organization, when it shares experiences, and when is stimulated the innovation in other organization as result of the establishment of inter-organizational relationships (Ingram, 2005). The influence of the environment is on the base of the inter-organizational learning.

According to Cyert & March (1963) and Argyris & Schön (1996), the results of learning in organizations do not depend only on its environment, also on its inner complexity and autonomy. In summary, organizational learning as Argote & Todorova (2007), propose is a process framed in the context and the experiences of the organization.

Non-profit organization (NPO): Following to Salamon & Anheier (1992), a non-profit organization is that which fulfill five conditions: to have a formal organization, be private, to have capacity of self-governance, does not distribute revenues and relies on voluntary participation.

Small Businesses (SB): The acronym SB refers to small businesses. According with Bridge, O´Neill, Martin and Cromie (2009), SBs are not smaller versions of large enterprises, and although there is not a simple and widely accepted definition of what is a small business, they consider that in order to define those enterprises additional to the quantitative measurements most commonly considered, some qualitative characteristics should be included.

The quantitative measurements are the number of employees and assets which might be within specified ranks. In Colombia according with the Ministry of commerce, industry and tourism: “small businesses are those that have between 11 and 50 workers and assets between 501 and 5,000 minimum monthly wages” that is equivalent to assets between USD 165.000 and USD 1´641.000.

About qualitative characteristics can be mentioned: they are businesses usually serving to local customers; having a limited share on their market; owned by one person or by a small group of people, in some cases families; the owners deal with the most of managerial issues, are independent businesses (Bridge et al., 2009; Cennamo, Berrone, Cruz, & Gomez-Mejia, 2012; Vives, Corral & Isusi, 2005).

SB-NPO partnership: is an open relationship between one SB and one NPO including basic interactions between the partners, working with complementary inputs to reach a

common purpose. In that sense partnership is a type of interaction with transactions, flows and linkages (Oliver, 1990) between organizations.

The above presented definition of partnership takes as a starting point the following definition: A partnership is a manifestation of inter-organizational relations characterized by "being in an open relationship between active partners whose strength lies in the different and complementary strengths of each party to reach a common agreed upon goal " (Fundación Corona- Programa Nacional de Alianzas- Colombia). In a complementary way Waddock (1988) clarify that a social partnership is not philanthropy or simple donations nor voluntary work.

SEKN (2006), developed a study about several cases of social partnerships in Latin America, and found that those alliances are stronger when the partners see them as learning environments. Those alliances have the effect of strengthening the partners, because give to them the opportunity to acquire new knowledge and capabilities.

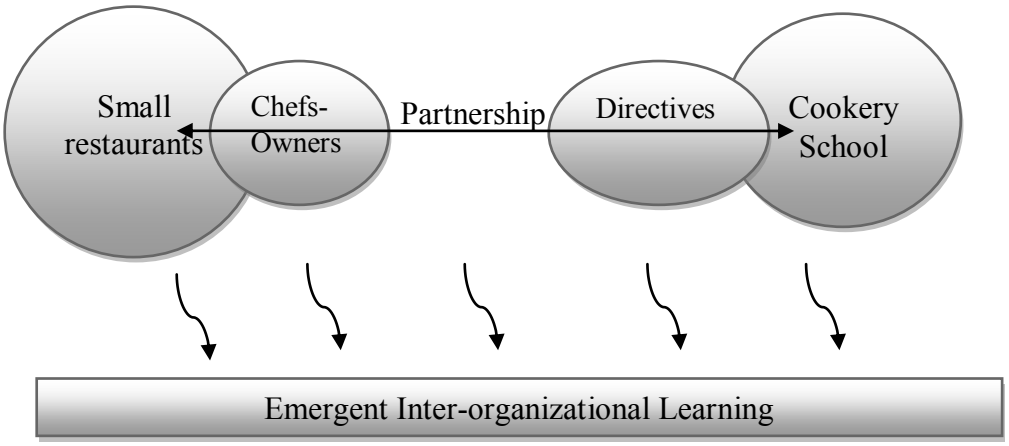

Figure 1- The learning in the partnerships between small businesses and non-profits organizations

Partnerships between businesses and non-profits are a mechanism to overcome the knowledge deficits, because can favour inter-organizational learning (Boydell, Hogget, Rugkasa and Cummins, 2008). They have transformational potential because attracts resources and capabilities and promotes the creation and distribution of value.

The schools of arts and crafts have been created to contribute to people formation on skills for employment. In Bogotá, capital city of Colombia, since 2005 works a foundation that offer job training in traditional trades such building industry, handmade paper, carpentry and food. The school of arts and crafts privileges the connection between knowing and doing.

The organization, leaded by the local city government was created with resources donated by the government of Spain and with the contribution of Colombian national government. The signed agreement established the gradual dismantling of economic contributions from governmental actors; in view of that situation, the school face the dilemma of how to be a viable organization at the same time that maintains teaching with a good quality.

The school attends to several groups of young population in the country, all of them considered extremely vulnerable. Some of the students belonged to illegal armed groups; are in a socio-economic difficult situation, and others had been displaced as a result of violence. Several students come from different regions around the country. The teaching in the school has the aim to offer job training opportunities to those young people.

In the case of the cookery school, some of the teachers are chefs and owners of small restaurants in the city. Those owner-chefs were engaged with the school beyond the teaching in two ways. First, they opened places on their restaurants for students´ practices; second, they created an association which collaborates in activities promoted by the school.

Also in important to remember, that small businesses are mostly organizations born from the entrepreneurial efforts of an entrepreneur or a small entrepreneurial team. That is the case of the small restaurants studied in this research.

Methodology

A descriptive research was developed in order to study how the formation of partnerships between SBs and NPOs, can contribute to learning. The qualitative approach was based in a one case study design (Saunders, Lewis & Thornhill, 2011).

The case for the empirical study corresponds to the cookery school which is part of the school of arts and crafts in Bogotá. The partnerships established between the cookery school and the owner-chefs exhibited results about learning through the establishment of partnerships.

The study started in August of 2013 and is an ongoing research. Three stages were developed: the design and test of the instrument, the development of semi-structured interviews and the analysis phase.

In a first stage, an interview instrument was designed, tested with non-participants and adjusted. The instrument included 22 organizational situations related with obstacles of learning. The participants explain for each situation three aspects: first, how experienced it; second, explain an specific example of that situation in the partnership, and in third place how he/she faced the situation.

In a second stage seven semi-structured interviews were developed. The instrument developed was the guide for the interviews. Directives and students of the cookery school and also the owners-chefs were interviewed. The interviews had a duration of 1 hour in average and were recorded.

Finally, the recorded interviews were analysed based on the ways that participants overcame the learning obstacles. Each of the 22 situations presented corresponded to a type of learning obstacle and in each case the participants presented 1 of 4 ways to face the situation. The relation between the elected way to face the situation, and the kind of obstacle which was overcome shows how the learning can emerge.

In relation with the sample, the starting point was the director of the school. By using a snow ball method (Biernacki & Waldorf, 1981) the other directives of the school and the teachers-chefs of the small restaurants were contacted. This method guaranties the effectivity in the contact.

Analysis

The described partnership between the small restaurants and the school gave place to inter-organizational learning, attracting resources and capabilities. As was defined learning is change in practices and inter-organizational learning produces the same effect.

The students change their practices because they learned the cookery technics and developed their practices on the small restaurants; the owners-chefs learned about the implications of working with a third sector organization with a rationality oriented to create social value but with the necessity of assure its sustainability. The directives and workers of the school learned about the interaction with the business entrepreneurs, chefs-owners, who needed also make their own businesses sustainable and have the knowledge on cookery.

The partners came from two different sectors but they had an intersection of interests: sustainability for their own organizations and sensibility for social issues.

According to what has been previously presented, this ongoing enquiry analyses the case of the collaboration established between organizations belonging to two different sectors. In the interaction was observed that the owners of the restaurants were guided by a rationality that balances the creation of social and financial value, and they not pursuit only the maximization of financial resources. That rationality permeated the organization and enabled it to participate in processes of collaboration and learning with third sector organizations, contributing in that way to the sustainability of both.

Beyond the balance between the economic and social rationalities, a second element emergent from the research was the way how the participants faced the situations that can inhibit the learning. The data suggested that the participants recognize some obstacles for learning in the partnership, but in general face them in a constructive way, trying to change or to do something to improve the situation.

The participants informed how face those situations. They could choose between four options: to ignore the situation; to recognize it but do nothing; to do something as an individual effort; and finally to talk to the others involved and make some agreements.

Considering that spectrum went from to ignore the situation up to make agreements with other persons involved, the trend in the participants was to do something instead of just ignore the situation. In the examples was relevant the fact that all the participants coincided that in the partnership always existed an active listening, and that the option of making agreements with others was open the most of times. The second most common option was the unilateral decision to do something. To ignore the situation was an answer of scarce appearance in the results.

Between the 22 situations presented as obstacles for learning, there were 5 situations that at least one of the participants never had experienced in the partnership. And one of

those, it related with to have been ignored due to belong to the other organization, that situation not happening according with the judgement of several participants.

The other 4 situations that some of the participants not have seen or experienced in the partnership are related with: not to recognize that persons from the partner organization can understand internal practices; be closed to the suggestions coming from a person belonging to the other organization; keep information hidden which can benefit the work of the partnership; not to have timely feedback about results of processes. Those results show, in the case studied, that some organizational situations that can interrupt the flow of information between partners inhibiting learning, were not identified. That cab be an effect of that communication is fluent and open.

Other situations presented were recognized by participants. However, the description of the situations associated can be split in two groups, situations that they identified and were perceived as problematic for the partnership functioning, and situations identified but that they consider are necessary for the appropriated development of the activities in the partnership.

In the first group of those situations, one related with confused boundaries between the domains informational and operational was highlighted by several participants. The cookery students need to learn the cookery technics and to develop the pertinent skills, the “doing” is crucial, but in the lessons is usual that students do not ask what do not understand. After that, they have problems in the practices when they go to work into the restaurants of their own teachers.

About the second group of situations, there were two of those situations that can help to illustrate the results. On those situations, the instrument had the text: “if the bosses did not exist everything would be better” and “you should continue up through the chain of command”. An interesting finding was that some of the participants recognize that they are always challenging the rules, which is not a weird situation because they are entrepreneurs. However, due to their roles as owners of their businesses, or as directives of an organizational unit; they understand that organization associated to work places and processes are necessary for the good work in the organization.

Finally, due to the entrepreneurial nature of the participants, they used to deal with problems and to overcome obstacles. Between the partnerships the owner-managers of the restaurants are business entrepreneurs, the directives of the school are institutional entrepreneurs and the students are formed in entrepreneurship. Probably their nature makes that they assume those situations in constructive way.

Conclusions

The collaboration established between the FETB and the owners-managers of the small businesses was successful because the built a learning community based on the recognizing of the others world vision.

Two limitations of the study are the particularity of the sample and the sector selected. However the case in the food sector and the orientation to social issues of the owner-managers, can give a closer vision to their way to see the world. In some sense the sector could make the actors of the studied case be aware of the importance of recover

human practices as collaboration. They work with food which are vital for persons and would make them be closer to act in a genuine way on their partnerships.

In that sense, the case teaches that overcome the obstacles not is a process of "how to struggle against them" is more see them with a different approach. In the case studied the learning is that the difference is the way which the partners deal with a variety of obstacles, not the situations by themselves. In other words the obstacle exists but the difference is in how is seen and the way that the persons face those.

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'Model M' 2013 – allow me to dream and realize my dream!
Practical trainingfor employment of young bachelors'

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Abstract: This paper presents a successful practical case ofa way from disruption to reparation – from unemployment of youngsters with university degrees of diverse programs from engineering to theology, to successful employment in companies, non-governmental organizations or self-employment in 2013. In 2014 the program is scheduled again. Theory is not included here.

Key words: bachelors, employment, IRDO - Institute for the Development of Social Responsibility, Maribor, Model M program, Ptuj, Slovenia, The European capital of youngsters 2013

Introduction

In 2013 the city of Maribor, Slovenia, had the honor to be 'The European capital of youngsters', after being 'The European capital of culture in 2012' (which will not be tackled here). The IRDO Institute for the development of social responsibility joined the related activities with the 'Model M – a pilot model of career training and consulting for increased employability of youngsters' (Maribor, 2012-2013). Here we summarize this experience.

Essence of the Model M 2013

The target group consisted of youngsters between 26 and 30 with B.S. degrees and/or from under-privileged social groups and without employment.

The project was aimed at generation of a 'Model for elaborating candidate's own career plan' (either as an individual business plan or an individual employment plan). The plan's basis is made of practical advices of various professionals and candidate's own evaluation of one's own cultural (knowledge, education, skills), social (social environment, social stratum, social status), and psycho-social potentials (personality traits and interests).

Thus, the project's objective was to enable the project participants to independently search their business opportunities or to competently offer their knowledge, education and skills in labor market. This is supposed to help the young project participants with what-ever tertiary degree to increase their employability, innovativeness, entrepreneurial spirit and entrepreneurship.

The objective was officially and un-officially assessed as fulfilled. 26 youngsters of 26 – 30 years of age from the Podravje Region (in Northeastern Slovenia) finished it. The Employment Offices of Maribor and Ptuj cities invited +100 candidates to possibly join the Project Model M 2013.Among them, 32 decided to join the program, 26 finished it, further 4 found jobs in the course time, 2 gave up for private reasons. In a year, 72% of them changed their situation (i.e. found a job or created it on their own), according to data of the Public Employment office of Slovenia, Unit in Maribor.

In the introductory meeting only two of them said they had experienced some education in entrepreneurship and innovation management in their tertiary education programs (this means that their schools tend to neglect these two skills, because their professors and deans still nurture two obsolete views: (1) 'innovation is only an engineer's topic'; (2) 'entrepreneurial spirit and entrepreneurship cannot be taught, being natural attributes only'). Equally extremely poor was the participants' education on systemic, i.e. requisitely holistic behavior.

Summary of results of the Model M 2013

The Model M 2013 project was, once finishedafter three months of training, assessed by its participants as a valuable contribution to their strategic goals by strengthening their capacity to:

- Gain and/or add to their competencies, skills and (learning) experiences from persons, who actively participated in preparation and execution of the Model M 2013 project;
- Develop their personal potentials, self-confidence and creativity;
- Increase their capability to realize their own ideas;
- Strengthen and broaden their social networks;
- Practice inter-generational cooperation between practitioners and professionals of various profiles aimed at increased employability.

They increased their employability and employment.

IRDO was able to attract several supporting partners and sponsors; without them the program could not be performed. All speakers joined the course for free.

In 2014 the M-model 2013 participants meet every month forming an alumni club. A part of them became entrepreneurs, another part of them are active as/in NGO, the third group found employment, some are still unemployed.

Program participants were happy with the program. They suggest it should continue and unemployed youngsters should join it. What about them-selves, the program should be up-graded with further models for their further training covering their needs as fresh employees or independent business persons, they said. They were sorry to see the end of the program.

All involved speakers – entrepreneurs, professionals and members of assessment commissions cooperated on a free-will basis and were enthusiastic with the M-model 2013 project, their participation in it and in the created networks. The organizers, on the other hand, were very happy with the IRDO members – entrepreneurs becoming project sponsors and contributed much professional and other literature, promotional gifts and free consulting and training delivered at the final conference of the project on 11 December 2013 in Maribor.

An additional value added was found in the organizers' innovative approach that gave priority to the respect for every participant, his or her knowledge and capability as well as the troubles he or she was facing in the given moment. Therefore the program was building on empowerment of every individual, while the entrepreneurial contents, knowledge and practice made an important part of the training, but not the key component. The key part consisted of recognizing the treasures inside every individual and of waking up the hidden capacities, life visions and wishes to make their life missions their reality.

Participants were taught about development of creative ideas, recognition of entrepreneurial tasks, public appearance, mutual respect, and networking. They strengthened their social capital and mutual links.

The Model M 2013 project's aim was successfully attained, since the program was finished by 26 youngsters in the age 24 – 30 years, all from Podravje Region as planned.

Project activities of Model M 2013

The project started with preparation in September 2012 and lasted until December 2013. Organizers from IRDO were able to continue anddo repeat/renew it in 2014; this is supported by sources of Maribor Municipality as upgraded programs of Maribor 2013 European youth Capital project. Program is also in 2014 free of fee for the course participants and with speakers mostly for free.

Activities in 2012 included program preparation:

1. Generation of the program 'career training for an easier entrance of youngsters in the labor market';
    a. Preparation of the module 1: 'discovering one's own mission, capabilities and limitations';
    b. Preparation of the module 2: 'learning to know the business and employment environment';
    c. Preparation of the module 3: 'elaboration of one's own employment and/or business plan'.
2. Preparation of the promotion – communication plan.

Activities in 2013 included the program realization:

- Program coordination and management;
- Selection of course participants;
- Course organization and realization;
- Realization of the promotion – communication activities.

The project was realized by IRDO - Institute for the Development of Social Responsibility and co-financed by IRDO and the City of Maribor in the framework of the project 'Maribor – European culture of youngsters 2013'. The core team consisted of the IRDO (non-profit institute) manager Anita Hrast, then un-employed and now employed in his professional area bachelor Aleš Jambrek, and then-student and after studying period self-employed sole entrepreneur Sabina Kojc. The speakers were mostly IRDO members, who are managers or entrepreneurs, heads of non-profit organizations, owners of enterprises or institutions in different sectors, with only two university professors on the team. All of them as well as all speakers joined the program as volunteers for free.

The M model project attracted:

- 7 members of the assessment commission,
- 4 representatives of partners – the co-financers and public employment offices,
- 28 professionals and entrepreneurs as speakers in the program, of which five were members of the organizing team and 23 were other volunteers.

Some speakers accepted the wishes of program participants and arranged individual discussion meetings with them. Their voluntary work came across no disturbances. All participants were also offered direct two-way communication at any time to realize the targeted Model M program fully.

The Model M 2013 program included regular weekly group meeting with course participants for who educational tasks were prepared, double-checked and realized in the form of individual and group consulting (matching their expressed specific needs), both in person to person meeting or by phone and e-mail.

Organizers had also regular contacts with professional – speakers and other tasks executors, collected educational materials and photo-documented the events.

In line with the contract, the organizers regularly reported to co-financers about the realized activities on a monthly basis.

Participants were selected on their own free-will basis after two information meetings that were organized to promote the project in cooperation with the Employment offices of Slovenia in Maribor and Ptuj, in August and early September 2013.

In cooperation with supporting project partner Public Employment offices of Slovenia in Maribor and Ptuj the course program was extended to 104 hours. This allowed the un-employed participants who registered in the un-employment evidence of these offices to receive reimbursement for their travel cost for joining the course classes. The organizer had to report on presence of every Model M 2013 participant therefore.

After the end of the Module 1 the participants has their choice to break up or continue, based on their assessment how suitable is the program to them. 26 out of 32 finished the program, while 4 found a job during the Model M, and 2 gave up for personal reasons. The Module 1 took two days as an introductory course. After it the participants formed three groups:

- A: profit oriented organizations;
- B: non-profit organizations;
- C: search for employment.

They specialized in competencies in their selected areas by in-depth educational techniques and programs. Twice a week organizers met with the Model M 2013 participants in education and consulting workshops to strengthen their competencies and gain experiences in their selected fields A, B or C above.

In the phase of the intensive realization of the Model M 2013 program, organizers met with all participants (groups A, B and C) twice a week for 8 hours each day, while participants worked at home on solving their given tasks and submitted their assignments for checking and correcting (their business plans, career plans and other assignments). The organizers also coordinated visits to organizations with good practices (Association TOTI DCA Maribor, Večer, CAAP ..) and prepared materials for participants'meetings.

Four participants found employment during the Model M 2013 course. The others actively participated in the program realization and attained "results beyond their expectation" in terms of implementation of the targeted tasks.

For the assessment commission, which evaluated the final products (business and career plans) forms and procedures were also generated. Documents included statement of confidentiality, invitation, evaluation document etc. The assessment commission had several meetings, read all participants' materials and selected the best ones – winners in the given categories. In the final event on 11 December 2013 recognitions were handed to all Model M participants, and so were statements of successful participation and gifts provided by several sponsors in the form of their promotional materials, books and free consultancy time.

An e-manual was also generated, which is internal by its nature and includes classes' materials and some assignments of participants, but not all of them, because some of them did not wish publication and in some cases data are confidential.

The promotion – communication activities in 2013 included several publications in various Slovenian journals, radio and TV stations. Model M organizers and participants were also invited to the event of handing-in the award Gazela 2013 (i.e. the most rapidly growing enterprises of the year)

for regions of Podravje and Pomurje (both in northeastern Slovenia); in the latter event, Model M participants were included in two-way dialogue of the awardees and audience with the task to create and put various entrepreneurial issues/questions.

Organizers attained agreement with the Governmental public agency SPIRIT (working on promotion of entrepreneurship etc.) for Model M participants to visit the 'Innovation Forum' on 13 November 2013 in Ljubljana. 15 + 4 interested participant of the Model M 2013 and some speakers joined the event.

Organizers sent 300 invitations to journalists to the final event of the Model M 2013 project.

Conclusions

The Model M 2013 project contributed to realization of the strategic objectives covering strengthening of the youngsters' capabilities that are too poorly covered by the usual tertiary education programs, e.g.:

- Strengthening and/or gaining of new competencies, skills and (learning) experiences of individuals who participated in preparation and realization of Model M;
- Development of personal potentials, self-confidence and creativity of all participants;
- Increasing of youngsters' capabilities to realize their own ideas;
- Strengthening and enlarging the youngsters' social networks;
- Intergenerational cooperation between practitioners and professionals of various profiles aimed at helping the youngsters to increase their employability.

In future organizers wish/intend to deliver their experiences and knowledge to other organizations and regions in Slovenia to help youngsters be (self)-employed as soon as possible.

Speakers were (by ABC of family names): Angelca Ademovič, Dr. Karolina Babič, Tomaž Bole, Irena Fištravec-Polak, DarijaHlade, Marjan Holc, Anita Hrast, Aleš Jambrek, Sabina Kojc, Suzana Kotnik, Vesna Kovačič, Vinko Kurent, Darija Lorbek, Katja Majer, MirjanaMladič, DDr. Matjaž Mulej, Nastja Mulej, Stanko Obradović, Dr. Andrej Naterer, NatalijaPostružnik, VesnaRebernak, JasminaSmajićŠupuk,Patricija Šenekar, Andreja Ternar,Alenka Zelenič, Mirjana Zgaga. All of them spoke about their own practical experiences, mostly as entrepreneurs or managers.

N.B.In 2014 IRDO Institute started with new generation of participants in project Model M 2014. At the time of this report (September 2014) there are 39 candidates involved in practical education and training for entrepreneurship, non-governmental organizations and active search for job in the region of Podravje (Maribor, Ptuj). 15 of them decided to create their for-profit business plan, 8 for non-profit business plan and 15 for active search for job. They are working together wellas a team and expressed, that each secondary school participant should go through this kind of education to find out, what he or she wants in his or her life and how to do it. They should allow themselves to dream and realize their dreams. And they should not listen to media and others how nothing is possible. Positive thinking makes people happy and effective. Negative thinking can kill their dreams and courage to realize them.

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IRDO archive of documentation on the Model M project 2013. IRDO Institute for the development of social responsibility, Maribor, Slovenia

Attachment: The schedule of the 2013 course

MODULE 1:
»Discovering of one's own mission, capabilities and limitations« - shared classes and discussions«

PROGRAM OF A TWO-DAY PROFESSIONAL CONFERENCE:
"Problems and chances of youngsters' employment Podravje region" - shared classes

Day 1, 10 September 2013

Time	Class title	Speakers
8.00 – 8.40	Presentation of social responsibility and the youngsters' role in its development	Prof. Emer. DDr. Matjaž Mulej, Anita Hrast
8.40 – 9.00	»The project Maribor 2013 – European Capital of youngsters and its role in employment of youngsters inPodravje«	Dr. Martina Rauter, Representative of Municipality of Maribor (Office ofcultureand youth)
9.00 – 9.20	»Presentation of the Model M and supportive environment for youngsters' employment«	Aleš Jambrek, Anita Hrast
9.20 – 9.30	**Break for networking**	
9.30 – 10.30	»Social capital, business networks and motivation of youngsters for work«	Mirjana Mladič
10.30 – 11.30	»How do I recognize what am I excellent in, and how can I show it to others?« and »Contemporary trends of Slovene andworld-wide youth«	Dr. Andrej Naterer
11.30 – 12.30	**Break for networking**	
12.30 – 13.10	»How can one approach a potential employer or business partner – basics of successful business and personal communication«	Sabina Kojc
13.10 – 14.10	»How can one gain EU unrepayable funds?«	Alenka Zelenič
14.10 – 14.30	**Break for networking**	
14.30 – 15.30	»Innovativeness and entrepreneurship for youngsters «	Prof.Emer. DDr. Matjaž Mulej
15.30 – 16.00	**Discussion at the end of the first day**	**Aleš Jambrek, Anita Hrast**

Day 2: 11.9.2013

Time	Class title	Speakers
8.00 – 8.20	Introduction to Module1, second part	Aleš Jambrek
8.20 – 9.30	»Functions of an enterprise, successful management and employment of youngsters; competitiveness in the market«	Stanko Obradović
9.30 – 9.50	**Break for networking**	
9.50 – 10.50	»Financial stability of enterprises; how to help youngsters to gain employment«	Angelca Ademovič
10.50 – 11.50	»How can one establish one's enterprise and who can help in this effort?«	Vinko Kurent, M.A.
11.50 – 12.50	**Break for networking**	
12.50 – 13.10	»Business plans for one's independent entrepreneurial or NGO career«	Anita Hrast
13.10 – 14.30	»Presentation of the current problems and chances for youngsters' employment in Slovenia and Podravje region«	Mirjana Zgaga, Public employment office, Unit Maribor
14.30 – 15.00	Presentation of questionnaires for inclusion of participants into individual consultation; description of the way of doing it	Aleš Jambrek, Anita Hrast
15.00 -16.00	**Discussion, filling in the questionnaires and the finish of the second day**	**Anita Hrast, Aleš Jambrek**

MODULE 2: »Recognizing the business and employment environment – shared classes and discussions

Module 2.1 Classes: Insight into organizations with good practices (enterprises, BGOs, self-employment in culture …)

16.9.2013

Time	Topic	Speakers
8.00 – 9.30	Explanation related to running the individual consultations; Allocation of participants into groups; Assignment of tasks and work	Aleš Jambrek, Anita Hrast
9.30-9.50	**Break for networking**	
9.50-11.20	Day-care center of activities for elderly; association TOTI DCA Maribor –its presentation; speaker's own experience in his creation of his self-employment	Marjan Holc
11.20-12.30	**Break for networking**	
12.30-15.00	Rhetoricand public appearance	Irena Fištravec
15.00-16.00	**Discussion and evaluation ofthe day**	Anita Hrast

17.9.2013

Time	Topic	Speaker
8.00 – 9.00	Presentation of social entrepreneurship and business intuition	M.A. Vesna Kovačič
9.00-9.45	Presentation of the speaker's own experience in production of organic soaps (procedure of gainingthe certificate of EU in the case of the naturalcosmetics)	Patricija Šenekar
9.45-10.15	**Break for networking**	
10.15-11.15	Presentation of the speaker's own experience–self-employed cultural worker (presentation of the status, experience and work)	Katja Majer
11.15-12.00	**Break for networking**	
12.00-15.00	De Bono's 6 thinking hats method (class and workshop)	M. A. Nastja Mulej
15.00-15.45	Neuro-marketing, personality development	Andreja Ternar
15.45-16.00	**Discussion and evaluation of the day**	Anita Hrast

18.9.2013

Time	Topic	Speakers
8.00 – 11.00	Visit to and presentation of CAAP and parallel activities	Representatives of CAAP, Karolina Babič
11.00-12.00	**Break for networking**	
12.00-14.00	Establishment of institutions and foundations	Tomaž Bole
14.00-14.30	**Break for networking**	
14.30-16.00	Arts and architecture - local and global cooperation	VesnaRebernak
15.00-16.00	**Discussion and evaluation of the day presentation of schedules for the further work**	Anita Hrast

Module 2.2: Work in groups A, B, C

Time	Topics in module 2 – work in groups (A, B, C)	Time per individual	Speaker / mentor
24.9.-26.9.2013	Presentation of participantsbiographies and motivationsforcareer and making ones' own ideas on career plans, neuro-marketing and personality development	8	dr. Andrej Naterer, Anita Hrast, Andreja Ternar
1.10.-3.10.2013	Business planning, project work; application for posts, recognizing of opportunities in market for self-employment or employment with employers	8	Alenka Zelenič, Aleš Jambrek, Anita Hrast
8.10.-10.10.2013	Leading the meetings, communication with clients, marketing planning forfor-profit and non-profit organizations	8	Anita Hrast
22.10.-24.10.2013	Formation of informal and formal networks, recognizing the supportive environment for	8	VesnaRebernak, Anita Hrast, Vinko Kurent, M.A., Aleš

	employment		Jambrek
29.10.-31.10.2013	Differences betweenfor-profit and non-profit organizations; chances for employment in NGOs	8	Anita Hrast, Darija Lorbek
5.11.-7.11.2013	Analysis of project work, review ofcareer plans, discussion aimed at improving of thecareer plans, evaluation of the accomplished work	8	Alenka Zelenič, Aleš Jambrek, Anita Hrast, JasminaSmajićŠupuk
12.11.-14.11.2013	Presentation of participants own career idea or planand suggestions for improvements– presentation in 15 min ofcreative suggestions for self-employment or employment with an employer; followed by discussion	8	StankoObradovič, AngelcaAdemovič, Vinko Kurent, M. A., DDr. Matjaž Mulej, M. A. Natalija Postružnik, Anita Hrast, Mirjana Zgaga, SuzanaKotnik, DarijaHlade

Module 3: "Presentation of participant's owncareer or business plan"

PROGRAM OF THE FINAL ONE-DAY PROFESSIONAL CONFERENCE - "Innovative modelsand development views for youngsters' employment Podravje region" - presentation of conclusions and achievements of the project
11.12.2013

Time	Topic	Speaker
8.00 – 9.00	»Achievements of the project Maribor 2013 – European Capital of YouthinPodravje region«	Dr. Martina Rauter, Representative of Municipality of Maribor (Office of culture and youth)
9.00 – 9.30	»Development perspectives of employment of youngstersin SloveniaandPodravje region; future measures of the Public employment office (ZRSZ)«	Mirjana Zgaga, ZRSZ,Unit Maribor, representative of ZRSZ,Unit Ptuj
9.30 – 10.00	Presentation of execution and achievements of the project Model M and the manual on employment of youngsters (results of evaluation forms – analysis)	Aleš Jambrek, Anita Hrast
10.00 – 10.30	Youngsters, creative thinking and innovativeness – the current global changes and challenges	Prof. emer. DDr. Matjaž Mulej, M. A. Nastja Mulej
10.30 – 11.30	**Break for networking, press conference**	
11.30 – 12.00	How did I detect my hidden capabilities and gain new knowledge for career path – presentation of experiences of participants of Model M training	participants of project Model M
12.00 - 12.30	Obstacles and perspectives for employment of youngsters – Model M participants' experiences	participants of project Model M
12.30 – 15.30	Presentation of the self-employingcareer andentrepreneurial paths of youngsters - project Model M participants	participants of project Model M
15.30 – 16.00	**Handing-in the certificates of participation, declaration of winners and handing-in the awards (and argumentation of them) to participants of the Model M project**	**IRDO, ZRSZ, Municipality of Maribor**

6

Computer modelling, power and the management of complexity

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Coping with social systems: agent reflexivity in computational models

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Abstract

With the advent of computer technology, complexity approaches to study and transform social systems have been steadily gaining an important place in the social science and engineering communities over the years. The use of computational models of social systems has become an promising option for understanding social systems and for exploring possibilities of change (e.g., Squazzoni, 2008). However, the popular complexity-related perspectives to study social systems are still strongly rooted in the physics tradition (cf. Castellano et al., 2009; Galam, 2012) and can be labelled as "physicalist" enterprises, in Mayr's sense, that is, the view that all nature obeys a single set of laws, and that therefore *organisms* are in no way different from inert matter (Mayr, 1996). Such an approach is especially problematic when the intention is to engineer, that is *to transform*, a social system since such a system is driven by contingent and changing decisions made by free agents. The assumption that such systems can be described by law-like statements easily ends up in mistaken, unsuccessful attempts that might even worsen the situation that is wanted to be improved in the first place.

Despite significant insights of physics-based models in the social sciences (e.g., Castellano et al., 2009), several differences between the physics tradition and the nature of social systems are not reconcilable (Fischer, 2013; Umpleby, 2007). For example, unlike entities in physics-inspired models of complex systems, *social agents* can reflect upon their decision rules and behaviour and change them over time. This is what we call *reflexive agents*.

The label "reflexivity" has different connotations in the literature, and is usually related to self-referencing statements: "[A] social scientist who formulates a theory of a society in

which he or she is a member is making self-referential statements" (Umpleby, 2007: 515). Umpleby (2007) also puts in contrast the equilibrium approach in economic theory with the reinforcing, out-of-equilibrium dynamics that reflexive systems might generate. Nonetheless, in referring to economist George Soros' ideas, Umpleby (2007) does not distinguish if reflexivity is a necessary or sufficient condition for out-of-equilibrium dynamics. In fact, we might infer that, in physics, out-of-equilibrium dynamics do not need to include reflexive agents. Similarly, we might say that boom-and-bust cycles might be either the result of the behaviour of reflexive agents or just oscillations that result from delayed feedback in dynamical systems models. Yet a different view on reflexivity comes from self-awareness of how disciplines frame what is and what is not important when dealing with (complex) social systems. If the observer assumes that s/he is not independent of the social system that s/he studies, findings cannot be considered "objective" and the research context becomes extremely decisive (Lessard 2007). Such considerations might have significant consequences in policy evaluation, as Lessard (2007) points out in the case of healthcare systems: "The increased emphasis on the context and process of data production highlights the issue of reflexivity in economic evaluation" (Lessard 2007: 1755). Lessard (2007) also highlights the work of sociologist Pierre Bordieu in reflecting the interdependency between objectivity and subjectivity (Bourdieu and Wacquant, 1992). "The practice of Bourdieu's sociological reflexivity enables researchers to identify, confront and transgress the socially constructed boundaries that delimit their practices" (Lessard, 2007: 1762).

Nonetheless, in the consideration of computational models of social systems, it appears that individual-level behaviour has seldom been explicitly addressed as representing reflexive behaviour (exceptions are for instance Goldspink (2002) and Dopfer (2005)). Yet, to demarcate our research scope, we do not focus on the above-mentioned connotations of reflexivity. We are interested in modelling agents' ability to modify their own behaviour by adopting different sets of decision rules. Thus, we understand *reflexive agents as those who have meta-models of decisions and /or behaviour*. The recognition that the behaviour of a system can be better characterized as the outcome of behavioural rules that affect behavioural rules , implies to question popular assumptions of physicalism such as: (i) the characterization of systems with immutable descriptions of logics of "behaviour"; (ii) the uniformity of nature—since the only possibility to meet the physicalist goal of "reliable" forecasts based on data, needs to assume that nature (or the observed system in this case) is uniform, as Hume remarked in order to deal with the problem of induction. This paper develops a theoretic perspective to understand how reflexive agents can be incorporated in computer simulation models, as well as we attempt to make a distinction between outcomes of reflexive and non-reflexive systems (Golspink and Kay, 2007). Our goal is to propose a dialogue that breaks away from the tradition of using statistical physics models as analogies to social systems, and propose alternatives to include the property of agent reflexivity (as we defined it above) in the study and engineering of social complex systems. We argue that this discussion is necessary in order to have effective and working designs and "solutions" to social systems issues.

Keywords
Reflexivity, social systems, agent-based simulation.

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Agent-based modeling and simulation of patronage networks. An analysis of the structure and dynamics of political clientelism with *Soc Lab*.

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This paper seeks to critically explore the potentialities and limits on agent-based modeling and social simulation for the study of complex political phenomenon. By understanding political phenomenon as a complex, dynamic, non-linear, and self-organized system, our goal is to help articulate Political Science and Complex Systems Science.

This paper presents the main findings of an agent-based modeling simulation on political clientelism. The model was developed by the operationalization of a theoretical model of patronage networks via *Soc Lab* platform.

The paper is structured in three parts: First we present the theoretical model of patronage networks. Second we present an introduction to agent-based modeling in the social sciences. Finally we explain the *Soc Lab* platform and present the model developed for the study of political clientelism.

1. A theoretical model of political clientelism

For the purpose of this paper, we understand political clientelism as a link between citizens and politicians, who relate through the exchange of political support and selective benefits. These exchanges involve three types of agents: patrons, brokers and clients; and each of them has specific roles. In the iteration of their relations these agents create behavioral routines, shared norms and values, and rules of interaction, which cause the emergence and persistence of patronage networks.

Our theoretical model of political clientelism has been developed in previous works (Aguirre 2012, 2013); and its main findings for the porpoise of this paper are the following: (i) The basic social structure of patronage networks is the patron-broker-client triad; this triad is conceptualized as a complex system in which the three types of agents and the relations that structure their behavior are taken into account. (ii) Through different sets of negotiations, agents relate to each other and their local interactions generate the emergence of a network of agents in which each one has a particularly position and role.

The agent´s interaction rules are based in: (i) "preferential attachment", the new agents are linked onto the network by connecting to the agents already in the network depending on a probability based their previous amount of connections. This means that: a) agents with more

links are more "attractive" to new agents, and b) the agents are incorporated into a pre existing social network. (ii) "Fitness index", which allows the quantification of different sets of agent´s characteristics that are relevant for the relations they establish. (Aguirre 2011, Barábasi 2003, Watts 2006). The "Fitness index" allows us to incorporate into the model, the local rules of interaction and their relation to the characteristics of clientelistic negotiations (monitoring behavior, embeddedness, uncertainty, and negative incentives to cooperation).
These two features of the theoretical model, allows us to articulate agent individual characteristics with rules of interaction, and thus analyze both the structure and dynamic of patronage networks.

2. Agent-based modeling and simulation
Agent-based models [ABM] are a new generation of computational methods that allow the modelization of the structure of a complex system and simulate its dynamics and evolution. The use of computer-based simulation (especially ABM) for the study of social, political, and economic phenomenon, is a growing trend in the social sciences en the develop world (Epstein, 2006; Squazzoni, 2012). Unfortunately, the use of computer base methods in social sciences is less prevalent in Latin America, although interesting contributions stand out (Herrera et al., 2004; Terán y Domingo, 1997; Varsavsky et al., 1971).
An ABM constitutes an artificial society integrated by autonomous and heterodox agents that interact in a non-tribal way between each other and the environment according to fixed rules. The computer based simulation of an ABM allows us to analyze how macroscopic and self-organized social structures emerge from microscopic interaction among agents.

3. SocLab application to the study of political clientelism
SocLab (Sociology Laboratory) is a theoretical and methodological framework for the study of the structure and dynamic of social systems, throughout computer-based multi-agent simulation. SocLab has been developed from the formalization of the "Sociology of Organized Action", a well-known theory from French sociology of organizations, and it allows to: modelize different types of organizations (formal and informal), analyze their structure, and simulate their behavior and interactions among the agents that constitute them. It´s main goal is to study the organizational dynamics and the forms of regulation of social systems. The objective of this paper is to show how to model patronage networks with SocLab and the result of our main findings.

Keywords
Social simulation, agent based models, political clientelism, patronage networks, SocLab

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Modeling and Simulating Moral Emotions in Organizations: exploring its impact on collaboration

Abstract. The paper presents how moral sensitivity and emotions are modeled in organizational setting by using the SocLab formal framework. Additionally simulation results, including an interesting tendency for a Free Rider model, will be given. SocLab is a platform for the modeling, simulation and analysis of cooperation relationships within social organizations – and more generally Systems of Organized Action. Taking into account the fact that decision-making processes are not merely driven by instrumental interest, the SocLab learning simulation algorithm has been extended to represent moral sensitivity, so actors can prevent bad emotions and search for good emotions. To this end, a moral sensitivity parameter has been introduced in the algorithm to equip virtual actors with moral and emotional behaviour.

Keywords: social simulation, modeling organization, moral emotions, strategic games.

1 Introduction

The paper presents how moral sensitivity and emotions can be modeled in organizational setting within the SocLab framework. SocLab is a platform for the modeling, simulation and analysis of cooperation relationships within social organizations that is inspired by a well-experienced theory of the sociology of organization, the Sociology of Organized Action, or Strategic Analysis, initiated by M. Crozier and by E. Friedberg (Crozier and Friedberg, 1980).

Social simulation consists in the modelling of social systems and the study of their behaviour by the performance of computer simulations (Axelrod, 1997), including economics, organization, politics, history or social-ecological systems (see for example the JASSS on-line journal for a number of examples).

Regarding the simulation of social relationships (Squazzoni, 2012), Sibertin-Blanc et al. (2013a) proposes a formalisation of the Sociology of the Organized Action (Crozier and Friedberg, 1980) which studies how social organizations are regularized, as a result of the counterbalancing processes among the power relationships of the social actors. This formalization is implemented in the SocLab environment (El Gemayel, 2013) which enables to define the structure of an organization as an instance of a generic meta-model, to study its structural properties in an analytical way, to explore the space of its possible configurations (and so to discover its Pareto optima, Nash equilibriums, structural conflicts and so on), and to compute by simulation how it is plausible that each actor behaves with regard to others within this organizational context.

According to the Sociology of the Organized Action, the behaviour of each actor is strategic while being framed by a bounded rationality (Simon 1998). In this approach, the interaction context defines a *social game*, where each actor adjusts his behaviour with regard to others in order, as a meta-objective, to obtain a satisfying level of capability to reach its goals. The aim of a social game is to find stationary states, i.e. a configuration where actors no longer modify their behaviour because each one satisfies himself with the level of capability he obtains from the current state of the game, so that the organization is in a regularized configuration and can operate in this way.

The SocLab framework has been applied to the study of concrete organizations (see e.g. Sibertin et al., 2006; Adreit et al., 2010; El Germayel et al., 2011; Sibertin et al., 2013a) on the basis of sociological inquiries. However in some cases, the simulation algorithm that makes actors to play the social game (Sibertin et al., 2013b) provides results about the behaviour of some actors that do not accurately match the field observations.

This gap between the observed and the computed behaviours can be ascribed to the fact that SocLab neglects emotions. However, it is well known that social emotions contribute to the regulation of actors' behaviours together with phenomena such reputation and trust (Giardini et al., 2013).

A moral sensitivity parameter has been introduced in the SocLab's learning based decision-making mechanism of actors. This parameter incites actors to select a behaviour that satisfies its aim, a mix of what it gives to and receives from others. Introducing this additional factor of human behaviour helps in understanding better the complexity of actors' action in organizational settings. Following the OCC (Ortony, Clore, Collins) theory of emotions, quantitative measures of moral emotions are defined in terms of the actor's situation at SocLab regulated configurations. A preliminary work was presented in Terán et al.

(2014a, 2014b). To illustrate this, simulation results of a Free Rider model are offered, in which we have found the following tendency: when some actors have their largest value of moral sensitivity (ms=1), and consequently are strongly collaborative, other actors take advantage of this and do not collaborate. Thus, the best level of collaboration within a System of Organised Action (SOA) is found when actors ms is somewhere below the maximal value (in [0.7, 0.9]).

The paper is organized as follows. The second section introduces the SocLab modelling framework. The third section gives a short overview of the OCC theory. Section four explains how the moral sensitivity parameter is introduced in the learning algorithm, and defines some quantitative measures of emotions. Section five offers simulation results for a Free Rider Model. And, finally, section six depicts some conclusions.

2 SocLab

To enable the modelling of social relationships between the actors of an organization, SocLab proposes a meta-model that catches the common concepts and properties of social organizations and is instantiated on specific cases as models of concrete or virtual organizations or Systems of Organised Action (Crozier and Friedberg, 1980). Accordingly, the model of the structure of an organization is composed of instances of *actors* and *relations* that are linked by the *control* and *depend* associations.

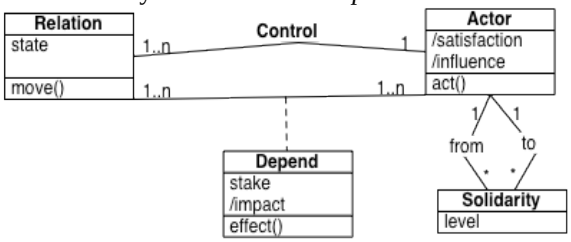


Fig. 1. The core of the meta-model of the structure of Systems of Organized Action

Fig. 1 shows the meta-model of organizations' structures as a UML class diagram. A relation is founded on an organization's resource, or a set of related resources, and it is controlled by a single actor. Resources are material or cognitive (factual or procedural believes or expectations) elements required to achieve some intended actions, so that their availability is necessary for some actors. The *state* attribute of a relation represents the behaviour of the controller actor with regard to the availability of the resource for the ones who needs it. Its range of value SB goes from the least cooperative behaviour, -1, of the controller preventing the access to the resource, to the most cooperative behaviours, 1, favouring this access, while the zero value stands for neutral behaviours.

The *stake* attribute of the dependence of an actor on a relation corresponds to the actor's need of the relation to reach its own goal, on a scale:

null = 0, negligible = 1,… ,significant = 5,… , critical = 10.

The *effect function* evaluates how much the state of the relation makes the resource available to the actor, so that $effect_r : A \times SB_r$ ---> *[-10, 10]* has values in:

worst access = -10, ..., neutral = 0, ..., optimal access =10.

In addition, actors may have solidarities the ones with regard to others, defined by as function *solidarity(a, b)* ---> *[1, -1]*, where negative values correspond to hostilities and positive values to effective friendships.

Defining the state, or configuration, of an organization as the vector of all relations states, each state of the organization determines on the one hand how much each actor has the means he needs to achieve his goals, defined as:

$satisfaction(a, s) = \sum_{c \in A} \sum_{r \in R} solidarity(a, c) * stake(c, r) * effect_r(c, s_r)$

and, on the other hand, how much it contributes to the satisfactions of each other actor, defined as:

$influence(a, b, s) = \sum_{r \in R;\ a\ controls\ r} \sum_{c \in A} solidarity(b, c) * stake(c, r) * effect_r(c, s_r).$

This interaction context defines a *social game*, where each actor seeks, as a meta-objective, to obtain from others enough satisfaction to reach its goals and, to this end, adjusts the state of the relations he controls. Doing so, it modifies the value of its influence and therefore the satisfaction of actors who depend on the relations it controls.

The aim of a social game is to reach a stationary state: there, actors do no longer change the state of the relations they control, because every one accepts his level of satisfaction provided by the current state of the game, so that the organization is in a *regularised configuration*.

The actors' strategic attitude is framed by a bounded rationality (Simon, 1998), where the actors' rationality is implemented as a process of trial and error based on a self-learning rule system. Each actor manages a variable that corresponds to his ambition, and the game ends when the satisfaction of every actor exceeds his ambition.

To sum up, each simulation run yields a regularised configuration which associates to each actor numerical values for its satisfaction and its influence, and these values may be used to determine whether this configuration is able to arouse a kind of emotion.

3 The OCC theory of emotions

We use the theory of Ortony, Clore and Collins (Ortony et al., 1988) (OCC) for the characterisation of the various kinds of emotions because: (1) it is well-funded and recognized as a standard in computer science, notably in MABS; and (2) it deals with most social emotions we have to consider.

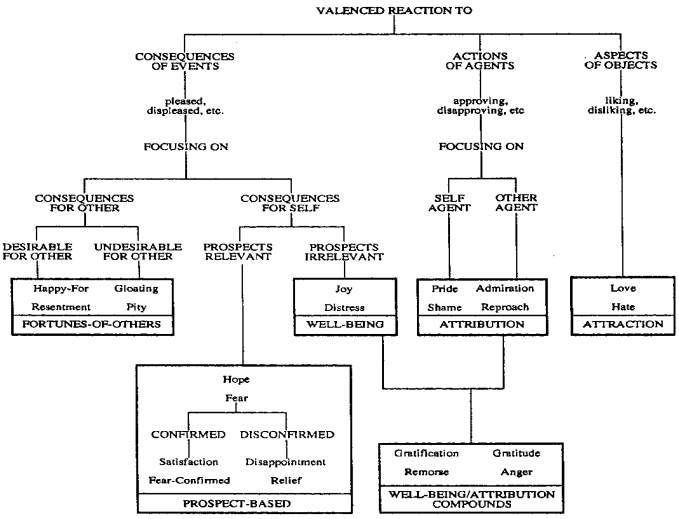


Fig. 2. The Ortony *et al.* (2000, pp 30) classification of emotions.

Following OCC, emotions are linked to events, to actions of people (oneself or other) or to objects. Emotions are classified in a tree structure (see Fig. 2), as follows: (1) in case the linked element is an event that affects the achievement of a goal, the outcome of the event is appraised either as desirable or as undesirable, and the actor feels either pleased or displeased, correspondingly; (2) in case the linked element is an action that complies or not with a behavioural norm, the actor appraises the action either as praiseworthy or blameworthy, and his reaction will be either approval or disapproval; (3) in case the linked element is an object, the actor appraises the object either as appealing or unappealing, and so he will either likes or dislikes it. In SocLab only the two first kinds of emotions appear: goal-based (e.g. related with properties of a configuration whose occurrence is an event) and norm-based (e.g. regarding the behavior of one actor toward another one or towards the whole SOA) since actors do not face objects. Emotions related to prospected events can also not be considered, because the SocLab model of actors accounts just their aims, not their expectations. A SocLab event corresponds to the fact that a simulation experiment puts the organization in a certain configuration. Then, the action of an actor corresponds to its positive or negative contribution to this configuration.

4 SocLab decision-making algorithm and the quantification of emotions

In the original SocLab's actors' decision-making algorithm, actors seek to maximize their satisfaction. In the new algorithm being tested, maximizing an actor's satisfaction is replaced by maximizing the actor's aim. An actor's aim is defined as a linear combination of the actor's satisfaction or instrumental goal

(what the actor receives), and what the actor gives to others, weighted by a moral sensitivity parameter, as follows:

*Aim(ai, ms(ai), s) = (1-abs(ms(ai)))*Sat(ai, s) + ms(ai)*Inf(ai, s),*

where:

- *abs* is the operator absolute value,
- *Sat(ai,s)* is what the actor ai receives from others at the configuration s, (see equation (1),
- *Inf* is what the actor ai gives to others at the configuration s (see equation (2)),
- *ms(ai)* is the moral sensitivity of the actor ai defined in the interval [-1, 1]. It indicates the relative importance between the instrumental (Sat) and the moral (Inf) goals for the actor. The higher the value of this parameter, the more the actor consider its contribution to the satisfaction of others and thus the well-working of the organization. Usually, it takes values in [0, 1], as negative values mean that the lower the actor's collaboration (even if it is negative) the higher will be the actor's achievement of its aim, what rarely occurs. Moral sensitivity is defined as a disposition/motivation to give importance to moral issues, including moral emotions such as shame or pride: the larger the moral sensitivity of an actor, the higher the importance for the actor of both positive and negative feelings.

4.1 Quantifying Emotions in SocLab

Table 1 shows the emotions a SocLab actor is likely to feel in a configuration of the organization. The occurrence and intensity of an emotion at a configuration are given in pairs, defined as a potential (given in terms of a proportion) and two thresholds. If the potential is above the high threshold then the positive emotion occurs, and if it is below the low threshold then the negative emotion occurs. In case the potential is between the thresholds then no emotion appears. The potential of an emotion is always a comparison between what actually happens (e.g., the influence exerted by the actor) and what could happen (e.g., the range of influence it could exert). Indeed, a social actor "appraises" the situation in the context of the possibilities available for it. The emotional interpretation of the values of each index depends on the very nature of the organization under consideration and of individual traits of each actor. Globally, considering as an example the Joy/Distress emotion, one could consider that Joy appears above 70% (high threshold) and distress under 50% (low threshold).

These indexes are not variables used by SocLab actors in their decision making process. They are based on essential properties of configurations, i.e., what is given (Influence) by a to b, and in what is received (Satisfaction) by a from b, where a and b may be: a particular actor or the whole organization (SOA), as shown in Table 1. The higher the value of ms of an actor a, the higher its concern for collaboration, and so what a gives to the others, which has two consequence in terms of emotions: a) the higher will be the contribution of a to the potential intensity of positive emotions of actors who depend on the relation a controls, for instance, joy of an actor b (joy is based on what the actor receives from he itself and the others, including a, see below); and b) the higher will also be the intensity of emotions such as Pride of a, which depend on what the actor a itself gives (see the definition of Pride below). We will use short names for the variables: *Sat(a,s)* for satisfaction(a,s), *Inf(a,s)* for influence(a,s), *minSat(a)* (resp. *maxSat(a)*) for the minimal (resp. maximal) satisfaction a can receive from the whole. Because of the lack of space, we will only give the complete definition for the first emotion, and short summaries of some of the others (for a complete description of these quantitative measures of emotions see Terán (2014b)).

Table 1. Emotions Experienced by an actor in SocLab

		Influence exercised by				
		Self	***Other(s)***	***The SOA***	***SOA & self***	***SOA & other***
Satisfaction Received by	***Self***	pride /shame	Admiration /reproach	joy/distress		
	Other	pride /shame	Admiration /reproach	If pleased/displeased about ° desirable event: happy-for/resentment ° undesirable event: gloating/pity		
	SOA	pride /shame	Admiration /reproach	joy/distress	Gratification/ Remorse	Gratitude/ Anger

1. Well-being emotions: Joy/Distress

The OCC model defines joy (resp. distress) as to be pleased (resp. displeased) about the occurrence of a desirable (resp. undesirable) event. In the SocLab model of an organization, the occurrence of such an event corresponds to reaching a regulated configuration that is satisfying (resp. dissatisfying). Joy/Distress of an actor a is given as:

Potential:
propSat(a,s)=(Sat(a,s) - minSat(a))/(maxSat(a) - minSat(a)), which value is in [0, 1].
Thresholds: *JoyThresh(a)* and *DistressThresh(a)* are the maximal (resp. minimal) values of the proportion of satisfaction a receives generating the emotion Joy (resp. Distress).

JoyThresh(a) and *DistressThresh(a)* are the thresholds making actor a liable to these emotions

Intensity: *Joy(a,s) = max{0, propSat(a,s) - JoyThresh(a)}*
Distress(a,s) = max{0, *DistressThresh(a) - propSat(a,s)}.*

2. Attribution emotions: Pride/Shame and Admiration/Reproach.

An actor could feel prideful (resp. guilty or shameful) when he approves (resp. disapproves) its own praiseworthy (resp. blameworthy) action regarding its effect on itself, or on some other actor(s) close to it. But an actor can also feel prideful by a praiseworthy action performed by another actor close to it. This proximity of an actor a toward another actor b can evaluated as its Cognitive Unity *cogUnit(a,b)* $\in$ *[1, 1]*. Thus, the pride/shame of a when it evaluates what b gives to c will be (it might be the case that either a=b, a=c or b=c):

*Pride(a,b,c,s)=max{0,(propInf(b,c,s)-PrideThresh(b,c))*cogUnit(a, b)* cogUnit(a,c)},*

*Shame(a,b,c,s)=max{0,(ShameThresh(b,c)-propInf(b,c,s))*cogUnit(a,b) *cogUnit(a,c)},*
provided that *cogUnit(a,b)* > 0 and *cogUnit(a,c)* > 0, otherwise both pride and shame are null, and where:

propInf(b,c,s) =(Inf(b,c,s)-minInf(b,c)) / (maxInf(b,c)-minInf(b,c))

So, we define pride/shame as the product of a measure of actor a's approval of the action of b (*profInf(a,b,s)*), multiplied by the cognitive units of a with b and with c. This is in accordance with the extension of OCC proposed by Steunebrink et al. (2012) (they consider only the case a = c). Additionally, we propose to calculate cognitive unit as follows: *cogUnit(a,b)= ms(a)*Sol(a,b).*

The case for Admiration/Reproach is similar but a sees b as another, i.e. *cogUnit(a,b)* is null and so it is not taken into account. Also, a has a positive cognitive unit towards c and it evaluates the influence of actor b on c.

3. Well-being/Attribution compounds emotions: Gratification/Remorse and Gratitude/Anger

OCC defines gratification (resp. remorse) as being pleased (resp. displeased) about a desirable (resp. undesirable) event or situation that results from oneself action and thus entails the approving (resp. disapproving) of one's own praiseworthy (resp. blameworthy) action. As said above, an event is related with the action of the whole SOA, which results from action of individuals. If the actor feels Joy (resp. Distress) about the situation of the SOA and it considers himself as responsible for it, then it will feel Gratification/Remorse, as follows:
Gratification(a, s) = max{0,(propGSat(s) - GratifThresh(a)) ms(a) * propInf(a, s)},*
*Remorse(a,s) = max{0, (RemorseThresh(a) - propGSat(s))*ms(a)* proInf(a, s)}*,
where *propGSat(s)*is the global proportion of satisfaction the SOA has.

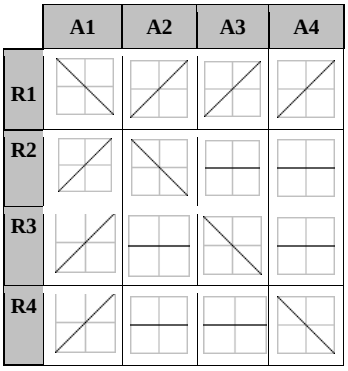
Gratitude (anger) is a similar case to gratification (remorse), but it regards what is given by someone else instead of what is given by oneself (in the right side of the equation we will have *propInf(b, s)* rather than *proInf(a, s)*}.

5 A Case: the Free Rider model

This model includes four actors and four relations, where actor Ai controls relation Ri, for i = 1 … 4 . As shown in the left side of Table 2, A1 depends on the three relations controlled by the other actors with a stake of 3 on each; actors A2, A3 and A4 highly depend on the relation controlled by A1 (with stake 9); and every actor depends much more on others than on the relation it controls, in the proportion 1/9. There is no relationship between any pair of actors: A2, A3, A4. The right side of Table 2 shows the effect functions: for each relation, the functions of the controller actor and of the other actor(s) have opposite slopes, that is, the interest of each actor on the relation it controls is contrary to the interest of other actors.

Table 2. In the left side: Stakes of the actors on the relations (in bold the relation is controlled by the actor) for structure 1/9. In the right side, the effect functions of the relations on the actors: the satisfaction given to the actor (y-axis) depending on the state of the relation (x-axis).

		Actors				
		A1	A2	A3	A4	Relevance of the relation
Relations	R1	**1.0**	9.0	9.0	9.0	28
	R2	3.0	**1.0**	0.0	0.0	4
	R3	3.0	0.0	**1.0**	0.0	4
	R4	3.0	0.0	0.0	**1.0**	4



5.1 Behaviour entailed by the moral sensitivity parameter

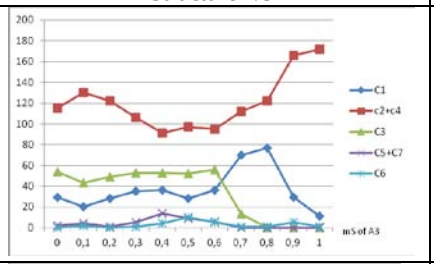
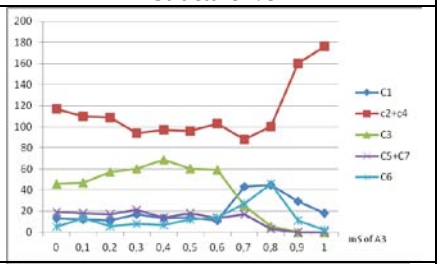
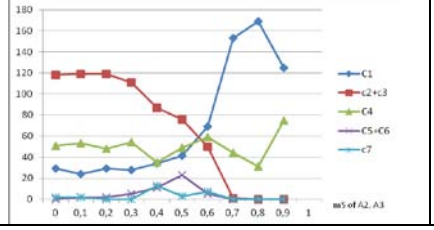
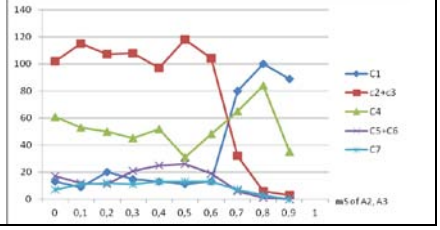
The simulation experiments usually converge toward the configurations given in Table 3, where each configuration represents a norm of behaviour, either all actors collaborate (conf. C1) or only one of the actors defects (C2…C4), rarely two of them defect (C5…C7), only in some extreme cases A1 defects (C8), and never three or all of them defect. When ms = 0, the reference case, A1 collaborates in any case and, in most cases, either A2, A3 or A4 defects while benefiting from the cooperation of the two others.
The graphs in Table 4 show the frequency of configurations for the following exploration of parameters: a) structure of the model, which takes the distribution of stakes 1/9 and 2/8; and b) moral sensitivity (ms) of the actors (ms of Ai will be named Ai.ms), as follows:

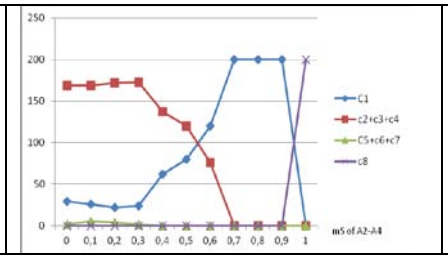
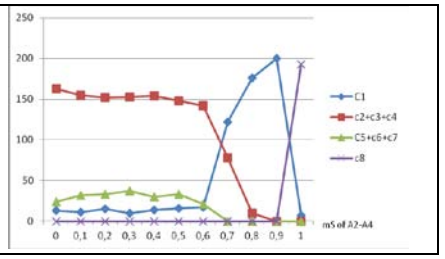
- A3.ms: [0, 0.1, 0.2, …, 1.0]
- A2 and A3.ms: [0, 0.1, 0.2, …, 1.0]
- A2, A3, and A4.ms: [0, 0.1, 0.2, …, 1.0]

Table 3. Characterisation of the Configurations resulting from simulation, where a configuration is defined as ($state_{R1}$, .., $state_{R4}$).

C1: (10, 10, 10, 10): all collaborate	C5: (10, -10, -10, 10): A2 & A3 do not collab.
C2: (10, -10, 10, 10): A2 does not collab.	C6: (10, -10, 10, -10): A2 & A4 do not collab.
C3: (10, 10, -10, 10): A3 does not collab.	C7: (10, 10, -10, -10): A3 & A4 do not collab.
C4: (10, 10, 10, -10): A4 does not collab.	C8: (-10, 10, 10, 10): A1 does not collab.

Table 4. Frequency of the configurations C1… C8 for a combination of the two factors: in columns, the structure of the organisation (1/9 or 2/8); in rows, ms varying from 0 to 1 for either A3; A2 and A3; A2, A3, and A4; (ms of A1 is kept in 0).

	Structure 1/9	Structure 1/8
ms of A3 varies		
ms of A2 and A3 varies		

ms of A2, A3 and A4 varies		

We can observe a noteworthy tendency: too much (unconditional) collaboration from one actor or from several actors is not good for the whole organization, as other actors take advantage from this. Let us explain using the graphs:

- First row of Table 4 (A3.ms is varied, and structure of the model is either 1/9 or 1/8) the higher the A3.ms (disposition to collaborate of A3), the higher the number of C1 (all actors collaborate) until A3.ms reaches the value 0.8; then, when A3.ms is larger than 0.8, the higher the value of A3.ms, the lower the number of C1, given that the number of defections of A2 and A4 (C2+C4) increases considerably.
- Second row of Table 4: the higher the ms of actors A2 and A3, the higher the number of C1 up to ms = 0.8. When ms = 0.9, the number of C1 decreases because A4 collaborate less; 127 experiments converged to the configurations C1 or C7, and four to the configuration C8. For ms = 1 we had difficulties to characterise the simulation output, as the regulated states appeared defined in terms of decimal values – for instance [8.5, 3.75, 3, 10] – which are not in the set C1-C8 (this is also the case for about 63 experiments when ms = 0.9). Because of such a difficulty, this set of experiments will not be taken into account in section 4.2.
- Third row of Table 4: The higher the disposition to collaborate of actors A2 to A4, the higher the number of C1, up to some point in which it reaches its maximal value (0.7 … 0.9 in case of structure 1/9 and 0.9 in case of the structure 2/8), and then, when these actors collaborate unconditionally (ms = 1.0), A1 does not collaborate anymore, and the C8 appears.

These results indicate that the best level of collaboration is between 0.7 and 0.9 rather than 1.0 (being unconditionally collaborative). This is consistent with the well known Prisoner Dilemma experiences, where the (Rapoport's) strategy tit-for-tat becomes better suited than all the other strategies and especially than unconditional collaboration (Axelrod, 1981).

5.2 Joy/distress of the actors and state of the relations

This subsection shows the intensity of Joy/Distress, where proportions are represented as percentages. Joy/distress was selected because it shows the overall state of each actor. We will consider three cases of variation of the moral sensitivity parameter: i) ms of A3 in [0,1]; ii) ms of A2, A3, and A4 in [0,1], and finally ms of A1 in [-1,0]. Only the model with the distribution of stakes 1/9 will be considered.

i) Case 1: Moral Sensitivity of A3 takes the values: 0, 0.1, 0.2,..., 1.0

Table 5 indicates that joy of A1 increases up to A3.ms = 0.8, and then decreases; joy of the actors A2 and A4 keeps somewhat stable with intensity around 93, while joy of A3 decreases slightly. Joy of A1 decreases when ms of A3 is over 0.8, because A2 and A4 take advantage of the high collaboration of A3 and give less. In the lower part of Table 5, we see how A3 collaboration (i.e. the state of the relation R3) increases. We also see how the collaborations of A2 and A4 (R3 and R4) decrease after A3.ms is over 0.8. This result confirms the findings described above that actors A2 and A4 take advantage from A3's unconditional collaboration.

Table 5. Intensity of joy felt by the actors, and states of the relations; varied factor: A3.ms

	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**
A1	64	62	64	64	63	61	64	71	71	64	63
A2	93	93	93	93	94	94	93	93	93	94	94.2
A3	93	92	93	93	93	93	93	91	90	90	90
A4	93	93	93	93	92	93	93	93	93	94	94.8
R1	10	10	10	10	10	10	10	10	10	10	10
R2	3.6	3	4.2	4	3	2.7	4.6	4.8	3.7	1.2	1.7
R3	4.4	5.3	5	4.2	3.3	3.9	3.8	8.7	10	10	10
R4	4.7	3	3.5	4.7	5.7	4.1	4.2	3.5	3.9	1.2	0.5

ii) Case 2: Moral Sensitivity of A2-A4 takes the values: 0.1, 0.2, ..., 1.0

Table 6 shows how A1 benefits (its joy increases) from the higher collaboration of A2, A3, A4 as their ms increases. The joy of A2…A4 suffers only slights changes. The highest collaboration of A2…A4 is reached when ms = 0.7, and stays at that level for higher values of ms. Interestingly, when actors A2 to A4 do collaborate unconditionally (their ms=1), A1 defects because it no longer needs to cooperate to obtain the others' collaboration. In this case joy of A1 reaches its maximal value (intensity 100), while actors A2…A4 are strongly distressed.

Table 6. Intensity of joy felt by the actors and states of the relations; varied factor: ms of A2, A3 and A4.

	0	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**
A1	64	63	63	64	70	72	79	90	90	90	100
A2	93	93	93	93	93	92	90	90	90	90	0
A3	93	94	93	93	92	92	90	90	90	90	0
A4	93	93	93	93	92	92	90	90	90	90	0
R1	10	10	10	10	10	10	9.6	10	10	10	-10
R2	3.6	4.6	4.1	4.6	4.5	5.7	7.4	10	10	10	10
R3	4.4	3.1	4.1	4.5	5.2	5.8	7.4	10	10	10	10
R4	4.7	4.4	3.8	3.4	6.6	6.5	7.6	10	10	10	10

iii) Case 3: Moral Sensitivity of A1 takes the values: 0, -0.1, -0.2, ..., -1.0.

As A1 always cooperates in the reference (base) case, the question arises until how far of low moral sensitivity it does so. When ms of A1 decreases from zero, A1 collaborates less and less, reaching the lower point (R1 = -10) from ms = -0.5 (see Table 7). As A1 collaborates less, also A2, A3, and A4 also collaborate less. Surprisingly, when A1's ms decreases from -0.1 to -0.2, the collaboration of A2…A4 increases considerably. A possible interpretation for this fact is the following: the slightest collaboration from A1, when its ms passes from -01 to -0.2, leads A2, A3 and A4 to further cooperate in order to induce A1 to do the same. However, when collaboration of A1 is too low (below -0.2), there is no incentive for the other actors to collaborate as the organization is still in a bad state and they will get a low collaboration from A1 whatever their collaboration could be.

Table 7. Intensity of joy felt by the actors and state of the relations depending on A1.ms; from -0.6 to -1, the results are the same as with ms = -0.5.

	0	**-0.1**	**-0.2**	**-0.3**	**-0.4**	**-0.5**	**-0.6**	**-0.7**
A1	64	62	83	46	20.4	10	10	10
A2	93	94	57.4	25	12.4	10	10	10
A3	93	93	56.5	24	12.4	10	10	10
A4	93	93	57.8	24	12.5	10	10	10
R1	10	10	2.4	-5.3	-9.2	-10	-10	-10
R2	3.6	2.8	7.4	1.3	-7.5	-10	-10	-10
R3	4.4	2.6	8.8	0.1	-7.5	-10	-10	-10
R4	4.7	4.7	6.7	-0.2	-7.8	-10	-10	-10

6 Conclusion and further research

This paper has shown the introduction of a moral sensitivity parameter in the SocLab actors' decision process. This allows the definition of social emotions together with quantitative measures of their potential arousal within actors in organizational setting. The level of the moral sensitivity parameter affects the collaboration of an actor, what it gives to others, and consequently the intensity of emotions felt by the actors who depend on it, including itself. Some simulation results about actors' collaboration and emotions in a Free Rider model were presented. A particular noteworthy tendency is that actors' unconditional collaboration, which occurs when their moral sensitivity reaches its highest value, is not so good since it exempts other actors from collaboration (who take advantage from the unconditional collaboration), while values of moral sensitivity somewhat below the highest value (between 0.7 and 0.9) still induces collaboration from the others.

The introduction of the moral sensitivity parameter allows actors to orient their selection of a behaviour not only toward their instrumental satisfaction, but also to the search for positive emotions and the prevention of negative ones. It will hopefully permit to overcome some limitations of SocLab, to represent more suitably social organisations, and get better results in further research and applications.

Further research will consider the inclusion of a parameter to represent actor's Group Identification (as defined, among others, by Simon), which might be more suitable than the moral sensitivity parameter to model actors' organizational engagement and motivation. Group identification is understood as an actor's self-concept derived from its knowledge of its membership in a group, along with the value and emotional significance of that membership. This notion is also important to determine emotions of an actor linked to its cognitive unit with others.

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Towards a simulation model of the social game associated to the potatoes seed in a Venezuelan region

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Abstract

In most of Latinamerica, and in particular in Venezuela, consumption and production of potatoes is highly important. The region around Mucuchies town in Venezuela concentrates the highest national production of potatoes seed. This paper aims at representing the (social) game of power around the potatoes seed in this region. Such a game involves not only private entities but also the Venezuelan state, which seems to have contradictory strategies and actions: on one side, it favors research and production of national potatoes seed; and, on the other side, it supports potatoes seeds importation. Importation of foreign potatoes seeds discourages national production. We will show a descriptive, and a computational model of this social game, by using the simulation platform SocLab. The model is aimed at understanding better the game of power, and to evaluate the potential (power) of the Venezuela State to significantly increase national potatoes seed production. Particular importance will be given to the organization identification of the actors involved in the system (organization) of production of national potatoes seeds.

Keywords: potatoes seed, game of power, organizational identification, SocLab.

Simulation of Power Relations in the production, importation and distribution of Potato's seeds in Venezuela

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the participants' in-group identification effectVenezuelan people and its organizations' idiosyncrasy and wrong longstanding organizational politics, support the generalization of a behaviour that serves to individual and socially disconnected benefits, and improve the strengthening of individual's organizational and social withdrawal. The production and importation of potato seeds in Venezuela has became a complex -and not very easy comprehensible- problem, since there are several social and institutional participants playing different roles. These participants (whose can be people, institutions, cooperatives or small companies) represent actors where each of them -consciously or not- advocates for its own interests and stakes; aspects that make of this system a complex system.

The SocLab software is intended to help academics, researchers and any other stakeholder, to build models and simulate the behaviour of organizations. It is particularly helpful to represent complex organizations in which the effect of the members' interests and preferences affect their personal and collective behaviour.

This paper is going to synthesize the results of the modelling, simulation and validation of the "System of production, importation and distribution of potato seeds in Venezuela" using the SocLab software and/or any modified version of it to represent de power relations that define and determine this system´s behaviour. The model is going to be built considering different aspects of the system that affect both the real system and the results of the simulation, such as solidarities, stakes, cooperative skills, and as an innovative component: the in-group identification, which is a new variable tightly related to an actor or participant´s organizational commitment.

It is intended to obtain at the end of this experiment a proposal of "alternative way" to consider organizations, so that it is helpful and powerful in discovering how related are their individuals, how can they manage their resources, how their individual preferences influence the collective behaviour, and how their organizational commitment would affect the system´s behaviour on the short and the long term.

Collective intelligence: Analysis and modelling

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Abstract

Purpose - This paper focuses on the underpinning dynamics that explain collective intelligence.

Design/methodology/approach - Collective intelligence can be understood as the capacity of a collective system to evolve towards higher order complexity through networks of individual capacities. We observed two collective systems as examples of the dynamic processes of complex networks—the wiki course PeSO at the Universidad de Los Andes, Bogotá, Colombia, and an agent-based model inspired by wiki systems.

Findings - The results of the wiki course PeSO and the model are contrasted with a random network baseline model. Both the wiki course and the model show dynamics of accumulation, in which statistical properties of non-equilibrium networks appear.

Research limitations/implications - Our work is based on network science. We analyzed data from two kinds of networks: the wiki course PeSO and an agent-based model. Limitations due to the number of computations and complexity appeared when there was a high order of magnitude of agents.

Practical implications - Better understanding can allow for the measurement and design of systems based on collective intelligence.

Social implications - In the context of higher education systems, the question remains of how to design teaching methodologies to develop collective thinking.

Originality/value - The results show how collective intelligence emerges from cumulative dynamics.

Keywords Knowledge management; Collective intelligence; Agent-based models; Network science.

Paper type Research paper

1. Introduction

The production of knowledge in contemporary societies has experienced a phase of transition away from individualism towards collectivism. For instance, the science of past centuries was characterized by eponymy (Merton, 1968), a situation that brought about some famous first author disputes: Newton versus Leibnitz on differential equations or Darwin versus Wallace on evolutionary theory. In these cases, discussions about and between first authors were frequent and open. Today, acknowledgement of the individual scientist could be not so important.

The Internet has allowed for new forms of social interaction and organization. In this context, the aim of this paper is to understand new forms of knowledge production. In the new socio-technical system, ideas flow and interchanges grow over time in a way that has not been seen before. Along with this expansion have come questions about plagiarism and other forms of misconduct (although we do not develop on this topic here). Furthermore, collective behavior on the Internet has given rise

to projects such as Wikipedia, a collectively developed encyclopedia which is the most complete in existence, and crowdsourcing, where many ideas from many participants are organized together to solve complex problems. Such examples show how alternative forms of organization around knowledge may appear. In these new forms of organization, interactions and interchanges grow, and the probability of new outcomes emerges.

In this paper, we study collective intelligence through two complementary approaches. On the one hand, we analyze the structural properties of networks obtained from data from the Wiki course PeSO at the Universidad de Los Andes, Bogotá, Colombia. On the other hand, a mathematical model of collective intelligence based on wiki systems is proposed. This work is based on networks, specifically equilibrium and non-equilibrium networks (Dorogovtsev and Mendes, 2013).

The results show similar behavior for both the model and the PeSO wiki course. The model reproduces the curves of clustering coefficient and average path length over time in a similar way to small world networks. The empirical networks (the model and the PeSO wiki course) are compared with a random baseline. The results are consistent, revealing small world network properties as a to study collective intelligence. We observe collective intelligence as a complex adaptive system. Thus, the measurement of collective intelligence can be based on the differences between a random process and self-organized criticality (Tang and Bak, 1988; R Chialvo, 2004; Sornette, 2006; Barrat *et al*., 2008; Dorogovtsev and Mendes, 2013).

This document is organized into four sections. The first section presents our motivation for measuring collective intelligence. The second section describes the empirical analysis and the proposed model. The third section shows the results. The final section presents the discussion and proposals for future work.

2. Motivation: Towards the measurement of collective intelligence

2.1 Motivation

We assume that many people nowadays are interconnected via the Internet, and that the resulting interactions and networks allow for the development of projects of collective intelligence. In fact, around the world there are $2.8e10^9$ interconnected people producing information, outcomes and knowledge, such as Linux (operating system), Wikipedia (open encyclopedia), Open Government (in the US), crowdfunding (funding network) and crowdsourcing (networks to solve complex problems based on knowledge).

Collective intelligence can be understood as the capacity of a group of people to collaborate in order to achieve goals in a complex context (Heylighen, 2013). Collective intelligence is distributed within a network where each interaction continually aggregates value. It is coordinated in real time, developed through the effective mobilization and reciprocity of competencies (Lévy, 1994). In addition, collective intelligence can be seen as the capacity of a human community to evolve towards higher order complexity thought, problem solving and integration through collaboration and innovation (Pór, 1995). In this paper, we propose an operative definition of collective intelligence, based on which it is possible to compute measurements and modeling. Thus, collective intelligence is defined—more or less successfully—as the capacity of a collective system to evolve towards higher order complexity through networks of individual capacities.

2.2 Research proposal

We observed the collective production of knowledge over time by building up a co-authorship network through the Wiki-ITRB (http://wiki.uniandes.edu.co/PESO/tiki-index.php). The Wiki-ITRB is one activity in the course 'Organizational System Thinking' or PeSO (its Spanish acronym), offered at the Universidad de Los Andes, Bogotá, Colombia. The activity was developed between 2011 and 2012.

The purpose of the Wiki-ITRB is to collectively write ITRB (Informe Técnico de Revisión Bibliográfica—Technical Reports of Literature Reviews) documents. ITRB documents propose one question for a given topic, and students then include arguments, author positions and opinions about the proposed question. The activity aims to encourage students to acquire the competencies to write argumentative documents. Based on the theory of collective intelligence, we designed a collaborative document schema via a wiki platform. Students participated in the writing and modification of several documents, with references, arguments, corrections, etc. Each student could promote, eliminate and/or edit a text or document. Finally, each student decided to be the author of a subset of documents, which she or he edited and evaluated.

The participation of students in the Wiki-ITRB is stored up over time; this allows for the building up of a network from the aggregation of connected authors via co-authored documents. We constructed a dynamic network through the extraction of subnets of documents over time. We were therefore able to evaluate the dynamics of structural network properties.

3. Empirical analysis and modeling

Classical random networks (Erdős and Rényi, 1959) are constructed with connections between randomly selected pairs of vertices. By contrast, small world networks are characterized as being highly clustered, and small path lengths (Watts and Strogatz, 1998). For the networks in our study, we computed clustering coefficient and average path length. Both have behaviors that are totally different in equilibrium networks (random networks) and non-equilibrium networks (Dorogovtsev and Mendes, 2013). We assume that the mechanisms underpinning the networks of wiki systems are not random, but are rather mechanisms that self-regulate collective production.

In this paper, we study the network of co-authored Wiki-ITRB pages based on clustering coefficient and average path length. At the same time, the proposed agent-based model was studied using the same measurements. The wiki systems were therefore studied based on independent structural features. Random graphs, built according to the Erdős–Rényi (ER) model, exhibit a small average shortest path length (varying typically as the logarithm of the number of nodes) along with a small clustering coefficient. Small world models have a small average shortest path length, but at the same time a clustering coefficient significantly higher than expected for a random model.

We propose an agent-based model to understand collective intelligence in a socio-technical system. This is a model organized by a non-linear combination of agents (Wolfram, 2002; Flake, 1998) Thus we propose that collective behavior can be modeled as non-linear relations among editors. In this paper, we focus on the study of non-equilibrium networks and their structural properties as a measurement of collective intelligence, as explained above.

3.1 Agent-based modeling

The aim of the agent-based model is to understand the evolution of wiki systems in order to gain a better understanding of collective intelligence. The agents are people and documents, where people have an agent edition capacity, which indicates how many documents they can edit (and not the number of modifications they are able to do in a single document). Documents have a probability of being selected, and in terms of the accumulation of total edits, this affects (in a similar way to votes) their probability of being selected in the next iteration of the model.

The parameters analyzed are the number of agents, agent edition capacity and simulation time (represented as steps in the execution of the model). For each parameter, one network of co-author editions was constructed and measurements of clustering coefficient and average path length obtained.

Our study of collective intelligence is made through the accumulation of editions for each document and its influence on the documents' probability of being selected and taken into account for future edition by an agent. Thus, the evolution of a network of co-author editions on the basis of previous editions is presented. The model's reinforcement loops perform in a similar way to other complex systems, such as brains, ant colonies, etc. (Wolfram, 2002; Flake, 1998). In this sense, agent

edition capacity is like the computing capacity of a node that belongs to a network that presents behavior more intelligent than each individual node.

3.1.1 Assumptions

- Agent edition capacity is a natural value and all agents have the same capacity; for instance, when agent edition capacity = 2, this means that one agent can edit 2 documents.
- Each agent edits documents according to their agent edition capacity; the greater their edition capacity, the more documents they can edit.
- The agent selected at each step is chosen in a uniformly random way.
- The edition of documents positively affects their probability of selection in the future. Therefore, documents with more editions are more likely to be edited again in the next round.

3.1.2 Description of the model

The model produces a network of agents or a co-author editions network, where an edge connects two agents who have made editions to the same document. The network is constructed as follows:

```
total-editions = 0

for i = 1 to t
  iteration

link all agents that edited same document
```

Pseudocode for one iteration:

```
agent = choose one random agent

for i = 1 to k
  document = choose one document based on probability
  add agent to document's list of editors
  increment by 1 editions in document
  increment by 1 total editions

for each document in documents
  probability = (editions + 1) / (total-editions + total-docs)
```

k = agent edition capacity and t = simulation time.

The documents' probabilities are updated as follows: at the beginning of the simulation, every document has the same probability, 1 per total number of documents. After each iteration, as can be seen in the pseudocode, the probability of one document is calculated taking into account the edition made to it and the total editions made in the system.

3.1.3 Experimental design

The probability of connection between two agents, given a determined number of agents, depends on the simulation time and the agent edition capacity. We observed the structural properties of the co-author editions network according to three assigned parameters: total agents, time simulation and agent edition capacity.

Each parameter was evaluated as follows: total agents between 10^1 and 10^3. For each number of agents, the time simulation was evaluated from 2 times to 10 times the number of agents. Agent edition capacity was evaluated from 1 to 10. Each simulation was run 80 times, thus the measurements presented below correspond to the average over 80 simulations.

Experiments were performed in NetLogo 5.0.5 (Wilensky, 1999) with an implemented extension to export the resulting graph to graph6 format (https://github.com/erikasv/NetLogo-graph6), and the analysis was performed in Mathematica 9 (Wolfram Research, Inc., 2012).

4. Results

Aside from the produced results, the model was developed as a framework to study networks constructed from interaction rules at a micro level. It allows for the study of collective intelligence based on a network science approach.

Figure 1 shows the clustering coefficient for each number of agents and the Wiki-ITRB. In a, b and c, the results show how the curve of the average clustering coefficient evolved over 80 simulations. Figure 1 d. shows the dynamic of higher values of clustering coefficient for the Wiki-ITRB. The clustering coefficient in wiki systems (model and Wiki-ITRB) demonstrates the same behavior and is consistent with the clustering coefficient in small world networks.

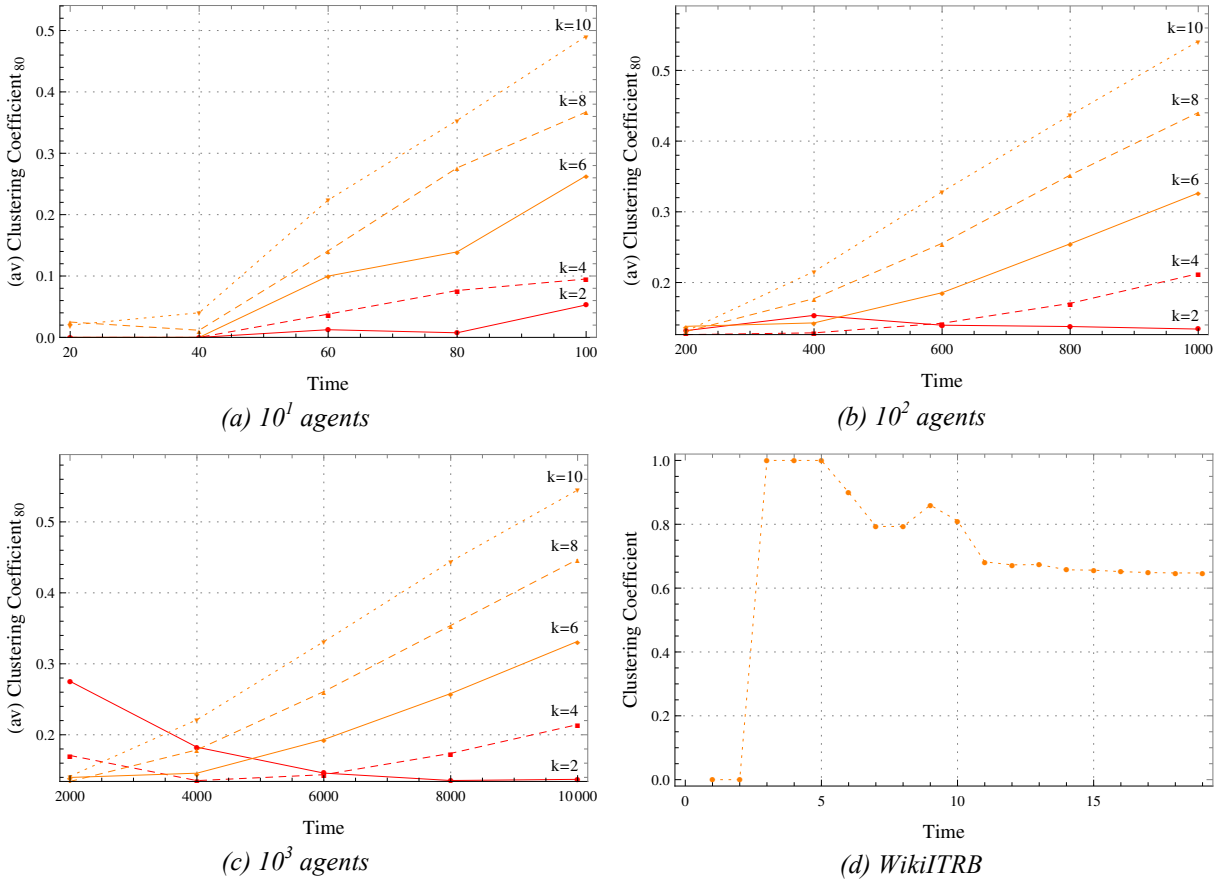
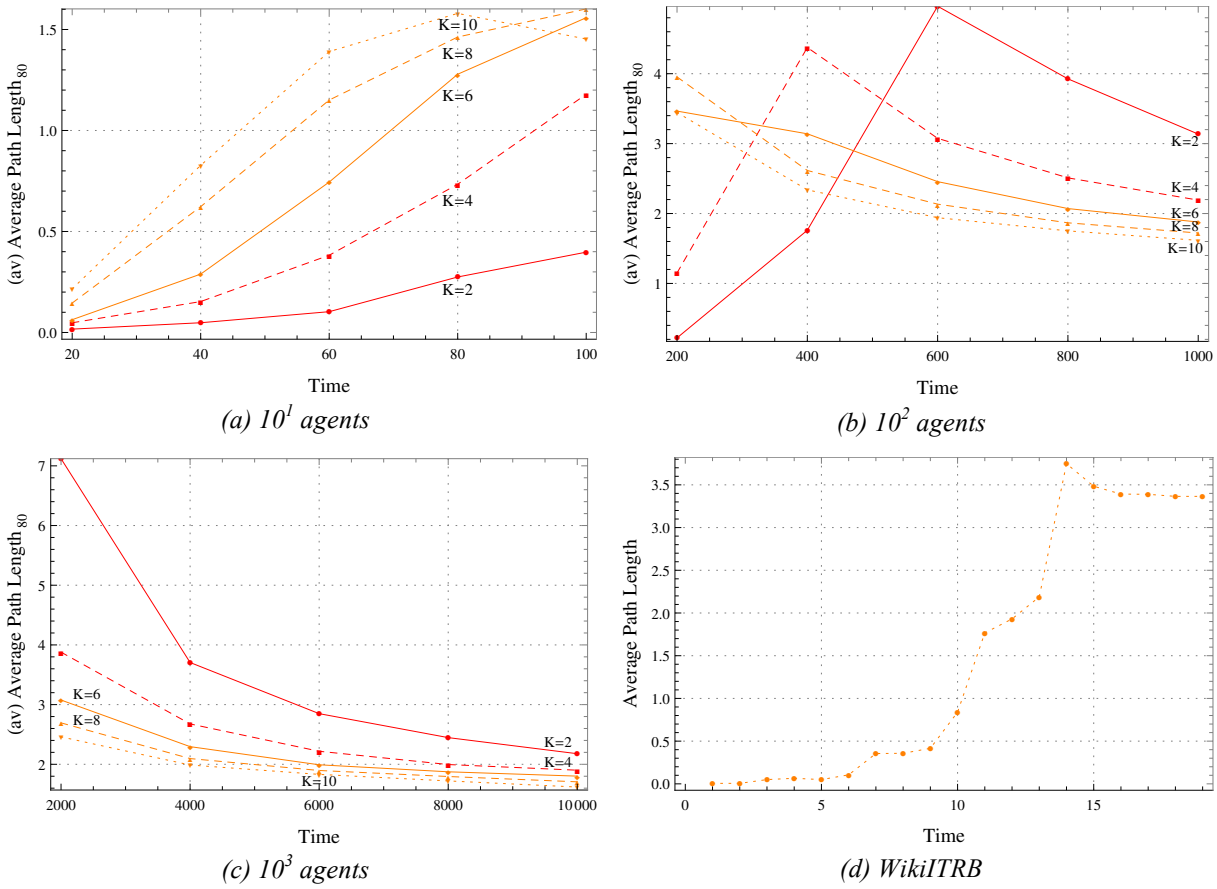


Figure 1. Values of the clustering coefficient through time units. Figures a, b and c correspond to model executions with 10^1, 10^2 and 10^3 agents respectively, and Figure d corresponds to the Wiki-ITRB. In Figure 1, along the x axis are time units and the y axis shows the clustering coefficient. Figures a, b and c shows the clustering coefficient of the resulting network after running the model. Each line in the graphic corresponds to one value of agent edition capacity (k).

Figure 1 shows that when both time (t) and k increase, the clustering coefficient also increases. Regardless of the number of agents, all graphics resulting from the model are very similar to the one of the Wiki-ITRB. While k increases, there is monotonic growth over time; however, this behavior is not present for low values of k. Thus, when k >= 3 and t >= 5 times the total number of agents, behavior is expected to be consistent. This shows how the values of individual edition capacity (k) and the time simulations (t) are relevant in the design of measurements or design systems based on collective intelligence. The implications of this result are discussed below.

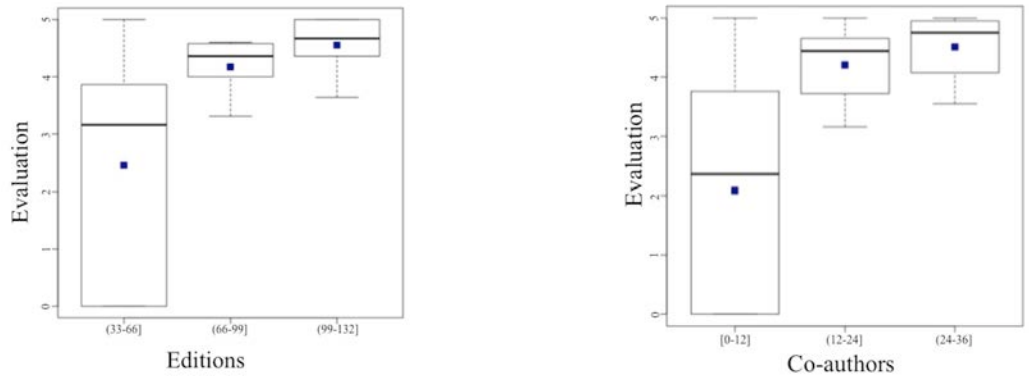
Figure 2 shows the average path length (apl) for each number of agents and the Wiki-ITRB. In a, b and c, the results show how the curve of the average apl over 80 simulations evolved for the model and Figure 2 d. for the Wiki-ITRB. The apl in wiki systems demonstrates the same behavior. The results showed in Figure 1 and 2 are consistent with (Ingawale et al., 2009).



(a) 10^1 agents *(b) 10^2 agents*

(c) 10^3 agents *(d) WikiITRB*

Figure 2. Values for average path length through time units in model executions with 10^1 (a), 10^2 (b) and 10^3 (c) agents. In this figure, average path length is represented along the y axis. Contrary to the clustering coefficient, the average path length decreases when t and k increase, which is consistent with the behavior of small world networks.



(a) Editions *(b) Co-authors*

Figure 3. Values of evaluation (scale 1-5) (a), average evaluation and standard deviation of evaluation documents by bins of number of editions. In a similar way, b shows the average evaluation and standard deviation of evaluation documents by bins of number of co-authors of wiki pages.

In Figures 1 and 2 it can be seen that the clustering coefficient and average path length are saturated by high time values. The time for simulations for higher values therefore implies that a lot of agents have connections and the small world structure disappears. In-depth study of this behavior and the umbrals for the measurements is proposed for future work.

Figure 3 shows the evaluation of each document in the Wiki-ITRB, and demonstrates how the documents with more editions or more co-authors receive a better evaluation (scale 1-5). These results suggest that individual edition capacity and time are relevant for the acquisition of emergent properties such as those of small world networks, where group composition is self-organized. At the same time, the accumulation of a number of editions has an effect on the qualifications of documents. In sum, it suggests that collective intelligence is related to the accumulation dynamics of editions, thus with better documents there are more editions and more agents working on them. This constrains the evolution of co-editor networks and the structural properties of small world networks appear.

5. Discussion and future work

Collective intelligence can be understood as the capacity of a collective system to evolve towards higher order complexity through networks of individual capacities. We observed two collective systems in terms of a dynamic process in complex networks—the Wiki course PeSO and an agent-based model based on wiki systems. The results from both the course and the model were contrasted with a random network baseline model. Both the course and the model show dynamics of accumulation, in which statistical properties of non-equilibrium networks appear. The proposed model reproduces the behavior observed in the PeSO course; this behavior is also described for small world networks (Watts and Strogatz, 1998). From this, we interpret that collective intelligence emerges from cumulative dynamics.

Two measurements have been observed: clustering coefficient and average path length. Both had consistent values in terms of individual edition capacity (k) and time units (t), where neither could be too large or too small. As the results show, when values are too large, the outcome of the simulation are complete graphs, and when values are too small, the graphs are not connected, which means that either it is a random system or it is too simple. For this set of values, however, there is enough complexity to replicate phenomena observed in real systems. Thus, we show how the process of accumulation of editions can be seen as being self-organized system.

The results presented here demonstrate how collective intelligence emerges from cumulative dynamics. This provides a better understanding of how to measure and design systems based on collective intelligence. In the context of higher education systems, one example of this is Wiki-ITRB activity (the PeSO wiki course); however, it would be necessary to develop a better understanding of collective intelligence in order to implement this strategy. An open question for further investigation is how teaching methodologies in higher education can be designed to develop collective thinking.

Intelligence is hard to define in a rigorous way, but it is related to the perception, adaptation and even modification of an environment, for the purpose of survival and reproduction (Dawkins, 1986). Systems that are completely organized and where nothing changes (or that only follow deterministic rules) are rigid; they cannot adapt to differing or complex environments. On the other hand, systems that are completely random have, by definition, no memory, thus the system cannot learn from similar past situations and react appropriately. In an intermediate point are chaotic systems, which can adapt better to extreme events (Langton, 1990) and can generate self-organized structures. In (Kauffman, 2000) it is mentioned that the complexity of the universe is due to the fact that it is not ergodic, i.e. all possible configurations have not been explored. This could explain the loss of the small world phenomenon in our study when the time units in the simulation were too large. At the same time, individual capacity cannot be too low (values of $k < 3$) otherwise the system becomes quite similar to a random network. The study of these umbrals is proposed for future work.

We understand wiki systems as resulting from a cumulative process, whereby the accumulation of editions goes towards the development of wiki pages. Thus, the more editions there are, the better the wiki page (more visible, more votes and/or more edited); furthermore, the more editions a wiki page receives, the more editions it is likely to receive in the future. This reinforcement cycle of the wiki system transforms a random network into a small world network of co-authors or co-editors. The model presented here is thus an accumulative system, where there is no loss of information (no loss of nodes or edges). It is proposed that in future work, a less accumulative system should be examined.

To better understand collective intelligence, we propose that future work focuses on the in-depth study of the proposed model: distribution of agent edition capacity (k) and the computation of other measurements such as Small-World Characteristic Q and robustness.

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Managing Complexity in Mexican SMEs to Evolve and Last over the Time

Raul Gonzalez Sanchez.

Abstract

The Small and Medium Enterprises (SMEs) have great importance in the economy and employment nationally and regionally, both in industrialized countries and in those of less developed. Worldwide, the SMEs represent the segment of the economy that contributes the largest number of economic units and employed persons. In the international context we can say that 90%, or a higher percentage of total economic units, is made up of SMEs. They generate more than half of employment and a somewhat smaller fraction of gross domestic product. In many countries, SMEs represent the most dynamic sector of the economy, playing an important role on competition, as well as ideas, products and new jobs (INEGI, 2011).

At the same time, organisational complexity continues to grow. Organisations are forced to address more issues and greater diversity in their operating environments. The rate of change boosted by technology proliferation, globalization and other macro-level changes force organisations to operate in increasingly complex ways. The reason old models are failing is that the problem is not just organisational complexity or the rate of change, it is the combination of the two and the dynamic that these have together (Hoverstadt, 2008). This combination has a big influence on most human activities like business organisations and therefore SMEs also.

However organisations continue to be based upon a set of theories, methodologies and methods that are inadequate to deal with current challenges imposed by current complexity. Given these, new paradigms will be needed in management science to address emerging unprecedented challenges in the modern world and SMEs.

Researcher's professional practice in SMEs shows some evidence about several challenges faced that influence their lasting and evolution through time. The problem identified by the researcher focuses on the unconscious that exists in SMEs to take into account management of complexity with a systemic approach. And even more, management of complexity as part of key business processes and not only based on understanding of some people or some efforts. At the end, SMEs need to adopt a process to manage

complexity as part of internal culture throughout all organisation to enable all stakeholders to address the challenges that modern world presents in an increasingly complex environment.

The focus of research is to promote the use of an ongoing process to management of complexity. This process will be adopted in all the system named "Enterprise" with a formal continuous learning process. The learning process will be the foundation for necessary evolution in understanding of complexity in SMEs. The understanding and management of complexity must help SMEs to last in time with financial results and improvement of their work environment. Based on the above research problem we can derive following main research question:

How can SMEs in Mexico adopt in a conscious and formal manner, an ongoing business process for Managing Complexity in order to evolving and lasting over the time?

Three additional supporting questions emerge from this central research question:

- How can managers of SMEs develop the organisational ability to achieve an ongoing systemic understanding of their organisations as a system in an easy manner to apprehend, teach and use in everyday practice?
- How can managers of SMEs apprehend, teach and use an efficient and effective balance between external and internal variety as part of a daily work process, not based only on the understanding of some people but adopted as part of organisational culture?
- How can managers of SMEs create an internal learning and feedback process that allows them to improve the collective intelligence in the SME in relation to management of complexity in order to evolving and lasting over the time?

The Viable System Model (VMS) is a useful model for improving goal seeking and viability of the organisations. The VSM seeks to help us design complex systems of all sorts and to make them viable in rapidly changing environments (Hoverstadt, 2008). With the VSM's framework as backbone, the researcher will integrate other complementary theoretical perspectives to build the K+ Model to managing complexity as a daily process in SMEs with focused efforts.

The K+ Model is integrated by three key components: first, the theories to understand the perceived reality in a systemic way and their relation with current internal culture of SMEs; second, the Multi-Methodology approach to be used to address research using the VSM as the backbone; third, the necessary enablers that allow the learning process for managing complexity.

In the first key component, perceived reality, three themes were identified: first, VSM as the Systems approach that models and represents the systemic relation between organisation and its environment (Beer, 1988); second, the organisational evolution path (Adizes, 1999); third, the cultural evolution path (Beck and Cowan, 1996). For the first theme, the VSM will be base to work on it.

The Multi-Methodology approach, second key component, is based on understanding how individuals within an organisation interpret the world and collaborate between themselves. From the methodologies, methods, models, techniques and tools developed in this work, they can operate the management of complexity as a key internal process. And, due of the nature of the research, the researcher proposes to use a Multi-Methodology approach because it deals with a multidimensional issue: all research questions are interrelated questions with complementary and interrelated contexts and purposes that need different methodologies and methods to achieve necessary outcomes. Therefore, the pluralist approach to mixing methods provides an appropriate research approach (Midgley, 2011).

For the third key component, enablers, learning process will be the foundation for necessary evolution in understanding of complexity in SMEs. The K+ Model is based on Gestalt approaches, using the guidelines of Senge's Learning Organisation (Senge, 2006) but developing through the VSM as the cornerstone of the Systems Thinking discipline. In order to improve the Learning Organisation, the K+ Model uses also the coaching approach (Echeverria, 2006) that apply mainly on Personal Mastery and Mental Models.

With the VSM's framework as backbone, the researcher will integrate other complementary theoretical perspectives to build the K+ Model to managing complexity as a daily process in SMEs with focused efforts.

Keywords

Management, Complexity, SMEs, Systems, VSM

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Towards a Simple Dynamical Model of Citizens' Perception

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Abstract

Purpose : We propose a minimal dynamic two-dimensional map for the relation between citizens' perception of quality oflife (y) and their perception of the city Mayor management abilities (F).

Approach : We use data from the Ciudades cómo vamos? project and test a simple hypothesis: there is a linear positive correlation between y and F . Following we propose a two-dimensional map based on ideas from a statistical regresion model and a non-linear dynamical map on the [0 , 1] interval.

Findings : We give evidence that suggests that y and F are not linearly correlated. We show that the two-dimensional map, mentioned above, is able to reproduce non-trivial and unsynchronized relations between the variables, as well as the whole range of correlation coefficients.

Limitations/implications : There is a very limited amount of data to work with, therefore it was not possible to explore other possible relations thoroughly. Regarding the dynamical map, we are aware that there are still many venues for its study.

Originality/value : To the authors' knowledge, this is the first reported attempt at modeling the dynamics between two variables obtained via survey on which perception is a key component of the questions.

keywords : Perception of city life, perception of government, perception of quality oflife, dynamic maps.

1 Introduction

Independent studies like the Ciudades cómo vamos? project of Fundación Corona [1] are becoming ubiquitous around the globe. See for example the Red Latinoamericana por Ciudades y Territorios Justos, Democráticos y Sustentables [2]. These are non goverment endeavors that make a periodic follow up of changes in the quality of city life and the execution of the development plans oflocal administrations —among other measurements. The Ciudades cómo vamos? project, in particular, is ongoing since 1988 and evaluates the recoil or advance of the quality oflife on a particular city; this is carried out via a set ofindicators, and by the use of a yearly poll of citizens' perception. This program is currently evaluating 10 cities in Colombia (Barranquilla, Bogotá, Bucaramanga, Cali, Cartagena, Ibagué, Manizales, Medellín, Pereira, and Valledupar). Of all the results that the project has collected we are interested in two particular results from the citizens' perception polls: the perception of quality of city life, and the perception of government management. Since government actions (like investing in services, health, education, etc) are, in principle, taken in order to address a disfunction within the city or to improve it, one could argue that the mentioned perceptions must be correlated to a high degree; that is, if the perception of city quality is high, then the perception of government management should be high (or vice versa) or that if one detects a trend on city quality perception (raising or declining) then one must also detect the same trend on the perception of government management. However this is hardly the case, as will be shown in Section 2

The first part of our study (Section 2) is to describe the data from the 10 cities from the Ciudades cómo vamos? project and show that there is no general correlation that one can consistently find between the perception of the city management and the perception of the quality of life in said city. I limit the study to four (Barranquilla, Bogotá, Cali and Cartagena) of the 10 cities in order to have time series that include more than four years of surveys.

Section 3 is concerned with an attempt to model the relationship between the perception of the city government and the perception of the quality oflife in a particular city. We take as a starting point the statistical model proposed by (Pudney, 2007). Based on this statistical model we explore a series of two-dimensional maps that relate the perception of the quality oflife ($y_t = h(\{y_{t-i}\}, F_{t-1})$) with the perception of the city government ($F_t = g(\{F_{t-i}\}, y_{t-1})$), where h and g represent different functions. Therefore, we are proposing to model perception of the quality oflife as a function of the perception of city government management and vice versa. As is well known (see for example (Villalobos et al., 2010)) the maps outlined above can have non-trivial and chaotic behavior.

This work can help in the understanding of complex dynamics like the one discussed above. Simple models that are capable of describing a wide range of behaviors (like fixed point, periodic or strange attractors) are a

[1] http://www.fundacioncorona.org.co/templates/plantilla_cinco.php?loc=5
[2] http://redciudades.net/blog/

useful tool when understanding Complex Systems. Models like the ones on this paper can be used as insightful tools that can help policy makers understand the different kind of behaviors that policies may have on the population. Understanding the potential that dynamical systems have to move towards chaotic regimens is a relevant insight when dealing with complex situations.

2 Ciudades cómo vamos? A state of the art.

In this section we will do a brief description of the Ciudades cómo vamos? project and the particulars that are relevant to this work. We will describe the construction of an index of the perception of the quality oflife (QL) and another for the perception of city government management (MM). Also, we will limit the data sets of our study based on the availability of data for each of the cities that participate on the project. We will show that for four cities the linear correlation between QL and MM is not trivial.

City	Years	City	Years
Barranquilla	2008-2013 (6)	Ibagué	2010-2013 (3)
Bogotá	1998-2013 (11)	Manizales	2012-2013 (2)
Bucaramanga	2010-2013 (3)	Medellín	2012-2013 (2)
Cartagena	2008-2013 (6)	Pereira	2011-2013 (3)
Cali	2008-2013 (6)	Valledupar	2011-2013 (3)

Table 1: Cities that are part of the Ciudades cómo vamos? surveys and the years from which data is available; total number of years with complete data are given between parenthesis. Emphasized cities are the ones studied in this paper.

The project Ciudades cómo vamos? is currently under way in 10 cities (see Table 1 for a complete list). The goal of this project is to evaluate the quality oflife of the citizens regarding safety, the city general situation, education, health, mobility, neighborhood and housing, public services, public spaces, recreational and cultural offer, coexistence and mutual liability, and finally the management of the city. Unfortunately this survey was not applied to different cities at the same years, therefore we have to content with, at least, a ten years gap between Bogotá's survey and other cities; the range of surveys for different cities can be seen in Table 1. This fact creates a difficulty for the analysis and data correlations among all cities. We have to work with this restriction and limit our study to four cities: Barranquilla, Bogotá, Cartagena, and Cali, (emphasized on Table 1).

The surveys applied in the different cities that are part of the Ciudades cómo vamos? study are made up of close to 48 questions divided among 7 categories. We are interested in questions that inquiere about

the perceived quality of life in the city and the perceived efficiency of the Mayor's management.

In this paper we will use the following categories derived from the surveys [3],[4]:

1. citizens' perception of the quality of life (QL), and
2. citizens' perception of the Mayor's management (MM).

Variable QL is taken directly from the question: "Are you satisfied with your city as a place to live?". We built MM as an average percentage of the following questions (these questions inquire about the perception, they are not the official figures): "Fiscal Performance Index", "Overall performance index", "Timely responses to petitions, complaints and claims", "Percentage public servants", "Poverty line", and "Indigence line".

An exception to our data is the survey from the city of Bogotá because the question "Are you satisfied with your city as a place to live?" is not present. Therefore, we use the questions: "How is your overall satisfaction with the selr service?", "How is your overall satisfaction with the electrical energy service?", "How satisfied are you in general with Bogotá's road infrastructure?" and "How safe do you feel in your neighborhood?" to make an average percentage. All these questions have three possible answers: satisfied, not satisfied and indifferent. Results are given as percentages of these possible answers. We are aware that care should be taken when working with don't know responses (indifferent in our case) (Manisera & Zuccolotto, 2014). The treatment of don't know responses is still an open issue, although there are good techniques on how to handle them (see for example (Schafer & Graham, 2002)). In this paper we will treat the indifferent response as equivalent to the not satisfied answer.

In Table 1 we show the range of years for which the cities of the Ciudades cómo vamos? study have data that is relevant to this paper. We have emphasized the cities that have gathered data from questions that relate to the perception of quality of life and the perception of government for, at least, four years. Let us note that Bogotá has missing (or incomplete) data for 1999, 2001, 2002, 2004, and 2013.

From the collected data we propose to build two indexes for each city: (a) the citizens' perception of quality of life (QL), and (b) the citizens' perception of the Mayor's management (MM). The indexes are built as percentages (from 0 to 1) and both obey the following formula: number of people that answered in a positive way (answered satisfied) divided by the total of people that took the survey.

As we discussed in the Introduction, it is somewhat intuitive to argue that there should be some kind of correlation between these indexes; after all one must expect that good governments have a positive impact on the quality of life of its citizens. Using the indexes described in the previous paragraph we have explored if there is some consistency between them. In particular we have calculated Pearson's correlation coefficient (PCC) (Pearson, 1895) between both indexes for each city.

[3] We have used the reports found in http://www.bogotacomovamos.org/acerca-de/red-de-ciudades/ and http://redciudades.net/blog/tag/red-colombiana-de-ciudades-como-vamos/ as data sources.

[4] Authors' translations

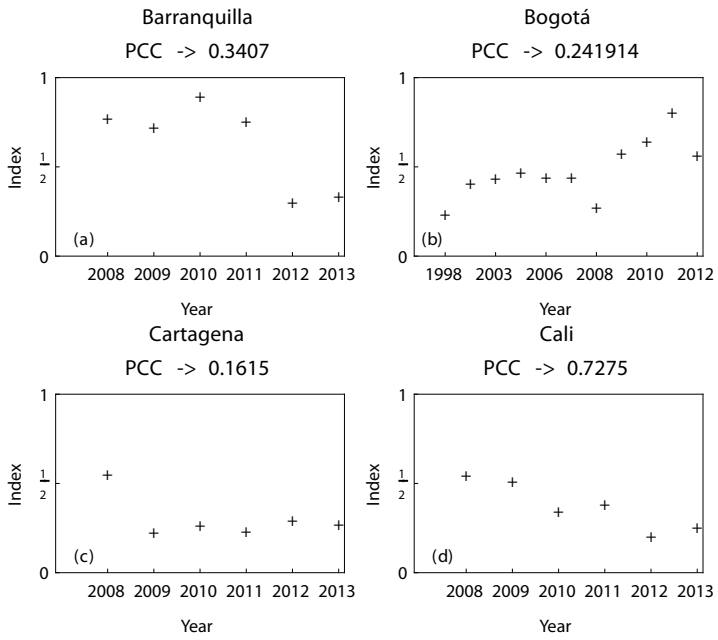

Figure 1: Plots of QL ($\times$) and MM (+) with Pearson's correlation coefficient between both indexes for (a) Barranquilla, (b) Bogotá, (c) Cartagena, and (d) Cali.

The PPC is a measure of the linear dependency between two sets of variables; it is a number between -1 and +1 where a value of 0 indicates no correlation, +1 a total positive linear correlation, which means that both series are synchronized, and -1 a total negative linear correlation, which means that if one series raises the other one falls by similar amounts. Here we understand a total correlation if we can express one index (y) as a linear function of the other index (x) in the form $y = mx + b$ for some pair (m, b).

Figure 1 shows both indexes (QL plotted as $\times$, and MM as +) and the PCC between them (limited to four significant figures). As can be seen from the picture, there is no consistent value of the correlation coefficient between both series. Also, there is no obvious synchronization between them. All coefficients are positive and small, except for the data from Cali. We note that Bogotá (the city that has more data to examine) has a small coefficient.

It is possible that the correlation between these variables could behave differently and in a more consistent way. For example, one could propose

that introducing a delay on one of the series could give more consistent results. However, in order to explore this posibility much more data is needed for each city than the currently available and, also, we could not ignore missing data as has been done. It is for these reasons that we have limited ourselves to calculate the PCC directly and not with a different approach.

We have shown that a simple assumption: that the citizens' perception of the Mayor's management should be correlated to their perception of the quality oflife in their city is not true. We used data from the Ciudades cómo vamos? project from Fundación Corona in order to explore the correlation between those variables.

The results from this Section can be interpreted in at least to ways: (1) the relationship between QL and MM is not linear, or (2) the relation has a very important stochastic component. We assume the former and propose a non-linear minimal model in the following Section.

3 Some models for the dynamics of perception

In this Section, we build a simple dynamical model that aims to capture the rich dynamics observed between the citizens' perception of quality of life and their perception of government management. As was showed on the previous Section, these variables are not linearly correlated. We found positive correlations for all data sets, but some were close to 0 and others close to +1. There are many possible explanations for this observation, one being that there is not enough data to support a trend or identify some global behavior. We put forward the hypothesis that the relation between these variables is not linear; our purpose is to present a simple model that may help explain the dynamics involved between these two variables.

There is very few work done on the dynamics of perception, we found only one scientific work related to it (Pudney, 2007). The previous statement does not imply that there is little work done on perception, on the contrary the literature on the topic is abundant (see for example (Méndez, Pérez, Prado, & Merchant, 2014; Norwich, 2014)). However we were not able to find published work that tries to model perception as a variable. We propose to use (Pudney, 2007) as our staring point; there the authors propose a statistical regression model where they argue that the perception of well-being, $y_{i,t}$ of an individual i, at time t, can be expressed as

$$\Delta y_{i,t} = \lambda (W_{i,t} - y_{i,t-1}) \Delta z_{i,t} \cdot \beta + \mu \xi_{i,t}, \quad (1)$$

where we write $\Delta x_{i,t} = x_{i,t} - x_{i,t-1}$, and $W_{i,t}$ is the well-being ofindividual i at time t, $z_{i,y}$ is a vector of observable quantities, $\xi_{i,t}$ represents a stochastic variable, and both $0 \leq \lambda \leq 1$ and β are parameters to be found using regression techniques.

Based on equation 1 we propose the following non-stochastic dynamical model for a citizens' perception of some quantity y_t related to another

perceived quantity F_t at time t:

$$y_t = (1 - \lambda) y_{t-1} + \lambda\psi F_t + \mu\Delta F_t, \qquad (2)$$

where λ [0, 1] and ψ, μ [− 1, 1]. We restrict both y_t and F_t to the [0, 1] interval. Intuitively one can interpret (1 − λ) as some sort ofinertia or resistance to change; if we set $\psi = \mu = 0$ we are left with a model of exponential decay where 1 − λ determines how fast y_t decays. In this paper we make no attempt at interpreting the ψ and μ parameters beyond bounding them to the mentioned intervals.

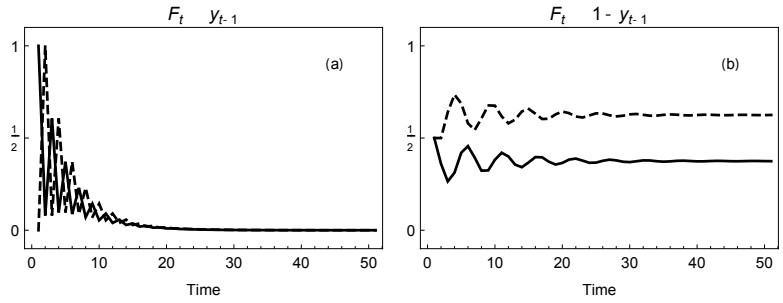

Figure 2: Dynamics of the citizens' perception of the city's quality oflife (solid line) and the citizens' perception of the Mayor's management (dashed line). (a) For the linear map $F_t = y_{t-1}$, and (b) for $F_t = 1 - y_{t-1}$. In both cases we use Equation 2 for y_t. See the text for parameter values.

The model in Equation 2 is quite simple and can be interpreted as a proposal where the perception y_t is proportional to yesterday's perception (y_{t-1}) and both the actual perception value of F_t and its change. Following the observations made in Section 2 we propose y_t to be perceived quality oflife (QL) and F_t to be the perception of the Mayor's management (MM).

We must give some mathematical form for F_t. A first proposal that comes to mind is for it to be a growing or decreasing function. A growing function, like $F_{t+1} = \alpha F_t$ or $F_{t+1} = \alpha + F_t$, for $\alpha > 0$, can be interpreted as a situation where the Mayor's management is always better perceived. Regardless of whether this assumption can be true or not, the fact remains that equation 2 will grow in the same manner as F_t. The same happens if we use a decreasing function like $F_{t+1} = -\alpha F_t$; this particular function goes to 0, which may be a more realistic model of the perception of public management, but also forces y 0.

A second and more realistic proposal is to model F_t as an oscillatory function (like sin(ωt) or a square pulse, etc). But given the nature of equation 2 we would find that y_t always synchronizes with F_t; this implies that there is a high positive correlation between both variables in contradiction with the observed behavior.

A third proposal is to make F_t dependent on y_t; several options are available but we will keep a simple form. The simplest dependence on y would be to write $F_t = y_t$; which has a simple interpretation: management perception is the same as life quality perception. Another option is $F_t = y_{t-1}$, this would tell us that management is equal to last year's percieved quality oflife. The dynamics displayed by this proposal is shown in Figure 2(a); there we can observe that after a transient oscillatory behavior the dynamics between both indexes converge. For Figure 2(a) we have used $\{\lambda = .8, \psi = .6, \mu = -.6\}$ and $y_0 = 1, F_0 = 0$.

A fourth proposal is $F_t = 1 - y_{t-1}$; in this case we would be implying that the perception of management is the complement of the perception of the quality oflife i.e., that the citizens would have an excellent opinion of management if the quality oflife is very low and vice versa. We give an instance of the behavior of this functional form in Figure 2(b); there we can observe that after a transient oscillatory behavior the dynamics between both indexes converge; we have used $\{\lambda = .7, \psi = .6, \mu = -.8\}$ and $y_0 = F_0 = 1/2$. As can be seen from the figures, there is no difference (in terms of how the dynamics correlate) between both indexes. This observation gives us an argument to look for more complex models in order to find non-trivial dynamics for both variables.

In the following subsection we will analyze the dynamics of both variables when they are related via a non-linear map. We will use the tent map (Collet & Eckmann, 2009) sice it has a simple interpretation on this context.

3.1 Analysis of tent map

A tent map is a one-dimensional map given by the following piece-wise function:

$$x_{t+1} = \begin{cases} 2x_t & \text{if } 0 \leq x < \frac{1}{2} \\ 2(1 - x_t) & \text{if } \frac{1}{2} \leq x \leq 1 \end{cases},$$

this is a non-linear map that has chaotic dynamics (Collet & Eckmann, 2009).

We propose to use this map together with Equation 2 to build a two-dimensional map as follows:

$$F_t = \begin{cases} 2y_{t-1} & \text{if } 0 \leq y_{t-1} < \frac{1}{2} \\ 2(1 - y_{t-1}) & \text{if } \frac{1}{2} \leq y_{t-1} \leq 1 \end{cases}. \tag{3}$$

Figure 3 shows the tent map F_t described by Equation 3. We interpret the tent map in our model as follows: if the perception of quality oflife (y_t) is either very low or very high (this is either close to 0 or to 1) then, the perception of the Mayor's management (F_{t+1}) will be very low. However, if y_t $1/2$ then we have F_{t+1} 1.

We now turn our attention to the possible dynamics that this map offers. First, let us do a cursory exploration of the possible time series that can be observed with this proposal. In Figure 4(a)-(d) we show four possible realizations of the map for different parameter values. All series are presented from time step 500 through 550. In other words, we are plotting y_t and F_t for $t = \{500, 501, \ldots, 549, 550\}$. We do this in order

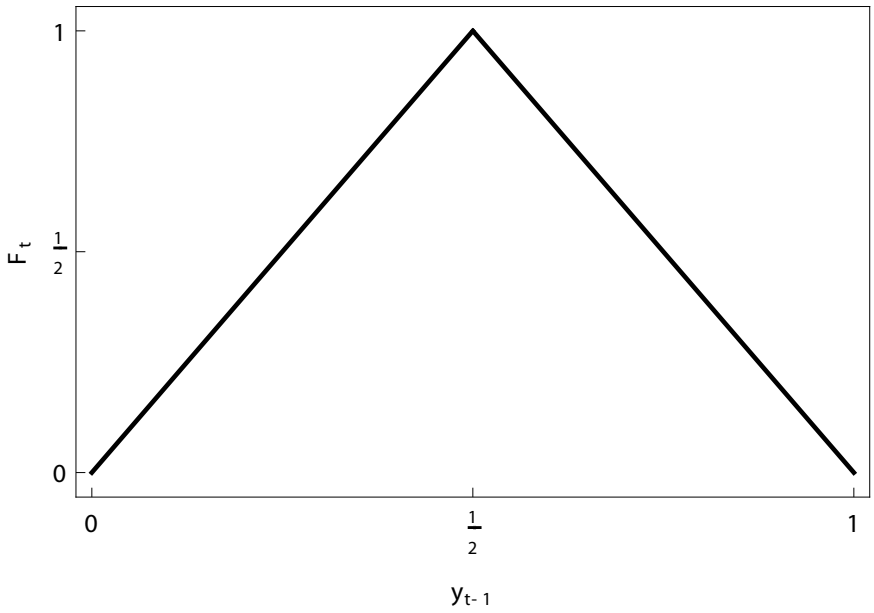

Figure 3: Tent map from Equation 3. This figure shows the behavior of F_t according to the value of y_{t-1}.

to be sure that transient behavior is not part of the plot, and that we are in fact studying the asymptotic dynamics of the system's attractor (Villalobos et al., 2010).

Figure 4(a) shows a fixed point steady state, in this case the dynamics is constant and does not change; clearly the PCC between these two series would be equal to one. This is not a very interesting case, however it shows that our model is capable of reproducing steady state dynamics of the form $(y_t, F_t) = (y_{t-1}, F_{t-1})$.

Figure 4(b) shows a period-two steady state for both variables. Here we see oscillatory behavior where the odd time steps take one value, and even ones a different one. Also note that both series are synchronized, for this series the PPC is also equal to one. As with the fixed point case, oscillatory behaviors can be modeled with much simpler maps of the form $(y_t, F_t) = (y_{t-2}, F_{t-2})$.

Figure 4(c) shows synchronized chaotic behavior. We call it synchronized because it is clear that there is a high (close to one) correlation coefficient between both series. We call it chaotic in the dynamical sense (Strogatz, 2014) —although we do not show that there is high sensitivity to initial conditions or positive Lyapunov exponents. High sensitivity to initial conditions and positive Lyapunov exponents are to be expected given the chaotic nature of the tent map used in Equation 3. Chaotic behavior is interesting on its own, but is not the aim of this paper to explore and characterize it.

Figure 4(d) shows unsynchronized chaotic behavior. We call it unsyn-

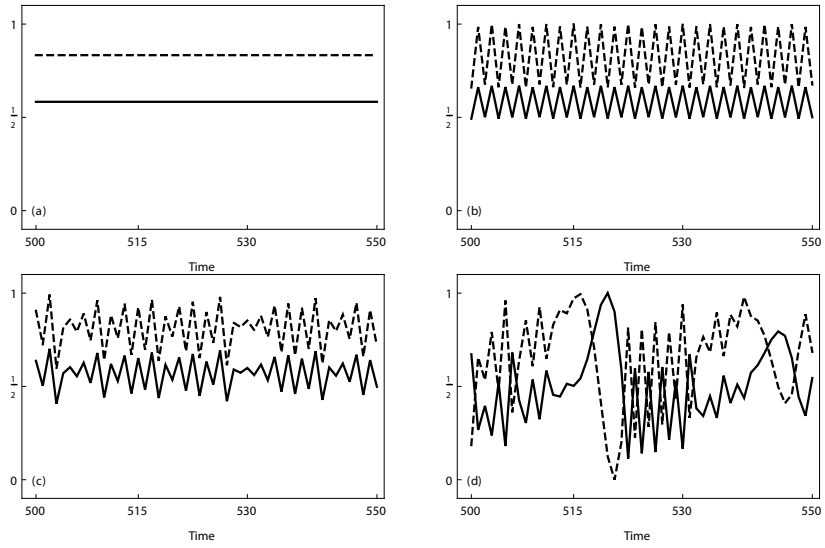

Figure 4: Four possible realizations of the model described by Equations 2 and 3. I show the dynamics without transient behavior. All plots used initial conditions $y_0 = F_0 = 1/2$. (a) Fixed point dynamics, obtained with $\{\lambda = 0.2, \psi = 0.7, \mu = -0.4\}$. (b) Period-two oscillations, obtained with $\{\lambda = 0.2, \psi = 0.7, \mu = 0.4\}$. (c) Synchronized chaotic dynamics, obtained with $\{\lambda = 0.2, \psi = 0.7, \mu = 0.6\}$. (d) Not synchronized chaotic dynamics, obtained with $\{\lambda = 0.2, \psi = 0.8, \mu = -0.8\}$.

chronized because it is clear that the correlation coefficient between these series is not one. Given that we have high sensibility to initial conditions (the dynamics is expected to be chaotic) we must find that the correlation coefficient is also be sensitive to initial conditions. Meaning that if we change the initial conditions of the map (y_0, F_0) we would observe a different correlation coefficient between the series. This is shown in Figure 5 where we have plotted the resulting PCC between both series on the vertical axis and the difference between initial conditions $\delta = y_0 - F_0$. As can be seen from the picture, for a single set of parameter values (in this case $\{\lambda = 0.2, \psi = 0.8, \mu = -0.8\}$) we get a wide range of possible correlation coefficients. We have calculated the PPC with steps 500 through 550 of the series resulting from a simulation with initial conditions $(y_0, F_0) = (1/2, 1/2 + \delta)$

Finally, we turn our attention to the behavior of the PCC as a function of the model's parameters ($\{\lambda, \psi, \mu\}$). Given that we have a three parameter model it is not easy to visualize its behavior across all possible combinations. We propose to use a density plot for variables $\{\psi, \mu\}$, i.e., a Cartesian plot where, for a fixed value of λ, $\psi \in [-1, 1]$ is placed on the horizontal axis and $\mu \in [-1, 1]$ on the vertical. Point (ψ, μ) is colored according to the value of the PCC between y_t and F_t. We show one

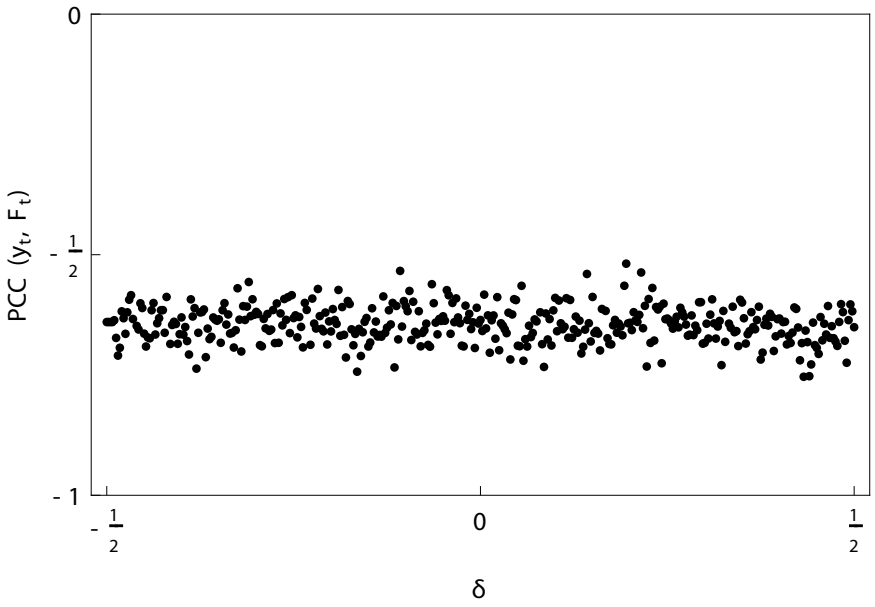

Figure 5: Pearson's Correlation Coefficient (PCC) as a function of the difference between initial conditions $\delta = y_0 - F_0$. This Figure was obtained with $\{\lambda = 0.2, \psi = 0.8, \mu = -0.8\}$, and $y_0 = 1/2$, $F_0 = 1/2 + \delta$.

density plots constructed with this procedure on Figure 6. The following color convention is used to represent the PCC: a blue point (dark gray on a gray-scale) represents a PCC -1, orange is for values near 0, and light orange (light gray) represent a PCC close to 1. White regions are combinations of parameters that are not valid in our model (they give either negative values for y_t or F_t, or $y_t > 1$ or $F_t > 1$).

It can be seen in Figure 6 that the model described in Equations 2 and 3 can reproduce all possible values for the PCC between y_t and F_t, from -1 to $+1$. This fact, together with the evidence for chaotic behavior are good arguments in favor of our model as an adequate, and simple, candidate to capture the dynamics between the proposed variables.

We have showed that a simple non-linear dynamical two-dimensional map is capable of reproducing all possible linear correlation values between its variables. We interpreted this map as the relation between citizens' perception of quality oflife (y_t) and their perception of the city's Mayor management abilities (F_t) along with a possible interpretation of the model. We also did a cursory examination of the possible dynamics that the map is able to reproduce.

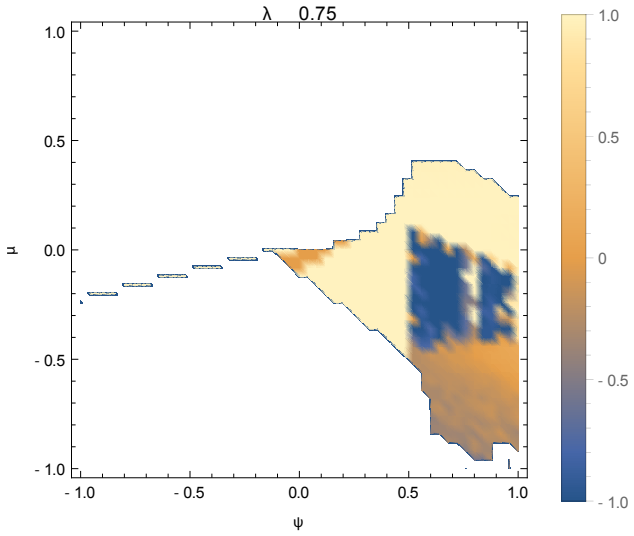

Figure 6: Pearson's Correlation Coefficient (PCC) between y_t and F_t on a density plot, as a function of (ψ, μ) for fixed λ. Blue (dark gray) is for values close to -1, orange for 0, and light orange (light gray) for +1. White regions indicate combination of parameters for which the series take values outside the $[0, 1]$ interval.

4 Conclusions

In this paper we have proposed a simple minimalist model for two survey variables. The initial motivation to undertake this work is the data gathered from different Colombian cities by the Ciudades cómo vamos? project. Surveys on different cities asked questions that, at a first approximation, should be consistently correlated: the perception of the quality oflife in the city and the perception of the Mayor's management ability. After all, if the Mayor is good at managing her resources, then the quality oflife in the city should be good. We found that this is not the general case for four of the cities of the study. We found that these two variables are, indeed, positively correlated but not highly correlated on some cases.

Given a diversity of correlation values we proposed a dynamical two-dimensional map based on a statistical regression model for the perception of the quality oflife in the city as a function of the Mayor's management ability and explored some simple relations. We found that the simplest model that was able to generate non-trivial dynamics was one where the perception of the Mayor's management followed a non-linear functional form (the tent map). We arrived at this conclusion after exploring simpler relations like linear or oscillatory ones.

We explored the possible steady state dynamics that the proposed model was capable of reproducing, we found that for certain sets of parameters our proposal was able to reproduce fixed point dynamics, oscillatory

behavior, as well as chaotic behavior with both variables synchronized or not. We also showed that for the case of unsynchronized chaos, the Pearson Correlation Coefficient varied in a non-trivial way with respect to changes in initial conditions. This behavior was expected, since chaotic behavior is, by definition, high sensitivity to initial conditions; however the dispersion of values observed was not. This point merits further research, it would be interesting to characterize the variance of the PPC as a function of the difference in initial conditions; as well as the possible distributions of the coefficient.

We closed the study of the model by showing an instance where, for a fixed value of λ, all possible values of the correlation coefficient (from -1 to $+1$) could be obtained. From this result we can infer that it is highly possible that both variables (perception of the quality oflife in the city and the perception of the Mayor's management ability) are actually correlated, but in a non trivial way.

Acknowledgements

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An Application of the Systemic Methodology for Developing and Maintaining Dynamic Balanced Scorecards (SMDBSC-DM) : A Dynamic Balanced Scorecard for a Peruvian Industrial & Systems Engineering Faculty.

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Abstract:

The Present paper presents an application of the Systemic Methodology for Developing and Maintaining Dynamic Balanced Scorecards (SMDBSC-DM) in a Dynamic Balanced Scorecard development for a Peruvian Industrial and Systems Engineering Faculty.

For doing the research a real-world problem was identified in a Peruvian Industrial & Systems Engineering Faculty, where the need for having strategic indicators for strategic planning, monitoring and controlling was emerging if it is aspired to the the Faculty under study should be competitive considering the national and Latin Americans ambits.

After that, an application of the SMDBSC-DM was done, following this methodology step by step.

The paper presents its outcomes as well learning points from the experience of develooping a DBSC.

Key Words: SMDBSC-DM, efficiency, efficacy, ethics, aesthetics, change, culturally feasible, systemically desirable.

7

Networks of influence: systems dynamics

Application of Organizational Cybernetics and ICT to collective discussion of complex issues

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Structured Abstract

Purpose: The purpose of this paper is to expose how Organizational Cybernetics related concepts could be used in combination with Information and Communication Technologies (ICT) to facilitate the organization and development of group discussions on complex issues and to show its impact in a real case through an experiment with two groups of people involved in a deliberation process around the same issue. One of the groups was supported with ICT while the other not. Some of the qualitative and quantitative results obtained with these groups are presented.

Design/methodology/approach: A software inspired in Organizational Cybernetic concepts and in particular Team Syntegrity has been developed with the aim of helping groups of people to explore and deliberate around complex issues through Internet. Two groups of persons with similar backgrounds were chosen to follow a deliberation process around the same issue. One groups had the support of ICT while the other group did not. We used the same questionnaires to both groups trying to get qualitative and quantitative information about the results obtained in each case.

Findings: The results obtained show, in this case, that the group working with ICT support did produce a much better output (quality and quantity) as a result of its deliberation process than the group not supported with ICT. Also the degree of satisfaction of the first group was higher in practically all indicators than the second group. Since we are dealing with just one experiment we can not make a generalization but we think that the fact that the first phases of a deliberation process (generation and aggregation of ideas) can be done in a much more extended and relaxed period of time has a major influence in the quality of the physical meetings in which the detailed final answers to the issue question proposed to the groups are generated.

Originality/value: An Internet based software was created to facilitate the first phases (generation and aggregation of ideas) of a deliberation process. This software was used in an experiment with two groups of people with similar backgrounds to measure its impact in the quality and quantity of information produced through the deliberation process. The results are promising in the sense that ICTs combined with Organizational Cybernetic concepts seem to improve the quality of deliberation processes.

Keywords
Organizational Cybernetics; Variety; Debates Organizer; Deliberation

Paper Type: Case study

1. Introduction

Over In the last few decades the world has changed dramatically. Many are the interrelated factors involved in that change (socio-economic crisis, globalization, demographic, etc.). The consequence is that we live in a very complex social system. To qualify the level of complexity of a system (or a situation) Ashby (1956) proposed the concept of variety (number of possible states of a system) and set in his Law of Requisite Variety that "only variety can destroy variety". At the start of the seventies, Conant and Ashby (1970) had argued, in the famous theorem that bears their name, that "a good regulator of a system must be a model of the system" and that the variety of the regulator must be at least equal to the variety of the system that it pretends to regulate. If we think in the role of managers of organizations as "governors" of them then they need models adequate to the task, that means models with requisite variety. The Systems Thinking field and in particular Organizational Cybernetics (OC) provide some models like the Viable System Model (VSM) and tools like Team Syntegrity® (TS)[1] that can help decision takers to tackle the complex problems facing them.

If we focus our attention in how to facilitate the decision-making and communication processes we should consider that, as Pérez Ríos (2008, 2012) expressed it: "The new frontier of humanity is, at the start of the XXIst century, not so much scientific or technological development as an understanding of the complex social systems in which we are immersed. Such understanding is fundamental for our being able to deal effectively with the problems of social tension facing mankind. We must explore new ways to organize and engage in relations that will enhance the processes of communication and decision-making…certain fundamental challenges which still have not been resolved in a satisfactory way: for example, the development of group-decision processes which are at the same time democratic, creative and efficient, or the replacement of hierarchical organizational structures by other more democratic ones in which all points of view can be effectively taken into consideration. "(Pérez Ríos 2012, pp. 201-202).

[1] Team Syntegrity® and Syntegration® are registered trademarks by Team Syntegrity Internacional Inc. and Malik Management Zentrum St. Gallen.

But, at the same time that the world changed and experienced an increase in its dynamic complexity, a whole new set of technological tools related to information and communication technologies (ICT) became available. Also the interest about the role that these can play as a support to higher levels of people participation in discussions and decision-making kept increasing. Examples of those technologies can be found in what is generally known as "groupware", which includes software for planning and programming in groups, computer-assisted cooperative undertakings, and the whole arsenal of tools that have appeared within the so-called Web 2.0 (Almuiña, Perez Rios et al., 2008, pp. 253-265). "The conjunction of these two cornerstones—namely, on the one hand, the new conceptual framework for the design of organizational structures and decision processes, and, on the other, the availability of a technological support allowing remote collective inter-communication—opens up new horizons for relations between individuals and institutions." (Pérez Ríos 2012, pp. 202).

In this paper we focus our attention on the application of concepts taken from the Systems Thinking field and in particular Organizational Cybernetics (Beer 1979, 1981, 1985; Schwaninger 2006, Espejo and Reyes 2011, Pérez Ríos 2012) to help decision makers to study complex issues with the help of the information and communication technologies (ICT). In it we present a software tool developed within the Systems Thinking and Organizational Cybernetics Research Group (STOCRG-INSISOC) at the University of Valladolid (UVA) that based on OC concepts use ICTs to help groups of people to study complex issues in a collaborative way through Internet. The paper is structured as follows. First we make reference to how OC has been applied to help collective decisions making and show two international pioneering experiences in which ICTs have been used in combination with OC concepts. The purpose in one case was to create a collective scientific book by a group of scientists working at distance and, in the second case, to organize a major academic international event. Next we show an example of specific software developed in the STOCRG through the last 15 years with the aim of helping any size of groups of people to organize debates on complex issues through Internet. In the last part of this paper we present the results obtained with the application of this tool in a real case. We show the results obtained by two groups of people exploring the same issue; having one of

them the support of the above mentioned Internet based software tool and the other without it.

2. Organizational Cybernetics and Group Decision Making

Among the diversity of conceptual tools that OC can provide to help collective decision-making we will focus our attention on Team Syntegrity® due to its value to facilitate those decision processes (Espinosa and Harnden, 2007). "Team Syntegrity® consists basically of a methodology developed by Stafford Beer (1994) with the aim of offering a creative, synergetic and participative platform for studying complex problems…which we might regard as a structured means of creating and communicating a group awareness" (Pérez Ríos 2012, pp.203).

The goals of the TS application can be summarized as follows: "1) To generate a high level of participation among the individuals concerned 2) To provide a structure and a system of communication that guarantee the non-hierarchical nature of the process 3) To benefit from the variety and wealth of knowledge supplied by each individual within the group, putting into practice the synergies derived from the interaction among all its members 4) To create a collective awareness, if possible shared among all the members of the group, regarding the central issue being considered and analyzed" (Pérez Ríos 2012, pp.205).

The main phases in which is structured the process of application of TS are the following: a) Opening question. The TS application process starts when a question is asked concerning the issue to be studied or discussed. This question is normally (though not necessarily) of a general, open nature; b) Explosion of variety (Statements). In this stage, each participant prepares statements he/she considers relevant to the central question. The only requirements regarding these statements are that they can be refuted and are not very extensive; c) Reduction of Variety and grouping. After issuing and grouping the statements, we go on to generate Aggregated Statements d) Assigning topics to people. When the topics for discussion have been identified, it is necessary to determine which persons among the group are going to take part in the debate on each of them. We need therefore to find out their preferences. Once these preferences have been ascertained, this information is

processed with the aid of a computerized assignment algorithm, which tries to maximize the degree of satisfaction in the group e) Generation of content. In this phase the different teams which debate each of the main topics generates the information that clarifies the topic.

In the next section we will see some examples of how TS was used to help two different groups of people to work collaboratively through Internet.

3. Information and Communication technologies and Group Decision-Making: Two examples

The fast development and diffusion of ICTs opened new ways to apply elements of the OC to help people to debate complex issues without having to be necessarily in the same place. Two pioneering examples of this are the Stafford Beer Festschrift Project (SBFP) and the Horizonte 2000 Project.

The Stafford Beer Festschrift Project (SBFP) is the first application in the world of TS, using ICTs. The purpose of the project was to set up a collective study in which over 30 cyberneticians (among them the author of this paper) from four continents and sixteen countries could create a scientific work, revealing the usefulness of S. Beer's different theories for all kinds of organizations and for society in general. The undertaking was carried out between October 1995 and July 1996. Almost all of the work, consisting of both identifying the chapters it would include (12) and drawing up the content (more than 600 pages), was done remotely via Internet. This scientific work has been published under the title: To be and not to be that is the system: A tribute to Stafford Beer, CD ROM (Espejo, Schwaninger et al., 1997).

The second example is the Horizonte 2000 Project. The aim of this project was to promote the cooperation among the universities from Iberoamérica and those of Spanish influence in the U.S.A. The project was presented in the event named "I Encuentro de Rectores de Universidades Hispano-Americano-Filipinas" which, organized by the University of Valladolid, took place in Valladolid (Spain) on 23-27 march 1998. Its purpose was expressed as: "To identify and to start new ways of relationships among the various

Spanish speaking universities. It intends, from 1998 on, to open a new historical period of relationships based upon the equality, democracy and mutual trust. To make it possible and to foster this process the new information and communication technologies will be used." (Almuiña, Pérez Ríos et al, 2000, pp.14-15). The communication system created to make this possible was based on OC principles and it used a software tool created specifically for this event (Iberforo-98 Project). We will comment some details of this tool in the next section.

4. Group Decision-Making software tools. Debates Organizer

Based on OC principles and in some elements of the first phases of the TS approach we initiated in 1997 within the ST and OC Research Group of the UVA the development of software tools to support several phases of the process of knowledge capturing and organization of debates.

One group of tools (based in TS) includes: 1) Software to optimize (maximize participants satisfaction) the assignments (persons to topics) in the physically organized sessions; 2) Software to facilitate through Internet the visualization in 3D of the various TS configurations (view of Topics and Participants, as vertex and struts respectively, in figures corresponding to various groups sizes/configurations as represented by the icosahedron-30, octahedron-12, etc.). Another group of tools was oriented to help decision makers to study complex issue through Internet. Here we will make reference to a software application (Debates Organizer) developed to facilitate the organization of debates of complex issues to any number of persons through Internet (www.debatesorganizer.org).

The advantage of using this Internet modality of debates versus the physical meetings (i.e.: the meetings organized with TS, as mentioned above) is that the persons who compose the group can be located anywhere in space and can intervene at the time that best fits their needs or availability. Another advantage is that a person is not limited to belong only to two specific teams (Topics), as happens in the physical applications of the TS (the two vertex connected by a strut). A person can participate "virtually" in as many Teams/Topics as

she/he likes. Of course there are practical limitations about its number (time availability etc.).

The first version of this software was used in the above-mentioned Project Horizonte 2000 (Pérez Ríos 1998, 2000) to organize the "I Encuentro de Rectores de Universidades Hispano-Americano-Filipinas" mentioned in the Section 3 (See Almuiña, Pérez Ríos et al. 2000). This project financed in part by the BSCH (Banco de Santander), was the precursor of the Universia project created in 2000 by the BSCH. The ICT based software tools used in this project constituted the Iberforo-98 project. One of its components was the software (www.debatesorganizer.org) to facilitate the organization of debates. Let us see how the actual version of this software works. To illustrate it we will use the data generated in the case that, as we describe in the next section, did allow us to evaluate the impact of ICT use in a deliberation process. We will explore the results of a deliberation process with two groups of students. One of them had the support of the software to organize debates while the other group did not have any ICT support.

The organization of a debate starts with the identification of the people who is going to intervene in the process (it can be located anywhere because their activity will be done through Internet) and the configuration of the debate. In Figure 1 (screenshots from the software Debates Organizer) we can see some of the menu options for the administrator to configure the application.

INSERT FIGURE 1 HERE

Once created the debate the first step is the launching of the question that expresses the issue to be clarified/answered. This question was presented to the group as a debate kick-off in the form of a manifesto to the group. The issue/question proposed to the students of Information Science Engineering was: ¿How the ICTs can help to improve public and private organizations?

Once known the question the members of the group had a period of time to generate the statements/ideas that each of them did consider it relates to answering the issue/question

proposed. In Figure 2 we can see one of the screens with a list of Ideas produced by the participants. If we click on any idea we can see a more detailed description of it. Also the software allows making comments to any idea.

INSERT FIGURE 2 HERE

Once concluded the period of time provided for this stage (generation of statements), which can be configured with the duration wished by the organizer, we move on to next phase of "Aggregation of Ideas". Any participant can create an Aggregated Idea (See Figure 3). The software allows selecting just by clicking any number of the Ideas introduced in previous phase, as he/she considers pertinent. Comments to the Aggregated Ideas are also possible. The software allows navigating through all elements (Ideas, Comments, Aggregated Ideas etc.) just by clicking over them. This phase concludes with the selection of the final number of Topics established when configuring the debate.

INSERT FIGURE 3 HERE

In addition to the functionality that the software provides to facilitate the deliberation process described, it also includes additional components to help the organizer to monitor the degree of participation of all team members. Also it interesting to point out that all information generated through the deliberation process is accessible to all participants at any time. The software acts as a repository of all the information produced in all the phases of the process.

In next section we describe the result of the experiment made with the purpose of evaluating the usefulness of the Internet based software tool just described.

5. Collective discussion of an issue with and without ICT support.

In order to check to what extent the use of ICTs may improve the quality of a deliberation process we made two tests with two groups of people. The two groups had a high level of similarity in education and background. They were composed of students of Information

Science Engineering. The first group (Group I) was composed of 17 students, all of them in their final year (fourth) of their Degree in Information Science. The second group (Group II) was composed of 10 students, all of them in their first year of a Master in Information Science that has duration of 1.5 years.

The Opening Question

The "opening question" for both groups was the same: ¿How the ICTs can help to improve public and private organizations?

We think that given the character and vocation of all these students the issue was motivating enough for them. In fact the opening questions to be used was discussed previously with all of them to check what kind of an issue would they prefer to invest the time of the experiment. There was unanimity in accepting this opening question as the one to be answered.

The sessions

The organization of the sessions for the two groups was similar from the point of view of space, lay out, auxiliary elements (overhead projector etc.). The main difference between the two groups was the use of ICT tools to support the process. Group I had no support of ICT. The process (Opening Question, Generation of Ideas, Aggregation of Ideas and selection of the six Final topics to be explored in teams) was done following the traditional way. The generation of ideas, aggregation and selection of the six final topics, was done during a two-hour session. The deliberation and exploration of the six topics content was done in two different days. One day (2 hours) was dedicated to making two iterations and another day (1 hour) to make a plenary presentation of the six teams results.

In the case of Group II, the phases that correspond to Generation of Ideas, Aggregation of Issues and selection of the six final Issues to be explored in teams, were done through Internet along a period of 38 days. The participants had freedom to enter in the deliberation

system when they prefer without any limitation. The deliberation and exploration of the six topics content was done in a 3.5-hour session during which two iterations were made.

The form used to configure the six teams was the octahedron (six vertices and 12 struts). Since the number of students in Group I was 17 we doubled 5 struts. That means that in five of the six topics there were 5 persons instead of four in the team. In the case of Group II, since the number of students was 10 we had to use a "fictitious member" to create the six groups. That means that in two of the groups the number of members was 3 instead of four. As we will see later when comparing the results between the two groups we will see that this difference in the number of persons does not seem to have produced much impact.

The assignment of persons to topics

In both groups we used an optimization software developed in our research group to maximize the degree of satisfaction of the participants with the topics assigned to each of them both as actors and critics according to their preferences. The software provides a satisfaction index, in which 100% means that all participants have assigned the topics number one and number two of their list of preferences. The software allows selecting different criteria to make the assignments but the one selected in this case is the one that tries to put the participants in their preferred topics teams[2]. The degree of satisfaction obtained for the two groups has been 89,3% for Group I and 90,9% for Group II.

The technology

As we have mentioned, the Group I did not have any ICT support. In Group II we did use the software to organize debates through Internet (www.debatesorganizer.org) that we have previously described.

[2] The preferred topics have a decreasing value: 1st choice-6 points, 2nd choice-5 points, 3rd choice-4 points, 4th choice 3-points, 5th choice 2-points, 6th choice -1point.

In previous section we have described how this software was used and have shown examples of various of its screen in which we may see the list of Ideas, the lists of Aggregated Ideas and also the Ideas contained in each of the Aggregated Ideas etc. Next let us see some of the results obtained in both groups.

Results Comparison (Content)

In Table 1 we have a summary of the results for both groups. We tried to evaluate some of the quantitative and qualitative results obtained within each of the two groups. In first place and related to some quantitative aspects, Group I generated 90 ideas (5.3 ideas per participant on average) and Group II generated 48 ideas (4.8 ideas per participant on average). The number of Aggregated Ideas was 8 for Group I and 7 for Group II. In both groups the selection of the six final topics was a relatively fast and straightforward process.

In what concerns the content produced during the physical (teams) deliberation process around the six final topics there is a considerable difference between the two groups, both in its quantitative (number of pages) and qualitative aspects. Group I presented one page for each topic with a, in general, quite simple content, while Group II did present a very elaborated set of topics´ conclusions totaling 22 pages. And in reference to the quality of their conclusions the ones corresponding to Group I were: not focused, quite simple in their contents indicating a rather week effort to reach sound and deep conclusions and with a small number of sentences included in each of the final topics conclusions. On the contrary, Group II did present much more focused and reasonably deep conclusions reflecting an intense effort to produce valuable content and a quite detailed (long) document (22 pages in total) describing their final conclusions.

INSERT TABLE 1 HERE

Results Comparison (Process)

If we shift our attention now towards the process itself rather towards the content produced we can say that in both cases the results were quite positive, but with consistently better results in Group II that in Group I. We used questionnaires with scales (1-7) to measure the degree of agreement with a set of questions related, on one side (12 questions), to how the participants did perceive the degree in which they improved their knowledge about the issue treated (opening question) and, on other side (22 questions), to what was their opinion about the process itself, that means how useful they considered the various phases of the process and the process itself. Most of the questions were answered before starting the process and also after the process was completed. In the case of Group II we did an additional round of questions just after the deliberation meeting but before the plenary presentations of the final conclusions. This additional set of answers did allow us to get some idea about the impact that the plenary sessions made to the group.

Expressed in qualitative terms we can summarize the results indicating that in Group I we observed a significative improvement in the value given to the answers after the process in comparison with the answers to the same questions before the process. And this improvement applies both to the questions related to the level of knowledge about the issue under deliberation as well as to the questions related to the satisfaction with the deliberation process itself.

The same can be said in relation to the Group II, with the additional consideration that the values obtained in the answers to the questions in it were in general higher than their corresponding ones in Group I.

INSERT TABLE 2 HERE

Summarizing the comparison between the results obtained in Group II and in Group I we can say that we obtained consistently better results in practically all questions in Group II

(ICT) versus Group I (no ICT), both in quality of content and in the degree of satisfaction with the deliberation process. In Table 2 we summarized the results obtained for both groups.

6. Limitations of the study

Even the results produced by the use of ICT to support the deliberation process described in this case are promising we must take into consideration some limitations of this study which recommend to pursue farther research in order to confirm these results. Among its limitation we first have to consider the short amount of time dedicated to the deliberation process, especially in the physical meetings. Another limitation is the number of iterations (two) done in both cases. It is recommended to make three iterations for the teams to produce the final detailed content of their topics. Another aspect to take into consideration could be the possible existence of some (even small) difference in the technical level of knowledge between the two groups (last year of a Degree level versus first year of a Master level). Another limitation of the study is that we are dealing with only one sample of two groups. It would be convenient to repeat the experiment with various groups and in different contexts.

Finally it may be useful to mention some of the comments made by some participants, as ware the following. Some indicated that the final topics should be more focused. Others suggested making the iterations more separated in time. Others proposed more time for the role of critics in the teams. A general expressed wish was that of participants being able to intervene in all six topics, not only in three (2 as actors and 1 as critics).

7. Conclusions

The availability of ICTs opens new opportunities to obtain better results when applying systems thinking approaches. While some approaches, as for example system dynamics, have a long experience applying these tools, others did not make yet extensive use of them. In this work we presented some examples in which Organizational Cybernetics concepts

were used in conjunction with ICTs with the aim of improving the quality of collective deliberation processes.

We described a software tool (www.debatesorganizer.org) created with the aim of facilitating groups of people to explore in a collaborative way a common issue working at distance.

In this work we also commented an experiment carried on with two groups of people to check to what extent the use of ICT combined with OC concepts could improve the quality of a deliberation process. Both groups had the task of exploring a common issue of interest to them. We organized the process for one of the groups without any ICT support and for the second group we used the above-mentioned software. We used this tool to support the first phases of a deliberation activity carried out by the group.

Our aim was to evaluate the impact of this ICT tool both in the quality of the deliberation content produced by the group as well as in the quality, as perceived by the participants, of the process itself. The results of this experience show a significative improvement in the quality of the work produced by the group which did use this Internet based software, as well as a higher satisfaction with the whole deliberation process.

To conclude we must say that even the results of this study are quiet promising we have to have into account its limitations. Additional experiments with different sizes of groups and different contexts are necessary to validate the results here exposed.

8. Acknowledgements

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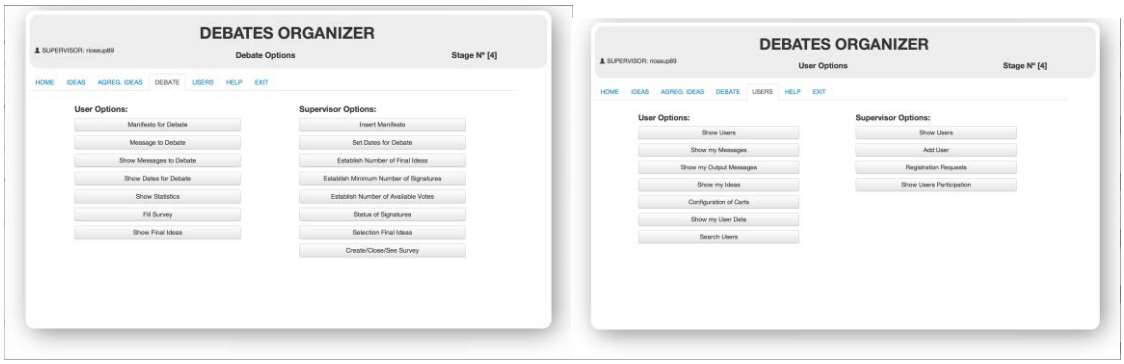

Fig. 1 Debates Organizer main screens (Administrator and Users options)

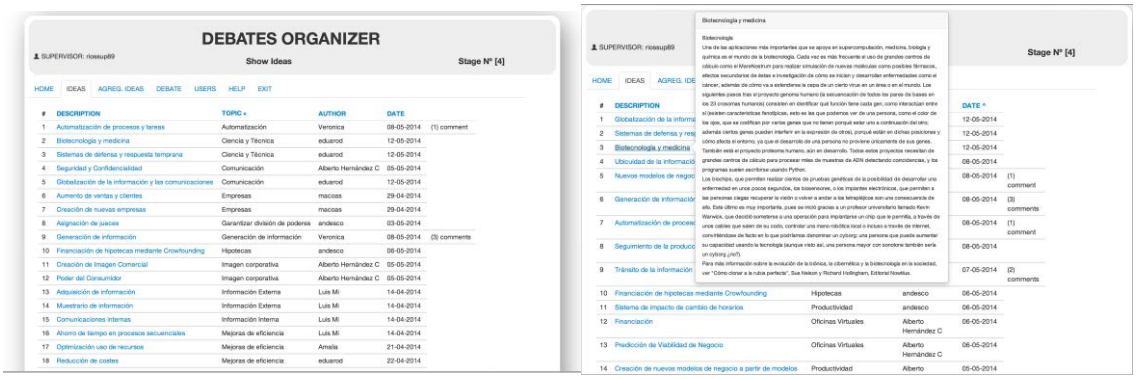

Fig. 2 Debates Organizer (List of Statements/ Ideas)

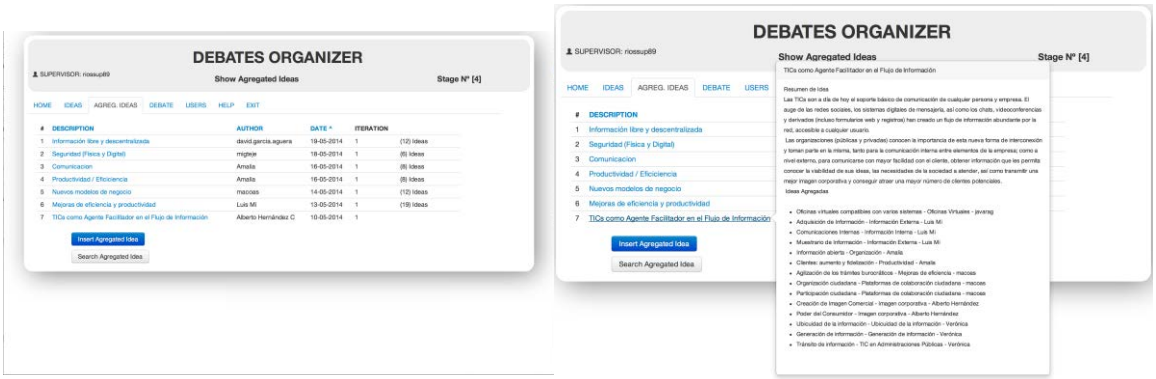

Fig. 3 Debates Organizer (List of Aggregated Statements)

	Group I (No ICT)	Group II (With ICT)
N. Participants	17	10
N. Ideas	90	48
Ideas/Participant	5.3	4.8
N. Agregated Ideas	8	7
Final N. Issues	6	6
Ideas generation and issues (virtual DO)	NA	38 days
Ideas generation and issues (physical)	2 hours	NA
Issues deliberation In 6 teams (two iterations)	2 hours	3.5 hours
Presentation of conclusions for the 6 issues	1 hour	1 hour

Table 1: General data. Group I and Group II

	Group I (No ICT)	Group II (With ICT)
N. Participants	17	10
Satisfaction with topics assignement	89,3%	90,9%
OUTPUT/CONTENT		
N. Ideas	90	48
Ideas/Participant	5.3	4.8
N. Agregated Ideas	8	7
Final N. Issues/N. pages	6 / 6	6 / 22
Content Final output	Not focused	Highly focused
PROCESS		
	After versus before process	After versus before process
Degree of issue knowledge	Significative improvement	Significative improvement
SatIsfaction with process	Significative improvement	Significative improvement
COMPARISON GROUP II (ICT) WITH GROUP I (NO ICT)		
Consistently better results in practically all questions in Group II versus Group I, both in quality of knowledge produced and satisfaction with the deliberation process		

Table 1: Summary of results. Group I and Group II

Networking and Cybernetics: Interrelated theories with Systemic approach

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Summary

Purpose - This paper aims to study an organization under the joint application of two methodologies from a systemic approach to demonstrate advantages of joint implementation.

Design / methodology / approach – It incorporates elements of Social Network Analysis methodology and organizational cybernetics, worked from an ethnographic approach . All this presented as a case study based on fieldwork in the NGO Langar Chile.

Findings - From research conducted, aspects from both methodologies were applied in a complementary way, enriching each other and having matching results. It was shown that both analytical approaches can be integrated into a look with systemic perspective, where social network analysis provides important information on the distribution of power within the organization. In turn cybernetic methodology provides a detailed look at the work of the social group under study.

Research implications / limitations - The methodology examines the organization from synchronic view, where the topography of the system can inquire deeper and the model can be applied to organizational contexts. The research is presented as an exploratory study applied to a particular case.

Originality / value- This paper is a first step of inquiry in the work of both methodologies together. As such, it is presented as an innovative contribution to both cybernetic methodologies as for Social Network Analysis.

Type Paper - Case Study

Keywords - Organizational Cybernetics, Social Network Analysis, VIPLAN.

1. Introduction

This document is part of the context of an investigation being launched around the idea of complementing two theoretical approaches applied to the study of social organizations where systemic view is shared.

From the area of social sciences, specifically from Anthropology, arises in the early twentieth Networks Theory. This approach seeks to make a diagnosis and a parameterization of the underlying social structure in a social group. Moreover, from a current from the natural sciences, Systems theory arises.

For both perspectives, systems are composed by parts which in turn operate as smaller systems and where the whole is greater than the sum of its parts. Within Systems theory has been selected organizational cybernetics development settled by Checkland and Beer.

Thus the theoretical and methodological research proposal aims to complement these two methodological tools, building an approach to work on the strategic development of organizations. And thus provide a more complete support to give its members practical instruments for the fulfillment of its mission and vision.

Fieldwork and information gathering was conducted from October 2013 to September 2014, and was carried out at different stages were combining both methods.

2. Theoretical Framework

2.1 Viable System Model

The Viable System Model (VSM) was developed by Stafford Beer, as a conceptual tool for understanding organizations. The VSM helps to understand the interaction of people in shared communication spaces, whether real or virtual, within a particular structure. Viable systems are those able to sustain an independent existence, having the ability to solve problems by themselves to have the potential to respond to the unexpected. This ability is the hallmark of viable systems, allowing them to adapt and evolve in changing environments.

The idea of complexity is essential in cybernetic thinking. An organization is surrounded by much more complex than can be handled from one to one perspective. This imbalance must be recognized and addressed by strategies to reduce the complexity and thus, enable the organization to respond to this variety within the parameters established and expected answers. Therefore, the complexity of an area is less than that of the entire organization.

A viable system needs to have five functions (systems) keys to behave efficiently in their environment; these functions are: Implementation, Coordination, Control, Intelligence and Policy.

a. Implementation: responsible for producing and delivering products or services to the environment to give meaning to the organization, performing as the core of the recursive model.
b. Coordination: The objective of this system is combining the interfaces between functions that add value and operations of the operating units. These units can be interconnected through production processes, supply chain or simply compete for resources. This may eventually lead to conflicts between units looking forward to use the same means to achieve their specific goals.
c. Control: responsible for managing the operational units within the organization, seeking integration between the sub-systems, an harmonic function and trying to exploit the potential synergies from the interaction between the various operating units.

d. Control is responsible for the allocation of resources between units, and to establish mechanisms for accountability of operational units in order to stay informed about their operation and the degree of fulfillment of goals. Overall systems, (d) and (e) assign objectives to each operating unit.
e. Intelligence: its main function is to deal with the future and the environment of the organization; is the link between bilateral primary activity and the external environment. Intelligence is the cornerstone for adaptation.
f. Policy: is the highest authority within the organization, and is the only one able to regulate the interaction between systems (c) and (d); all unsolved problems in control or intelligence systems must be solved by policy as the highest authority of the organization. The main objective of policy is to provide clarity on the direction, organizational values and purpose of the organization as a whole.

2.2 VIPLAN

In the nineties, Dr. Raul Espejo develops the methodology VIPLAN, using as basis the Viable System Model. This method offers a tool to evaluate and design the structure of a political organization based on its mission, vision, strategy, and values; in other words, the identity and purposes of the organization. Purposes can be attributed to the same organization, and a number of different structures can be relevant.

This paper presents some elements of VIPLAN, applied along with Social Network Analysis. Although there have been major advances in the application of this methodology, only some elements are exposed in order to maintain an appropriate extension and a less diversified complexity.

The VIPLAN methodology consists of five activities:

a. Establishing the identity of the organization: Seeks to define a unique identity of the organization by the broadest possible consensus among those who are responsible for the preservation of it.

It is achieved by:

i. *Name organization:* Phrase who allows identifying the viable system in focus, as shared as possible by its relevant components. The statement should be read as follows: "a system (context), which makes (x) by (y), to obtain (y)".
ii. *Characterize Organization:* Discussion focused on determining the various factors involved to form properly the organization. It is done according to the mnemonic composed TASCOI: What *Transformation* input is converted into which output?, Witch *Actors* are involved in carrying out the activities that bring transformation?, Who are the *Suppliers* of entries processing? Who are those who receive the outputs of the transformation as *Customers*? Who *Owns* the system and has an overview of the transformation? Who acts as an *Interventor* from outside, defining the context for the transformation of the system?

b. Structural model (organizational boundaries): This study brings together all those technological activities necessary to perform the transformation defined in the Organizational Identity System. The sum of technological activities defines the boundaries of the organization.

c. Structural model in levels (structural recursion): The purpose of structural modeling is to begin to examine the "separate pieces" of complexity that are central to the oganizational strategy and how this works.
d. Distribution and discretion model (centralization / decentralization): Searches to relate regulatory activities with those defined as primary in the organization. To achieve a recursive distribution of responsibility that is consistent with control and adaptation. Thus, the commitment to autonomy and discretion is defined for those responsible for regulating the primary activities.
e. Model of organizational structure (structural mechanisms): Once the balance between the levels of autonomy of operations and discretion in charge of your system is done, it only remains to define and model the regulatory mechanisms to enforce the regulatory action. Regulatory mechanisms are two, the Adaptation and Monitoring-control.

2.3 Social Network Analysis

Network theory presents an approach where theoretical, conceptual and methodological devices are closely related, support and sustain. It is an innovative approach as emphasizes the relationships between individuals, watching over the structural attributes of the subjects. From this perspective poses a systemic approach; and proposes a paradigm shift, because instead of focusing on the characteristics of people seen as a measurement unit covers link or relationship to understand the social framework (Lozares, 1996).

Social networks may be described as a well-defined set of actors linked to each other through a relationship or a set of social relationships. Wasserman and Faust (1994: 17-20) work the fundamental concepts that constitute the basis of networks, and limited to the following:

a. Social actors: are social entities subject to links of social networks. (individuals, enterprises, social collective units, departments in a company, public service agencies in the city, states, etc.)
b. Relational ties: are the links between pairs of actors, unit of analysis in social networks.
c. Dyad: is the specific relationship between two actors, including their relationship.
d. Triad: The set of three actors and their relationships. Allows the analysis of balance and also consider transitive properties.
e. Subgroup: is an extension of the above concepts. Subset of actors is any subset of actors besides the links between them.
f. Groups: social networks also have ability to model relationships between actors, called group systems as a set of all actors on which ties are measured .

There are two criteria that guide, intuitively, the analysis of node relationship within a network. *Subjective cohesion*, in a relational perspective, observes association of group members with their group, with the understanding that individual interests are tied to the interests of the group. Objective cohesion linking, from a positional line, is considered an objective observable process independent to individual's feelings (Ritzert, 1992, 1993).

The essential phenomena of social networks, and therefore also the focus of analysis is essentially threefold: the limits of networks, ties and behaviors (STRUCTURE, version 4.2 in

Lozares, 1996). And the principles that correspond to models and criteria for analyzing these phenomena are - besides the cohesion and structural equivalence linked to the above criteria - the prominence, range, and brokerage.

These principles define the different types of interpretations that can be given of social phenomena from social networks. Each principle implies a structural intuition associated with an implicit motor inside the behavior and beliefs of the social group observed in an image.

To characterize more precisely a network and its components indicators can be used to facilitate the analysis. There are some of them that analyze the entire network and others evaluate each node. This way you can understand better who has greater weight in the network. Velasquez and Aguilar (2005) review in their manual key measures or networks indicators;

a. *Density.* It shows the percentage value of the network, pointing out hi or low connectivity in the network. Density is a measure expressed as a percentage of the ratio between the number of existing relationships with all the potential ones.
b. *Centrality degree.* Corresponds to the number of actors to which an actor or node is directly attached (percent).
c. *Centralization.* It is a special condition in which an actor plays a fairly central position to be highly connected in the network, where nodes need to go through the center to connect with others.
d. *Brokerage.* It is the ability of a player within the broker network communications between pairs of nodes. These nodes are also called bridge actors.
e. *Proximity.* It is the ability of an actor to reach all nodes in the network. This is calculated by counting all the geodesic distances (shortest distance) of an actor to reach others.
f. *Eigenvector centrality.* This indicator measures the recursive centrality, ie, the relationship between a node and the actors with greater centrality in the network. So, looks at the "neighborhood" related to an actor, whereas those with higher centrality are more influential than others. (Monsalve, 2008)

3. Methodology

This research took the form of research-action, where was sought to link the experimental approach to social science with particular social problems. This model was first proposed by psychologist Kurt Lewin (1944), and is developed by Lawrence Stenhouse, Gary Anderson, Carr and Stephen Kemmis.

It is intended to simultaneously treat knowledge and social change, so that practice and theory understand together social problems that emerge in usual contexts, moving toward the analytical and philosophical approach.

The cybernetic perspective and social networks methodology were complemented with a qualitative ethnographic approach where participant observation and semi-structured interviews were conducted. This approach has its origins in phenomenology, symbolic interactionism and ethnomethodology. It is characterized by looking at the phenomena from a holistic perspective, seeking to achieve the full content and not just parts of it, seeking to describe in depth to capture and reconstruct the meanings associated with experiences and behaviors.

In particular, the case study methodological approach aimed at analyzing contemporary phenomena characterized by the existence of fuzzy boundaries between the phenomenon and its environment. This also means that there are many more variables of interest to observational data (Yin 1994).

The methodology incorporated Social Network Analysis tools to the "Methodology for Strategic and Structural Development of an Organization" , given by Professor Dr. Pedro Arregui Narvarte. This methodology is based on the active participation of organization members in different workshops. The following shows schematically the general steps followed in the investigation

a. Step 1

Identification of the Organization: Performed by a historical and one current account. This gives an overview of the NGOs in general: how was created and why, what are the main lines of work, equipment and current situation.

Within this step two social network analysis tools of were incorporated;

Sociogram: Considered as a character sociometric technique, measures the social relations among members of a group, where its elements are known, have common goals and influence each other. Graphically represents relationships through points (individuals) that appear linked by one or more lines (inter-relationships).

Sociocentric networks: is presented as a more or less accurate analytical and methodological concept and procedures to facilitate the collection of data and the systematic study of patterns of social relations between actors (Freeman, 1992).

b. Step 2

Organization diagnosis: SADF tool was used to understand the projected feelings towards the NGO by its team, including Satisfactions, Aspirations, Dissatisfactions and Frustrations. In addition, sub groups were formed based on sociocentric networks to deepen information on semi-structured interviews.

c. Step 3

Organizational Identity Construction: through *Identity* and *Mission and Identity as characterization* concepts, a better definition of the NGO was achieved. For the first concept Identity sentence was used: (X) (Y) (Z), which captures the interaction of the relevant stakeholders and gets their image on the organization. The second was held with the help of the mnemonic tool TASCOI, which allows meeting new organizational elements. Both tools work performed in groups, following the same foregoing structure.

4. Results

4.1 Identification of the Organization

a. Historical Narrative and Legal Framework

The May 25, 2003, 2 men, students of the teachings of Yogi Bhajan had the same inspiration; to cook together and deliver food to the homeless people who sleep next to the fruit market in Santiago de Chile (central Vega). The work began handing out cheese sandwiches and tea there.

After a while, it appeared the opportunity to prepare meals in the Chilean Academy of Yoga, which meant a change in the manner of operation of the group. Cooking duties were defined and centralized purchasing of inputs.

On May 25 in 2008, takes effect an assembly in order to legally constitute a private corporation, nonprofit, called "NON-GOVERNMENTAL DEVELOPMENT ORGANIZATION LANGAR CHILE". The meeting was chaired by Nicolas Maza Honorato, and Raul Peña y Lillo Thiek served as Secretary. The institution doesn't have bylaws or articles of incorporation, only a Decalogue that regulates the activities of distribution in the street as a security measure.

The earthquake in Chile in 2010 was a milestone in the history of the organization. Then, with the financial support of United Sikhs kitchen was organized to deliver food in Tejas Verdes camp. There were the new volunteers who allowed the accomplishments that year as: website, Solidarity Dinner, submissions to competitive funds. This helped to consolidate a more corporate and professional image and that same year the current account in the bank is achieved.

The spontaneous emergence of local versions of Langar (Viña del Mar and Osorno) gave the opportunity, at the dawn of the 10 years of Langar Chile, to acquire a role of support and help to new instances, leveraging the resources provided by the institutional as NGOs. This year 2014 an emergency group has been activated again in Valparaiso to help victims of the fire that occurred in late April.

b. Story of Today

Langar Chile is an NGO that operates on donations and volunteering. It works with a network consisting of a president, treasurer and secretary of directors. In addition to the management team, there are certain charges related to the everyday functioning of the NGO.

The NGO works in an office where a cellar and the kitchen are rented. All things are saved there and group comes together to cook. It also works as the meeting point to start and finish the work of distribution.

Langar team works every week in three shifts. The first shift meets every Thursday at 16:00 and cooks. Then, between 18:00 and 19:00, runs the linkage turn. This group leaves all washed up and prepares all things to distribute food in the street. Then around 21:00 joins the group of volunteers who will distribute food. A blessing of the food is made, and then the 3 groups that target each of the distribution points are armed.

In addition to the work that remains week to week, Langar Chile is activated when certain emergency situations occur. One example was the earthquake of 2010.

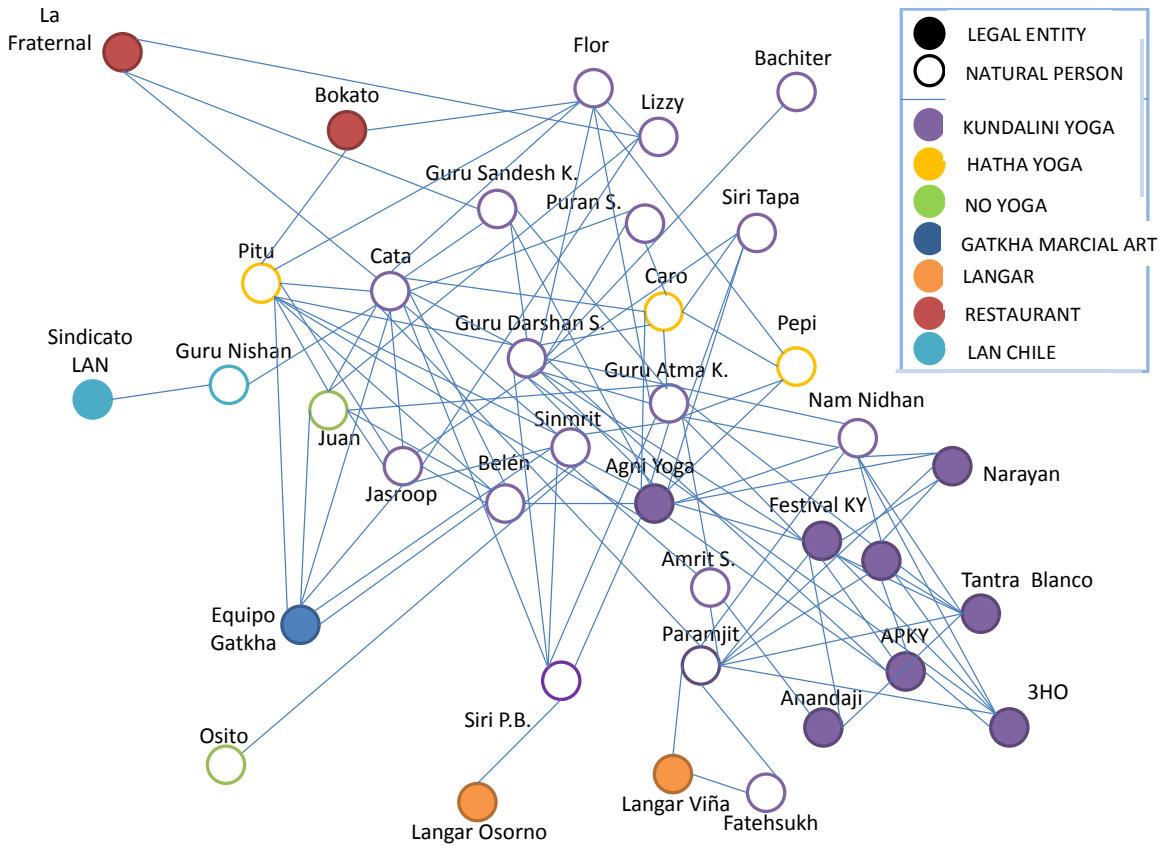
Langar resources are derived mainly from donations. There are NGO partners who donate every month. In addition the pilots' union of LanChile donates in products every month.

There are certain instances by Langar organized to raise money for the NGO. An example of this is the benefit dinner that takes place every year. There are also certain activities that bring the Kundalini community where Langar is present selling items, attracting partners and in some cases organizing certain aspects of activity.

In addition to the work of the NGO in Santiago, there is a group that distributes food in Osorno every Thursday and one in Viña del Mar every Wednesdays. Both bodies have been formed by Kundalini yogis related with Karma Yoga.

c. Organization Sociogram

The research began with regular meetings with the management team of the NGO Langar Chile. During those meetings, they talk about the aspirations that members had regarding the organization and began to build a Sociogram.

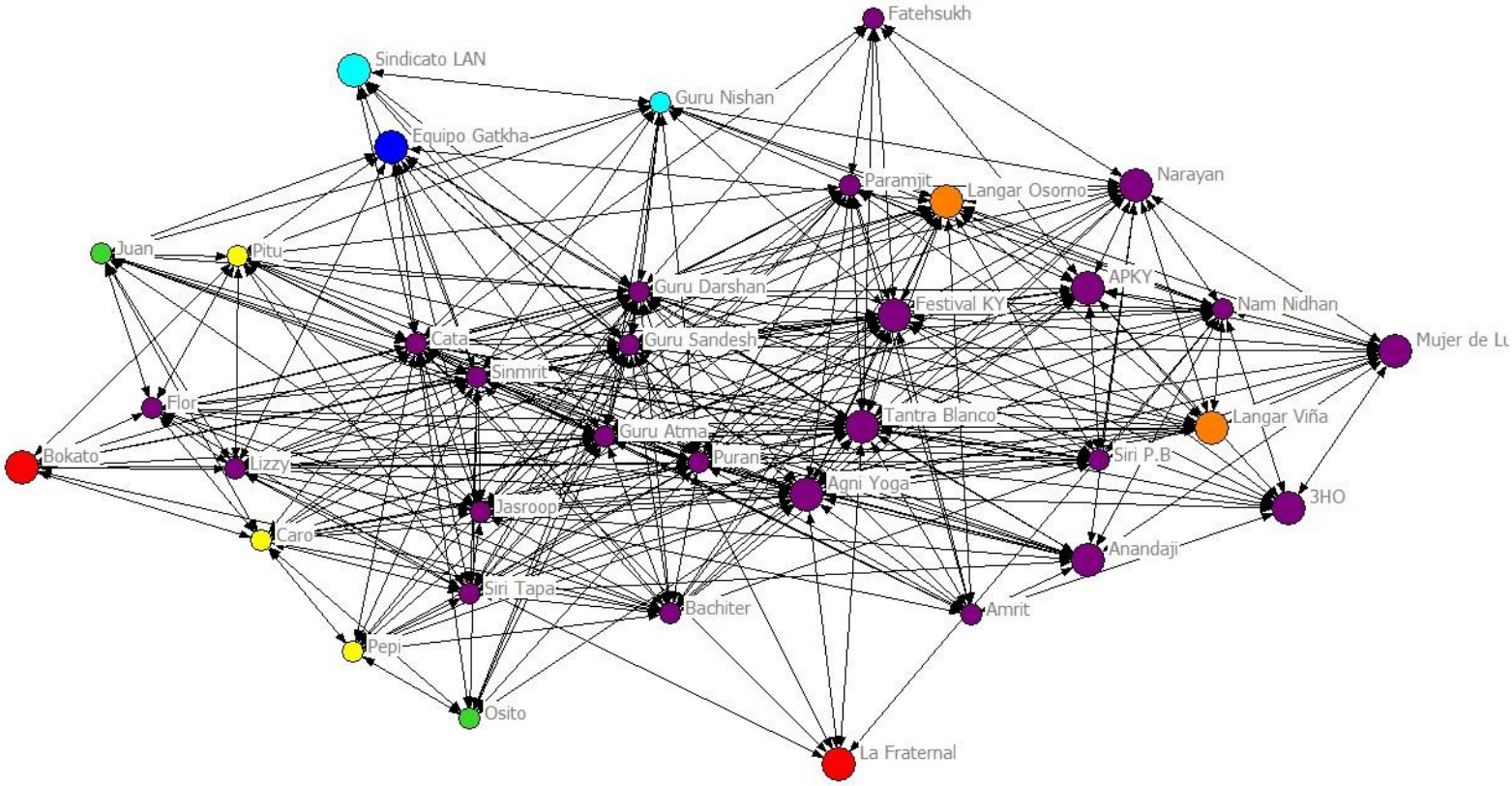


1. Langar Chile Sociogram

Within the categories listed can be seen that the group of Kundalini Yoga is the most representative while occupying central locations. At first glance one might say that the NGO has quite dense internal networks where you can see a core group. Finally organizations that do not correspond to Kundalini Yoga appears more distant to the central core of the sociogram.

d. Langar network and selection of core group

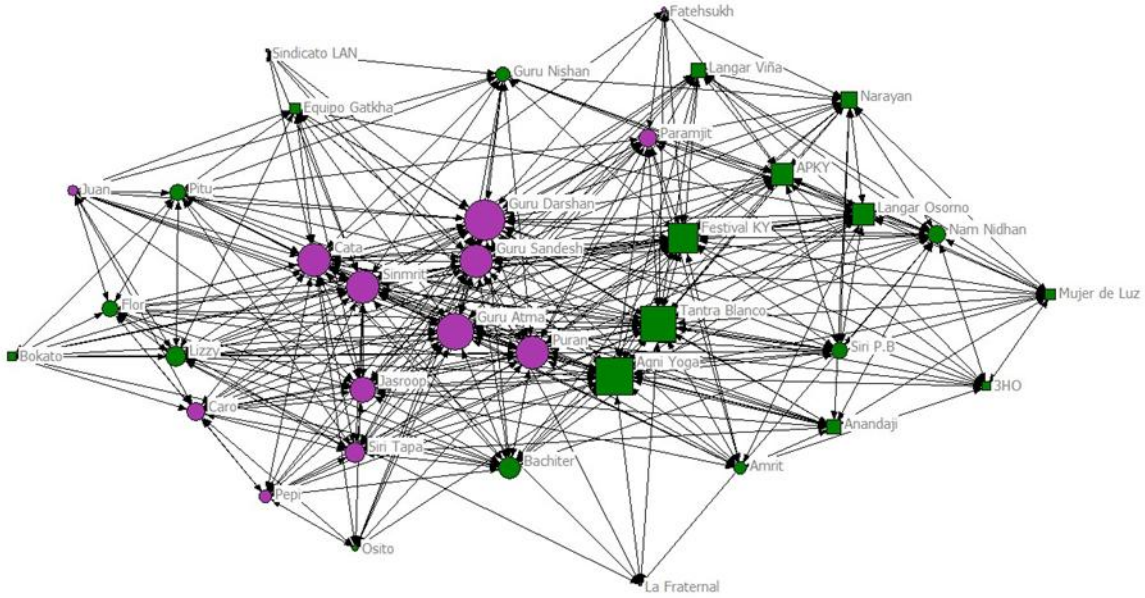
From the information gathered in the construction of Sociogram a first sociocentric network was performed. As can be seen the network shows many similarities with the previous Sociogram. The relationships observed denser; individuals and institutions linked to Kundalini Yoga are in central locations in the network. Langar Osorno and Langar Viña are also incorporated into central locations, and this can be explained because both are formed mostly by practitioners of Kundalini Yoga groups.



2. Langar sociocentric network

4.2 Diagnosis of the organization

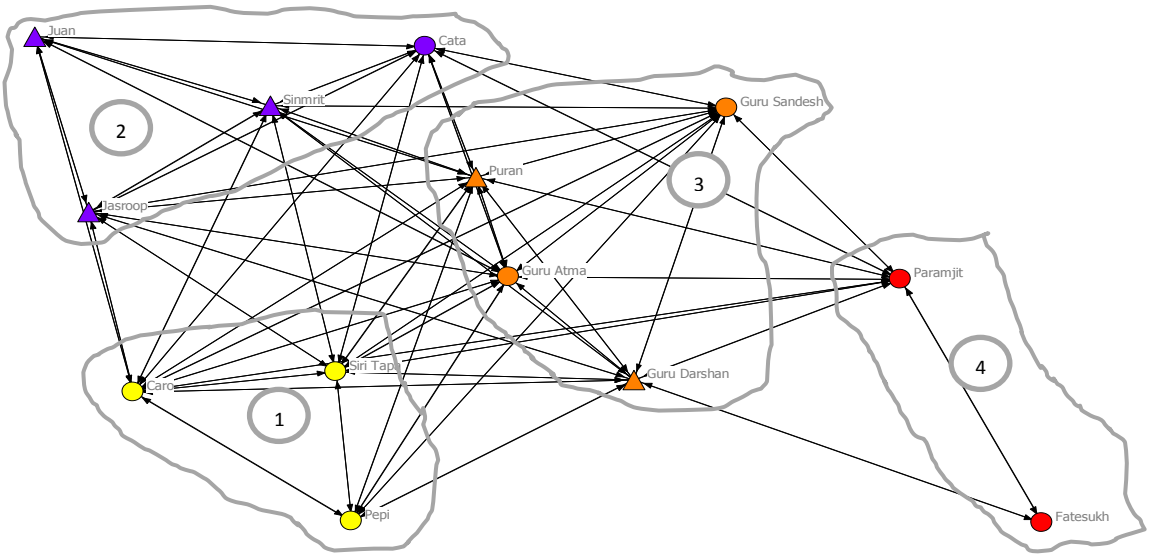
From the central tendency measures of this network, there was a group of 13 members selected to continue the research. This group added two team members from Langar Valparaíso who are not in a central position, however it sought to incorporate their perspectives in research. Then in the diagram are actors who were selected as a sample for further investigation. (in purple)



3. Sample group

a. SADF

We worked with the selected group applying organizational cybernetic tools at different stages. We began applying SADF to the sample group throughout the annual meeting of members. From the application of SADF certain differences in the assessments of the instrument, especially those associated with dissatisfaction and frustration were identified. Many assertions with high scores and high standard deviation were presented. For this reason it was decided to work in group interviews. To do this we construct a second social network according to the indicated sample, from which four working groups were selected. In diagram, men are represented by triangles and women by circles.



Satisfactions

Within the satisfactions associated with Langar Chile membership, ideas associated with service from simple and concrete goals appeared. The personal satisfaction of serving constitutes one of the strongest elements, doing it with joy and love.

There is the satisfaction of every week work and more ambitious goals such as emergency situations. Langar is a space to share with others, as well as fellow volunteers and homeless people. This link is the most important, since there is the possibility of equal treatment to people who are apparently removed from society.

Aspirations

A series of aspirations related with internal projections of NGO development were presented. Ideas like professionalized activities are more ambitious goals; fluid communication channels, organized emergency team, more methodical roles and certain paid charges within the institution. Related to this there is a need to have an independent place and to open a dining area to deliver food to people who need it.

There are also certain aspirations related to growth or expansion of the NGO; replicate Langar model in other cities, creating links with other public and private institutions, increase the number of volunteers.

Among those aspirations with some divergence is the idea of diversification of the work. Some members want to carry out a project that covers most areas of vulnerability and other vulnerable people (disabled, elderly, abused people); while others think it is more important to grow in the efforts already made and strengthen NGOs.

The average score values are between 3.5 and 5 (of 5). If the averages are calculated per group some differences can be found between the steering group and the others. Is the case of generating waged labor inside the NGO, were management team has a lower average score than the rest.

Dissatisfactions

Within the dissatisfactions there are several ideas associated with the lack of internal structural organizing. Lack of established roles, beyond certain persons performing activities is the principal. This does not allow roles being defined by specific activities, there's only people who display certain activities. It is therefore considered a reason why the group does not advance organically. This element, although it is perceived by the management group, is lower scored than the other groups.

Related to structural problems, lack of professionalism in the NGO is considered unsatisfactory. There are no statutes, donations certificates and expeditious communication channels to be feasible or optimize performance.

Finally some quarrels appear as a problem group. This is seen as an element that hinders the well-being and functioning of NGOs. In the case of the steering group (3) and its closest group (1) in the network, is perceived as less unsatisfactory than the rest.

Frustrations

In the category of frustrations is where greatest divergences appear, represented by several assertions with significant standard deviation are presented. In some cases certain shared ideas were found in interviews, but not all represent frustrations - as they simply are perceived dissatisfactions or uncomfortable features related to Langar.

Group identity appears as a frustration; while it may be considered positive in many cases, in others it becomes exclusive and generates segmentations with volunteers who are not included in it. On this issue the management group perceives the situation in a less negative way than the rest.

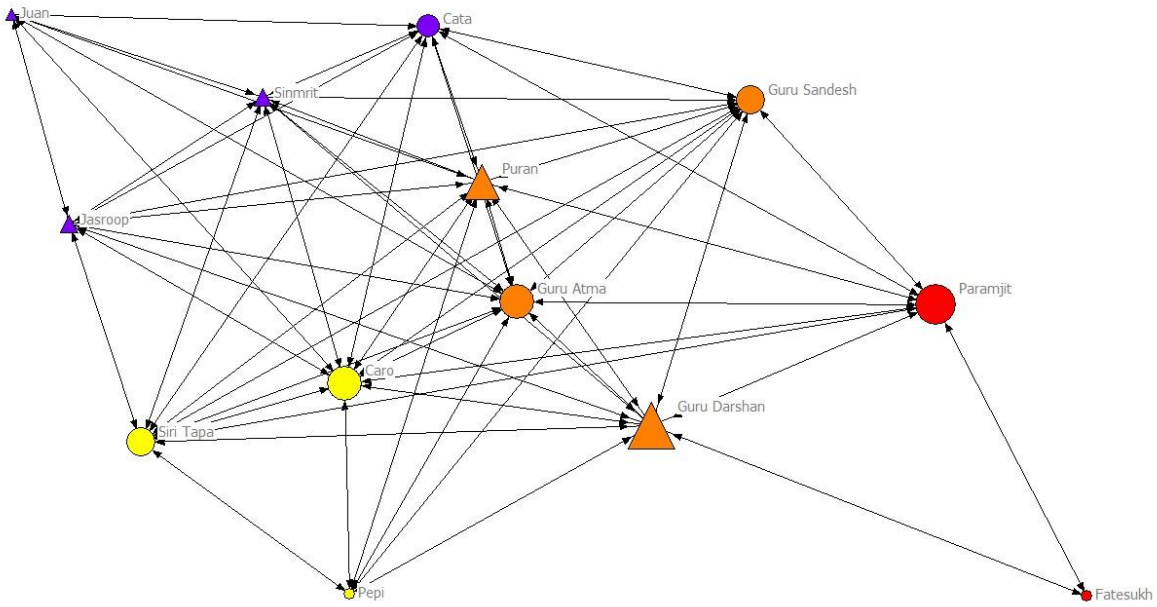
On the other hand there is a significant gap identified in the daily functioning of the organization, between those who perform operational activities in the NGO and its directory. In the case of this frustration there is a marked difference presented between group 2 - with higher score (5) - and the other groups (values close to 2.5). While this group actively participates in the NGO daily operational tasks, has the highest average in satisfaction response associated with Langar.

Lack of inclusion and segmentation within the NGO, is perceived as less frustrating in the case of management group- 3- and group 1 (which is closest to it in the network).

b. Social Network Analysis

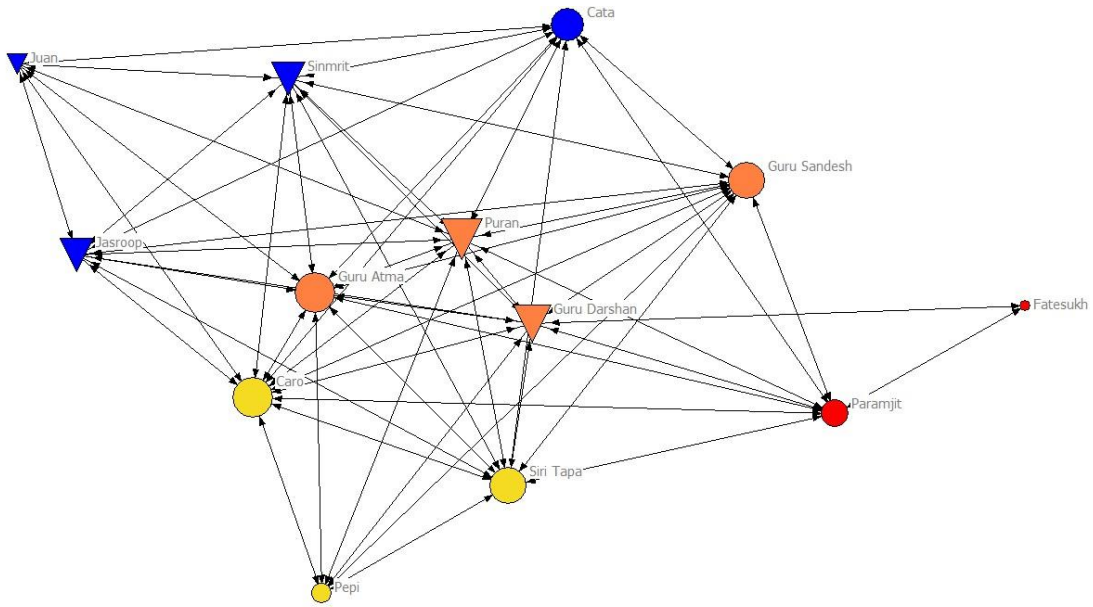
In terms of the indicators, Langar partner network has a density of 59%, this means that there are 59% of the total possible relationships that might exist if all nodes were connected to each other. By observing the network we can say is centralized at group 3 corresponding to the executives or managers, those nodes that have more links are mostly part of this group. This implies that this group focuses more real power related to mobilizing resources within the network.

Below you can see brokerage indicator on the graph. Regarding this measure appears Guru Darshan as a central mediator of network, the president of the NGO. In the second place appears Guru Atma, which also belongs to the steering group. There are several actors that play secondary intermediation roles (Jasroop, Sinmrit, Siri Tapa, Puran and Caro). Finally there are 4 people on the network who doesn't mediate relationships (John, Guru Sandesh, Fatehsuk and Pepi). It can be seen that in each group exists at least one node that is mediating the other groups. This accounts for all brokers reported, which are equivalent in the groups and involve important sites within the network.



5 . Brokerage

In terms of proximity, nodes that are better able to reach the other actors in the network are, in descending order: Guru Atma , Guru Darshan, Puran, Caro and Siri Tapa. The first three are part of group 3 and the following of group 1.



6. Proximity

Looking at the scores of this parameter can show that group 1 has more relative closeness degree to the core group than group 2. So it appears that this sub graph shows similar trends and is near to steering group. It clearly shown that group 4 is far from the rest. This group corresponds to Langar Viña del Mar members of who participated in the research.

Measuring eigenvector centrality within the network located Guru Atma as she relates to the most influential actors in the network. Secondly; Puran, Caro and Siri Tapa appear with equal

scores. This accounts that both group 3 as 1 are strategically connected within the network in terms of "neighborhood".

4.3 Construction of Organizational Identity

Identity Sentence

Identity exercises were performed in subgroups armed as the categorization based on the social network sample. The results of the exercise are presented for naming systems, where participants were asked to name the organization that they aspired to have.

In the NGO work appears the concrete vision as serving food or providing social assistance, and others associated with the idea of service. Only in the steering group the concept of Karma Yoga is developed on the speech. For others it ranges from ideas like "serve the world", "self-serving", and “seeks to provide support and social integration."

Thus, the ultimate aim of the NGO is not perceived equally by all groups, even when it always maintains a sense which is common. You can identify concepts and ideas as "social assistance", "contact with people on the street", "sharing life experiences," "include people outside the system." They allude to the ultimate goal of Langar Chile; give dignity to homeless people.

In addition, for the steering group the purpose of Langar is to expand the teachings of Karma Yoga. Teaching people the value of service.

TASCOI

Transformation: Within transformation category it is identified that there are many levels considered as generating a transformation. Langar transforms society while promoting reflection of basic needs that state does not cover. It transforms beneficiaries who are fed each week and create a bond with the volunteers. And volunteers are transformed in their awareness through selfless service, placing them in reality. Thus, elements emphasis varies depending on the group that is questioned.

Actors: Depending on the group interview, the variety of actors that were identified. All groups identify volunteers; in some cases steering group was identified. In some cases also the Masters or Gurus who are behind the work of Langar in origin were named, with the understanding that they accompany and support this service in some way.

Suppliers: Suppliers or permanent donors are identified. Agni Yoga Center was also considered as a provider, because is the place where most Langar Chile events are held.

Customers: There are two types of customers, those who receive food from the NGO and those involved in it. Those who receive food are vulnerable people, homeless and those who have problems because of some catastrophe.

Those who participate as volunteers of the NGO are customers from the perspective of Karma Yoga. Since serving others is serving yourself, they practice this type of yoga and are also considered customers.

Owners: Three types of owners who are at different levels were appointed. Founders and / or directory are at the individual level. In addition; all who participate actively in the Langar. As a macro level, it belongs to Guru Amar Das (Sikh Guru who invented Langar in India) and his lineage.

Interventors: different types of interventors were identified; in a domestic level the sub groups formed within Langar. This is not considered by the steering group.

Schools and other organizations (especially associated with churches) can be considered new entrants as they go hand out food to homeless people. On the other hand in times of winter, state shelters that receive some of these people.

In terms of government agencies, while there is no intervention, the possibility of it is identified. In this case they named; health service SESMA regulation, the Health Ministry, Social Services Directors, Internal Revenue Service – for donations themes - Justice Ministry and police investigations - PDI.

Other interventors may be different Yoga centers and Langar India.

5. Analysis of results and discussion

There are some overlaps from the results given by different methodological tools. In the case of SADF and semi-structured interviews with sub groups formed from the network, it was observed that there are certain topics where appears different perspectives or some variation depending on each group. In general there is agreement regarding satisfactions and aspirations, and greater dissatisfaction if disagreements and frustrations.

Regarding the content analysis of the group interviews it was observed that the speeches of group 3 and group 1 are closer. At the same time if the indicators observed in the analysis of these networks and groups appear more akin to similar measures.

In identity exercises, there are certain nuances that provide distinctions. One of them, which appear most, has to do with the objective of NGOs associated with the selfless service - or Karma Yoga, as it is called by the board of the NGO. For this group Langar is for Karma Yoga, while the other groups considered the service element, Langar has a specific goal related to emotional support and deliver food to those who need it.

On the other hand, in the TASCOI tool, some consider the internal transformation of who volunteer at the NGO, and others watch it from the perspective of beneficiaries receiving food. In what has to do with Interventors, the only group that does not identify domestic competitors is the steering group.

By analyzing the contribution of mainstreaming cybernetic and networking methodology, it can be said that the main input is related to the observation of power concentration within the organizational system. The central power groups have matches to the most controversial SADF dimensions where differences are observed between the sub-groups.

That shows some communication difficulties and conflict of divergent interests among certain sub-graphs. What is also based on an analysis of indicators in the network, were each sub group weight is reflected on its relation to the rest of the network.

6. Conclusions

From a systems approach, it was found with this research that methodologies worked together with complementary and consistent matching results. From this perspective it can be said that this study is only an exploratory perspective on this matter, and that there is a way to deepen on it.

The cybernetic approach complemented with social network analysis has several advantages as it enriches the characterization of the system and provides a topography that allows the analysis of power. Thus, under the analysis of the centrality measures or indicators in the network can have quantitative information on who have more central locations, who mediate and concentrate more links.

By observing the network of a system, inner working can be understood in a more profound way. Having information on the affinities within the group may recognize subgroup that doesn't always appear clearly when the organization is seen as a system.

Knowing this information allows strengthening relations affinity and / or existing work. It may guide decisions regarding the operation of the organization or restructuring role definitions.

The research makes a contribution in relation to the case study associated with Social Economy in Chile. From this perspective presents the application of a cybernetic methodology to deliver elements to make certain contributions to the NGO and restructuring Langar Chile.

Undoubtedly the most interesting contribution has to do with the incorporation of both methodological approaches, and this has been shown to be integrated in a coherent and enriching way. No doubt there are many remains to deepen and refine in the subject, and this research is only a first step. A more comprehensive survey would better networks complicate the social structure of the organization, and give out more information on the flow of resources in the network.

These elements have been better understood and related thanks on qualitative deepening that although it has a secondary character, proved invaluable when relating the results of the cybernetic approach and networking.

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Construction of a cybernetic model for the management of the socioecological system of Lima metropolitan

Aldo Mallma Granados
José Antonio Villa Guerra

1.- Objective

This project is an approach of the environmental problem in Lima Metropolitan, from the perspective of the management of the socioecological system of the city, in order to become it viable.

2.- Background

The city of Lima has suffered an accelerated population growth (graph 1) over the last decades, this was a consequence of the migration phenomenon from the provinces to the capital city.

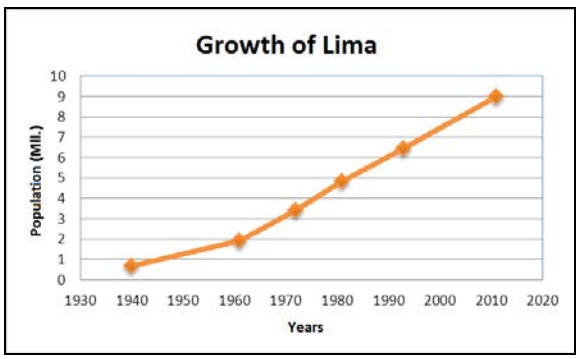
The magnitude of this migration was not part of any previous design of the city, so the growing was happening in a chaotic way without policies to set the new citizens areas and, what is more, without planning to preserve natural areas for the city.

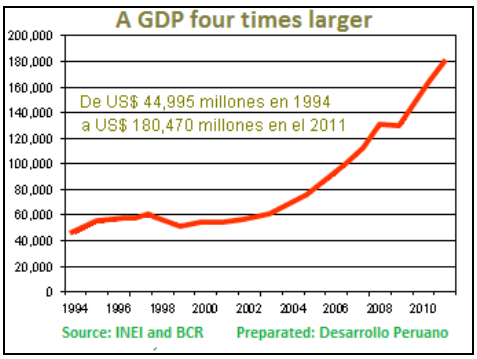
Across the years, this new Lima, also began a chaotic industrial and commercial development, factories were set in anywhere available area impacting all their environment. At the same time, something similar happened with the vehicle fleet that has become the first factor of the environmental pollution of Lima.

The mentioned factors, all together, with the world process of global warming has put a Lima in a very vulnerable situation to the climate change effects, mainly to the water scarcity.

At national level, the central government has become aware of the damage in the environment and in the last years has started actions to stop the pollution through a national environmental policy which includes controls in the industrial sector, besides a environmental educational policy to impulse the ecological awareness.

These policies have been basically national guidelines but they have not been replied or directly performed at local level to make them respect effectively.





3.- METHODOLOGICAL FRAMEWORK

In a complex environment as previously we have pointed, with a diversity of actors and subsystems with different purposes like the socioeconomical and the ecological, the Science of Systems and the Cybernetic Organizational were found as the methodological framework that better fits to approach the structural problems of the organization, the control mechanisms and the general principles to reach the viability of the management system.

Under this framework, the approaches of the professor Raul Espejo with the VIPLAN and the approaches of the professor José Pérez Ríos in designing and diagnosis of viable organizations; both were taken to lead us to a structured development of the viability concepts for organizations.

Finally, according the latest investigations, the Dynamic Systems was used as a methodological complement of the Cybernetic in order to build the model of the Total System and; beside this, to get a feedback through the sensitivity analysis that allows to verify the structural consistency of the model and the mechanisms of viability that were designed.

4.- Definition of the System

The TASCOI technique was used to the definition of the System, in order to identify what the system does or what it should do, besides this, external references and specialists were consulted to limit the system, to understand it and define its objectives.

MISION	VISION
To maintain the socioecological balance of Lima Metropolitan trough policies, programs and services that allows a sustainable social and economical development.	To Lima Metropolitan become a city with ecological culture where every social and economical initiative harmonizes with ecology.

The set of processes which define the reason being of the system were the following:

- Protection and Water Recycling: This process is oriented to rationalize the use of water, to protect the reserves, and the development of wastewater treatment and the water recycled reusing.
- Solid Waste Management: Process in charge of the recollection, treatment, disposition and development of solid waste recycling.
- Protection of Natural Areas: This is the responsible of the maintaining and looking after natural habitats and biodiversity as so as the urban natural areas.
- Air Quality Management: Process that rules, supervises and measures the impact of economical activities on the air.

5.- Present Situation of the Architecture of Viability

As follows will be described the present situation of the five subsystems of viability of the management of the socioecological system of Lima.

Subsystem One

- Protection and Water Recycling:

SEDAPAL (governmental institution responsible of provision of potable water and its final disposition) is in charge of the management of this process, which is focused mainly on the coverage of the service and in the rationalization of its use, but only at residential and industrial ambit, not considering the agricultural sector, and finally, another issue is the insufficient impulse on water reuse.

- Solid Waste Management:

  This process is deployed in a decentralized way to district municipalities, being successful in the solid waste collection; nevertheless, the recycling is not very developed because the lack of a provincial strategy that allows cost synergies and the planning of long-term and short-term projects to develop the solid waste industry as it is for example in Brazil.

- Protection of Natural Areas:

  Lima has very few natural areas which are looked after by the Municipality of Lima and they are pretty safe in this way. The problem is in the green spaces and in the arborization that are managed by the district municipalities where the average is in 1.5m2 of green space by habitant; meanwhile, the international standards have set the optimum between 8m2 and 15m2.

- Air Quality Management:

  This process is controlled and ruled even by three different institutions like they are: DIGESA (Dependency of the Environmental Ministry), the Municipality of Lima and Transport Ministry. The key issue in the air pollution is the contamination by the automotive fleet (86% as Environmental Ministry reports), which could not been solved in an integral way by the mentioned actors.

Subsystem Two

Lima Metropolitan does not count with an institution which represents the subsystem two, this is a consequence of a separated management in the Operational Units, where the owners of each process, have objectives to some extent unrelated to the environmental matter. What is pointed does not limit that in singular projects or works exist the deployment of the coordination function.

Subsystem Three

As in the case before, it does not exist an entity which represents the subsystem three, nevertheless, the Municipality of Lima with a vision more social than ecological, manages the majority of processes described previously, but not in an integral way nor with the necessary authonomy for a successful management.

Subsystem Four

Even though there are not identified all the functions of this subsystem, we can find many entities that perform part of the intelligence function in an isolated way, like they are the “Instituto Metropolitano de Planificación”, the “Subgerencia de Desarrollo Institucional” of the Municipality of Lima, among others. But, almost in every case, the function is done more in a reactive way than preventive one; and, what is least, there are not works in simulations or prospectives that help to the viability of the system.

Subsystem Five

Nowadays, there are at least three entities in Lima Metropolitan which performs the function of defining policies and the socioecologial vision of the city, like they are the Environmental Ministry, SEDAPAL, and the Municipality of Lima, which works in an isolated way and overlapping functions with very little coordination.

6.- Viable Model

6.1.- Architecture of Viability

Different structural models were made after the used of the TASCOI method, in order to have a more detailed vision of the system processes, like they are technological, geographical, segmentation and finally the causal model, which allowed identified the operational units (subsystem one) and to understand the whole system in itself.

Finally, with the methodological framework of the professor José Perez Ríos, the rest of subsystems were designed with their respective channels of control and communication.

6.2.- Application of the Intelligence Function

The climate change acceleration urges to prevision the future and to change the current way of management; it other words, it means the application of the intelligence function in the viable architecture.

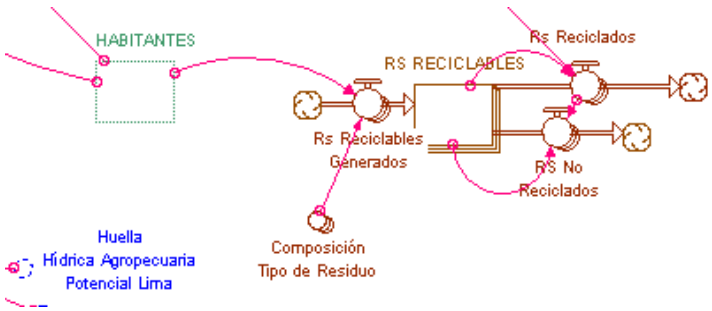
The System Dynamics is a methodology that allows to simulate the behavior of the socioecological system and a better understanding of the complexity of the present situation.

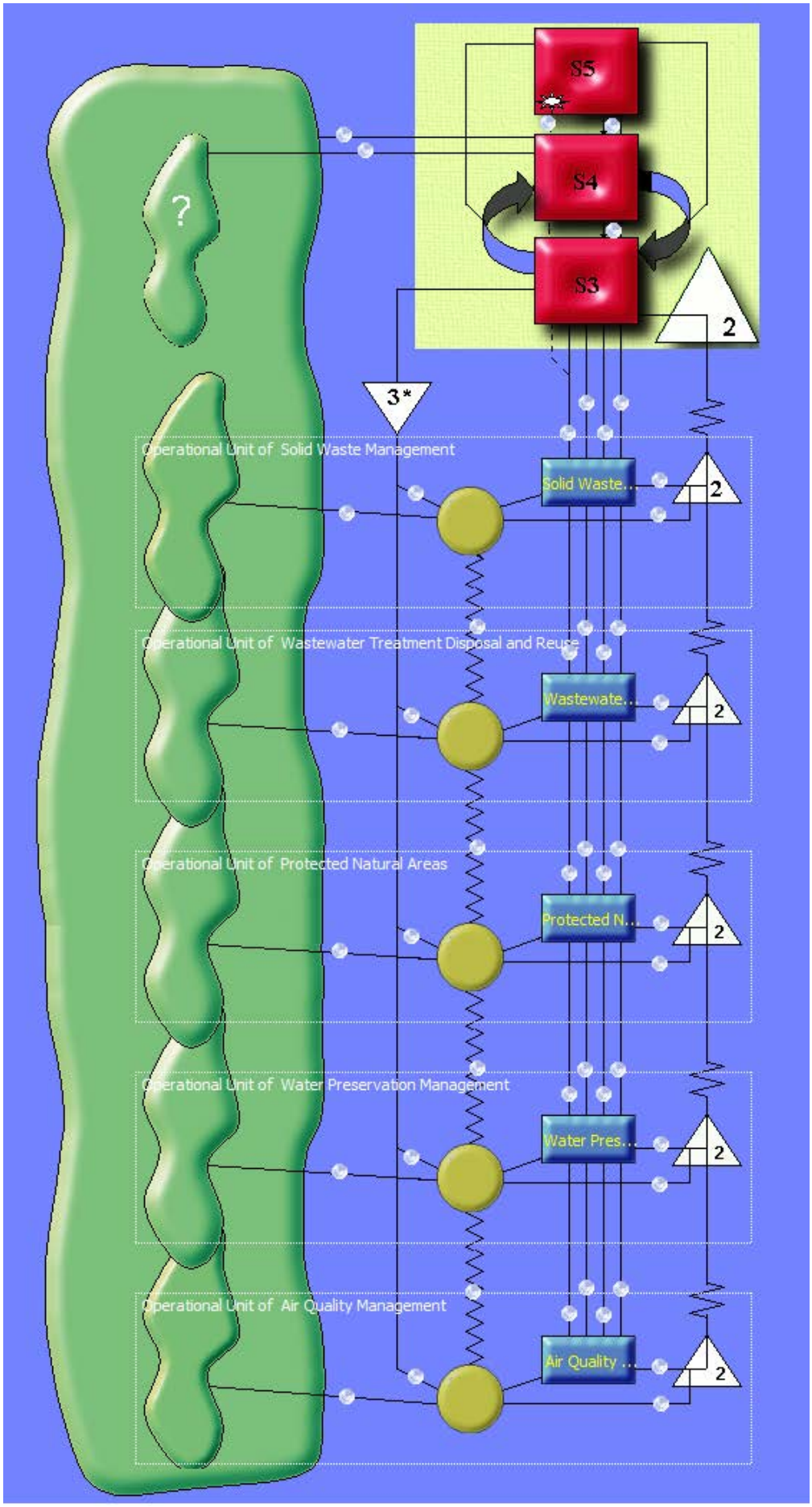
The application of this methodology implied the following phases:

- Causal Model: The conceptualization of the variables that define the current situation and the interaction between them, it all was made with the support of specialists in environmental management and municipality management, and with the final validation of consultors of the Environmental Ministry.

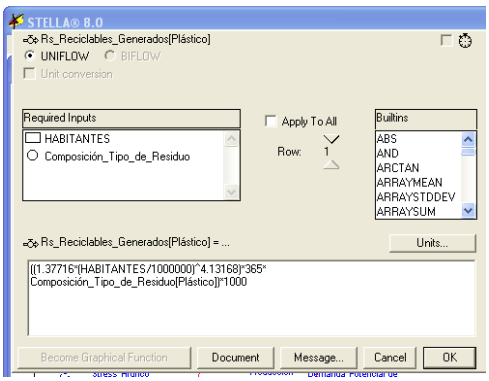
- Variable Quantification: The causal relationships between the variables were quantified through statistics functions, mathematical relationships, scientifical papers and with complementary field research.

As follows is presented an example of causal relationship:




S5
S4
S3
2
?
3*
Operational Unit of Solid Waste Management
Solid Waste...
2
Operational Unit of Wastewater Treatment Disposal and Reuse
Wastewate...
2
Operational Unit of Protected Natural Areas
Protected N...
2
Operational Unit of Water Preservation Management
Water Pres...
2
Operational Unit of Air Quality Management
Air Quality ...
2

The next picture, details the quantification of the flow variable “Rs Reciclables Generados” from the previous relationship:



As it is showed, the quantity of solid waste generated depends on the quantity of habitants through an exponential function, which is annualized to standardize the values with the respective units.

The relationship that is showed by the graph is only for plastic waste, but it was defined in the same way for organic solid waste, paper and glass.

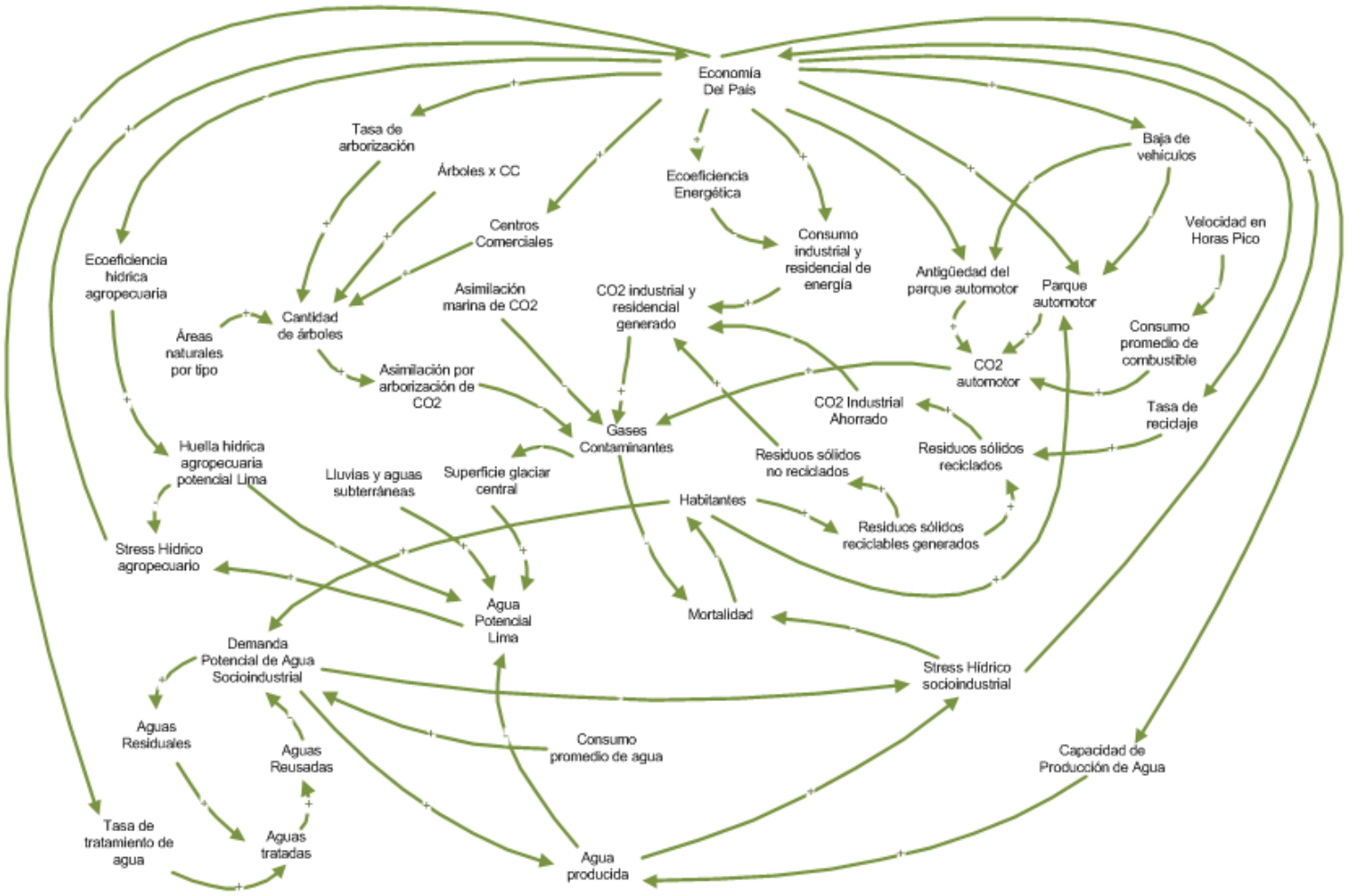
- Sensitivity Analysis: Once the model is built, the base scenario was projected, simulating (Using the application: Stella) the current behavior of the socioecological management. After that, many scenarios were simulated with the application of different policies until the ideal scenario was found.

  A set of main variables which represents the socioecological system were defined for the evaluation of every scenario; these variables represent the human, society and the interaction with the ecosystem which host them.

  These variables were:

  - Population: Number of persons that habits Lima Metropolitan.
  - PBI Relativo: Relative value of the Gross National Product respect its value in 2010.
  - Global Hydric Stress: It represents the quantity of available water in Lima Metropolitan in respect to its demand for agricultural and socioindustrial activities
  - Net CO2 Increase: It is the annual production of CO2 in Lima Metropolitan (automotive, industrial, residential and by solid waste) minus the effect of marine assimilation, arborization and what is saved by recycling.
  - Central Glacier Surface: It is the area of Huayhuash and Raura glaciers, which are the main sources of water for Lima Metropolitan.

  As follows will be showed the variable set graphs in the simulations of the Base Scenario and the Ideal Scenario.


Economía Del País
Tasa de arborización
Árboles x CC
Centros Comerciales
Ecoeficiencia Energética
Consumo industrial y residencial de energía
Baja de vehículos
Velocidad en Horas Pico
Ecoeficiencia hídrica agropecuaria
Áreas naturales por tipo
Cantidad de árboles
Asimilación marina de CO2
CO2 industrial y residencial generado
Antigüedad del parque automotor
Parque automotor
Consumo promedio de combustible
CO2 automotor
Asimilación por arborización de CO2
Gases Contaminantes
CO2 Industrial Ahorrado
Tasa de reciclaje
Huella hídrica agropecuaria potencial Lima
Lluvias y aguas subterráneas
Superficie glaciar central
Residuos sólidos no reciclados
Residuos sólidos reciclados
Habitantes
Residuos sólidos reciclables generados
Stress Hídrico agropecuario
Agua Potencial Lima
Mortalidad
Demanda Potencial de Agua Socioindustrial
Stress Hídrico socioindustrial
Aguas Residuales
Aguas Reusadas
Consumo promedio de agua
Capacidad de Producción de Agua
Tasa de tratamiento de agua
Aguas tratadas
Agua producida

Base Scenario:

This scenario consists in the projection of the current behavior under the current socioecological policies without any corrective action.

The economical growing has an inherent consequence with the CO2 increase which triggers an accelerated reduction of the glacier surface until approximately the 2045 where the economy is braked because the severe hydric stress.

Ideal Scenario:

The ideal scenario was found after many iterations through the application of a set of policies which are list as follows:

- Reduction of the automotive fleet in transit.
- Investment in increase the water production and new available sources.
- Improvement of the agricultural hydric ecoefficiency (1M3 x S/.1000 PBI).
- Increase of arborized surface.

The economic growth keeps its rhythm and it is extended until approximately the 2075; but in contrast to the Base Scenario, the CO2 increase is not too aggressive, so the glacier surface experiments a slow melting.

Finally, despite all the benefits of this scenario, still there is a crisis point which will urge to reformulate the socioecological policies in a new exercise of the subsystem four and in this way to find a new equilibrium point.

6.3.- Deployment of the Adaptation Mechanism

As follows will be done the exercise of the application of the policies proposed by the subsystem four through the whole organizational architecture:

- Elaboration of the Proposal of Policies: The subsystem four, through the simulation, gives quantifications of the policies proposed from a theoretical point of view but with a study of technical and economic feasibility.

- Definition of the Policies: The subsystem five leads a board of discussion with the subsystems four and three in order to define which are the policies to implement and in what measure they will be applied.

  For this particular exercise were defined the two following policies:

  - Reduction of the automotive fleet in transit: The defined goal was to reduce in 50% the quantity of vehicles in transit in Lima Metropolitan until the 2016..

    For this, will be necessary that the subsystem three makes a study to evaluate (with the responsible entities like the Transport Ministry and Municipality of Lima among others) the impact in the operation, feasible avenues for implementation in peak hours, legal restrictions, guilds impacted and another factors that will be needed to consider for the application.

    Additionally, the subsystem four has to research what other complementary actions or norms were applied in another cities with this experience.

  - Improvement of the agricultural hydric ecoefficiency: The defined goal was to get an increase of 30% respect the current value until the 2030.

    In a similar way, the subsystem three has to evaluate (with the responsible entities, mainly Agricultural Ministry and Municipality of Lima) what agricultural products are key ones, what information systems have to be implemented for the monitoring of results and what technological initiatives have to be developed with guilds and universities.

    Finally, the subsystem four has to find similar experiences in reduction of agricultural hydric ecoefficiency and methodological and technological advances.
- Elaboration of the Operation Plan

Once the policies, goals and scopes were defined, the subsystem three has to lead the board of discussion with the subsystems two and one in order to define the detail of the Operation Plan.

As the whole system is a management system; at this point, it is necessary to invite to the entities that are directly involved in the operation, like the dependencies of the Agriculture Ministry, Transport Ministry, the Municipality of Lima and the District Municipalities.

The Operation Plan has to include the units responsible of execution, the mechanisms of communication and education, the indicators of management and the assigned budgets.

Project	Management Unit
Reduction of the automotive fleet in transit	Air Quality Management
Improvement of the agricultural hydric ecoefficiency	Protection and Water Recycling

- Monitoring and Execution

The subsystem one is in charge to lead the initiative with the involved actors, tracking de controls, measuring and monitoring the indicators and in general the managing of the project.

6.4.- Conclusions

- The integration of VSM and Dynamic System methodologies allowed a feedback process which gave consistence to the structure of the model and to the definition of the operational units.
- The water footprint and the energetic eco-efficiency were key variables in the construction of the Total System Model and they are very valuable in the understanding and definition of the socioecological management.
- Municipal Processes like the looking after of urban green space or reducing water consumption, they do not have a really big impact in the viability of the ecosystem.
- The viability of the system is directly related to the definition of only one institution responsible of the socioecological management with the authority and needed resources.
- The work developed, shows the importance to have an Intelligence System, which, besides the function of looking the outside and then, that has also the responsibility of defining and reengineering the structure of viability.
- If the current behavior does not have a relevant change, the socioecological system will not be viable in short.

Using VSM to understand the place of business events in organisational performance

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P Thomas biography: Dr Thomas is a lecturer in the School of Tourism and Hospitality , Faculty of Commerce at the University of Johannesburg. Until 2013 Peta worked in industry but on attaining a PhD entered academia. Dr Thomas supervises MBA, Masters of Commerce and MPhil business management students and 200 undergraduates. Peta did an 18 month specialised course at the University of Cape Town Business School on business management specifically related to using systems thinking techniques in 2008 which was the beginning of her interest in this specific body of knowledge.

Abstract

Purpose: this paper applies Beer's Viable System Model to an organisation's knowledge system

Design/methodology/approach: The concept of a business event (meeting, exhibition, conference) used to alter an organisation's knowledge system is examined highlighting the need to understand the work process of the business event and its relationship to other elements of the organisation.

Findings: this analysis produces a theoretical representation of the business event work process and its role in changing the future performance of an organization. The modeling allows for more structured thought about risk and strategy in knowledge management.

Originality/value: The originality is the application of VSM to acknowledge a business event as part of an organization's knowledge strategy.

Key words: business event, knowledge, risk management, VSM

Paper type: conceptual paper.

Introduction

Business tourism, whether a segment within tourism or a separate but aligned industry to other tourism activities, creates business events that bring together members of business organisations (Getz, 2007:38: ICCA, 2012). The goal of each business event attendance is to enhance personal professional knowledge commuting this into the organisation in terms of improved employee performance and thus influencing and improving organisational performance. Jago and Deery argue business events (trade shows, exhibitions, conferences and business meetings) have a vital role to play in contributing to improving organisational performance and may in fact influence improved productivity in aligned industries. Business tourism has the ability to influence the gross domestic product contributions of many industries within an economy through the attendance of business people who network, learn and gather new ideas (Jago & Deery, 2009:8-10; Hallebone & Priest, 2009:94). This paper argues that business events are strategic interventions requiring a thorough knowledge of existing organisational knowledge systems before designing an event that changes the future behaviour of a knowledge system.

Business events

Business events attendance is often specific to a domain of knowledge, for example engineering, science or medicine. Many who attend are specialists in their fields seeking new ways of doing their business better. People 'who know what' about a domain, meet and collaborate to create a knowledge rich environment for sharing information about their subject (Dalkir, 2005:41). New knowledge is anticipated to flow back into the attendee's organisation and improve its performance (Lewin, 1951:83-84; Desouza & Awazu, 2005:93-98). Managing organisational risk is one of the key responsibilities leaders and managers carry out for their stakeholders. Von Krogh, Nonaka & Aben (2001:430-436) point out that establishing new knowledge in an organisation's systems creates the requisite information variety for adaptive reactions thereby helping with the making of the right decisions to mitigate or remove risk. Ashby's law of requisite variety goes further, encapsulating the importance of information when seeking to endow the organisation with the ability to deal with change stating that, "only variety can destroy variety" summating that when change impacts a system to the extent that the system does not currently have the required response within its existing set of responses, the system needs to create a new response if it is to survive at which point a inflow of new pertinent, knowledge is required (Nonaka, Toyama, & Konno, 2000:28; Pickering, 2004:502; Boisot & McKelvey, 2010:421). Authors Jago and Deery note that Australia places such an emphasis on business events for knowledge inflows that a national

business event knowledge strategy exists (Jago & Deery, 2009:8-10). The authors summarise the purpose and importance of business events for the Australian national economy as:

"Attracting investment by attracting influential participants" - creates opportunity for new growth from alliances and mergers.

"Showcasing local products, services and investment opportunities" - creating opportunities for future sales.

"Bringing regional and international expertise into the community where it is accessible to local professionals" - encouraging collaboration and knowledge sharing for continued professional development

"Generating new inflows of technology providing a vehicle for local business to access the latest developments in their respective fields" - fosters innovation opportunities (Jago & Deery, 2009:8-10; Business Events Council of Australia, 2011). The activity of knowledge creation is so valuable to all industries in gaining a competitive edge that it is important to understand how business events could shape a nation's overall performance. A viable knowledge system, just like any other function of an organisation, requires a strategy (Hoebeke, 2000:58-78). Milost argues for human capital being the only independent variable of an organisational system able to influence the value of performance obtained from organisational assets (Milost, 2007:126-127). Business events have a powerful role to play.

Behavioural change

Lewin (1951:25) postulated that new knowledge gained may influence the future behaviour (B) of that person. Applying this to the environment of a business event: .B = f (p, e) where B the future behaviour of a person is a function (f) of the people (p) present at the [business] event and the environment (e) of the [business] event itself. The value created in an employee by event attendance depends on how well the transformation intervention (the business event) does its work. Applying the CATWOE model to define the work process of a business event from the perspective of Lewin's theory, it can be seen that business events play an integral part in providing the variety of information required to make informed decisions and thus bestow a risk management capability to employees (Smyth & Checkland quoted by Bergvall-Kåreborn, 2004:56; Warren, 2008:35 & 528; Scholtes, 1998:383). The CATWOE follows:

*Stakeholder***:** The event attendees

Customer: Their organisation

Actors (people who carry out the work): The event organiser

Transformation Input- employee expectations of new knowledge/ *Output***:** an employee with new knowledge

Worldview (perspective) of stakeholders: The cognitive behaviour of the attendee is changed and influences the future workplace behaviour of the attendee

Owner (the person who can stop the process): The event owners

Environment: Threatening elements -poor design of the business event.

Knowledge is then a viable organisational system with business events being work processes. This explanation of an organisational environment in which knowledge dynamically grows fits the concepts of Beer's Viable Systems Methodology (VSM) where an organisation is reliant on its viability and success for the individual functions of each autonomous unit (Espejo, 1989:90; Nonaka, Toyama & Konno, 2000:26; Walker, 2001:11). In the case of knowledge assets the autonomous unit it is the employee who is essential in creating change in knowledge. .The degree to which knowledge influences competitive advantage can be argued to relate to the ease with which employee knowledge flows into, and is shared by, interrelated organisational systems (Holsapple & Singh, 2001:78). In the final column of the CATWOE value chain analysis model shows threat from event design quality (wrong knowledge/wrong employees) to the output value created in the transformation process. As such, event design needs to be a strategy that manages that risk within acceptable parameters (Burke, 2010:268). The Sarbanes-Oxley Act of 2002 section 404 currently places an onus on many USA organisations to annually submit an assessment of the effectiveness of their organisation's internal controls in maintaining the benefits accrued from any expenditure to be equal to or greater than the cost to organisation of that expenditure (Ramos, 2004:1; Zhang, 2007:2). The legislation, by implication, requires that organisations qualify business event expenditure (sending employees to business events of all kinds) by proving that the business event activity gave the organisation benefit. Quantifying the impact of knowledge gained from a business event on the future behaviour of an event is not easy to prove to justify event costs attendance. There are five risk management aspects for internal control recommended in the Sarbanes-Oxley legislative framework: organisational leadership (i), value chain analyses of all processes [including knowledge] to understand where and how value is added and lost (ii), managerial actions to standardise processes through policies and processes (iii), an information [knowledge] flow system (iv), and a monitoring system to recognise and manage risk (v) (Ramos, 2004:30). In countries where legislation does not exist, good business sense holds that as much value as possible is required from business meetings and while Sarbanes-Oxley may not have the same impact as it does for American companies, it still makes good organisational sense to try and quantify and map the value of knowledge . The answer to giving knowledge a value is, to some extent, found in

understanding knowledge flowing from a business event and how it contributes to organisational performance. Adding new knowledge to old can create previously unforeseen stresses between existing processes. This phenomenon would occur when the complexity of the system inter-relationships was not initially understood. Minimising disruption from new knowledge inflows to the running of an organisation suggests defining the "intelligent, complex, adaptive system" (Dalkir, 2005:67; Sveiby, 2007:1636-1638).

VSM for organisational knowledge and business events

Viable System Diagnosis (VSD) applied to knowledge (in the context of that arising from a business event being an intervention to change an organisation's knowledge) produces a three tier Viable System Model (VSM) that represents what the theoretical knowledge situation of the organisation may look like (Espejo, 1989:98). The system in focus at the recursive level one (R1) is the proposed situation of the knowledge system of an organisation. Activities that produce value from work need to be modified in response to environmental change to ensure ongoing performance. Incoming information from feedback loops from both the internal system environment (R1 and R2) and the external (R0) comes into the recursive systems and is used to adapt any or all of S2, S3, S4 and S5 activities and the work-system themselves at S1. The work activity subsystems at R0 are as follows: Sales, finance, marketing, human resources and knowledge (Figure 1). Each has an interdependent relationship with each other. Each also has an autonomous identity and the ability to be viable which infers the ability to exist alone (Espejo, 1989:78). Each is regulated by the others' actions and by information given to them from S2, S3, S4 and S5. The organisation's work system of knowledge is the system in focus at recursion level one R1 deriving value from actions taken at R2. Together, these work-systems create value thus affecting the potential of the overall performance of the organisation at R0 (Figure 1). The behaviour of variables that affect these activities can be modified by planned actions (strategic intent). Change influencing change in employee behaviour in a work system will add or depreciate the value arising from the system's work.

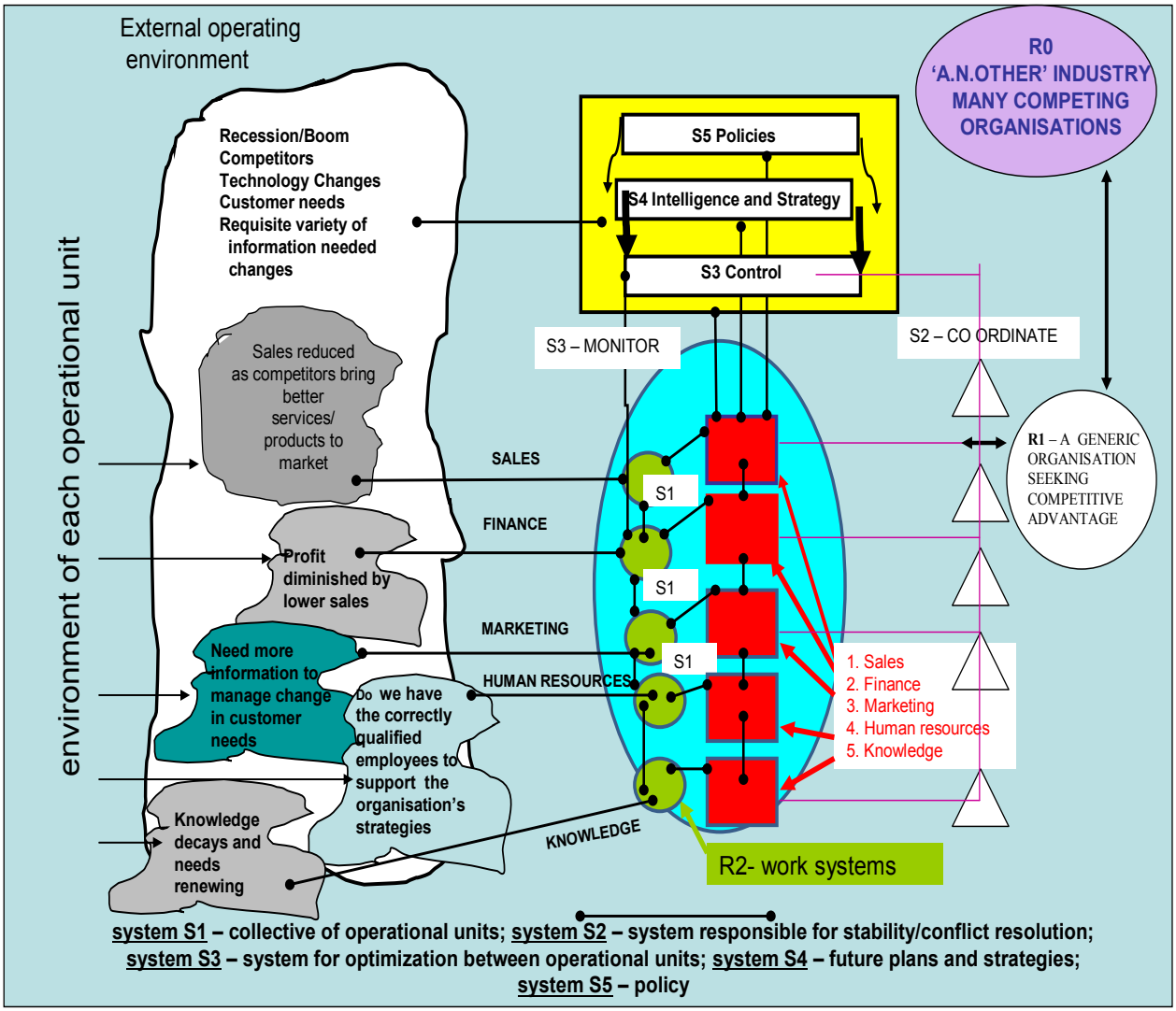

Figure 1: R0 -Viable systems model of an organisation within its industry

Source: Adapted from Walker (2001:9) and Espejo (1989:99)

The three VSM drawings can be thought of as floors in a building interconnected by water pipes, flights of stairs, lifts – in this case processes that tell each level what is affecting their own performance from another level (Figures 1 and 3). It can be seen from the VSM of R0 that together with the organisation's sub-system of work in its knowledge system that there are several other sub-systems within this level of recursion with which knowledge interfaces

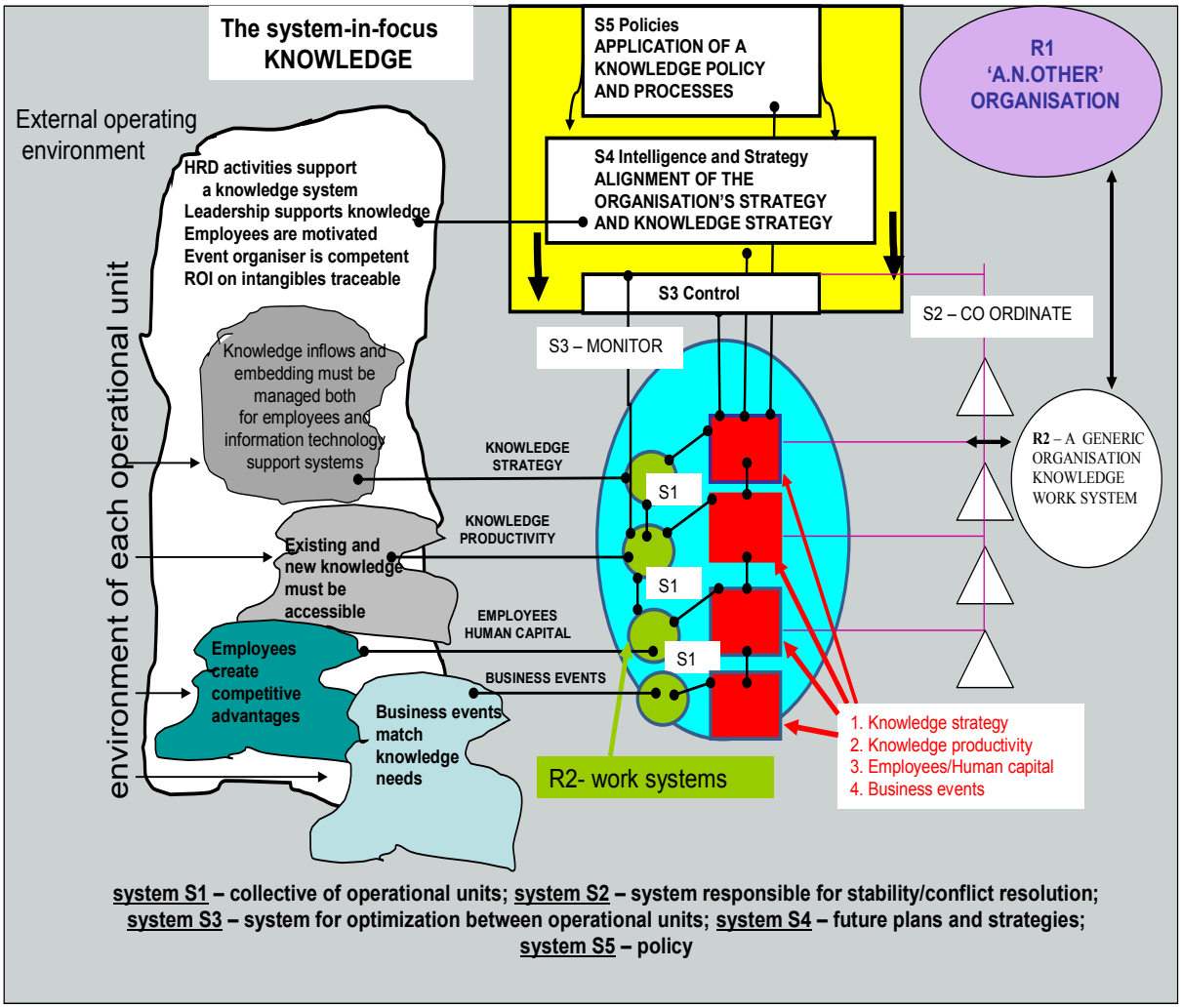

Figure 2: R1 -the organisation's work system-in-focus, knowledge

Source: Adapted from Walker (2001:9) and Espejo (1989:99)

These three levels (R0, R1 and R2) are all co-ordinated and monitored by processes that ensure viability. These processes are S2 (co-ordination), S3 (control), S4 (intelligence and strategy) and S5 (policies) specific to that level of the recursion. Each recursive level has then its own value chain of activities within which the processes are continually re-developed dedicated to maintaining organisational viability (Jackson, 2003:93).

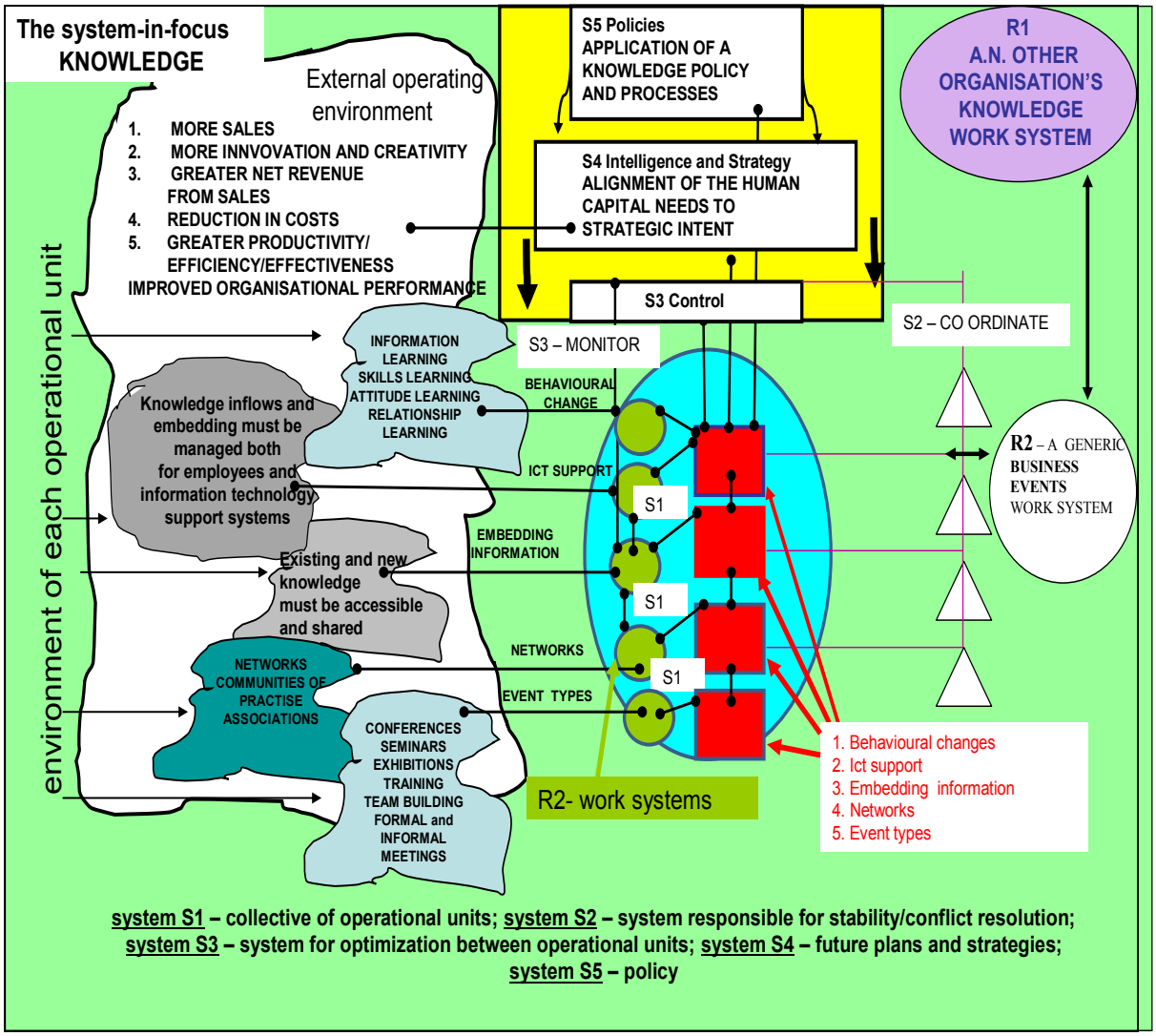

Figure 3: R2 – the systems of organisational knowledge derived from business events

Source: Adapted from Walker (2001:9) and Espejo (1989:99)

This suggests that a knowledge work system, like all organisational, tangible work processes, can be seen to have standard elements of a work transformation process (Scholtes, 1998:59):

- **Suppliers (S)** integral to the knowledge creation process (industry peers, event facilitators, knowledge champions, thought leaders, organisational managers and employees).
- **Inputs (I)** of raw material resources: business event design, knowledge strategy, and employee capabilities.
- **Process (P)** – the transformation of tacit knowledge and new information and the creation of new, possibly unique knowledge. The business event whether formal or informal influences to varying degrees an attendee' knowledge that manifests in workplace behavioural changes.

- **Output(s) (O)** as in new knowledge and information to drive innovation, creativity and competitive advantage.
- **Customer (C)** satisfaction because the new knowledge and information ensures improved organisational performance.

Conclusion

In these VSM drawings, elements of importance from a knowledge system viability perspective that help in maintaining a viable organisation and its functional work systems with interventions by business events for knowledge creation are shown. These illustrations are argued to have utility as they are a visual map of how knowledge links up between recursive systems. Mapping the systems helps give a clear understanding of the degree of knowledge dependency that exists between and within the recursive layers (Hoebeke, 2000:8 & 27; Walker, 2001:50).

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Dynamics and control of viable system for logistics operations

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Abstract

The Viable System Model (VSM) has been applied in different ways and in different types of organizations, in the present paper it is used in the diagnosis and redesign of logistics systems with two emphases, the first one as base for the control and the second in the identification of systemic archetypes, which arise in the interactions of the organization and its environment, as in the internal relations between the administration and operation. The organizational efficiency is achieved by means of different methodologies and complex administration systems, in this case when identify the systemic archetypes in the logistical operations of the Viable System, it is possible to describe the dynamics of its behaviour and evaluate if the system is viable.

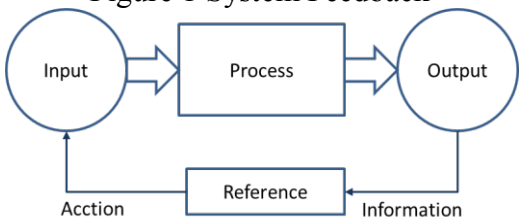
In this paper is presented a series of steps to make the diagnosis of logistics system, including the Viable System Model, to find gaps and improving the present archetypes. This makes possible to describe the dynamics of VSM in logistics operations.

LOGISTICS AND CONTROL SYSTEMS

Cybernetics develops the concepts of feedback. Each feedback loop involves input information and output information. The output affects the input information of the next cycle, based on the observed differences between the output and the target to be achieved; the control mechanism works on that difference in keeping the balance of system and thus determines the input information of the cycle.

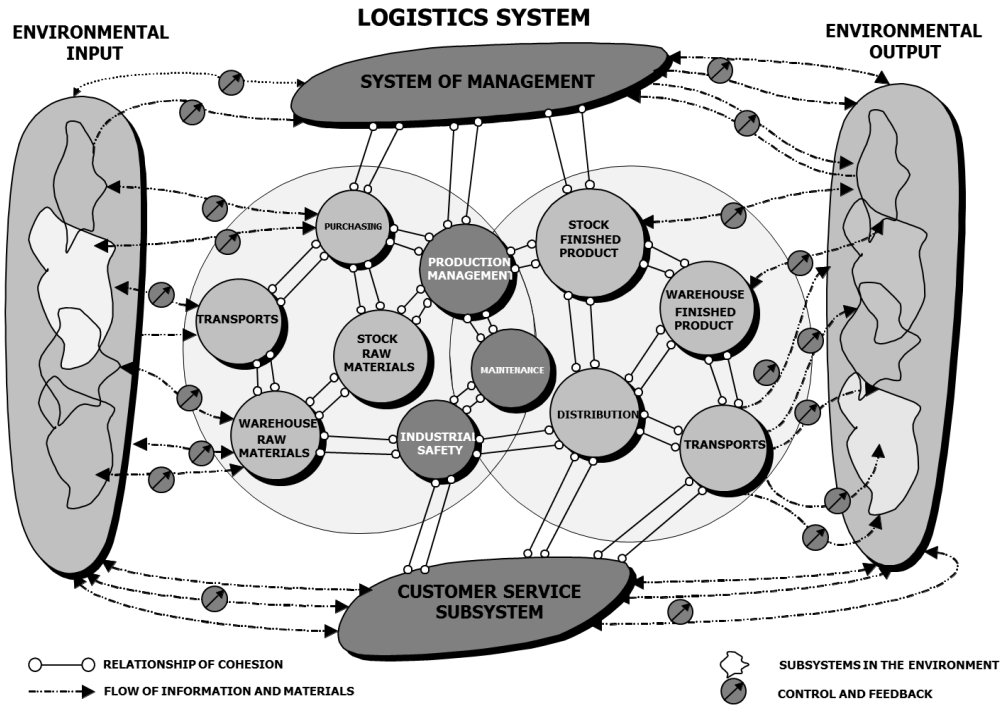
The feedback control and management in the most traditional sense, evaluates and ensures that the results are consistent with planned, so it is necessary to establish standards of acceptable results and obtain timely and reliable information to assess compliance of these standards and take corrective action. The Feedback system is presented in Figure 1.

Figure 1 System Feedback



Control theory and cybernetics in particular have proposed alternative mechanism to evaluate the performance of systems with great results minimizing the error. The diagram of the logistic system complexity is presented in Figure 2.

Figure 2 Logistics system



Source, Velásquez (1999)

Organizations have sought over time to obtain an "outperform in their business," which means to have a " superior" logistics system with innovative corporate strategies , a new vision of the logistics system , leverage strategies , cost reduction and increased profit (Anderson & Mulani , 2003). A comprehensive work shows the direct relationship between logistics system performance and financial success , is developed by Accenture, INSEAD

and Stanford University (Mulani , 2003), the most important conclusion is that companies with superior logistics systems grew faster rivals .

Logistics as a discipline [11] [12] [13] [14] is in the social sciences between engineering, management and economics. For example in economics is known as international and domestic logistics. In that sense, it's a trend to consider logistics as a strategic aspect of development of a country, region or company.

Regarding engineering uses quantitative techniques such as descriptive and inferential statistics, linear programming methods and nonlinear optimization techniques and simulation, all kinds of metaheurisitcs as swarm techniques, genetic algorithms, neural networks and many others. As for the administration functions such as planning, management and control are used, many indicators , cost management , which are oriented to comprehensive control systems strategic, tactical and operational level are used.

Regarding the relationship between logistics and supply chain, it is necessary to state that are complementary concepts, which can be understood as critical to increase efficiency, productivity and sustainability of institutions, enterprises or any production or service unit factors. The logistics business in recent years has shown a rigorous development popularizing academic training at technical, professional, specialization, masters and doctorates.

The subject matter of the logistics network processes supports the organization, infrastructure, inputs and resources required for the operation and flow of materials, information and money, made on a system. Then the structure of a logistics system [15] has five components:

Facilities
Transports
Individuals
Flows of material, information and money
Suppliers and customers

The number of facilities, types of transport [16], the number of people, the whole raw material, information and money transactions, the number of suppliers and customers, its geographical location and the product completed, determine the dynamics and complexity of the logistics system.

All logistics system has 4 macro processes or subsystems [17]:

Procurement (input)
Operations management (transformation)
Distribution (output)
Feedback (return)

The fundamental principle of logistics is customer satisfaction, efficiently meet your expectations, this is the goal of any logistics system. It consists of all units to support key business processes, the design is focused on the optimal management in relationships with members of the supply chain. These units are:

Purchasing	Transport
Inventories	Turnover
Industrial maintenance	Delivery
Storage	Distribution

The logistics system is an important part of the organization. Thus by induction define logistics as a subsystem of it, hosting facilities, conditions and properties. Organization is broader than the company and the logistics concept, if it is understood that the company is one of the many ways you can take the organizational phenomena. It is suitable for addressing the problem of logistics extend the discussion to the organizations as a whole in view all , like the companies , football teams , hospitals, prisons , present logistical cycles that must be analyzed and improved for the benefit of the same organization [18].

CYBERNETICS AND ORGANIZATIONAL DIAGNOSIS

In the understanding of complex problems such as the diagnosis and maintenance of a logistics system, the General Systems Theory, particularly cybernetics, provides an opportunity to view the organization as an integrated set of interdependent subsystems, with regulatory mechanisms for maintaining the balance and logistical support and other activities, which comprise the organization's intention to hit and stay in the market.

To diagnose and identify the processes in an organization can adopt a methodology viable system, this concept will help to raise the issue properly and establish assumptions (administrative, technical and operational) properly, organizations then leads to the design of a new system where the information management and communication will be central axis. The viable system is formed by:

NAME	SYNOPSIS	NAME INSTRUMENTAL
system 1	Joint operational units.	PROCESSES
system 2	Responsible for the stability and resolution of conflicts among operating units. Coordinating actions in time.	COORDINATION
system 3	Responsible for optimizing and generating synergy between management and operations.	CONTROL
system 4	Future plans and strategies. Adapting to a changing environment	PLANNING AND CHANGE
system 5	Policy and regulatory dynamics between the system 4 and 3.	POLICY
System 3 *	Are the indicators, compare and cross information.	INDICATORS AND AUDITS
System I	Integral operations planning and control, evidenced by reports, communications, data, information and knowledge.	COMMUNICATION SYSTEMS AND TECHNOLOGIES

Adapted from Walker, 1991.

The logistics system is a viable system so any diagnosis must be conformed with this characteristics.

Thinking and systemic dynamics

System dynamics is a discipline created in the 60′s by Jay W. Forrester at MIT, originally known as Industrial Dynamics. Also known as continuous simulation, it provides the methods and philosophy to analyse the behaviour of systems. This technique shows how the variables are changing over time and its impact on the system. It emerged in the search for an alternative to understand better the organization, management and environment (Forrester, 1982) extended their study to different social systems (Forrester, 1969 and 1971) budget (Meadows et al, 1972). Today it has become a tool used for the analysis of physical, chemical, biological and ecological systems.

Causal structure and dynamics

System thinking is a reflection in circles rather than straight. All parts of a system are connected directly or indirectly so that changing one of the parts that effect spreads to all others who experience a change and in turn affect the original part. When two parts are connected, the influence is transmitted in both directions. Most times the feedback generating network of causes and effects in which every action influences the next. There are two kinds of feedback these are: the reinforcing and balancing one:

Feedback reinforcing: occurs when changes in the whole system are fed to amplify the original change.

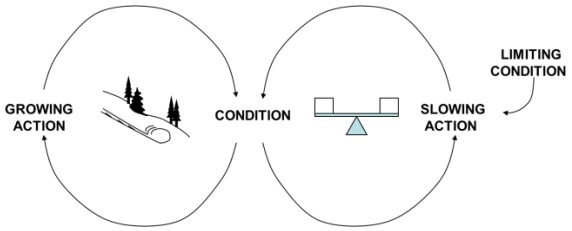
Feedback balancing: this is when the changes in the whole system oppose the original change to cushion the impact.

System thinking allows developing a graphical and quantitative representation of the observations, possibilities, interpretations and conclusions. When it is draw connections and interactions, it is possible to see the system and its dynamics.

Systems archetypes

There are a number of structures that describe behaviours that emerge from the interaction; the system exhibits a dynamic fashion pattern.

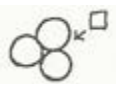
Figure 3 Limits to Growth Archetype



Source, Senge (1990, 125).

For example, having a position with the structure of Figure 3, the results are predictable time. It is called archetype because it presents very often.

Below in table 1, archetypes are presented in abbreviated form:

Archetype	Structure	Description
LIMITS OF GROWTH		An accelerated increase comes a point where it slows and even stops.
SHIFTING THE BURDEN		Composed of two balancing processes. They try to fix the same symptom. The intervention seeks to alleviate the symptoms, which becomes routine and the actors do not learn to identify the underlying problems.
EROSION OF GOALS		The effort is ongoing, but there is very little improvement from the beginning. The goals are to rise or set too high. The performance continues to decline.
SOLUTIONS FAIL		Workaround. Consider the consequences in the short and long term actions taken to manage to diminish the side effects of these. The lazy guy works double.
CLIMBING		Two actors, each of which sees welfare as dependent on a relative advantage over the other, continuously react to the progress of each. Whenever one below, leads to the other acted diligently to restore their lead, which activates the first, and so on.
OPPONENTS INCIDENTAL		Opposition between companies or groups that should and want to work together is created. Explains how to create opposition between groups that should and want to collaborate.
TRAGEDY OF THE COMMONS		Everyone wants the same thing and whenever they get less. The interaction between individuals in the presence of a common good can produce this depletion.
GROWTH AND UNDERINVESTMENT .		Growth approaches a limit which can be removed or moved forward if the actor invests in "capacity". But the investment must be intense and rapid to prevent reduced growth,

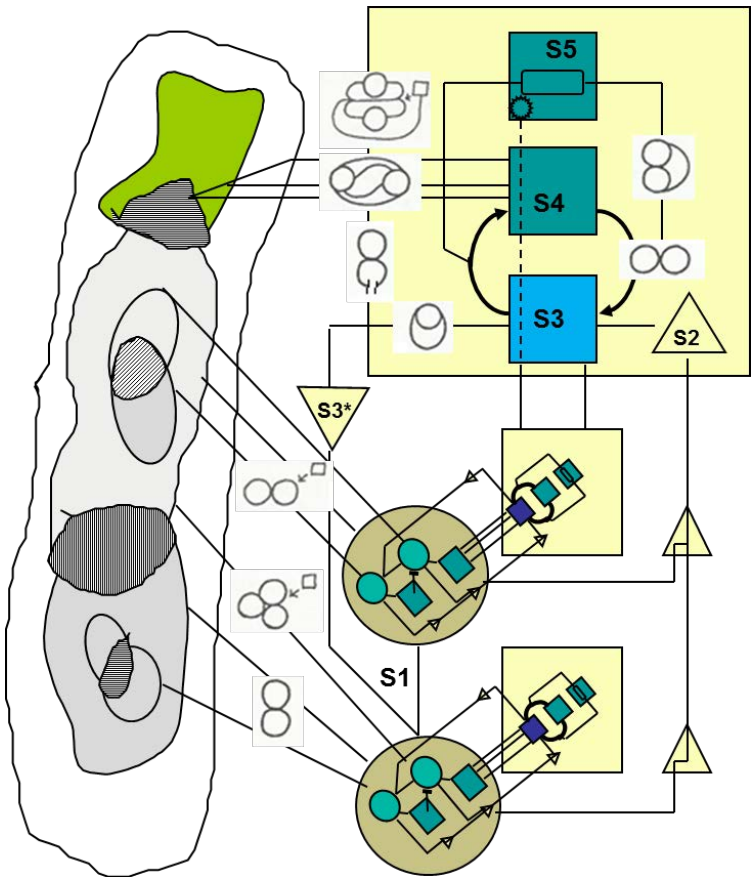
		otherwise it never will.
SUCCESS FOR HAVING SUCCESS		Trend, inevitable appearance to whoever began with advantage, pattern of Monopoly. Money calls money.

Table 1. Source: Adapted from the fifth discipline in practice, pg. 157.

VIABLE SYSTEM MODEL AND ITS DYNAMIC

The viable system exhibits multiple relationships with the environment and internally in these feedback loops can arise in different order and dynamics, first archetypes are identified and more complex variations of these, see Figure 4.

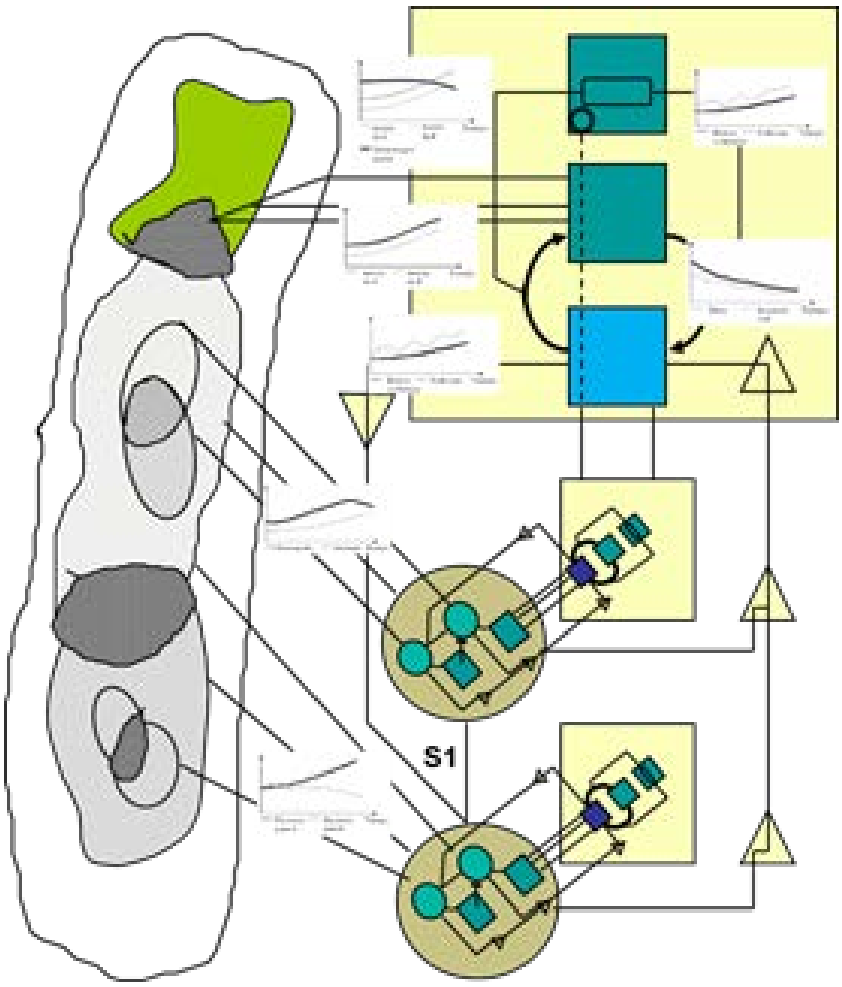
Figure 4. The viable system and the systems archetypes



Each archetype has a behavior (Mejía, 2006), which can be simulated by a computer application (Vensim, Stella, Ithink), either individually or together, which allows for the tendency of the whole system feasible.

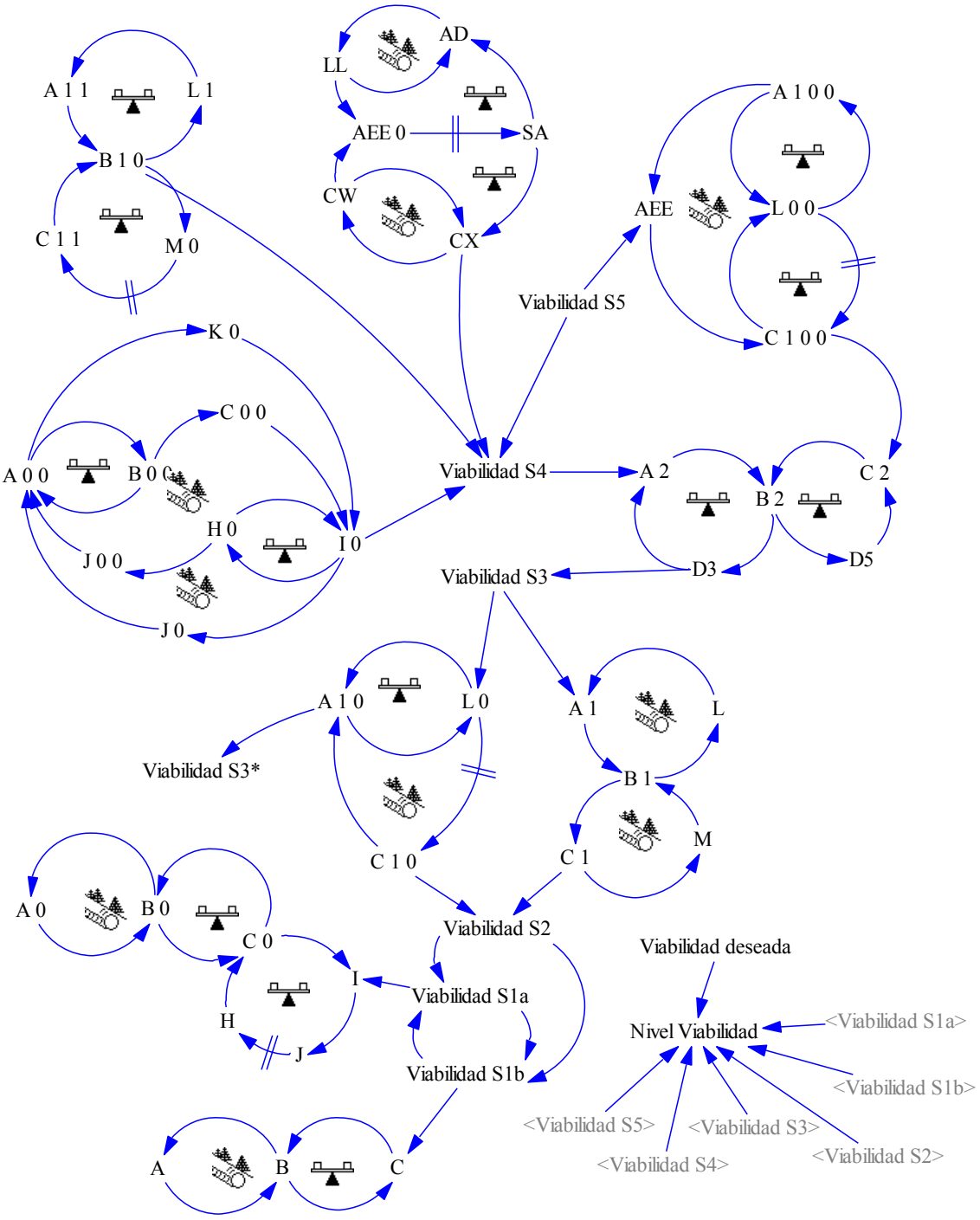
For example to analyze the process of purchasing trading activities, continuous bargaining processes and feedback, which can be described with some archetype were observed; success for one who succeeds, solutions fail or the displacement of the load. Control and performance of this process will more or less viable for the company.

Figure 5. The viable system and its dynamic performance



Archetypes has its own dynamics, some eventually are increasing, others decreasing, some oscillate, diverge, converge or stabilize. In general the system or model presents a set of patterns which can be operated or modified seeking behavior and viable results for the organization. Then viability can be simulated.

In conclusion, integrating systemic causal representations of Senge (archetypes) and simulation of Forrester to Viable System Model Beer, allows for an actual performance of the organization and develop intervention plans, measuring the consequences or effects on the system from of those changes. That is, by applying dynamic simulation we assess the viability of the system and redirect actions toward leverage points that make the organization more efficient and thus ensure the viability of the organization.



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Strategies for the Diffusion of Behaviors in Social Networks

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Keywords: Network Dynamics, Social Influence and Support, Simulation, Network Characteristics

Social networks have been identified as valuable representations of the relations between individuals of a social system. To understand the behavioral spread in which individuals are influenced by their peers is crucial for allocating resources and achieving success of a community intervention focused on the spread of a behavior. We propose a simulation model for identifying an efficient set of nodes to *initialize* a diffusion process in a social network in order to accelerate the diffusion process. We defined different sets of initial spreaders using 1) centrality measures of the network: Hubs (highest degree), Intermediaries (highest betweenness) and Closest (highest closeness) and 2) using local structural properties derived from the communities detected in the network: Community Bridges (highest number of links with other communities) and Community Hubs (highest number of links with the own community members). We simulated the canonical susceptible-infected model in the Erdös-Rényi random graph, Watts-Strogatz small-world and Barabasi-Albert scale-free network topologies by varying the initial set of spreaders, the contact probability and size of the networks. The results of the simulation suggest that Community Hubs perform equal or better than Hubs as the size of the Erdös-Rényi network increases. Community Bridges perform better than the other four sets of nodes for the Small-World topology independently of the network size. Hubs perform better than the other four sets of nodes for small scale-free networks. As the scale-free network size increases, Community Bridges equalizes the Hubs performance. Our sensitivity analysis for the Scale-Free topology suggest that Community Bridges perform better for low clustered networks whereas sets defined by centrality measures (Hubs and Intermediaries) perform better for high clustered networks.

A system dynamics model of the nutritional stage of the Colombian population by socioeconomic status

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Abstract

The prevalence of overweight and obesity and physical inactivity has become an important problem worldwide. These risk factors are associated with non-communicable chronic diseases (NCCDs) like diabetes, cancer and cardiovascular diseases.[1–4] Overweight and obesity and physical inactivity are ranked among the world´s top five leading risk factors of attributable death.[5] Developing countries are experiencing a nutritional and epidemiological transition. The burden of obesity, especially in women, tends to shift towards the population with lower socioeconomic development as the country's level of economic development improves.[6,7] In the case of Colombia, the prevalence of obesity among women in lower socioeconomic status (SES) has increased faster than in higher SES.[8,9] This transition make it difficult for the Colombian public health system to design strategies and policies to prevent overweight and obesity due to significant costs arising from these risk factors.[10–12]

Although different researchers have emphasized the understanding of nutritional transition by SES using statistics approaches,[6,7,13–15] less attention has been paid to understand the dynamics of nutritional stage of a population by SES as a complex adaptive system.[16] In

particular, three systems science methods have been used to study the dynamics of obesity and its associated features: system dynamics (SD),[17–27] network analysis (NA),[28,29] and agent-based modeling (ABM)[30,31]; however, no studies have been developed to study the dynamics of obesity by SES. Therefore, this study seeks to develop a system dynamics model that gives guidelines to policy makers about the dynamics of nutritional stages within the Colombian population by socioeconomic status.

The paper introduces a system dynamics model based on the hypothesis that the change of the population's nutritional stage by SES in developing countries is related to rural-urban migration[32,33], a higher female participation in the workforce[34,35], acquisition of new technologies[36,37], improvement in the educational level of the mother, and the expanding of soft drink manufacturers and fast food franchises[38–40], processes that occur when a country experiences an increase in its level of economic development. The model includes aging chains by three body-mass-index (BMI) categories (normal, overweight and obese). The population is divided into three age groups (0-4, 5-17 and 18-64) according to the age groups used in the Colombian Demographic and Health Survey (*Encuesta Nacional de Demografía y Salud* [ENDS]) and the National Nutrition Survey in Colombia (*Encuesta Nacional de la Situación Nutritional en Colombia* [ENSIN]). The population aging structure includes births, deaths for each cohort, net rural-urban immigration, and deaths due to NCCDs associated with overweight, obesity and physical inactivity in adults.

The model gives guidelines to policy makers about the nutritional transition of the Colombian population over time and the effectiveness of government nutrition programs policies to prevent overweight and obesity in all SES groups. Finally, the model helps to identify target subgroups of the population (by BMI category, age and SES) in order to design corresponding policies that cope with the dynamics of nutritional stages of population in Colombia.

Keywords

System dynamics, nutritional transition, public health, obesity, behavior science.

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Exploring the role of human resources in the value created from business event attendance

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Abstract

Van Winkelen (2010) and Clarke (2010) advocate that organisations have as a critical focus the need for an understanding of knowledge flow as represented in the SECI model if employee behavioural changes derived from business event attendance are to influence organisational performance (Nonaka *et al.*, 2000:12). At the final step of SECI, reflection on new knowledge is critical if it is to aid in future organisational performance (Tseng, 2009:493)**.** If the new knowledge is designed to augment existing knowledge, a well designed business event has the potential to confer on each attendee some or all of the appropriate requisite variety of information with which to make better decisions and design adaptations to changing market place demands. Each system in a recursive level of many systems is responsible for changing the environment in which it operates to ensure its survival and the continued value of its contribution to the organisation and this includes the role of the function of human resources with regards to employee development in an organisational system (Hoebeke, 2000:28). Buchanan *et al.* (2005) have drawn attention to what makes knowledge 'stick' and refer to Lewin's research applied to a business event using Lewin's *f* (p, e) (Lewin, 1951:25). The inputs to the work process of people (p) and event environment (e) are reviewed and, aligned to the role that HR plays in business events. It is clear that there is a need to refreeze the changed behaviour of individuals after an event or the knowledge will be lost. Structural Equation Modelling (SEM) is used to assess the relationships proposed by the theory for the work process of inputs and output transformed by the construct *f* (p, e) in a sample of international business event attendees. This conceptual model contains four components that theoretically describe the SECI model for behavioural change as seen in the literature review to explain what happens for knowledge creation at the business event (Nonaka *et al.*, 2000). The four components are

joined as the work process of the business event. This is a measurement structural model and shows how observed variables relate to the unobserved (latent) variables uncovered by the exploratory factor analyses against the work model derived from theory presented in the literature review. A theoretical path-process diagram is created of the variables representing the business event work process *f* (p, e). The first component of the construct considered is the HR influence in ensuring employees and the business event align to the organisation's strategy for future improved performance through human capital development and it has six items. The second component, the tacit to tacit knowledge, is the transformation where the learner's knowledge and that of the group is joined through socialisation at the event (Marchand, 2000b:305; Champoux, 2007:125; Chen & Hsiang, 2007:581; Kayes, 2007:428 Allee, 2008:6). Aligned to this component is the third factor in this variables system – another transformation component which recognises the potential of the individual to undergo personal tacit change (Floyd *et al.,* 2005). The final component (4) of the construct represents the outcome of the work process and is the relationship between components 1, 2 and 3 in creating a desirable organisational outcome in terms of the potential for strategic intent and improved future performance from the event. The research findings seem to be in contradiction to the current theory that Human Resources (HR) has a role to play in human capital development in terms of business events as development interventions but it is important to note here that none of the reviewed literature dealt with research about HR influence for the situation of a business event (Thomas, 2013).

TABLE 1

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	%Variance	Cumulative %
1	**4.343**	**72.380**	**72.380**	**4.023**	**67.043**	**67.043**

TABLE 2

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	%Variance	Cumulative%	Total	% Variance	Cumulative%
1	**5.698**	**51.804**	**51.804**	**5.280**	**48.000**	**48.000**
2	**1.175**	**10.685**	**62.489**	**.867**	**7.877**	**55.878**

TABLE 3

Factor	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% Variance	Cumulative %	Total	% Variance	Cumulative%
1	**3.671**	**73.419**	**73.419**	**3.349**	**66.979**	**66.979**

TABLE 4

LATENT FACTOR	**DIRECTION OF RELATIONSHIP**	**LATENT FACTOR**	**ESTIMATE**
Tacit to tacit socialisation	<---	HR impact on event attending employees as part of transformation *f* (p, e)	0.062
Personal tacit socialisation	<---	HR impact on event attending employees as part of transformation *f* (p, e)	0.088
Strategic outcomes	<---	HR impact on event attending employees as part of transformation *f* (p, e)	0.106
Strategic outcomes	<---	Personal tacit socialisation	0.182
Strategic outcomes	<---	Tacit to tacit socialisation	-0.007

Keywords

business events, human resources, SECI, Lewin

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Exploring methodology to maximise the potential of intangible returns on business events

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Abstract

Research findings indicate that there is often several gaps in the successfully gaining all the intangible value that is possible from attendance at a business event (Thomas, 2013). These findings are used to argue for using a template to link existing tools that can measure intangible value changes in an organisation from business event attendance. Event managers while encouraged to use the Kirkpatrick-Phillips return-on-investment model in many instances do not actually apply this model (Yorks, 2005:202-205; Phillips *et al.,* 2007:1; Kline & Harris, 2008:49). This lack of measurement of business event value creation and the research findings suggest that a process is required to ensure strategies defined in an organisational balanced scorecard tool ensure iterative and repeatable standardised actions are taken to ensure the intangible value outcomes of a business event (Von Krogh *et al.,* 2001:430-432). Because of the business event the organisational system should be moving from a current state before the event closer to an ideal state after the event (Leeman, 2002:101). Winter and Szulanski's arrowcore template used with a modified Kirkpatrick-Phillips model would theoretically fit under the larger management system of the Kaplan and Norton balanced scorecard which itself ensures policies and standardised processes to support the Kirkpatrick-Phillips objectives set for a business event (Kaplan & Norton, 2001a:96; Kaplan & Norton, 2001b:154; Winter & Szulanksi, 2001:735; Bose & Thomas, 2007:653; Burke, 2010:62). By doing this a recursive model of levels that feed up to the next is established and the business event value is better ensured. The Kirkpatrick-Phillips model would be modified with aspects of other models especially Qualitative Politicised Influence Diagram (QPID) (Powell & Swart, 2005:51), List of Operational Knowledge Assets (LOKA) (Andreou *et al.,* 2007:69; Andreou & Bontis,

2007:363) and Framework of Intangible Valuation Areas (FIVA) (Green cited by Andreou *et al.,* 2007:54; Masqood *et al.,*2007:128).

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Exploring methodology to maximise the potential of intangible returns on business events

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TABLE 1

Survey question	Event organiser responses
1. How important is a post-event budget to expenditure report to the organisation?	9% not at all to slightly important 17% important 74% very to extremely important
2. How important is a return on objectives report to the organisation (level 0 +1)?	17% not at all to slightly important 32% important 51% very to extremely important
3. How important is a post-event review meeting to the organisation?	8% slightly important 31% important 61% very to extremely important
4. How important is a post-event strategy to the organisation to absorb the new knowledge (levels 2, 3,4 5)?	**78% not at all to slightly important** 23% important 9 % very to extremely important
5. How important is adding event objectives delivered to organisational performance criteria (as ascertained by an instrument such as a balanced scorecard) to the organisation?	**44% not at all to slightly important** 28% important 28 % very to extremely important

Keywords

business event, template, intangible value creation

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Transdisciplinary modelling and decision processes

Utility-based Models and Decision Making Problems for Selected Network Processes

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Abstract

Purpose – The concept of utility was the first time applied in Economics. The paper reports its usefulness for the decision making in complex technological systems, in general and in computer networks, in particular. Three selected decision making problems are considered, corresponding solution algorithms are explained and results of numerical experiments are presented for the selected real-world case study.

Design/methodology/approach – Referring to similar decision making problems in Economics, three problems of different time horizon are investigated: strategic investment planning, short-term network rate allocation and on-line network operating. Deterministic and uncertain versions are taken into account, and the latter one is handled more thoroughly. The formalism of uncertain variables is used to represent the parameter uncertainty which concerns users' demands for service in computer networks as well as network links' capacities. Corresponding optimization tasks are presented. Numerical experiments concerning a part of the computer network Pionier working in Poland confirm the usefulness of the solution algorithms proposed.

Findings – The carried out numerical experiments confirmed the importance and worth of the decision making algorithms for the Pionier computer network. It particularly concerns the game theory based algorithm solving the on-line network operating problem which enables calculating the rates for computer links distinctly, i.e. separately for every link.

Research limitations/implications – More case studies should be considered to formulate more general corollaries. The application of utility concept for wireless sensor networks needs further studies on solution algorithms..

Practical implications – The results can be directly applied to a class of modern computer networks, e.g. content delivery networks, self-management networks, context aware network, multilevel virtual networks.

Originality/value – The paper presents the unified and systematic approach for individual results previously obtained and considers one case study.

Keywords Utility, Management, Decision making, Computer networks, Uncertain systems, Optimization

Paper type Research paper

1. Introduction

A concept of utility introduced by Daniel Bernoulli in XVIII century has been used in the field of Economics for a long time (see e.g. von Neumann and Morgenstern, 1953). The utility expresses a satisfaction experienced by a consumer of a good or service. Despite a consumer's utility is hard to measure directly, it was recognized that the utility can be represented by an increasing, strictly concave and continuously differentiable function. It made possible to quantify in a numerical way such a soft concept as preferences over some services or goods. It is practically impossible to mention all applications of the theory of utility, in general and the utility functions, in particular due to their variety. It is worth noting that from the point of view of the paper this approach has been borrowed by other disciplines where management and (or) organizational decisions are made. Especially, it concerns technological systems. The considerations of this paper are focused on selected types of networks, i.e. computer and sensor networks where management problems are solved with the use of utility based functions. The paper reports some examples of results obtained in the Division of Intelligent Decision Support Systems of the Wroclaw University of Technology, Poland. The problems presented refer to some very well-known types of analogous decision making problems in Economics, i.e.: investment planning where a plan for the purchase of resources are determined to maximize the expected incomes for minimal investment costs; deriving of optimal operational decisions where decisions connected with the operation of a company are made to maximize its profit for a given amount of resources; and on-line management of the market situation where the best strategy for a company is chosen in the presence of market competitors.

Emerging of new concepts in computer networks like the autonomic networking and the self-organizing networks entailed the development of managing of computer networks and their resources in the automatic or semi-automatic manner, e.g. Bettstetter and Prehofer (2005), Mortier and Kiciman (2006). It is strictly connected with the deriving of new management algorithms and computer protocols. Starting from Kelly's (1997) and Kelly's *et al* (1998) seminal works, the majority of them employ utility based approach.

In the paper we assume a computer network as a set of network facilities like routers, switches, wireless network access points and servers connected by wire or wireless directed links. Such networks are equipped with necessary resources being technical parameters of the facilities, e.g. computational power, capacities of links, storage, e.g. Tanenbaum and Wetherall, 2010. Nowadays, computer networks are used not only as a medium for the free exchange and distribution of information among end users but, first of all, as commercial service systems when costs and profits are crucial factors evaluating their work. In a consequence, users and owners (providers, operators) involved in such systems undergo market rules, and appropriate tools have been successfully applied for such technical applications.

Computer network service providers are mainly companies which solve long-term, short-term and on-line management problems. Clients pay for data transmitted and first of all for the quality of the transmission. Every transmission is described by the technical parameters like rate, delay, jitter or loss probability. These parameters depend on the amount of resources allocated by the network operator to the particular transmission. A client has to pay more for better transmission parameters. This relationship can be conveniently represented by the appropriate utility function. As the result, the relevant network provider's procedures are launched, and they are carried out in the automatic or semi-automatic way in contemporary computer networks. Unlike non-technological applications where human factors are directly involved to perform relevant management procedures, rigorous procedures (algorithms) run automatically are expected and specific for technological applications like computer networks.

Three following problems are addressed in the paper being examples of the mentioned types of management problems. The investment planning decisions have to be made at the strategic (long-term) level. First of all, a provider needs to design and plan the structure of a computer network as well as to buy appropriate network devices, i.e.: routers, switches, wireless network access points and servers. Then, the required resources like computational power, capacities of links, storage are acquired. The prospective incomes are usually evaluated based on utility functions expressing forecasted users' demands which allow the maximization of the profit. The minimization of costs of the network resources is also considered (see Gąsior and Turowska, 2006).

For a given network infrastructure, i.e. for network devices and interconnections between them, the short-term decisions consist in such an allocation of available resources to maximize outcomes resulting from the users utilities (see Kelly, 1997 and Gąsior, 2008. In the paper, the fundamental utility based resource allocation problems for computer networks are presented as the example of the short-term management problems.

Finally, the computer network service providers have to take into account the competition on the computer market among different operators which try to provide services for consumers. On the other hand, the co-operation among the operators is indispensable to fulfil users' requirements. This situation can be also modelled using the utility function approach like for the corresponding cases in economic systems.

1.1 Preliminaries

Let us consider a computer network expressed by a set of links between neighbouring network nodes. The general notation used for the modelling of computer networks is given in Table I. The most popular class of utility functions

$$u_r(x_r) = \begin{cases} w_r (1-\kappa)^{-1} x_r^{1-\kappa}, & \kappa > 0, \quad \kappa \neq 1, \\ w_r \ln x_r, & \kappa = 1, \end{cases}$$

Table I. Notation for computer networks

$l \in \mathbf{L} = \{1, 2, \ldots, L\}$, L:	link index, number of links, respectively,
$r \in \mathbf{R} = \{1, 2, \ldots, R\}$, R:	request index, number of requests, respectively,
$\mathbf{A} = [a_{rl}]$:	binary routing matrix where $a_{rl} = 1$ (0) if route of rth request traverses lth link (otherwise),
$\mathbf{x} = [x_r]$:	vector of transmission rates where x_r is the transmission rate of rth request,
$x_r^{\min}, x_r^{\max}$:	minimal, maximal acceptable rate of rth request due to Quality of Service (QoS) constraints, respectively,
w_r:	utility parameter of rth request ('willingness-to-pay'),
$u_r(x_r)$:	utility function of rth request,
C_l:	capacity of lth link,
e_l:	unit cost of lth link capacity,
$h_r(w_r)$:	certainty distribution of the utility function parameter w_r,
$h_l(C_l)$:	certainty distribution of the link capacity C_l.

adequate for modelling elastic flows like file transfers using the File Transfer Protocol (FTP), is called isoelastic functions, Mo and Walrand (2000). For the enhanced inelastic flows like Internet TV, function $u_r(x_r) = w_r \ln(x_r + 1)$ can be used for $x_r \geq x_r^{\min}$. Both functions conform to the requirements imposed on such functions in Economics.

Three decision making problems are considered in the next sections. The first one consists in planning of rate allocations for the network to minimize the investment costs for acceptable levels of the QoS as well as of the total utility. The next problem deals with the short-term management where decisions on feasible rate allocations maximizing the total utility are made. The last problem considered concerns on-line management when different operators should compete and co-operate in the same computer network to fulfil users' demands. The selected results are illustrated for Polish Optical Internet, Pionier which is the Polish nationwide academic network currently consisting of high throughput optical links connecting 26 cities, Fig.1 [http://www.pionier.net.pl/, online access 21st July 2014]. In this case study, we consider the Pionier as an example of infrastructure capable of implementing content provider network functionality. The network can be considered as a backbone for metropolitan area networks. Thus, each city is considered as a routing node, and it is assumed that a caching server is connected to each such node.

1.2. Uncertain variables

For all investigated management problems, their non-deterministic counterparts are also considered. Such cases are closer to real-world applications where some parameters may be not precisely known and (or) rapidly change. For example, it can concern the utility parameters w_r which as the users' features can change and are independent on managing subjects. The link capacities C_l and the QoS parameters $x_r^{\min}, x_r^{\max}$ are also subject to variations during the computer networks activities. It is assumed that these uncertainties are represented by the formalism of uncertain variables which is briefly presented (see Bubnicki (2004), Gąsior and Józefczyk (2009) for details). The uncertain variables approach can be treated as the special case of the fuzzy approach for numerical parameters in the case when their exact values are fixed and certain, but they are not known for the user. Two soft properties are used in the definition of the uncertain variable $\overline{w}_r$: '$\overline{w}_r \cong w_r$' which means '$\overline{w}_r$ is approximately equal to w_r' and '$\overline{w}_r \mathrel{\widetilde{\in}} D_r$' which means '$\overline{w}_r$ approximately belongs to the set D_r'.

The uncertain variable $\overline{w}_r$ is defined by a set $\mathbf{R}$ of its real number values, the function $h_r(w_r) = v[\overline{w}_r \cong w_r]$ referred to as the certainty index given by an expert and the following definitions for any $D_r, D_1, D_2 \subseteq \mathbf{R}$:

$$v(\overline{w}_r \mathrel{\widetilde{\in}} D_r) = \begin{cases} \max\limits_{w_r \in D_r} h_r(w_r), & \text{for} \quad D_r \neq \varnothing, \\ 0, & \text{for} \quad D_r = \varnothing, \end{cases}$$

$$v(\overline{w}_r \mathrel{\widetilde{\in}} D_r) = 1 - v(\overline{w}_r \mathrel{\widetilde{\notin}} D_r),$$

$$v(\overline{w}_r \mathrel{\widetilde{\in}} D_1 \vee \overline{w}_r \mathrel{\widetilde{\in}} D_2) = \max\{v(\overline{w}_r \mathrel{\widetilde{\in}} D_1), v(\overline{w}_r \mathrel{\widetilde{\in}} D_2)\},$$

Figure 1. Layout of the Pionier computer network

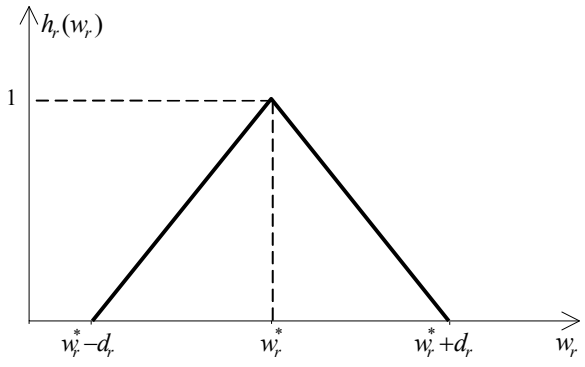

Figure 2. Triangular certainty distribution

$$v(\overline{w}_r \,\tilde{\in}\, D_1 \wedge \overline{w}_r \,\tilde{\in}\, D_2) = \begin{cases} \min\{v(\overline{w}_r \,\tilde{\in}\, D_1), v(\overline{w}_r \,\tilde{\in}\, D_2)\}, & \text{for} \quad D_1 \cap D_2 \neq \varnothing, \\ 0, & \text{for} \quad D_1 \cap D_2 = \varnothing. \end{cases}$$

The function $h_r(w_r)$ is called a certainty distribution. Usually, it is characterized by two parameters w_r^* and d_r which values indicate respectively the most certain value of the unknown parameter according to the expert's opinion and the range of possible values of the unknown parameter. This function is also characterized by the shape which illustrates the degree of certainty for possible values of the unknown parameter. Figure 2 presents used in the paper triangular certainty distribution when the values of uncertain variable $\overline{w}_r$ belong to the interval $[w_r^* - d_r, w_r^* + d_r]$. The ratio $\gamma_r = \frac{d_r}{w_r^*}$ is often used as the parameter characterizing the degree of expert's uncertainty, i.e. the expert's opinions are more confident for the less values of γ_r. It is commonly the same for all uncertain variables investigated, i.e. $\gamma = \gamma_r$ for all *r*.

The reminder of paper is organized as follows. Sections 2, 3 and 4 discuss respectively three mentioned management problems, i.e.: investment planning, rate allocation and on-line network operation. Both deterministic and uncertain cases are introduced, stated and illustrated using the example of Pionier computer network. The next section extends the investigations on Wireless Sensor Networks (WSNs) where similar management problems are present. Final remarks complete the study.

2. Investment planning problem

In the considered problem, we know in advance the set of requests ***R***, the routing matrix **A**, QoS requirements $x_r^{\min}, x_r^{\max}$, willingness-to-pay parameters w_r, the form of utility functions u_r as well as unit costs e_l. We seek for such a vector of rates $\mathbf{x}^* = [x_r^*]$ which ensures the minimum investment cost and guarantees given satisfactory value α of the total utility. The deterministic version of the problem is defined as follows:

$$\text{minimize} \quad Q_1(\mathbf{x}) = \sum_{l=1}^{L} e_l \sum_{r=1}^{R} a_{rl} x_r \tag{1}$$

subject to

$$Q_2(\mathbf{x}) = \sum_{r=1}^{R} w_r u_r(x_r) \geq \alpha, \tag{2}$$

$$\forall_r x_{r,\min} \leq x_r \leq x_{r,\max}. \tag{3}$$

We have the convex optimization problem due to the form of the utility functions u_r, so the Kuhn-Tucker or other known methods can be used to solve it (for example, see, Boyd and Vanderberghe, 2004).

The assumption of precise and full knowledge of all problem parameters is extremely unrealistic. Therefore, the uncertain version is now considered. Some results can be found in Gąsior and Turowska (2006). Let us now assume that the willingness-to-pay parameters w_r are not known precisely. We premise also the lack of experimental data necessary to estimate the values of probability distribution as the objective information of w_r treated as the realization of random variables. To describe this parameter uncertainty, the formalism of uncertain variables has been used which can describe possible values of parameters w_r, being the values of uncertain variables $\overline{w}_r$, in the form of certainty distribution $h_r(w_r)$. In a consequence of this uncertainty, the requirement

(2) concerning minimal total utility value in the network may not be fulfilled in the crisp way, but it can be only approximately satisfied according to the acceptable value $\overline{v}$ of the certain index v. Then, the uncertain version of the investment planning problem consists in solving the minimization problem (1) subject to

$$v\left[\sum_{r=1}^{R}\overline{w}_r u_r(x_r) \,\widetilde{\geq}\, \alpha\right] \geq \overline{v}, \tag{4}$$

and (3) for given $\boldsymbol{R}$, $\mathbf{A}$, $x_r^{\min}, x_r^{\max}$, u_r, e_l as well as $h_r(w_r)$, α and $\overline{v}$.
The solution algorithm presented in Gąsior and Turowska (2006) consists in a rather simple determinization of the problem leading to the non-linear optimization solvable by the classical methods.

3. Network rate allocation problem

Other management problems, which are important to solve for the computer networks in a short-term horizon when network infrastructure is ready, consists in the resource allocation. Let us consider the rate allocation as an example. Now, it is assumed that the network infrastructure, i.e. topology $\boldsymbol{L}$ and capacities of links C_l are fixed. Moreover, the set of requests $\boldsymbol{R}$ together with the routing matrix $\mathbf{A}$ are known. The QoS parameters $x_{r,\min}$, $x_{r,\max}$ along with functions u_r and the willingness-to-pay parameters w_r are also given. The management problem deals with the determination of feasible rate allocation $\widetilde{\mathbf{x}} = [\widetilde{x}_r]$ to maximize the total utility, i.e.:

$$\text{maximize} \quad Q_2(\mathbf{x}) = \sum\nolimits_{r=1}^{R} w_r u_r(x_r) \tag{5}$$

subject to (3) and

$$\forall_l \sum\nolimits_{r=1}^{R} a_{rl} x_r \leq C_l. \tag{6}$$

This problem was introduced and the first solution was proposed in (Kelly, 1997). Then, the problem has been intensively studied, see the survey Palomar and Chiang, 2007.
The uncertain version was also investigated using the uncertain variables approach like in Section 2. The uncertainty concerns now both the utility functions parameters w_r and the link capacities C_l. The non-deterministic character of the 'willingness-to-pay' parameter w_r is rather obvious. The changes in time of the latter parameters may be caused by different factors. Firstly, it is hard to precisely determine the values of demands x_r. Moreover, the values of link capacities C_l offered to users do not contain so called 'protocol overheads', i.e. some amount of capacities necessary to continue the transmission. Additionally, errors in network devices can appear which limit the available capacity, and some network technologies, e.g. wireless transmissions are characterized by volatile values of some parameters. The certainty distributions $h_r(w_r)$ and $h_l(C_l)$ given by an expert are known instead of the precise values of w_r and C_l. It is worth noting that now the uncertainty concerns both the criterion and the constraints, which significantly complicates the problem. The certainty indices are used to express both uncertainties. Finally, the uncertain version of the network rate allocation problem can be stated as follows.

$$\text{maximize} \quad v\left[\left(\sum_{r=1}^{R}\overline{w}_r u_r(x_r) \,\widetilde{\geq}\, \alpha\right) \wedge \left(\sum_{r=1}^{R} a_{r1} x_r \,\widetilde{\leq}\, \overline{C}_1\right) \wedge \ldots \wedge \left(\sum_{r=1}^{R} a_{rL} x_r \,\widetilde{\leq}\, \overline{C}_L\right)\right] \tag{7}$$

subject to (3) for given $\boldsymbol{R}$, $\boldsymbol{L}$, $\mathbf{A}$, $x_r^{\min}, x_r^{\max}$, u_r as well as $h_r(w_r)$, $h_l(C_l)$ and α.
The solution algorithm is presented in Gąsior and Orski (2013). The difficult optimization with multiple max and min operators is transformed to so-called epigraph form (Boyd and Vandenberghe, 2004) and then solved in the numerical way using the method of successive approximation.

4. Network operating problem

We assume in this section that each link $l \in \boldsymbol{L}$ is operated independently and its capacity C_l has to be divided among all requests traversing it. A part of lth link capacity assigned to rth request is denoted by $x_{r,l}$. The transmission rate x_r of the rth request results from the capacities of all corresponding links belonging to the request's path (route), i.e.: $x_r = \min_{l:a_{r,l}=1} x_{r,l}$. Obviously, the service of request implies the income for a network provider, which is proportional to the transmission rate. Additionally, the provider of lth link finds its capacity

allocation vector $\mathbf{s}_l \triangleq [x_{1,l}, x_{2,l}, \ldots, x_{R,l}]^{\mathrm{T}}$ solving the following local optimization problem which enable us to have the optimal partial rates for link l $\mathbf{s}'_l = [x'_{1,l}, x'_{2,l}, \ldots, x'_{R,l},]^{\mathrm{T}}$:

$$\text{maximize} \quad Q_3^{(l)}(\mathbf{s}_l) = \sum_{r=1}^{R} a_{r,l} w_r u_r(\min_{l:a_{r,l}=1} x_{r,l}) \tag{8}$$

subject to

$$\sum_{r=1}^{R} a_{rl} x_{r,l} \le C_l \,. \tag{9}$$

and (3) for given $\boldsymbol{R}$, $\boldsymbol{L}$, $\mathbf{A}$, $x_r^{\min}$, $x_r^{\max}$, u_r, C_l, w_r.

The local optimization problem (8) depends on similar problems for other links in the network possibly owned by other providers. Each provider intends to maximize his (her) own utility by making local decisions on partial rates. Such a form of decision making can be well expressed using the theory of games approach. Then, the decision making (management) problem, the operator and the feasible solution $\mathbf{s}_l$ are called game, player and strategy, respectively. Vector of strategies of all players is called strategy profile. The solution of this problem together with the explanation of the way to calculate the Pareto-optimal Nash equilibrium can be found in (Gąsior and Drwal, 2013).

5. Case study

All decision making problems and results of their solutions are presented in the paper using a case study of the Pionier network. Let us assume that an IT company plans to launch a new service consisting in the distribution of multimedia content, e.g. the video transmission to Pionier network's users. The company is located in Warsaw and its consumers live in the south-west of Poland. In a consequence, to start such a new service, the provider needs to establish its own network and to ensure indispensable transmission resources mainly expressed in terms of links' capacities. They may be purchased or leased from a core network, in our example from the Pionier network. It is assumed in the case study that the new service is available for users living in: Warszawa, Łódź, Poznań, Gorzów, Zielona Góra, Częstochowa, Katowice, Opole, Bielsko-Biała and the network useful for this service has a layout depicted in Fig. 1 with solid lines. The following $R = 8$ transmission requests can appear in the network: Warszawa – Łódź ($r = 1$), Warszawa – Poznań ($r = 2$), Warszawa – Częstochowa ($r = 3$), Warszawa – Katowice ($r = 4$), Warszawa – Opole ($r = 5$), Warszawa – Bielsko-Biała ($r = 6$), Warszawa – Zielona-Góra ($r = 7$), Warszawa – Gorzów ($r = 8$). The requests are transmitted by $L = 8$ links: Warszawa – Łódź ($l = 1$), Łódź – Częstochowa ($l = 2$), Częstochowa – Katowice ($l = 3$), Katowice – Opole ($l = 4$), Katowice – Bielsko Biała ($l = 5$), Łódź – Poznań ($l = 6$), Poznań – Zielona-Góra ($l = 7$), Poznań – Gorzów ($l = 8$). Consequently, the following routing matrix expresses the flow of requests:

$$A = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 & 0 & 1 \end{bmatrix}.$$

The first decision-making problem made by the provider for the new service consists in the determination of transmission rates x_r for users and, in a consequence, of the capacities of links C_l minimizing the total investment cost Q_1 and holding the satisfactory level of the total utility, i.e. in the solution of the deterministic version of problem (1). To solve the problem, the willingness-to-pay parameters w_r have to be known. Their values representing the demand for a transmitted content by users were calculated proportionally to population of corresponding cities (computer network nodes), namely: $w_1 = 7.18$, $w_2 = 5.5$, $w_3 = 2.34$, $w_4 = 3.07$, $w_5 = 1.21$, $w_6 = 1.74$, $w_7 = 1.2$, $w_8 = 1.24$. The results presented in Tables II and III have been calculated for the following values of other data: the guaranteed value of total utility $\alpha = 70$, the unit lease costs of link 1Gbps capacities $e_l = 1$, $l \in \boldsymbol{L}$, the QoS parameters $x_r^{\min} = 2$, $x_r^{\max} = 100$, $r \in \boldsymbol{R}$, the utility functions $u_r(x_r) = w_r \ln x_r$.

The deterministic problem (1) requires the precise values of parameters w_r which is quite unrealistic due to thefact that the actual values of users' demands are difficult to estimate. Therefore, the uncertain version seems

Table II. Deterministic version of problem (1) – the optimal solution

x_1^*	x_2^*	x_3^*	x_4^*	x_5^*	x_6^*	x_7^*	x_8^*	$Q_1(x^*)$	$Q_2(x^*)$
74.51	28.54	12.14	10.62	3.14	4.51	4.15	4.29	243.66	70,00

Table III. Deterministic version of problem (1) – the optimal capacities of links

C_1^*	C_2^*	C_3^*	C_4^*	C_5^*	C_6^*	C_7^*	C_8^*
141.9	30.4	18.27	3.14	4.51	36.98	4.15	4.29

to be closer to the real-world situation. Moreover, such a project as described in the case study is rather unique one. It makes impossible to use very well-known probabilistic approach for the representation of uncertainty. The formalism of uncertain variables introduced in Section 1 which is based on an expert's opinion is fully adequate to the considered example. We assume that the expert expresses his (her) knowledge in the terms of triangular distribution (Fig.1) assuming the values fixed for the deterministic version as $w_r^* = w_r$ and the values of parameters $d_r = 0.1w_r$. This form of the certainty distribution allows having values of the users' demands from the interval which bounds differ of 10% as the maximum from the most certain values w_r^*. Taking the expert's knowledge into account, we may solve the uncertain version of the investment planning problem (1). The results for different values of the certainty threshold $\bar{v}$ are given in Table IV.

One may notice that the higher risk is taken (the less values of $\bar{v}$) the less cost is incurred. This reasonable relationship is almost linear.

When the network is planned and the service is launched, the sizes of demands w_r can change. Then, the provider should try to maximize the profit by changing the transmission rates x_r for the available (leased) links' capacities, i.e. to solve the problem (5). To illustrate such a situation, the simulation has been conducted for the same data like for problem (1) besides the demands w_r which values have been now randomly generated according to the rectangular distribution from the intervals $[w_r - 0.3w_r, w_r + 0.3w_r]$ defined around values w_r for problem (1). The capacities of links C_l are now taken from Table III. The following new values have been generated: w_1 = 8.12, w_2 = 7.15, w_3 = 1.65, w_4 = 4, w_5 = 0,85, w_6 = 1,22, w_7 = 0,84, w_8 = 0,85. The results are given in Table V.

Similarly to the investment planning problem (1), as it has been pointed out in Section 3, it is hard to precisely determine the values of parameters w_r. Moreover, the values of links' capacities C_l can be different than the leased ones. Both uncertainties are taken into account while solving the problem (7), i.e. the uncertain version of (5). They are described by the triangular certainty distributions $h_r(w_r)$ and $h_l(C_l)$ represented respectively by parameters γ_1 and γ_2, defined in Sub-section 1.2. Taking into account such uncertainties, the rate allocation problem (7) was solved for different values of the parameters γ_1 and γ_2 characterizing the expert's knowledge and confidence (the less is value of γ the lower expert's uncertainty). It was assumed that the expert stated as the most certain values of demands w_r^* and of the links capacities C_l^*, i.e. the values being the solutions of the deterministic versions of problem (5) and (1), respectively. The results given in the Table VI are limited to the case $\gamma_1 = \gamma_2 \triangleq \gamma$. It turned out that the difference between ratios γ_1 and γ_2 doesn't change substantially the values of the certainty index *v*. It is caused by the low level of the required income α ($\alpha = 70$). This small value of the income expected by the provider enables us to have the almost sure optimal result ($v = 0.99$) despite the uncertain values of demands and link capacities. However, the income can change in time, and the solution

Table IV. Uncertain version of problem (1) – the optimal solutions for different $\bar{v}$

$\bar{v}$	x_1^*	x_2^*	x_3^*	x_4^*	x_5^*	x_6^*	x_7^*	x_8^*	$Q_1(x^*)$	$Q_2(x^*)$
0.9	72.35	27.71	11.79	10.31	3.05	4.38	4.03	4.16	236.57	70.00
0.7	68.31	26.16	11.13	9.74	2.88	4.14	3.80	3.93	223.39	70.00
0.5	64.65	24.76	10.54	9.21	2.72	3.92	3.60	3.72	211.41	70.00
0.3	61.31	23.48	9.99	8.74	2.58	3.71	3.42	3.53	200.48	70.00
0.1	58.25	22.31	9.49	8.30	2.45	3.53	3.25	3.35	190.49	70.00

Table V. Deterministic version of problem (5) – the optimal solution

$\tilde{x}_1$	$\tilde{x}_2$	$\tilde{x}_3$	$\tilde{x}_4$	$\tilde{x}_5$	$\tilde{x}_6$	$\tilde{x}_7$	$\tilde{x}_8$	$Q_2(\tilde{x})$
74.51	29.91	12.14	12.03	2.56	3.68	3.51	3.56	77.87

Table VI. Uncertain version of problem (5) – the optimal solutions for $\alpha = 70$ and different $\gamma_1 = \gamma_2 \triangleq \gamma$

γ	$\tilde{x}_1$	$\tilde{x}_2$	$\tilde{x}_3$	$\tilde{x}_4$	$\tilde{x}_5$	$\tilde{x}_6$	$\tilde{x}_7$	$\tilde{x}_8$	$Q_2(\tilde{x})$	v
0.9	74,52	29,91	12,14	12,03	2,56	3,68	3,51	3,56	77,88	0,99
0.7	74,53	29,92	12,15	12,03	2,56	3,68	3,51	3,56	77,90	0,99
0.5	74,55	29,93	12,15	12,04	2,56	3,68	3,51	3,56	77,92	0,99
0.3	74,56	29,93	12,15	12,04	2,56	3,68	3,51	3,56	77,94	0,99
0.1	74,52	29,91	12,14	12,03	2,56	3,68	3,51	3,56	77,88	0,99

Table VII. Uncertain version of problem (5) – the values of v for $\alpha = 100$ and different γ_1, γ_2

$\gamma_1 \setminus \gamma_2$	0.9	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.1
0.9	0.75	0.74	0.74	0.73	0.73	0,72	0.72	0.7	0.69
0.8	0.74	0.74	0.72	0.71	0.71	0.7	0.68	0.67	0.64
0.7	0.71	0.7	0.69	0.68	0.67	0.66	0.65	0.63	0.6
0.6	0.66	0.67	0.64	0.64	0.62	0.61	0.59	0.57	0.55
0.5	0.64	0,61	0.6	0.58	0.57	0.54	0.52	0.5	0.47
0.4	0.54	0.54	0.5	0.5	0.48	0.45	0.42	0.38	0.34
0.3	0.48	0.44	0.42	0.38	0.35	0.3	0.26	0.2	0.13
0.2	0,28	0.26	0.2	0.16	0.11	0.05	0	0	0
0.1	0	0	0	0	0	0	0	0	0

Table VIII. The optimal solution of problem (8)

x'_1	x'_2	x'_3	x'_4	x'_5	x'_6	x'_7	x'_8	$Q_2(x')$
74.51	29.91	12.14	12.03	2.56	3.68	3.51	3.56	77.87

of problem (7) should be repeated. Table VII presents the results, limited only to the values of certainty index v, for $\alpha = 100$ and different values γ_1 and γ_2. It is easy to see, and it is understandable that the solution (the rate allocation) with the positive values of $\bar{v}$, representing the achievement of assumed economic purpose in the form of utility, may not exist. One can notice from Table VII that for low values of γ_1 and γ_2, i.e. for the high risk for the required total utility, $\bar{v} = 0$ which means that it is not reasonable to expect any revenue. According to the second corollary resulting from Table VII, the credibility of expert's evaluation of w_r is more important than the corresponding evaluation of C_l from the point of view of the certainty of the obtained results, i.e. v.

The rate allocation for computer networks is the real-time process with extremely short processing times. Therefore, it is strongly recommended to carry out it in the decentralized form after the decomposition for individual elements of the network. Now, let us assume that the decisions are made separately for individual links according to the problem (8). The solutions for the considered case study with the same data as before are presented in Table VIII where $\mathbf{x}' = [x'_1, x'_2, \ldots, x'_R]^{\mathrm{T}}$. The capacity allocation vectors s_l can be easily calculated, e.g. $\mathbf{s}_3 = [0,0,0,12.03,2.56,3.68,0,0]$, and the sum of the elements of this vector does not exceed $C_3^* = 18.27$. It is worth noting that obtained results are the same as for the deterministic version of problem (5) (compare the results in Table V). Such results confirm the usefulness of the game theory based solution algorithm presented in (Gąsior and Drwal, 2013) which enable the conservation of the optimality despite the decentralization of the calculations.

6. Other problems

The utility based management problems are also important for wireless sensor networks. A sensor network consists of a set of sensors, i.e. small electronic devices capable to measure data on certain phenomena from a defined area. Sensors transmit later the data to sinks which collect data and provide them to final users. They are usually battery supplied and work in an environment that makes their constant maintenance impossible, so the proper energy management is the crucial task enabling the maximization of the total execution time of WSNs. It does not concern sinks which, unlike sensors, are constantly supplied facilities capable to collect and store measured data. All sensors and sinks, which constitute WSN, are wirelessly connected. The management problems presented previously for computer networks can be easily extended for WSNs,see, for example, (Zheng et al, 2013) where the profit expressed in the form of utility is connected with a part of link capacity (rate) assigned to different transmissions. However, another approach seems to be more reasonable for the latter networks for which the utility is not connected with the rate of a link capacity but with the importance of data measured and transmitted to the sinks via sensors. Considerations on the corresponding investment planning

Table IX. Notation for WSNs

$m \in \boldsymbol{M} = \{1, 2, \ldots, M\}$, M:	index of measurement point, number of measurement points, respectively
$s, r \in \boldsymbol{S} = \{1, 2, \ldots, S\}$, S:	indices of sensors, number of sensors, respectively
$j \in \boldsymbol{J} = \{1, 2, \ldots, J\}$, J:	index of sink, number of sinks, respectively
$x_{m,s}^{m}$:	size of data collected from measurement point m and transmitted to sensor s
$\overline{x}_{s,r}^{m}$:	size of data collected from measurement point m and transmitted from sensor s to sensor r
$\widetilde{x}_{s,j}^{m}$:	size of data collected from measurement point m and transmitted from sensor s to sink j
$e_{m,s}, \overline{e}_{s,r}, \widetilde{e}_{s,j}$:	amount of energy consumed by sensor s for activities (1), (2), (3) concerning the unit of data, respectively
E_s:	total energy available for sensor s
w^m:	utility parameter characterizing data collected at measurement point m

problem can be found in (Jagusiak and Józefczyk, 2013). Now, the formulation of the network operating problem is presented. Let us focus only on the deterministic version. Unlike previous investigations for the computer networks where the rates were results of decisions, we assume now that routing is not given and paths for data transmission should be designed. WSN considered is composed of sets of measurement points, sensors and sinks referred to as $\boldsymbol{M}$, $\boldsymbol{S}$ and $\boldsymbol{J}$, respectively. The following three individual activities in the network are distinguished: (1) the measurement and transmission of data to the sensor, (2) the transmission of data between different sensors, and (3) the transmission of data from the sensor to the sink. It is assumed that sizes of measured and transmitted data, being the multiple of unit data, are the decision variables presented in Table IX which form the corresponding decision matrices $\mathbf{X}$, $\overline{\mathbf{X}}$, $\widetilde{\mathbf{X}}$. All activities need the energy consumption, which expenditure for every sensor is limited. The total utility is proportional to the size of data collected in sinks, and the data received from distinct measurement points can provide the different extent of utility. The network operating problem can be stated as follows:

$$\text{maximize} \quad Q_2(\mathbf{X}, \overline{\mathbf{X}}, \widetilde{\mathbf{X}}) = \sum\nolimits_{m \in \boldsymbol{M}} w^m \left(\sum\nolimits_{j \in \boldsymbol{J}} u_j(\widetilde{x}_{s,j}^{m}) \right) \tag{10}$$

subject to

$$\sum\nolimits_{m \in \boldsymbol{M}} \sum\nolimits_{s \in \boldsymbol{S}} x_{s,r}^{m} = \sum\nolimits_{s \in \boldsymbol{S}} \sum\nolimits_{j \in \boldsymbol{J}} \widetilde{x}_{s,j}^{m}, \tag{11}$$

$$\forall_{r \in \boldsymbol{S}} \sum\nolimits_{m \in \boldsymbol{M}} \left(x_{m,r}^{m} + \sum\nolimits_{s \in \boldsymbol{S}} \overline{x}_{s,r}^{m} \right) = \sum\nolimits_{m \in \boldsymbol{M}} \left(\sum\nolimits_{s \in \boldsymbol{S}} \overline{x}_{r,s}^{m} + \sum\nolimits_{j \in \boldsymbol{J}} \widetilde{x}_{r,j}^{m} \right), \tag{12}$$

$$\forall_{s \in \boldsymbol{S}} \sum\nolimits_{m \in \boldsymbol{M}} \left(e_{m,s} x_{m,r}^{m} + \sum\nolimits_{r \in \boldsymbol{S}} \overline{e}_{r,s} \overline{x}_{s,r}^{m} + \sum\nolimits_{j \in \boldsymbol{J}} \widetilde{e}_{s,j} \widetilde{x}_{s,j}^{m} \right) \le E_s \tag{13}$$

for given $\boldsymbol{M}$, $\boldsymbol{S}$, $\boldsymbol{J}$, $e_{m,s}, \overline{e}_{s,r}, \widetilde{e}_{s,j}$, E_s, w^m. Constraints (11), (12) and (13) ensure respectively the data flow conservation and the feasible energy consumption. Any function fulfilling the general requirements mentioned in Section 1 can serve as the utility function $u_j(\widetilde{x}_{s,j}^{m})$, however, the form of

$$u_j(\widetilde{x}_{s,j}^{m}) = \sum\nolimits_{s: \widetilde{x}_{s,j}^{m} \ge 0} \ln(\widetilde{x}_{s,j}^{m} + 1) \tag{14}$$

is recommended.

7. Final remarks

The unified and systematic description of selected results on the utility based management of computer networks has been presented in the paper. Three management problems have been considered corresponding to the analogous problems in Economics. The main difference consisting in the way of performing of management procedures has been pointed out, which are carried out automatically or semi-automatically for computer networks. The concept of utility has been used for the formulation of problems. The case study of Polish Optical Internet, Pionier has been used to illustrate the problems. Some preliminary remarks on the application of presented approach to wireless sensor networks are also given.

Two main directions of further work are the most important. First of all, other management problems for selected classes of computer networks are worth investigating. It concerns the next generation networks like Content Aware Networks and the virtual networks. For example, the data placement problem waits for the solution for

the former networks. For the latter networks, the virtual network embedding problem is very important. As it has been mentioned in the paper, the data for the considered problems are not precise and not fully known. Therefore, the solution of non-deterministic versions is fully justified. The application of other representations of the uncertain parameters w_r and C_l, e.g. the pure interval representation without additional description of the uncertainty is planned. All the aforementioned problems are worth considering and some initial results may be found e.g. in (Drwal and Józefczyk, 2011, Gąsior and Drwal, 2011).

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Decision-making in a self-developing system (on the example of cultures of sub-Saharan Africa)

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Abstract
A concept of development that could serve as a strong foundation for the construction of self-developing systems so far has not been developed. Social practice strongly encourages researchers to explain properties of self-developing systems, to design them, and to provide advice on their rational behaviour in the course of development. Culture is one of the most striking self-developing realities. Problems posed by modern cultural studies directly indicate the necessity of explaining the phenomenon of development. In particular, this applies to issues arising during the decision-making involved in the implementation and maintenance of its key processes. The article identifies groups of the most significant properties of the class of self-developing systems and justifies the peculiarities of decision-making processes in such systems on the example of the development of cultures in sub-Saharan Africa. The results of these studies enable the authors to give recommendations regarding approaches to decision-making in support of self-development.

Keywords
development, self-developing systems, decision-making, culture, Africa

Word count 4,999

Introduction
Development is the most complex and understudied reality with which people deal and in which they participate. Although there exist many concepts of development, the vast majority of them have a particular character, explain specific aspects of development, and reflect particular patterns. These include concepts by Darwin, Mendel, Popper, Lamarck, Spencer and others. What this means is that there still has not been elaborated a scientifically recognized concept of development. There exists no systemic picture of development that could serve as a strong foundation for the construction of self-developing systems. At the same time, there are several fundamental studies that have created preconditions for a systemic breakthrough in explaining self-development. Among these are works in the field of self-organization (Saridis, 1977), purposeful behaviour (Ackoff & Emery, 1972), genetic algorithms (Holland, 1975), the evolution of world systems (Wallerstein, 2001), and others. Therefore, the attempts to define development and to distinguish its properties from the properties of other realities (process, growth, purposeful behaviour, etc.) should be continued and become even more intensive.

Despite all the above, social practice strongly encourages researchers to explain properties of self-developing systems, to design them, and to provide advice on their rational behaviour in the course of development. In this respect culture is one of the most striking self-developing realities. In

our context it should be viewed as a continuous cumulative process involving creative expansion of its "matter" and capabilities (White, 1949). The observed dynamics of individual cultures and the universal culture of man is a vivid example of self-development in which every new step increases its internal uncertainty and the range of options, which makes its next stage explosive and unpredictable. Problems posed by cultural studies directly indicate the necessity of explaining the phenomenon of development. This especially applies to issues arising during the decision-making involved in the implementation and maintenance of its key processes.

The article identifies groups of the most significant properties of the class of self-developing systems and justifies the peculiarities of decision-making processes in such systems on the example of the development of cultures in sub-Saharan Africa, which the authors have explored in the course of field research from cultural-anthropological and systemic perspectives. The results of these studies enable them to give recommendations regarding approaches to decision-making in support of self-development.

Known properties of developing systems

Anthropology, biology, cultural studies, sociology, social psychology, philosophy and other disciplines try to explain development from different perspectives. An aggregation of their results leads to a somewhat better understanding of a number of systemic properties of development for the subsequent conceptualization of the mechanism of self-development. We will present these properties in the form of groups of theses on the most essential properties of development as a class of systems.

The first group of theses. The patterns of development as a process

Most generally, development is an irreversible directional qualitative and quantitative change of wholes with special properties. Hereinafter the term "development" is used as a synonym for "progress" and in this sense differs from the term "evolution" interpreted by Darwin as any meaningful change in such wholes (Bondarenko, 2000). The changes conveyed by the term "development" should constructively be considered the fulfilment of limitations on quantitative and qualitative transitions that occur in living subjects. These limitations include, for example, energy dependence; progress being necessarily a change in the balance of contradictions; the containment of change by the limiting values of properties; cyclical returns to invariant states; changes of the direction of transformation of properties of wholes depending on the context, etc. Essentially we are talking about an extended set of dialectical patterns, the use of which in the context of development explains the most important properties that distinguish it from all other processes. This refers to the fact that the process of change alters not so much the state of objects but rather their invariant properties that make them what they are.

A comparison of pre-colonial and modern cultures of sub-Saharan Africa clearly illustrates the above findings. The latter have undergone more significant changes as compared to the former. At the same time, at the heart of development lies an augmentation of properties of cultures, which is reflected in the fact that only those new elements that exhibit compatibility with the central elements that earlier defined these cultures can establish themselves as their inextricable constituents. The overriding fundamental cornerstone of cultures of sub-Saharan Africa is the principle of communality – the ability of originally and essentially communal socio-political norms and relations, worldview and behavioural patterns to spread on all the levels of societal complexity, including supra- and non-communal ones (Bondarenko, 2014a). This principle still applies, demonstrating that in the course of development the initial fundamental properties of an object are not rejected but rather are complicated and supplemented with new ones, which are compatible with them.

The second group of theses. The mechanisms of development

Since the moment when "development became aware of itself" and since the appearance of conscious man it has operated through two mechanisms, one of which was previously unknown to

the Earth's nature.

The first mechanism of development is the so-called "Darwinian triad": variation – selection – inheritance. For millions of years the nature has been slowly developing itself through the proliferation of the most appropriate properties for particular environments. The development of living organisms continues the same way, gradually ramping up the quality of their cycles. But there where man has appeared this line of development is significantly distorted.

The second process could be called the "mechanism of will". It has brought about a fundamental turn of the lines of force of evolution and the beginning of history. Before, the period of evolution was cyclical. Now the world is changing differently than it was before man. His free will establishes various relations between different objects. The emergence of new relations with the world should be seen as development. From this viewpoint, development takes place when objects form new relations ("cells" of development) with objects of a different nature and when the diversity of these relations expands or narrows. This fact underlies the emergence of new properties as a consequence of the integration and differentiation of the wholes formed by new relations.

In the context of our study these theses lead to two important conclusions: 1) development is clearly carried out in the direction of expanding the "subtle"; 2) today, development not only takes place but is also carried out by people either unconsciously or consciously. Both variants may be a blessing to the world or a tragedy – or, simply put, death. This fact highlights the issue of approaches to conscious decision-making involved in choosing directions for expanding the sphere of the "subtle".

In African cultures this can be seen, firstly, in a marked acceleration of the dynamics of cultures, and, secondly, in a shift of cultural dominants in connection with the increasingly intensifying cultural interaction in the modern world. Most of the African cultures of the 2000s differ much more from those of the early 1900s than the latter differ from those of the beginning of the 19th century. Over the 20th century and the beginning of the 21st century not only social and political institutions and many elements of material culture previously unknown in Africa but also values established themselves on the continent. Despite many constraints, values associated with secular education, civil society, etc. are becoming important to wider sectors of Africa's population. This is illustrated by research on such topics as the relation between the level of education of citizens of these countries and the degree of their ethno-racial and religious tolerance and the attitude of Africans toward the problems of foreign economic aid and corruption (Bondarenko, 2004; 2014b; Bondarenko et al., 2013a; 2013b).

The third group of theses. The whole in the directions of development

Research in the fields of philosophy, social anthropology, and cultural studies shows (Wilber, 2001) that, firstly, development takes place simultaneously in several directions, which are affecting each other, and, secondly, deceleration or acceleration of just one of the directions leads to the contraction of its lines of force or a full stop. These ideas are supported by studies of the mechanism of autopoiesis (in the interpretation by Maturana and Varela).

According to these studies, the main directions of development of any wholes include the individual ("I" – as a growing awareness of individuals), collective ("We" – as the development of forms of social relations) and coactive ("It" – as the development of the products of activity) directions (Fig. 1). These directions are analogous to ontogenesis, phylogenesis and technogenesis. An increase or decrease in the speed of change in one of them without a corresponding change in the other two upsets the evolutionary balance and threatens the existence of the whole.

The history and modernity of many African cultures and nations confirms the thesis, demonstrating the coercive aspect of this property of development. With regard to pre-colonial societies, this is evidenced by the success of application of Claessen's Complex Interaction Model, which is similar to the discussed one (Claessen, 1984; Kochakova, 1999).Today we can see an example of a relatively balanced wholeness of the directions of development in the post-genocide culture of Rwanda. A vivid example of an evolutionary imbalance of the whole is Nigeria, which is

evident in the negative aspects of the political, social and economic situation in this country.

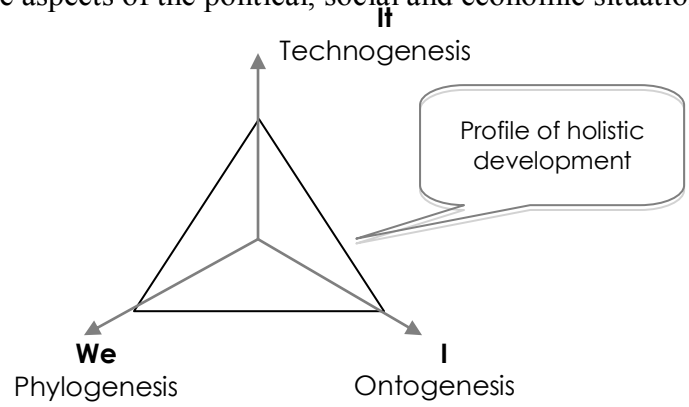

Fig. 1. Diagram of the notion of the whole in the directions of development

The fourth group of theses. The inheritance of generations

Nature continues through the development of relations in all aforementioned directions, which happens in the form of a generation change, i.e. in the form of the replacement of one generation with another. Nature still has no other way to prolong itself. This means that all living things – any idea, any biological, social or other structure, any technology, concept, or cultural innovation should be conceived, grow, mature and die off, clearing the way for the next generation (Fig. 2). The thought is most strongly accentuated in the works of Hegel as the idea of the "nodal line of proportions of measures" and the idea of "Aufhebung" (abolishment).

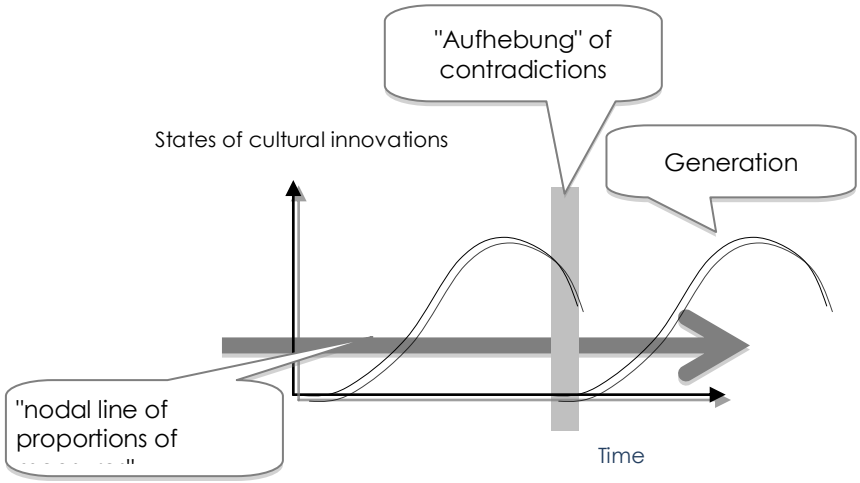

Fig. 2. Diagram of the replacement of generations in developing systems

This property of development, which should remain true for self-developing systems, introduces a distinction between two classes of supporting decisions: 1) the class of decisions associated with a slow, adaptive transformation of the quantity/quality of objects, which is brought about by mutations (in unconscious wholes) and a creative overhaul of reality (in conscious wholes); 2) the class of decisions associated with an aggressive, revolutionary abolishment of the contradictions of one generation as the next generation's contradictions emerge.

Both these processes can be seen in a number of well-known historical examples of cultures. In every culture – or even every civilization as a set of cultures with a similar historical dynamics – one of the two classes of supporting decisions becomes a priority, is considered more correct, and is

generally preferable. In this context, we can talk about predominantly adaptive and predominantly transformational cultures and civilizations. This phenomenon explains the uniqueness of the worldview and societal norms in these cultures. Indeed, the cultures of the sub-Saharan African civilization are among the predominantly adaptive ones (Bondarenko, 1997).

The presented groups of meanings, in our view, encompass the known properties of the class of self-developing systems to the extent sufficient to discuss the properties of decision-making processes and approaches to them.

The variety of decision-making processes in developing systems

Our studies (Baskin & Bondarenko, 2014; Teslinov, 1998, 2011) show that the identified properties enable us to systematically design developing wholes, bringing them closer to actual ones. The kind of intellectual projection leads to an understanding of the fact that this involves decision-making processes of extremely heterogeneous nature. Below is a number of these varieties, ordered logically according to the order of the theses on development.

Type I decisions

These decisions are related to the application of the dialectical laws of development. The group consists of three sets of heterogeneous decisions:

- The set of decisions regarding classification of the effects that indicate the occurrence of one or another pattern. For example, in artificial developing systems one should be able to recognize an indication that they are approaching the limiting values of the balance of polarities in emerging contradictions in order to prevent the destruction of a system or, conversely, to facilitate this process (Teslinov, 2011). Similarly one should be able to distinguish trends that imply the forthcoming mirror and inverse change of system properties. Due to these changes the course of events in the system changes its future value. It is necessary to make decisions regarding the system states that indicate the onset of a harmonious balance of contradictions, etc. These decisions will create the conditions for the successful management of the processes of development.
- The set of decisions regarding appropriate interference in system processes. These are essentially managerial decisions that help simulate the application of the objective dialectical laws of development. Such decisions should assist in systematically enforcing limitations on changes in the state of internal contradictions of developing wholes and their quantity/quality transformations. To the greatest extent this type of decisions has been researched in the field of homeostatic studies as a branch of cybernetics that deals with investigating conditions necessary to maintain homeostasis by controlling contradictions (Gorsky et al., 2008). Moreover, to simulate natural dialectical laws one should adopt from this field of science not just methods of maintaining homeostasis but also methods of destroying it in order to proceed to a new homeostasis.
- The set of decisions regarding methods of interference in the processes of qualitative/quantitative change aimed at preserving system stability.

The whole set of decisions must fulfil the role of the laws that are inevitably affecting system processes and keeping them in the "corridors" of sustainable development (see Fig. 3).

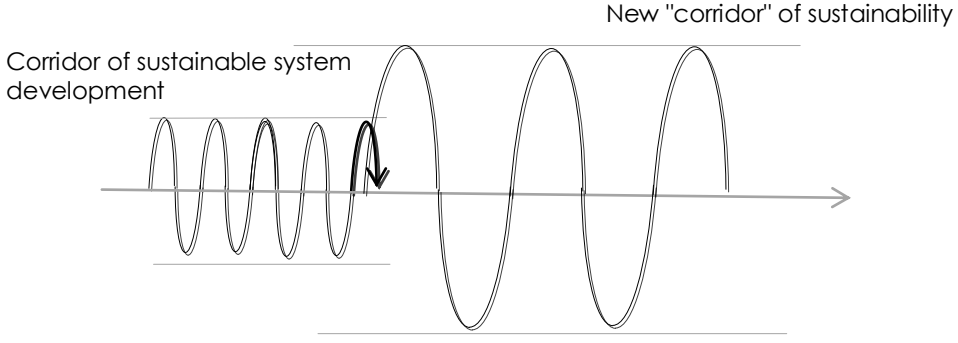

Fig. 3. Behavior of a developing system if Type I decisions are made

In "modern" cultures of, according to Weber's typology, the "rational-legal" type of authority, these decisions are made by the governing elite, which is acting on the basis of reflection of what is happening in certain areas (sectors) of social practice. This is the source of regulatory forces that keep the development of peoples within the boundaries of the chosen direction. In developing cultures, with, according to Weber, the "traditional" type of leadership, such decisions are based on the authority of customs. Still today in African countries, traditional social norms maintain their relevance and vitality, sometimes coming into conflict with modern legislation, sometimes sharing with the latter the spheres of influence and becoming subjected to codification by the will of the state, conscious of the futility of attempting to eliminate them. For example, Zambia's 1996 Constitution authorized the establishment of the House of Chiefs, the jurisdiction of which extended to the so-called "traditional issues". The House was assigned an advisory role within the organs of supreme authority. During a visit to the House, one of the present authors found out that its members did not hide their desire to spread its influence far beyond the "traditional issues", and research has shown that they have succeeded in this. Violating traditional norms with impunity is impermissible both in the spheres of public and private law. For example, in East African tribes – the Maasai, Datooga and others – a violation of a tradition is equated with treason and is accompanied by exclusion from the tribe and becoming an outcast (Photo 1). One should not expect a sharp decline of the role of traditions and customary law in Africa in the foreseeable future (Fenrich et al., 2011).

Type I decisions and the corresponding decision-making processes are linked to the maintenance of the homeostasis of the main trends in systems development. These decisions provide operational sustainability to objects in a changing environment.

Photo 1. A tribal Maasai (left) and an outcast Maasai, estranged from his tribe in accordance with the tradition (right)

Type II decisions

These decisions are related to the creation of development "cells". The group consists of three sets of heterogeneous decisions:

- The set of decisions regarding the choice of a future that will bring about a system's development rather than degradation. The decisions concern the direction of the development of the system's interaction with other objects and systems. One can call these decisions strategic because they have to determine the main directions of the change in the system's work processes and for expanding the sphere of the "subtle". For the sake of reducing the uncertainty in the choice of a future, these decisions must be able to work with the Unknown, within which it is necessary to choose the areas the development of which will guarantee the existence of the system in the near-step and further. The decisions of this type oppose the existing socio-cultural approach to development, in which society is hostage to discoveries emerging in a mature environment but not passing the filters of conscious selection. The decisions on selecting the innovations ("cells") that are to be implemented should be made by the means of increasing intellectual capacity, because the mechanism of will and the historical increase in human capabilities to influence the surrounding world increase the risk of transforming development into degradation.
- The set of decisions on the quality of the relations that a system should establish with other objects and systems in order to develop. The quality of the relations corresponds to their content and the scope of the involved components. For instance, the system should include decision-making processes that determine which relations are to be established and maintained, and to which classes of objects they should apply. All of these decisions need to be weighed against the decisions of the previous set.
- The set of decisions on the implementation of decisions. Methods of establishing the necessary relations, which are most appropriate given the prevailing circumstances, have to be identified.

Examples of this type of decisions are abound in modern cultures: they are the norm in economically advanced countries, but can also be observed in some Third World countries, including African (Rwanda, Tanzania and several others). In particular, the decisions of the type include multiyear strategic development programmes (excluding the imposed directions of economic development) – Fig. 4. It is another matter that in Africa such programmes often remain unfulfilled in practice.

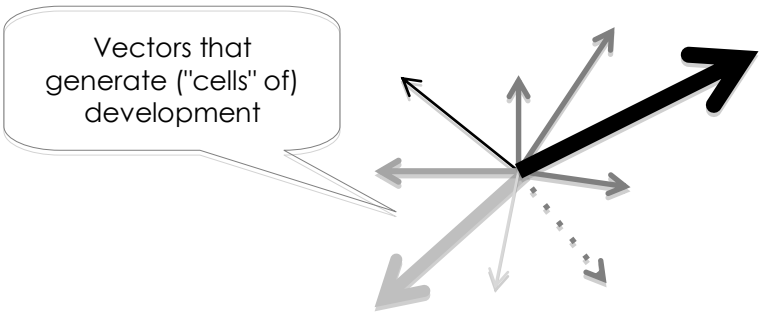

Fig. 4. Diagram of Type II decisions in a developing system

At that, decisions on the quality of the relations established in the direction of strategic development are made everywhere and, most often, irregularly. The strength or weakness of Type II decisions manifests itself in the expansion or contraction of the capabilities of countries acting as self-developing wholes.

Type III decisions

These decisions concern the balance of quantitative and qualitative transitions. They confer sustainability to developing objects in the long term. The decisions of this type should also be divided into three characteristic sets.
- The set of decisions on the assessment of the current distribution of a system's efforts in key directions of transitions, on which its future depends in the long term. The set has a meta-level

character with respect to all the previous sets because it is associated with the assessment of the balance of strategies rather than with the strategies themselves.
- The set of decisions on the redistribution of efforts in the directions of a system's development. This concerns the choice of classes of vectors generating the "cells" of development and their subsequent differentiation and integration. These are essentially decisions regarding the directions of redressing imbalances in the area defined by three key lines of evolution: ontogenesis, phylogenesis and technogenesis – Fig. 4.

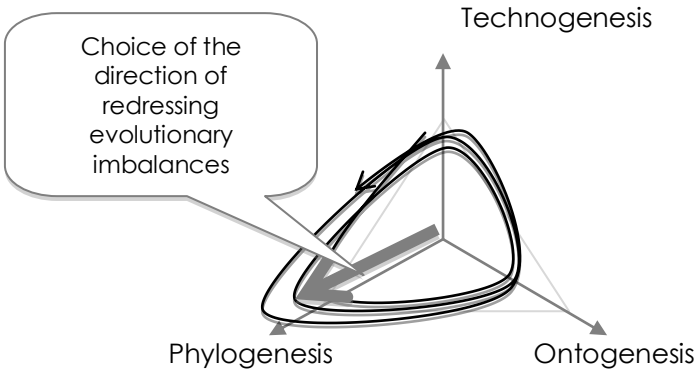

Fig. 4. Diagram of Type III decisions in a developing system

- The set of decisions on how to maintain the evolutionary balance.

Making decisions of this type requires a more powerful intellectual resource than making decisions of the first or second type. This involves the use of instruments enabling to work not just with senses of what is happening in a system, but with quanta of senses (sense units) of what is happening in it. In this context, the disciplines within the field of operations research lose their importance, and the methods of working with a variety of semi-structured fields of knowledge, i.e. the methods of working with concepts as theories, come to the forefront (Nikanorov, 2009; Teslinov, 2009). The absence or weakness of decision-making processes of this type poses a serious threat to the existence of a developing system, because the latter is not able to restore its vitality after a long period of existence under the conditions of evolutionary imbalance.

In existing civic cultures, this is embedded in the form of a regular meta-level reflection by society and its political institutions of the general path of development and of setting new priorities for change. In societies with a low level of self-reflection (i.e., those without a mature civic culture), these decisions are situational, i.e. provoked by the circumstances, hence they appear at the limits of conflicts or even catastrophic events, or under external influence. An example of a decision of such type was the 1985 decision by the Tanzanian leader Julius Nyerere, who had headed the country since its emergence in 1961-1964, to depart from the course of building socialism, which he had proclaimed in 1967, and to implement liberal economic and political reforms. These decisions were provoked by the economic crisis brought about by the failure of the socialist policy.

Type IV decisions

These decisions are related to the possibility and methods of replacing one generation of a system with another. It is also necessary to distinguish three different sets of decisions.
- The set of decisions regarding the exhaustion of the energy of the evolutionary wave in the current generation. These decisions concern the recognition of indications of the build-up of a new generation of a system. The relevance of such decisions increases as the system itself grows aware of its aging, the transition to the final stage of life and the necessity of rebirth. The moment is painful for the system but fundamentally necessary. A peculiarity of the decision-making process is

that it increasingly involves the preparation of the ground for the characterization of the fading nature of internal resources constraining development.
- The set of decisions on the character of the new generation of a system, in which its existence can continue. These are decisions of a "push-through" type. In a developing system they serve as a springboard for the transition to a new form of existence, in which all the aforementioned types of decisions will have to be made again. Decisions will have to form (indeterminate) clots of relevant (but not absolute) concepts of perfect forms of the existence of a system and choose the most appropriate ones. In other words, a system needs to create a new paradigm (model) of its existence. Decisions of this type are of the same paradigmatic character as described by Kuhn (2012). In the evolutionary algorithm by Teilhard de Chardin (1999), it is wildlife "groping" for new forms of life. These are perfect decisions that serve as "anchors" for the trajectories of quantitative and qualitative system transformations for the dimly foreseeable future.
- The set of decision associated with the search for ways to eliminate objective contradictions between generations of evolutionary waves. Among the properties of these processes is the conflict of generations, while a peculiarity of the decision-making process is the work with the new Unknown emerging in the conflict's course. These decisions are not the classic choice of alternatives. The alternatives have to be generated before the choice is made.

The decisions of this type can only be made on the basis of mature states of development of the systems themselves. In addition, the quality of these decisions depends on the quality of these states. In other words, such decisions are possible only in the presence of a mature public reflection of what is happening, i.e. in an existing civil society. Without the kind of reflection a system, not even coming to "consciousness", "falls through" into new generations, and the consequences of this are unpredictable.

In African cultures, these phenomena are observed in those numerous countries which, even though under external pressure, in different periods of their post-colonial history unjustifiably and uncritically took after models of foreign cultural development without any internal prerequisites for the implementation of such models. However, it is difficult to provide examples of a full application of all abovementioned decision-making processes.

Typology of decision-making processes in a developing system

An analysis of the variety of the decisions made in a developing system and of the corresponding processes leads to the construction of a typology that explains the principal property of the developing systems: they all contain a fundamental contradiction that impels them to develop themselves in order to increase their potential.
The typology is based on the following:

Levels of reflection of decisions.

As can be seen from the above list of sets of decisions, the results of every preceding set of decisions are subject to a reflection by the following set. Thus, the decisions concerning the direction of the development of a system's interaction with other objects are based on the decisions aimed at preserving system stability. In turn, these decisions provide a basis for the set of decisions on how to maintain the evolutionary balance, etc.

Depth levels of the Unknown, with which the decision-making processes interact. From one type to another the amount of the Unknown grows. This entails an increase in the ratio of generating algorithms in the decision-making processes versus selection algorithms. This fact is reflected in the dominance of the mode of divergence as compared to convergence as the complexity of decision-making processes increases.

The depth of reduction, which a system uses to make decisions. It is obvious that as the complexity of decisions reaches the high level area of reflection, which in turn is multiplied by high uncertainty, the decision-making methods will require a strong compression of senses and an aggregation of information. This inevitably will be accompanied by a reduction, which will still

permit to make decisions when their accuracy cannot be verified.

These bases provide a space in which different types of decision-making processes can be identified – Fig. 5.

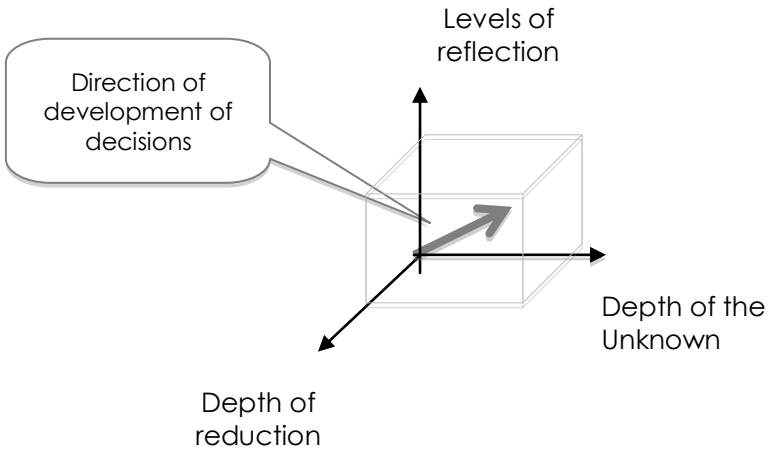

Fig. 5. Decision type space in a developing system

In this space, quite distinguishable is the direction of development of decisions as the evolutionary complexity of the processes which "service" these decisions in developing systems increases. It may seem paradoxical that as the complexity of decision-making and levels of reflection increase, the depth of reduction grows. However, the confusion is eliminated when taking into account the fact that nature maintains fundamental contradiction as the driver of development in the course of decision-making in the most difficult classes of systems.

Conclusion

The authors hope that a more accurate definition of the organizational picture of developing systems will allow the decision-making processes in them to be modelled and implemented more adequately. This extends the capability to establish and maintain developing wholes and on this basis to create realities contending with themselves in enhancing survivability. Hence, humanity has a chance to save itself and the diversity of cultures, with which it is paving its way into the future. The results give researchers the joy of understanding the surprising mechanism with which nature is endowed to continue itself in the direction of the true good.

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Multiple Attribute Decision Making based on the Mean Value of Grey Number

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Abstract: With respect to the multiple attribute decision making problem with subjective preference for a certain attribute, which weight value's range has been given but other attribute's weight value is unknown, a method based on the mean value of the grey number is proposed to analyze the decision problem. Firstly, the middle value of the preferred attribute's weight value's range is supposed to be its weight value according to the content of the mean value of the grey number. Secondly, in order to reflect the decision maker's subjective preference information, an improved optimization model which request the minimum deviation between the actual and expectation numerical of each attribute is constructed to access the attributes' weights. Thirdly, the correlated degree and the correlation factor matrix which were determined by the weight values of all attributes are used to rank all the alternatives. Finally, an example of the choice of supply chain partnership, on the condition that the decision makers have a preference for a certain attribute of various alternatives, is used to illustrate the feasibility and practicality of the proposed method. Thus, the proposed approach is proved to be able to solve the issue raised at the beginning of this article.

Key words: multiple attribute decision making; mean value of the grey number; correlated degree; optimization model

1. Introduction

Multiple attribute decision making problems, also known as multi-objective decision making problems with limited schemes, is a method that select the most optimal alternatives under multiple attributes. It has an extensive application in many fields like engineering, technology, economy, management, and military. In this decision problem, the relative importance namely the weight value of every attributes has an important influence on the evaluation results, thus knowing how to determine the weight value is a very important in multiple attribute decision making. Due to the obscurity of the attributes' concept, the limitation of the decision maker's cognition and the complexity of the background, the weight values are difficult to determine, we can only be provided with the possible range of every attributes' weight. How to reasonably determine the weight value has always been focus by the scholars, many scholars have used interval number to deal with this kind of fuzzy evaluation information. Huawen Liu proposed a relative membership degree method based on fuzzy set theory to handle the multiple attribute decision making problems with intervals is provided [1]; Jian Liu put forward the definition of dominance relation for decision making objects, he figured out the equivalence relations which exist between the value of advantage relationship for decision making object and the sum of two attribute values, and used the probabilistic dominance relation to sort and select the decision making objects[2]; With respect to dynamic multiple attribute decision making problem, in which period weights and attribute weights of each period are given and attribute values at different periods are expressed in interval numbers, Zhixin

Su presented a new method based on the basic concept of the traditional VIKOR method and integrated the operations of interval numbers[3]; Pengfei Wang defined the distance entropy of the interval grey number, and built a grey distance entropy maximizing deviations model of the attributes of uncertain multiple attribute decision making[4]; According to the grey correlation analysis, Xiaozhi Zhang defined the generalized optimal ordinal number and built two program model to determine the attribute weights and the time weights [5]. Some other scholars brought the new decision information into two parameters interval number to constituted the three parameters interval number, then used it to express the attribute value. Yong Dai improved the TOPSIS model based on three parameters interval number [6]; Zhiping Lu discussed the problems about dynamic weights of attributes and experts, and stage weight in multi-stage and multi-attributes group decision-making problem based on the theory about the distance degree of interval numbers and entropy values[7]; Manfeng Liu converted the decision matrix to triangular fuzzy number decision matrix with behavior preference, and established a linear programming model to obtain the attribute weights [8]. Many scholars tried to using new methods, new ideas, or the combined method of old and new to determine the weights of the attributes. Stan Lipovetsky suggested a new method of multi-attributes decision-making problem, this approach is a development of the Analytic Hierarchy Process enabling the united consideration of all horizontal and vertical connections of a hierarchical system in a single optimizing objective function based on statistical models of the synthesis process[9]; Zaidong Sun proposed a new index-alternative similarity scale, and presented a model based on this index for multiple attribute decision making with incomplete information [10]; Hongan Zhou extended the continuous ordered weighted geometric averaging (C-OWGA) operator to accommodate uncertain environment, presented some new operators for aggregating uncertain information in the form of interval numbers, such as the weighted C-OWGA (WC-OWGA) operator, the ordered weighted C-OWGA (OWC-OWGA) operator and the hybrid C-OWGA (HC-OWGA) operator[11]; Guodong Song combined the graph theory with multiple attribute decision making , he used score vector to take place of weight vector and made full use of the known information to determine the score vector[12]; Changyong Liang proposed a model with adjustability to seed objective weight based on entropy and integrated the subjective weight and objective weight into general weight linearly [13]. In this paper, we intended to solve the decision problem such as the decision makers have a subjective preference on a certain attribute, which weight value's range has been given but other attribute's weight value is unknown. We used the mean value of the preferred attribute's weight value's range to represent its weight value according to the content of the mean value of the grey number. Then we used an improved optimization model to access the attributes' weights to solve this multiple attribute decision making problem.

At present, there are also a lot of methods is using to select the supply chain partner. Guoxiang Wu proposed a new partner selection method based on technique for order preference by similarity to ideal solution (TOPSIS) and information entropy [14]; Yifeng Qiu estimated all the attributes' weights by an Eigen vector method, and figured out the attribute priorities with the relative position estimation [15]. In this paper, we selected the partner based on the correlated degree of each alternatives, this method is more convenient to solve the special problem in actual situation.

2. Principles and methods

2.1 problem description

Let $p = \{p_1, p_2, \cdots, p_n\}$ be a set of alternatives and $s = \{s_1, s_2, \cdots, s_m\}$ be a set of attributes in multiple attribute decision making problems. And use $\omega = \{\omega_1, \omega_2, \cdots, \omega_m\}$ to represent index weight vectors, where $0 < \omega < 1$ and $\sum_{j=1}^{m} \omega = 1$. Let $X = (x_{ij})_{n\times m}$ be the decision matrix, where $x_{ij} (i = 1,2,\cdots,n; j = 1,2,\cdots,m)$ is the consequence with a numerical value for alternative p_i respect to attribute s_j, and the numerical value of x_{ij} is comes from the decision makers' linguistic assessment information, like the assessment can be described in very poor $(x* = 1)$、 poor $(x* = 2)$、 a little poor$(x* = 3)$、 fair$(x* = 4)$、 good$(x* = 5)$、 very good$(x* = 6)$.

The practical problem studied in this paper is that the decision makers have a preference for a certain attribute of various alternatives, so the weight value's range of this attribute were given as (ω', ω''), where $0 \le \omega' \le \omega'' \le 1$, while the other attributes' information on weights was completely unknown. In Grey System Theory, the numerical value like the certain attribute's weight, we only know its range and don't know its exact value, is called grey number, $⊗ \in [a, b](a < b)$ [17]. In the absence of grey number's distribution information, if ⊗ is a continuous grey numbers, then we called $\widehat{⊗} = \frac{1}{2}(a + b)$ is the mean value of the grey number ⊗. In the basis of the mean value of grey number, we took the $\omega^* = \frac{1}{2}(\omega' + \omega'')$ as the weight value of the preferred attribute, then we calculated other attribute's weight value after this.

2.2 constructing the decision matrix

Since the attributes are generally incommensurate, the decision matrix needs to be normalized so as to transform the various attribute values into comparable values. The existing normalization methods mainly include the vector normalization, linear switching method and extreme value normalization [18]. We used the vector normalization to transform the initial decision matrix A in this paper.

Let $X = (x_{ij})_{n\times m}$ be initial decision matrix and $Y = (y_{ij})_{n\times m}$ be normalized decision matrix.

$$y_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}, j \in M$$

The weighting decision matrix $Z = (z_{ij})_{n\times m}$ can be got by the normalized decision matrix $Y = (y_{ij})_{n\times m}$.

$$z = (z_{ij})_{n\times m} = \begin{pmatrix} y_{11}\omega^* & y_{12}\omega 2 & \cdots & y_{1m}\omega m \\ y_{21}\omega^* & y_{22}\omega 2 & \cdots & y_{2m}\omega m \\ \vdots & \vdots & \vdots & \vdots \\ y_{n1}\omega^* & y_{n2}\omega 2 & \cdots & y_{nm}\omega m \end{pmatrix}$$

Definition 1: let z_j^+ be ideal value of every attribute.

$$z_j^+ = \max_{1<i<n}\left\{z_{ij} \middle| j=1,2,\cdots,m\right\} = \max_{1<i<n}\left\{y_{ij}\omega_j \middle| j=1,2,\cdots,m\right\}$$

$$= \max_{1<i<n}\left\{y_{ij} \middle| j=1,2,\cdots,m\right\} \times \omega_j = y_j^+ \times \omega_j$$

Definition 2: let y_j^+ above denotes the ideal value of the jth attribute in normalized decision matrix Y.

Definition 3: let d_j be the sum of squares of the distance between every alternative and the ideal alternative of every attribute.

$$d_j = \sum_{j=1}^{m}\left(z_j^+ - z_{ij}\right)^2 = \sum_{j=1}^{m}\left(y_j^+ - y_{ij}\right)^2 \omega_j^2$$

When we determine the attribute weight ω of every attribute, we should make the d_j as small as possible. According to this, we proposed an optimization model to determine the ω.

$$\begin{cases} \min D = \sum_{i=1}^{n}\left(y_1^+ - y_{i1}\right)^2 \left(\omega^*\right)^2 + \sum_{i=1}^{n}\sum_{j=2}^{m}\left(y_j^+ - y_{ij}\right)^2 \omega_j^2 \\ \omega^* + \sum_{j=2}^{m}\omega_j = 1 \end{cases} \tag{1}$$

According to the Lagrange function:

$$L = \sum_{i=1}^{n}\left(y_1^+ - y_{i1}\right)^2 \left(\omega^*\right)^2 + \sum_{i=1}^{n}\sum_{j=2}^{m}\left(y_j^+ - y_{ij}\right)^2 \omega_j^2 + 2\lambda\left(\omega^* + \sum_{j=2}^{m}\omega_j - 1\right)$$

And let $\partial L / \partial \omega_j = 0$

We got that

$$\sum_{i=1}^{n}\left(y_j^+ - y_{ij}\right)^2 \omega_j^2 + \lambda = 0,\ j = 2,3,\cdots,m \tag{2}$$

From formula (1) and formula (2), we got that

$$\omega_j = \frac{1-\omega^*}{\left[\sum_{j=2}^{m}\frac{1}{\sum_{i=1}^{n}\left(y_j^+ - y_{ij}\right)^2}\right]\left[\sum_{i=1}^{n}\left(y_j^+ - y_{ij}\right)^2\right]},\ j = 2,3,\cdots,m \tag{3}$$

$$\lambda = -\frac{1-\omega^*}{\sum_{j=2}^{m}\frac{1}{\sum_{i=1}^{n}\left(y_j^+ - y_{ij}\right)^2}} \tag{4}$$

2.3 Calculating the correlated degree of each alternative

Definition 4: The correlated coefficient, between the alternative i and the ideal alternative of every attribute j, is calculated. The formula is

$$\delta\left(z_j^+, z_{ij}\right) = \frac{d_{\max}}{d\left(z_j^+, z_{ij}\right) + d_{\max}} \tag{5}$$

Where $d\left(z_j^+, z_{ij}\right) = \left|z_j^+ - z_{ij}\right|, d_{\max} = \max_i \max_j d\left(z_j^+, z_{ij}\right)$

Then we could get the correlated coefficient matrix from above.

Definition 5: The correlated degree of each alternative is calculated as follows:

$$r_j = \sum_{j=1}^{m} \omega_j \delta\left(z_j^+, z_{ij}\right) \sqrt{b^2 - 4ac}$$

We sorted the correlated degree from small to large, and the corresponding result was just the final ranking of the alternatives.

2.4 The steps of the decision making

To sum up, the decision method proposed in this paper is mainly divided into three steps.

Step 1, constructing the decision matrix.

Step 2, identifying the weight of each attribute.

Step 3, ranking the alternatives according to the corresponded degree. The details are shown in Fig.1.

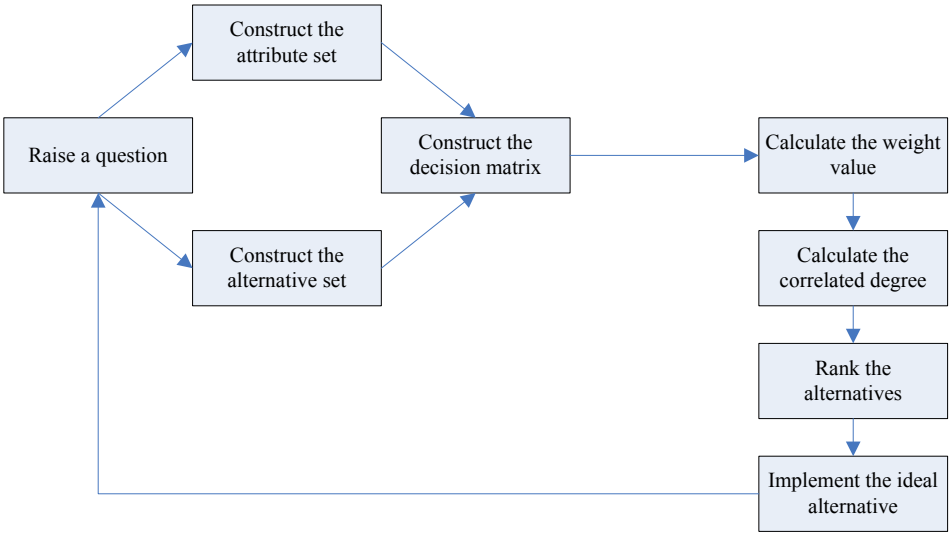

Fig.1. The steps of the decision making

3. Illustrative example

Supply chain management, as a new kind of management idea and enterprise operation mode, has been given more and more attention at home and abroad in recent years. The key of the supply chain management is the connection and cooperation between the every enterprise included in supply chain, and the thinking collisions between each other in such aspects as design, production, and strategy-making. Thus, partner selection is a priority to construct a supply chain. It directly decides the fate of a supply chain. We should comprehensively analyze the factors included in it when we choose the partner. All the factors are shown in Table 1.

Table 1 The consideration of the partner selection in supply chain

factor	factor analysis
Quality and technology	quality is always the top concerns of the merchants, is the life of the enterprise; the high-precision and advanced technology is the good weapon for enterprise' survival, is the core competitiveness of every enterprise
Response and supply	Enterprises need to maintain the vitality and respond rapidly to the market's changes. The supply ability has a direct relationship with the enterprise and even the whole supply chain's function.
Price and cost	Price and cost is the heart of business negotiation, it related to corporate profits directly.
Service	Service plays a growing role in today's market; its level is often related to the enterprise's image and survivability.
Culture and management	Management is the nerve of the enterprise and culture is the soul of the enterprise. These two factors affect the enterprise's development direction and organization structure.
Innovation and agility	Innovation and agility is the core competitiveness of an enterprise, they are also the guarantee of an enterprise' sustained profitability, the backup force to the brand image.
Logistics and information flow	Logistics and information flow in the enterprise support each other, and combine the goods, materials, funds and human recourse orderly; they are the indispensible factor to enterprise development
Environment	The development of enterprise depends on the environment, and also affects the environment. The enterprise needs to meet the requirements of sustainable development.

Let quality and technology (s_1), response and supply(s_2), price and cost(s_3), service(s_4), culture and management(s_5), innovation and agility(s_6), logistics and information flow(s_7), environment(s_8) be the factors of supply chain partner selection, and they constituted the set of alternatives $\mathrm{s} = \{\mathrm{s}_1, \mathrm{s}_2, \cdots, \mathrm{s}_8\}$.

Here, we work out an illustrative example to show the application of this method for multiple attribute decision making problems.

Assume a core enterprise in a supply chain to select a partner from four feasible alternatives. All the alternatives constituted the set of alternatives $p = \{p_1, p_2, \cdots, p_4\}$. Experts used the linguistic evaluation scale to evaluate four alternative enterprises respectively in eight attributes. According to the relation between linguistic variables and accurate real number, we were able to get the evaluation information which is shown in Table 2. Then the initial decision matrix X is given below. Besides, due to the quality as the core of the enterprise's function has gained the policymaker's most attention, the policymakers defined the weight of s_1 ranges from 0.15 to 0.2, and then they need to select an ideal partner under this condition.

Table 2- The attribute value of various alternative

attribute	quality and technology	response and supply	price and cost	service	culture and management	innovation and agility	logistics and information flow	environment
P_1	5	3	5	3	6	4	3	4
P_2	4	4	4	5	4	3	5	4
P_3	4	5	4	6	3	4	4	6
P_4	5	3	2	4	4	2	3	4

We transformed the initial decision matrix X into normalized decision matrix Y:

$$Y = \begin{pmatrix} 0.552 & 0.391 & 0.640 & 0.323 & 0.684 & 0.596 & 0.391 & 0.436 \\ 0.442 & 0.521 & 0.512 & 0.539 & 0.456 & 0.447 & 0.651 & 0.436 \\ 0.442 & 0.651 & 0.512 & 0.647 & 0.342 & 0.596 & 0.521 & 0.655 \\ 0.552 & 0.391 & 0.256 & 0.431 & 0.456 & 0.298 & 0.391 & 0.436 \end{pmatrix}$$

Then we got the value of ideal alternative in every attribute from the decision matrix Y:

$$(0.552 \quad 0.651 \quad 0.640 \quad 0.647 \quad 0.684 \quad 0.596 \quad 0.651 \quad 0.655)$$

The weight value of attribute s_1 is known as a grey number, so we used the mean value of the grey number to take the place of the weight value of s_1, $\omega_{(s_1)} = 0.175$.

The weight value of every attribute was calculated according to the formula⟨4⟩:

$$\omega^* = (0.175 \quad 0.120 \quad 0.101 \quad 0.112 \quad 0.082 \quad 0.164 \quad 0.119 \quad 0.127)$$

The correlated coefficient matrix was got according to the Definition 4:

$$\begin{pmatrix} 0.175 & 0.060 & 0.110 & 0.056 & 0.082 & 0.164 & 0.06 & 0.064 \\ 0.088 & 0.079 & 0.083 & 0.084 & 0.049 & 0.109 & 0.12 & 0.064 \\ 0.088 & 0.119 & 0.083 & 0.112 & 0.041 & 0.164 & 0.08 & 0.127 \\ 0.175 & 0.060 & 0.055 & 0.067 & 0.049 & 0.082 & 0.06 & 0.064 \end{pmatrix}$$

At last, the correlated degree of every attribute was calculated according to the Definition 5:

r_1=0.770， r_2=0.675，r_3=0.81，$r_4$3=0.611

The alternative p_3 is the best partner for this core enterprise in the supply chain.

4. Conclusion

On the basis of the Mean Value of Grey Number, we built an optimization model to determine the importance degree of each attribute, and then combined the correlated degree of each alternative to make decisions. This method can suit the decision makers' subjective preferences on certain attribute well, and when applied it to the supply chain partner selection, it was proven to be feasible and effective. Besides, it can also be applied to other kinds of decision problem; it has both important theory significance and extensive application value.

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Parametric Control of Macroeconomic Indicators Volatility of the Regional Union's Countries Based on One Global Multi-Country Model

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Abstract

In the paper, methods for solving the actual problem of detection and suppression of macroeconomic indicators volatility is considered on the base of both the developed global macroeconomic model in the class of dynamic stochastic general equilibrium models (Tovar 2009) and the parametric control theory (Ashimov et al. 2013).

The developed model describes the global economy in accordance with the following assumptions:

- The world economy is represented by the functioning of interacting economies of the following seven regions (countries): Kazakhstan, Russia, Belarus, Armenia, Kyrgyzstan, the European Union and the Rest of the World. The first three countries form Customs Union, Armenia and Kyrgyzstan are candidates to join the union;
- Economies of each country are represented by the following agents: households, oil and non-oil producers and governments;
- Agents operate and interact in stochastic environments;
- Activities of the respective agents are the same in all regions;
- Interactions of economies are implemented through goods and capital flows;
- Households and producers are participants of monopolistically competitive labor and goods markets respectively;
- Households and producers are participants of perfectly competitive capital (fixed assets) market;
- Oil producers are participants of perfectly competitive oil market;
- Goods prices and wages are sticky;

- Governments are monopolists in the bond market;
- All agents are perfect rational;
- All markets are in equilibrium.

On the basis of these assumptions and corresponding agents' behaviors, a substantial description of the functioning of interacting economies of the listed regions representing the world economy is developed. A nonlinear model of the world economy within the framework of its adopted representation is obtained from the developed substantial description. The resulting nonlinear model consists of

1) Conditions for the existence of solutions (first-order conditions) of the corresponding optimization problems for agents;
2) Descriptions of the rules of government policy;
3) Descriptions of the rules of shock setting;
4) Descriptions of the conditions for equilibria in the markets.

The resulting model has the following vector form:

$$\mathrm{E}_t F^{\theta}\left(X_{t-1}, X_t, X_{t+1}, H_t^{\Sigma_H}\right) = 0. \quad (1)$$

Here E_t is a sign of conditional mathematical expectation on information available at time t ($\mathrm{t} = 1,2,\ldots$), F^{θ} is a known vector function, θ is a set of structural parameters and autoregressive parameters of shocks, X_t is a vector endogenous variables and first-order autoregressive shocks (X_0 is given), $H_t^{\Sigma_H}$ is a vector of i.i.d. white noises, Σ_H is a set of standard deviations of noises.

Initial model (1), after conducting the standard procedure of log-linearization in the neighborhood of its steady state is presented in the form of linear rational expectations model:

$$A^{\theta}\mathrm{E}_t\hat{X}_{t+1} + B^{\theta}\hat{X}_t + C^{\theta}\hat{X}_{t-1} + D^{\theta}H_t^{\Sigma_H} = 0, \quad (2)$$

where $A^{\theta}, B^{\theta}, C^{\theta}, D^{\theta}$ are matrices of appropriate dimensions, $\hat{X}_t$ is a vector of endogenous variables of the linear model corresponding to X_t.

To estimate the parameters there were used statistics of the mentioned regions and taken as the results of measurements of the observed variables the deviations (in percentage) from their trends of the following macroeconomic indicators: final consumption expenditures of households, final consumption expenditures of government, gross accumulation, exports of goods and services, GDP, consumer price index, average nominal wages, people employed in the economy, refinancing rate of the Central Bank, government budget revenues, government budget expenditures, tax revenues, domestic government debt, foreign government debt, the official exchange rate, the volume of oil production and oil prices. The interval of the parameters estimation is from the 1st quarter of 2000 till the 4th quarter of 2012.

Parameter estimation was carried out using the Bayesian approach (Fernandez-Villaverde 2010). As a result, the set of model parameters θ, the set of standard deviations of Σ_H, as well as the composition of shocks in the economies of each region are estimated.

In the framework of the parametric control theory, a verification of the estimated linear dynamic stochastic general equilibrium model is conducted for the practical application capability by retroforecasting and evaluating of the stability indicators. Verification process

showed that the mean square deviations of obtained forecasted values of economic indicators from the relevant statistics were about 3.2% and the obtained evaluations of the stability indicators for the period from 2013 to 2018 didn't exceed 3.8%, which characterize applicability of the model.
A macroeconomic analysis of the effects of internal and external shocks on the macroeconomic indicators of the regional union's countries is conducted for the historic and forecast periods. In particular, there are given decompositions of GDP and inflation deviations from their trends for the historic period and decompositions of their standard deviations for the forecast period on the effects of various shocks.
Analysis of the results, in particular, showed that the volatility of the GDP of Kazakhstan is most strongly affected by internal productivity, oil production and the risk premium shocks, as well as oil prices external shock; the volatility of inflation in Kazakhstan is most strongly affected by internal price markup, oil production, wage markup shocks, as well as oil prices external shock.
On the base of an approach of the parametric control theory, there were formulated and solved the problems of minimizing the volatility of macroeconomic indicators (GDP and inflation) of the regional union's countries at the level of individual country and at the level of whole the regional union.
Conducted to solve the problems of the parametric control computational experiments showed that the parametric control provides significant reductions of standard deviations of GDP and inflation at the both levels in the historical and forecast periods. So the reductions of the standard deviation of GDP of Kazakhstan on applying the parametric control at the level of Kazakhstan and at the level of the Customs Union in the forecast period are 39% and 39% respectively, and in the historical period ones are 34% and 37% respectively.

Keywords
Volatility of macroeconomic indicators, Global multi-country model, Dynamic stochastic general equilibrium model, Regional union, Parametric control

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Methods of Parametric control theory for testing models

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Abstract

Purpose.The aim of this paper is to demonstrate an effectiveness of applying a number of the new methods, proposed in the parametric control theory for testing macroeconomic models for the possibility of their practical application.

Design/methodology/approach. Approaches of system analysis on building and calibrating the mathematical models; provisions of the parametric control theory for both numerical testing of the calibrated models for the possibility of their practical application and solving the parametric control problems.

Findings.One global computable general equilibrium model (CGE model) is built and calibrated.2. The effectiveness of applying two developed numerical algorithms is demonstrated for estimating stability indicators and estimating stability (in the sense of the theory of stability of smooth mappings) of mappings defined by the model during solving the problem of testing this model for the possibility of its practical application. 3. On the base of the tested CGE model there are given the solution results for a number of the parametric control problems aimed at economic growth and decrease of economic disparities in the development of Regions.

Originality/value. By the example of the developedCGEmodel, it is demonstrated an approach of the parametric control theory for testing macroeconomic models for the possibility of their practical application.

Keywords: The theory of parametric control, Indicator of mapping stability, Stability of smooth mapping, Structural stability of the model, CGE Model.

Paper type: Research paper

Introduction

In the natural sciences and economics to study the properties of domain objects are widely used mathematical models of relevant subject objects (problems). However, to meet conditions of adequate transfer of research results on the mathematical models to the relevant subject areas requires extensive testing of the models used for the possibility of their practical application.

It is known (Orlov, 2002) that a necessary requirement for the adequacy of mathematical macroeconomic model is the requirement of the corresponding small changes in its output variables for small (in some sense) changes in the exogenous parameters of the model. It is known (Arnold, 1988) that one of the conditions for the transfer of research results on mathematical models (represented by continuous or discrete dynamical systems) to the relevant subject areas is the preservation of the qualitative picture of the phase portrait of dynamical systems given the small (in some sense) change in the models under study; in other words, it is required that such a model has the property of weak structural stability. Also, the practical use of the research results on mathematical models in the relevant subject areas naturally requires the preservation of the qualitative properties of smooth mappings, defined by models,given small (in some sense) changes in these mappings, that is, requiresfulfillment of the stability properties of these smooth mappings (Golubitsky, 1973). However, the introduction into routine testing ofmathematical models used (for solving the problems of subject areas) for possessingby them the above conditions are still hampered by the absence in the prior art of the corresponding algorithmic support.

Within the framework of a topical problem of testing the calibrated macroeconomic models for the possibility of their practical application to:

- Solving the problems of macroeconomic analysis,
- Finding the rational values of the economic policy instruments and
- Estimating their feasibility,

in the theory of parametric control of macroeconomic systems (Ashimov*et al*., 2013) along with traditional methods it is offered a number of the followingmethods and the corresponding algorithms.

1. Methods for estimating stability indicators defined by the mapping model, transforming the values of the selected set of (input) exogenous parameters of the model into the values of its endogenous variables (Orlov, 2002; Ashimov*et al*., 2013; Ashimov*et al*., 2014).

2. Methods for estimating stability (in the sense of the theory of stability of smooth mappings) defined by the mapping model (Golubitsky, 1973; Ashimov*et al*., 2014).

3. Methods for estimating the structural stability of the model (in the case of its specification as a discrete or continuous autonomous dynamical system) (Robinson, 1980; Ashimov*et al*., 2013; Ashimov*et al*., 2014).

4. Methods for estimating the adequacy of the model based on the correspondence analysis of the results of counterfactual and forecast scenarios carried out based on the model to the main provisions of the macroeconomic theory.

Such testing is carried out in two stages:

1. Stage of testing the basic variant of the model under study.

2. Stageof testing the feasibility (found by methods of the parametric control theory) of rational values of the economic policy instruments on the basis of the model under study.

In this paper, the effectiveness of three methods developed for testing macroeconomic models, as well as approaches to make recommendations in the area of effective economic policy is illustrated by the example of one global dynamic computable general equilibrium model (hereinafter the Model).

2. The Model

2.1 General features of the Model

The Model describes functioning and interaction of economies of seven Regions (including countries): Kazakhstan, Russia, Belarus, Armenia, Kyrgyzstan, the European Union, and the Rest of the world.

Economy each Region in the Model includes the following 16 sectors (producer agents): Agriculture, Production and transmission of electricity, gas and hot water, Mining, Oil and petrochemicals production, Metallurgy industry, Chemical and petrochemical industry, Metalworking industry, Construction Materials production, Textile manufacture, Food industry, Construction, Education, Public health, Public administration, Other industries, Other Services.

In addition to these producers, in each Region there are consumer agents: Households and Government. Each Region has an agent Banks.

The model also has another special agent Globe, earning income from transport margins in the export and import of products between Regions.

Model compared to the baseline variant of GLOBE [I] is developed as follows:

- Taking into account the existing agreements of the Customs Union, GLOBE model structure is bound to seven selected Regions (including countries), covering the global economy, as well as 16 economic sectors and two factors (labor and capital) in each Region.
- It is added to the Model the financial blocks of Regions, including indicators of the monetary sphere: monetary base and monetary aggregates M0 and M3.
- It is added to the Model the banking sectors, describing the mechanisms of forming loans and deposits of legal entities and individuals (industries and households in the Regions).
- It is added to the Model a description of forming and service of government debts of the Regions;
- The model has taken a dynamic structure, there are added a number of dynamic equations for the computation of the following variables: technological factors of production functions for GAV (gross added value) of all industries in the Regions, factor supply by the Regions' Households, levels of government debts of the Regions.

2.2. Conceptual description of economy of the Model

It is assumed that Producer agents, Household agents and Government agents are perfect rationality agents.

Producer agents. Each sector in each Region of the model in its activities each year:

- Produces one type of product (from the condition of cost minimization);
- Produces gross added value (using factors: labor and capital of households);
- Exports part of output (from the condition of profit maximization);
- Imports intermediate and investment goods from other Regions;
- Consumes intermediate and investment goods;
- Pays net tax payments to its Government.

Industries solve the following two pairs of embedded optimization problems:

- Minimizing industry costs for the purchase of intermediate products and GAV costs of industry for a given production output;
- Minimizing the industry costs for the purchase of production factors for a given output of the final product;
- Maximizing profits from sales within the Region and beyond for a given production output;
- Maximizing profits from exports to different Regions for a given level of exports.

Households in each Region in their activities each year:

- Receive income from factors (labor and capital) on the basis of demand for factors by producers in their Region;
- Consume consumer products (according to the problem of maximizing their utility function under the budget constraint);
- Carry out savings in the form of investment products based on their income and consumption;

- Pay net tax payments to the Government of their Region.

Government in each Region in its activities each year:

- Defines the effective tax rates and receives revenues in the form of net tax revenues (including revenues from customs duties);
- Consumes the final product (government spending);
- Carries out savings in the form of investment products based on its income and spending;
- Determines the monetary base, monetary aggregates and the refinancing rate in its Region;
- Generates and services the government debt of its Region.

Sectors, Households and Government of each Region yearly jointly solve the following optimization problems:

- Determination of the optimal share of imports in the consumption of each product by minimizing the cost of domestic and imported components of this product;
- Determination of the optimal regional structure of each type of imported products by minimizing the cost of this kind of imported products.

Banks determine interest rates on loans and deposits and carry out banking functions on lending and receiving deposits in their Region.

Pricing and balances. The model uses a composite system of endogenous prices for all 16 types of products of each Region, including prices of both buyer and seller, the prices of both exporter and importer and so on [I].

Calculated price values provide implementation of the annual balance relationship, providing:

- Equilibrium in factor markets (labor and capital);
- Equilibrium in markets of each kind of product;
- Bilateral current balance of payments for each pair of Regions;
- Equilibria of savings (Households, Governments) and their investments in sectors of the Regions.

Informative description of the economy contains statements of the above optimization problems with the relevant first order conditions, the equations describing the rules for agents behavior, balance ratios for prices and quantities (real indicators measured in the prices of the seller), the internal balances in the accounts of the government and the external balances in trade accounts.

2.3 Mathematical model and its solution

Taking into account the conditions of agent perfect rational behavior, a dynamic mathematical Model (based on the abovementioned formalization) has been derived in the result of combining into one system of equations:

- first-order conditions of optimization problems;
- rules for agent activities;
- balance relations for prices and quantities;
- dynamic equations noted in section 2.1;
- the auxiliary equations (intended for finding aggregate values and calculating scenarios).

This model is generally represented by the following system of relations, composed of two subsystems.

1) Subsystem of differential equations, linking dynamic endogenous variables $x_1(t)$ values for two consecutive years:

$$x_1(t+1) = f_1\big(x_1(t), x_2(t), u(t), a(t)\big). \quad (1)$$

Here $t = 0, 1, \dots, n-1$is a number of year, discrete time; $n = 18$;$t = 0$corresponds to the year 2001);

$x_1(t), x_2(t)$are vectors of endogenous variables of the system. $x_i(t) \in X_i(t) \subset R^{m_i}, i = 1,2, m_1 = 133, m_2 = 100815$. $x_1(t)$vector coordinates include shift parameter values (technological coefficients) of CES production functions for GAV of sectors, labor and capital supplies for sectors, government debt amount in Regions. $x_2(t)$vector coordinates include values of all endogenous variables of the model (demands and supplies for various goods, prices and others), excluding those in$x_1(t)$;

$u(t) \in U(t) \subset R^q$is vector function of controllable (regulated) parameters. Coordinate values of this vector correspond to various governmental economic policy instruments, for instance: various tax rates, government spending shares, required for consumption and others. In below mentioned parametric control problem $Pr_W: q = 238$;

$a(t) \in A \subset R^s$is vector function of uncontrollable parameters. Coordinate values of this vector characterize various external and internal social and economic parameters: production function coefficients and aggregation function coefficients, amounts of minimum product consumption by consumers and others. Further in the paper in parametric control problem$Pr_W: s = 12117$;

$X_1(t)$, $X_2(t)$, $U(t)$, $A$are compact sets with nonempty interiors, $X_1(t)$, $X_2(t)$sets determine phase constraints$U(t)$sets specify constraints on control of solving parametric control problems on the basis of the Model; $X_i = \bigcup_{t=1}^{n} X_i(t)$, $i = 1,2$; $U = \bigcup_{t=0}^{n-1} U(t)$;

$f_1: X_1 \times X_2 \times U \times A \to R^{m_1}$ – differentiable mapping.

2) Subsystem of algebraic equations (relatively unknown $x_2(t)$), describing the behavior and interaction of agents in different markets during the selected year, in particular the first order conditions of optimization problems of agents, rules of Governments behavior, Globe agent and balance equations:

$$f_2(x_1(t), x_2(t), u(t), a(t)) = 0. \quad (2)$$

Here $f_2: X_1 \times X_2 \times U \times A \to R^{m_2}$ – differentiable mapping.

Computable Model (1), (2) given fixed values $u(t)$and$a(t)$functions for each time $t$determines the values of $x(t)$, endogenous variables, corresponding to the equilibrium price of demand and supply in goods and factors markets within the next algorithm.

1) It is assumed $t = 0$ and the initial values of$x_1(0)$ variables are set.

2) Calculate the values of $x_2(t)$ for the current t by solving the system (2).

3) Based on obtained equilibrium solution at time t using the dynamic equations (1), the values of $x_1(t+1)$ variables are found. $t$value increases by unity. Go to step 2.

The number of iterations of steps 2 and 3 of the algorithm are defined in accordance with the objectives of the forecast and parametric control on the pre-selected time intervals.

Solving the system of equations of the Model (1), (2) according to the abovementioned algorithm is performed using software implemented in the IDE GAMS [II], using embedded MCP solver PATH [III].

3. Forming and processing of statistical database for Model calibration

The central core of the Model database are social accounting matrices (SAM) for each Region, illustrating how product flows are distributed between Industries, Households, Governments, importers and exporters.

Statistical database for the Model calibration consists of the following three components.

3.1 Macroeconomic data for 2002, 2003, 2005, 2006, 2008-2012 for mentioned seven Regions, derived from the available statistical sources (IMF, WB, and NEA): GAV and their components, indicators of mutual trade, indicators of budget sphere and finances.

3.2 Some indicators of financial blocks, banking sectors and government sectors in selected Regions for 2001-2012.

3.3 The extracted by a special converter [IV] from the GTAP in accordance with an accepted structure of the Model the part of four-dimensional SAM, which is a set of two-dimensional SAM numbered by the index of time (year) *t* (for 2001, 2004 and 2007) and the index of the Region *r*.

3.4 In accordance with the SAM forming algorithms and matrices SAM obtained on the basis of available in GTAP, such matrices are formed for the years, missing in the GTAP database. Statistical data specified in sections 3.1 and 3.2 are used. Some data (Investment, Foreign trade, Transfers) if necessary, adjusted to eliminate the existing discrepancies in them with requirements to the SAM.

As a result of this stage, we have the final four-dimensional SAM, containing all the necessary data for the years 2001-2012, which is then used for calibration stage.

4. The Model Calibration

At the stage of calibration, calculation of exogenous variables values of in the model for points in time from 2001 to 2012 according to the following steps.

4.1 Replacement coefficients values of various factors in the sector production functions; replacement coefficients of different kinds of products in functions of sector outputs, households utility functions and aggregation functions, which describe consumption of agents, are taken straight from the literature [V].

4.2. The values of the rest exogenous parameters in the model are calculated using special expressions [I] based on the formed SAMs(Social Account Matrices) for the mentioned Regions for 2001-2012, which are the expansion of Leontief tables of intersectoral balance by adding to them the results of financial activities of economic agents.

Consequently, calibrated Model precisely reproduces used in its calibration statistical data from GTAP and other sources. Obtained values of all its exogenous parameters were extrapolated to prognosis period 2013-2018 to get the basic calculation of the Model until 2018.

5. Testing the Model for the possibility of its practical application

The calibrated Model has been tested by three techniques.Due to the fact that this model is a non-autonomous dynamical system, an estimation of its structural stability was not provided.

5.1. Estimation of stability indicators

According to the definition(Orlov, 2002), a mathematical modelis a mapping of the form

$$f : A \to B, \tag{3}$$

transferring the values of initial (exogenous) data $p \in A$ into solutions (the values of endogenous variables) $y \in B$. For a number $\alpha > 0$ and $p \in A$ the stability indicator $\beta(p,\alpha)$ of the modelis a diameterof the ball's image with radiusαcentered at the point$p$ (in relative values) given the mapping$f$.

An algorithm for estimating $\beta(p,\alpha)$ by the Monte-Carlo methodconsists in the following.

1. The sets of input parameters (X) and output variables (Y) are chosen, and respective normalized values for them are calculated.

2. The vectorof normalizedinput data$p$, the number $\alpha > 0$ and the set $U_\alpha(p) = \{p_1 \in A : \rho(p_1,p) \le \alpha\}$ are determined,where $\rho(\cdot,\cdot)$ is the Euclidian distance.

3. The set of sufficiently large amount of Mpseudorandompoints $\{p_1, p_2, \ldots, p_M\}$, uniformly allocated in $U_\alpha(p)$, is generated.

4. For each point p_j of the derived set, the point $y_j = f(p_j),\ j = 1,\ldots,M$ is determined by calculating the model.

5. The value of $\beta = \max(\rho(y_i, y_j) : i, j = 1,...,M)$ is calculated.

6. Stop.

If for all points $p \in A$ the numerical estimate $\lim_{\alpha \to 0} \beta(p,\alpha)$ is close to zero, thenthe*f* mapping, defined by the model under studyis evaluated on the set*A*as continuously depending on the input values.

In experiments with the Model as the set A it was considered a set (parallelepiped) of the possible tax rates of the model (in relative values) for 2001, and as a set of output variables B – GDP, exports, imports, government debt (in relative values) of all Regions of the Model for a fixed calculated year t (2001 to 2018); $\alpha = 0.01$.

Estimation results of the model stability indicators for basic point p are shown in Table 1.

Table 1. Stabilityindicatorsvalues

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Indicator (in %)	0.73	1.18	1.24	1.91	1.89	1.96	1.94	3.32	3.04
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Indicator (in %)	2.73	3.51	3.76	4.76	5.01	6.13	5.31	4.39	7.18

All the above in Table 1 stability indicators estimates do not exceed 7.18, which characterizes the Model stability (in the sense of stability indicators) in the calculations until 2018 as sufficiently high.

5.2. Estimating stability of smooth mappings, defined by the Model

For estimating stability of smooth mappings like (3) on the base of numerical estimate of meeting conditions of respective theorems from (Golubitsky and Gueillemin, 1973), the authors elaborated and implemented a set of numerical algorithms (Ashimov*et al.*, 2014). These algorithms are for:

- Estimating the set of singular points of the*f* mapping (Algorithm 1);
- Estimating nonlocal injectivity of the*f* mapping (Algorithm 2);
- Estimating the transversalityof 1-stream of the mapping under study and subset consisting of all streams of corank 1 in the corresponding space of 1-streams; estimating the dimension of the sum of the tangent space to the manifold of singular points of the mapping (3) and the kernel of the differential of this mapping at each singular point; estimating theinjectivity of the restriction of the mapping (3) on the set of its singular points (Algorithms 3 and 4).

Implementation of algorithms from the mentioned set allows to evaluate the stability of the mapping (3) for the cases when this mapping belongs to the class of immersions, submersions or submersions with the fold as follows.

1. If in the case $\dim A < \dim B$ as a result of applying Algorithm 1, the set of singular points of the mapping (3) is evaluated as empty and as a result of applying Algorithm 2 this mapping is evaluated as one-to-one with its image, then (3) is evaluated as stable immersion.

2. If in the case $\dim A \geq \dim B$ as a result of applying Algorithm 1, the set of singular points of the mapping(3) is evaluated as empty,then (3) is evaluated as stable submersion.

3.Let in the case $\dim A \geq \dim B$ as a result of applying Algorithm 1, the set of singular points of the mapping(3) is evaluated as non-empty.Let, also,as a result of applying Algorithms 3 and 4 be checked the following conditions:

-1-stream of the studied mapping and a subset consisting of all 1-streams of corank 1 are transversal in the corresponding space of 1-streams;

- the sum of the tangent space to the variety of singular points of the mapping (3) and the kernel of the differential of this mapping at each singular point has dimension $\dim A$;

-the restriction of the mapping (3) on the set of its singular points is injective.

Then(3)is evaluated as stable submersion with the fold.

Due to the fact that the calculation time of the proposed above algorithms increases approximately exponentially with increasing dimension of the domain A, to complete the calculations in a reasonable time we had to limit the number of input variables for the mappings defined by the model.Experiments considered the basic mappings of the form (3) with $\dim A = 3$ and $\dim B = 7$, where as the arguments of the mapping*f*were taken the values of rates of value added taxesin three countries (Kazakhstan, Russia, Belarus) for 2009, and asthe output variablesof the mapping *f*were taken the values of GDPof allseven Regionsfor 2018.The boundaries of three-dimensional parallelepiped Acentered at the point $p = (p_1, p_2, p_3)$, corresponding tothe basic values of the mentioned tax rates, are distant from the p_i values by the amount of $0.5p_i$. The results of numerical experiments based on the first two of these algorithms demonstrated the absence of singular points of the f mapping in domain A and injectivity, and, consequently, the stability of such immersions for both the base and a number of scenario calculations of the model, to the corresponding obtained solutions of the parametric control problems.

5.3.Conducting a number of counterfactual and prognosis scenarios

Within testing the Model, counterfactual and forecast scenarios for 2009-2012 and 2013-2018 respectively were calculated on its base.In particular, during the scenario with a 10% decrease in the effective rates of VAT and taxes on the incomes of producers and 10% increase in government consumption in each country of the Customs Union, Armenia and Kyrgyzstan, there was an increase in GVA of each sector in the corresponding country ranging from 0.11% in 2009 to 3.56% in 2012, compared with the observed data. The results of this (and other) experiments are consistent with the provisions of the macroeconomic theory, which indicates an adequate response of the Model to changes in these exogenous parameters.

The results of three methods for testing the Model presented above, as well as the results of applying these methods to a number of scenario calculations lead to the conclusion of a successful test of the Model under study for the possibility of its practical application.

6. Statements and solutions of some parametric control problems based on the Model

A number of parametric control problems Pr_i(directed to the economic growth and reducing regional development disparities) was formulated and solved within the framework of estimating optimal values of economic policy instruments of Regions of the Model for 2013-2018. In these problems, the values of all unconrollable exogenous variables of the Model correspond to the baseline forecast of these variables. Here and further indices $i, r = 1, \dots, 7$ correspond to the Region number: 1 - Kazakhstan, 2- Russia, 3 – Belarus, 4 - Armenia, 5 - Kyrgyzstan, 6 - European Union, 7 - the rest of the world. $i = CU$index corresponds to the Customs Union, $i = W$- the world economy.

Statements of Pr_i parametric control problems. To find for each Pr_i problem, based on the Model, the control parameter values (effective tax rates on producer revenues (Corporate Income Tax), sales tax (VAT), and customs duties; government spending shares, which are for consumption) for 2013-2018, those provide the maximum K_i criterion value (5)-(7) given appropriate constraints on control instruments (±10% from their baselines) and constraints (4) on some endogenous variables.

For Pr_r, $(r = 1, \dots, 7)$ problems, control parameters are the mentioned government policy instruments in r-th Region, for Pr_{CU} problem – in three countries of the Customs Union, and for Pr_W problem – in all seven Regions of the Model in aggregate.

The constraints on endogenous variables in the Model in Pr_i problems are as follows.

$$CPI_r(t) \le \overline{CPI_r}(t), \quad GD_r(t) \ge \overline{GD_r}(t), \quad QVAP_r(t) \ge \overline{QVAP_r}(t), \quad r = 1, \dots, 7, \ t = 2013, \dots, 2018. \tag{4}$$

Here: $CPI_r(t)$is consumer price level in the Region $r$with parametric control; $GD_r(t)$ is an amount of government debt in the Region $r$with parametric control; $QVAP_r(t)$is GDP per capita in the Region$r$with parametric control; sign " ¯ " denotes basic values of corresponding indicator (without parametric control).

In stated problems the criterion K_r, characterizes the average GDP rate value (in current USD) in the Region$r$for the period 2013-2018:

$$K_r = \frac{1}{6}\sum_{t=2013}^{2018} TQVA_r(t), \tag{5}$$

where$TQVA_r(t)$ is annual GDP rate in the Region$r$in the year t.

K_{CU} and$K_W$criteria of Pr_{CU}andPr_Wproblems characterize correspondingly the average GDP rate value in the Customs Union and World economy (in current USD), as well as relative deviations in GDP per capita in the Model Regions from GDP per capita in the European Union (the Region that has the highest value of GDP per capita among all of the Model Regions) for the period 2013-2018:

$$K_{CU} = \frac{1}{6}\sum_{t=2013}^{2018} TQVA_{CU}(t) - \frac{1}{6\sum_{r=1}^{3}\varepsilon_r}\sum_{r=1}^{3}\left(\varepsilon_r \sum_{t=2013}^{2018}\left|\frac{QVAP_r(t)-QVAP_6(t)}{QVAP_6(t)}\right|\right), \tag{6}$$

$$K_W = \frac{1}{6}\sum_{t=2013}^{2018} TQVA_W(t) - \frac{1}{6\sum_{r=1,r\neq 6}^{7}\varepsilon_r}\sum_{r=1,r\neq 6}^{7}\left(\varepsilon_r \sum_{t=2013}^{2018}\left|\frac{QVAP_r(t)-QVAP_6(t)}{QVAP_6(t)}\right|\right). \tag{7}$$

Here: $TQVA_{CU}(t)$, $TQVA_W(t)$are correspondingly annual GDP rates of the Customs Union and World economy in the year$t$; $QVAP_r(t)$is GDP per capita in the Region $r$in the year t; $\varepsilon_r$is weight coefficient, its value is$\varepsilon_r = 1$for less developed Regions (Belarus, Armenia, Kyrgyzstan, and the Rest of the World),$\varepsilon_r = 0.1$for mid-developed Regions (Kazakhstan and Russia).

The formulated Pr_iproblems were solved by numerical procedure using provided by GAMS optimization algorithm. The results of their solution in the forms of changes in the average GDP value in Regions for 2013-2018 (in percentage relative to the baseline) are given in Table 2.

Table 2. Change in average GDP values of Regions in the result of nine parametric control problems solution

Problem	Change in average GDP value of Region r for 2013-2018						
	r=1	r=2	r=3	r=4	r=5	r=6	r=7
Pr_1	**3.20**	0.42	0.11	0.08	0.15	0.01	0.00
Pr_2	0.51	**2.18**	0.21	0.13	0.14	0.02	0.01
Pr_3	0.19	0.23	**2.58**	0.06	0.08	0.01	0.00
Pr_4	0.09	0.12	0.02	**2.77**	0.04	0.00	0.00
Pr_5	0.20	0.19	0.05	0.01	**1.55**	0.00	0.00
Pr_6	0.31	0.67	0.36	0.14	0.13	**1.35**	0.09
Pr_7	0.24	0.53	0.25	0.09	0.23	1.05	**2.55**
Pr_{CU}	**3.38**	**2.31**	**2.64**	0.16	0.19	0.02	0.01
Pr_W	**3.39**	**2.43**	**2.66**	**2.91**	**1.68**	**1.49**	**2.90**

The analysis of Table 2 shows that in the problem Pr_i, $(i = 1, \dots, 7, CU, W)$, the parametric control approach at the level of all Regions (Pr_W problem) as well as at the level of three Customs Union countries (Pr_{CU} problem) gives greater effectsfor each separate Region in comparison with parametriccontrol at level of each separate Region (Pr_rproblems, $(r = 1, \dots, 7)$).

The optimal valuesfoundfor economic policy instruments of all the aboveproblemsof parametriccontrolwere tested forthe possibilityof their implementationas follows.Scenarios of the calibratedModelfor theseoptimal values of theinstrumentswere tested by threemethods mentioned in Section 5. In allcases the results ofthe calculationsshowed:

- The acceptable values of the estimates of stability indicators;
- An absence of singular points of the mappings under study in their respective domains and the stability of these mappings;
- Coordination of the results of forecast scenarios for 2013-2018 with the main provisions of the macroeconomic theory.

The analysis of presented results of the problem Pr_i solution and results of appropriate tests shows high potential of parametric control approach to make recommendations for coordinated optimal government economic policy at the global level and at the level of regional economic union.

7.Conclusion

1. There are presented theproposed methods fortesting themacroeconomic models for the possibility of practical application.

2.There is demonstrated the effectiveness of the use of developed two numerical algorithms for estimatingstability indicators and estimating stability (in the sense of the theory of stability of smooth mappings) defined by the mapping model during solving the problem of testing one computable general equilibrium model.

3. Test results show the possibilities of their application for the study of macroeconomic mathematical models.

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9

Cyber-systemic Governance Autopoiesis and Social Processes

Autopoiesis and Sociopoiesis: Investigating the operational dynamic of human organizations

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Abstract

This paper discusses and studies the characteristics and components of the operational dynamic and the viability of human organizatons in general and business organizations in particular. The objective is to rethink the concept of a human organization in light of the theory of autopoiesis.

Using the for-profit organization –firm- as the object of study, we have conducted a critical analysis of the concept of a human organization and we have debated whether or not it is justifiable to characterize a human organization as an autopoietic system. This debate has been an ongoing issue within the academic community for over thirty years. In fact, the debate about the question of the autopoietic nature of human organizations has been reflected in the work of many systems and organizational theorists. As an alternative to this concept, we develop and propose a process calle sociopoiesis. Sociopoiesis is understood here as the composition and arrangement of acts. This definition, based on acts, allows us to claim that people and their interactions with other elements—of a diversity of types, such as assets or resources—should not be understood as components of a business organization, but rather, in a performative fashion, such elements 'produce' the firm and more broadly, human organizations.

Key words: Autopoiesis, sociopoiesis, components, organizational dynamic, viability.

Introduction

For over a century the conception and definition of human organizations has revolved around the concept of people and groups of people. In recent times some have added other terms, such as "people and resources" or "people and assets," but without fully explaining or shedding light as to what resources and assets they were talking about. In effect, the traditional definition of a human organization, which is still in use today, runs something like this: "human organizations are groups of people who work together to generate a surplus" or "groups of people who are deliberately organized to achieve a common goal," without specifying exactly what the common goal or purpose is (for example see: Koontz et al., 1998:7).

A good definition proves its worth when we test it in the real world in a concrete manner; if the result that we obtain is the phenomenon expressed in the definition, then the definition is accurate. If we do this with the traditional definition of a human organization cited above, applying it verbatim, word for word, we end up with some type of human grouping, depending on the whatever common purpose is proposed, but by no means will it come close to resembling a contemporary business firm.

Let's try another course of action, which consists of empirically observing a large number of firms from different fields in terms of their products or services in order to analyze what is taking place in them. If we are good observers, we will see that there are four distinct classes of elements that are repeated in all the firms in the world: people; material elements (all types of assets); symbols (language, knowledge, and values); and energy (of any type). As we will see, this general approach to the contemporary business firm necessarily involves the active participation of these four classes of elements and uses them as a basis for developing concepts that will allow us to understand how a firm is created, how it functions, and how it sustains itself over time.

Certainly, we are not alone on this critique. It is the opinion of a significant number of authors that the fundamentals of the classical theory of the organization should be reconsidered, given that they have been incapable of reflecting the characteristics of the contemporary firm (we are referring to authors such as M. Wheatley (1994), P. Drucker (1999), A. de Geus (1998), P. Senge (1992), R. Echeverría (2000), and F. Capra (1998, 2003), to name only a few). Aditionally, Capra (2003) suggested that the nature of human organizations has increasingly become the object of multiple debates in business circles and in business administration. In Capra's words, the insecurity of these executives and their difficulty in understanding and predicting the future is a product of the extreme complexity and rapid, incessant change that characterizes the world today. Technological progress, to cite only one factor, despite being greatly admired for its contributions, at the same time generates an economic and organizational environment that is virtually unrecognizable from a theoretical

perspective of the theory and practice of traditional management (Capra 2003). As Erik Brynjolfsson and Andre McAffe (2004) has demonstrated quite convincingly that robotics are now posing a real challenge to 'blue collar' jobs and workers. Works itself is changing and, as a result, so are organizations. This is the imperative that leads us to argue that the theories and the study of the firm, and in general human organizations, must be readjusted to adequately reflect this complex phenomenon.

Individual, Society, and Human Organizations

For a long time it was held that society was comprised of people, among whom there were multiple kinds of relationships. However, in the second half of the 20th century, Niklas Luhmann (1991) defied this traditional view and posited that the social sphere is really constituted by communication and that this system of communication is self-generating and self-sustaining. Moreover, he used the concept of autopoiesis, coined by in the field of biology by Maturana and Varela (1972, 1984), to explain what he meant by self-generating behavior. Furthermore, Luhmann himself describes social organizations as autopoietic systems composed of decisions. However, Steve Bruce and Steven Yearley (2006:16) have indicated that the current use of the term, taken from the biology, 'seems more metaphorical than literal.'

Luhmann's proposal was harshly criticized in the beginning, but with the passing of time, a growing number of sociologists began to accept his ideas. By way of example, and in the context of Latin America, his work was had a strong impact on several groups of sociologists (see Rodriguez & Torres, 2003). In addition, some Scandanavian academics have established that Luhmann 'has emerged as one of the most controversial and influential social scientists of our time' (Hermes & Bakken, 2003: 1151). In the field of organizational studies, and in light of the book *Social Systems* (1995), several social scientists and organizational theorists have developed their own thinking about the autopoiesis of organizations as a system of decisions (see for example: Zeleny & Hufford, 1992; Mingers, 1992, 2003; Robb, 1989; Kay, 2001, Thyssen (2003), y Baecker (1999)). As a corollary and later as a deep analysis of Luhmann's theory of autopoiesis, Hermes and Bakken proposed that Luhmann's ideas, in particular that which establishes the autopoiesis of social systems, arose from a more creative way of thinking about social systems, as are the human organizations referred to in this text.

Luhmann's theory of communication demonstrates that the idea that a human organization is comprised solely of people is weak. This is clear when we understand communication as 'the synthesis of three selections: the unit of information, the utterance of information, and the comprehension of information (Luhmann, 1995: 147). For Luhmann communication is only possible and only occurs when the utterance of a unit of information

is comprehended. However, such a conceptualization leads him to claim that 'verbal communication is always found in the world of perception' (Luhmann, 2000: 16). In an interesting interpretation of Luhmann, the social psychologists Steve Brown and Paul Stenner (2010: 163-164) suggest that Luhmann's conceptualization presupposes what Volosinov calls 'extra-verbal pragmatics' (1980: 98). In the other hand, the theory of autopoiesis is related to the phenomenon of communication, where 'communication is only possible as a self-referential process" (Luhmann, 1995:144). As Maturana would say, information is created when the receptor interacts within its own cognitive framework (Maturana, 1980: 32). New information only makes sense as it relates to the structures created by previous concurrences of information. Thus, we agree with Hermes and Bakken (2003) when they argue that Luhmann's use of the concept of autopoiesis presents a challenge to the ways in which we conceptualize organizations, and it highlights the importance of recursion in organizational phenomena.

Although Luhmann provides a breath of fresh air to the analysis of society and human organizations, the questions: what are the components of human organizations? and how did they emerge? are left open and unanswered. To answer these questions, we will use the biology of knowing as developed by Humberto Maturana.

As Maturana tell us, it was basically when the first bipedal hominid appeared and began walking erect that the social history of humanity began (see Maturana & Varela, 1984). This event was more transcendent than we can possibly imagine: it set us on the path to becoming the beings that we are today. Walking upright decreased the corporal pressure on our brain mass, which is characteristic of all quadrupeds. This allowed our cranial capacity to expand and accommodate a larger and more complex brain. Moreover, at some point in time, this allowed prehistoric hominids to invent the marvelous mechanism of coordination that we call language and the possibility of 'languaging,' as Maturana calls it (1994), which, in turn, allowed us to make distinctions, to know things, to think, and to reflect. Moreover, like our closest relatives, the higher primates, humans are gregarious beings. Since our very beginnings, we have lived in communities that have led to the generation of various types of conduct, both ontogenic and phylogenetic (1). Since the beginning we have displayed what we call protosocial behaviors. These behaviors developed within the group in such a way as to regulate, both explicitly and implicitly, the complex interactions taking place in order to ensure the coordination of the group and provide an atmosphere suitable to healthy cohabitation.

From a psycho-social perspective a behavior can be viewed as a set of linked acts. From a cybernetic point of view, an act is a transformation (2) and its result is taken as a single thing. It is just from a pedagogical

perspective that we distinguish the transformation (or the process) from its result, but this is certainly an arbitrary distinction; what occurs is that as the transformation or process is unfolding, the result is likewise emerging following the same sequence. In sum, both primitive and modern human groups regulate their behavior in order to make harmonious cohabitation possible, and they do it by explicitly or implicitly prescribing or proscribing certain *acts*. In other words, society is focused not on regulating the thinking or intentions of its members, but rather on regulating the actions that its members carry out. We can argue, then, that social life is contained within a certain sphere or domain that contains all the acts conceivable that can result from interactions among human beings and crucially between human beings and other objects/artifacts, whether material or intellectual. Therefore, we can rightly claim that society is a set of acts in interaction and, moreover, that human organizations, by belonging to the social sphere, are also systems of acts.

Autopoeisis and Autonomy in Human Organizations

Chilean biologists, Humberto Maturana and Francisco Varela (1972) shifted the focus of attention of their research from the nature of the components (and their properties) of a living system to the organization of a living system, by proposing that living systems are 'autopoietic' systems (3). Autopoietic systems are self-producing systems which are, therefore, autonomous. Autopoietic systems are organized as networks of processes of production of components, such that when the components interact with each other, they reconstitute the same processes of production that produced them (Maturana & Varela, 1994 (1972)). As we can see, in this definition the network of processes is operationally closed. Operational closure allows for a permanent and uninterrupted dynamic: and as long as this dynamic exists, the system sustains itself.

The concept of autopoiesis attracted the interest of scientists from other disciplines, sociology among them, and it was sociologists who first attempted to use the term autopoiesis to explain human organizations. Both Maturana and Varela emphatically rejected such attempts, with Varela called them "metonymy," that is, an abusive use of language. However, between the years 1974 and 1977, Limone (1977) publish *L' Autopoïèse dans les Organizations* a direct application of autopoiesis theory within organizational studies. The author, along with others working at that time (see for example: Zeleny (1977) and Facheux & Makridakis (1979)) developed an initial approximation of organizations based on autopoisis theory.

The debate that has arisen between the advocates of using autopoiesis as a valid explanation for the genesis of human organizations and those that oppose it, it is a longstanding one (Brocklesby, 2010). We propose that in

order to elucidate and advance a different conceptualization, we should review the requisites a system must display in order to be recognized and treated as autopoietic. According to Maturana and Varela (1994 (1972)), these requirements are:

a) Autopoietic systems are autonomous.
b) All their changes are subordinated to the maintenance of their own organization (which defines them).
c) Autopoietic systems are unities and their borders are specified by the functioning of their process of production.
d) Autopoietic systems have individuality, which allows them to maintain their organization invariant and preserve their identity independent of their interactions with any observer.
e) The process of constituting identity is circular: it consists of a network of productions of their own components (for living beings these are called metabolic productions).
f) This type of system does not have inputs or outputs. External events can perturb it, but it undergoes internal structural transformations to adapt to the perturbations. However, if the transformations are not adequate to fully adapt to the perturbations, the machine will disintegrate (Maturana & Varela, 1972).

Furthermore, Varela insists on the following three requisites:

a) The system is, necessarily, a closed network of processes of the production of components.

b) The system has a border generated by the same processes of the production of components and that border participates actively in the autopoiesis of the system.

c). The processes constitute the system in the space or domain in which said processes exist and are carried out (Varela, 2000:67)

Aditionally, a rich and complez understanding of the notion of autopoiesis, requires the understanding of concepts such as: self-referencing, operational closure, structural coupling, natural drift, and phenomenological methodology. All of these concepts form a significant part of the autopoietic conception and cannot be used or fully applied to other phenomenological domains outside of this conceptual web. For example, it is not possible to divorce the concept of autopoiesis from a broader and more general class of operative dynamic, such as the idea of operational closure: and, in turn, operational closure cannot be totally divorced from the notion of self-reference, and so on. This means that the concept of autopoiesis is a particular case of the concept of autonomy, and this is with respect to self-referencing.

In the opinion of Varela and Maturana, autopoiesis is the dynamic that allows living beings to maintain their autonomy. This is an aspect that exclusively characterizes a living being, in particular the cell, the minimal unity of life. Despite this, Varela claims that autonomy is not an exclusive feature of living beings. It is possible to conceive of larger or different systems, including biological systems, which are produced by the coupling of autopoietic unities. How does the author explain the autonomy of these higher systems without using the notion

de autopoiesis? He developed 'operational closure,' concept which can be generalized to particular cases of autopoiesis that have a broader and more comprehensive scope. This is what constitues a 'general theory of autonomous systemss' (Rudrauf et al., 2003: 14).

Claiming that *all autonomous systems are operationally closed* (Varela, 1989: 89). Varela defines operational closure as a concept that plays a key role within autonomy, which is understood as the main property of mechanistic (dynamical) systems, defined, in turn, as unities by their organization, which necessarily involves operational closure. *Closure and the identity of a system are interwoven in such a way that a closed operational system necessarily dedicates all of its transformations to the preservation of its identity* (Varela, 1989, 89-91). We claim that human organizations meet virtually all of the requisites of autopoietic systems-or if not, they could hypothetically meet them. However, organizations cannot fulfil the requisite of producing the component of people. Hence, whether viewed from the traditional concept or from our proposed concept, where human organizations are composed of four classes of elements (people, materials, symbols, and energy) in interaction, we face the same problem: the firm conceptualized in a manner that includes the component of people cannot be considered autopoietic (Mingers, 1995). As Luhman express autopoiesis is not a 'point of epistemological or semiotic departure' for human organizations (Luhmann, 1995:281, cited in Hermes and Bakken, 2003: 1530).

Following Varela, we want to propose that organizations are autonomous and operationally closed systems. To do that, it is first necessary to explain the difference between simple unities and composite unities.

Simple unities are those that assume an indivisible and unanalyzable whole. We interact with them by means of their own properties and conduct. Composite unities are those in which we distinguish parts. Therefore, we interact with them by modifying their internal interactions in order to modify their conduct. A human organization it is not an exception of this dichotomy. It manifests itself in two different domains: as a simple unity in the social domain and as a composite unity in the physical domain (Limone, 2000). Moreover, a simple unity is an emergent system that arises out of the interactions that are generated in the composite unity; hence, the simple unity is generated in the physical domain of a composite unity, but emerges in the social domain. Therefore, the composite unity exists and operates in the physical domain. We claim that this unit is composed of four classes of elements (people, materials, symbols, and energy), what we call: economic machine.

This distinction allows us to take into account the fact that people in interaction with other elements do not constitute the firm, but rather produce the firm. Furthermore, the interesting question is how do they produce it? Through a process that is very similar to autopoiesis but which, nevertheless, displays noticeable differences. To distinguish it from autopoiesis, yet note the similarities, we have called this process sociopoiesis (4).

Sociopoiesis

To understand sociopoiesis, we need to clarify a constitutive aspect of human acts, which is that all human acts involve emotions and that all human acts take place under a dominant emotion (Maturana & Varela, 1994; Limone & Cademártori, 1998). For a firm to be constituted, the concurrence and interaction of three types of acts are needed: labor acts, technological acts, and economic acts. Each of these types of acts takes place under the domain of an emotion. Labor acts occur under the dominant emotion of commitment and its fulfillment; technological acts occur under the dominant emotion of the domain; and economic acts occur under the dominant emotion of gaining an advantage or profit.

With these clarifications in mind, we can postulate a conceptualization of the firm by means of a definition that functions as an operation of distintion, setting forth its organization: the firm is *a network of processes of the production of labor, technological, and economic acts, in interaction and with operational closure, constituting the firm as a unity in the social domain* (Limone & Cademártori, 1998: 40). This network of processes of production operates on an incessant flow of people, materials, symbols, and energy, which interact with each other to produce the three types of acts. Moreover, these four classes of elements interact within the interior of a circumscribed domain that is not only separated from its environment, but also participates in the production of acts. This circumscribed domain is continuously generated through interactive relations that account for the how the system emerges. These relations require a more thorough explanation, which will be provided below.

The relations are produced through the interaction of acts in function of the overall state of the system. Since they are indispensable for the generation of any system, we call them foundational relations. These three types of relations are the following: *Relations of specification* wich are those that determine which elements and properties are to be incorporated as components of the system. *Constituent relations* that determine the distances, proximities, and other spatial relations needed to form the topology in which the component elements can interact and generate the system. And finally, *Relations of order* that determine the way in which the components are linked or connected in their relations of specification, constituent relations, and order as required by the

dynamic of the system. The fundamental relations of the whole system will be those that allow for the circumscribed space to be developed with the elements cited above of people, materials, symbols, and energy (Limone and Cademartori, 1998).

Initially the types of people, as well as the characteristics they need to have, who will be incorporated into the system are precisely specified. The same thing occurs with regard to the other elements belonging to the other classes—material, symbols, and energy. These first elements, once they begin to operate and interact with one another inside their circumscribed domain (for example, an office), allow the people who formed the original group to produce new specifications that will make it possible to incorporate more people, materials, symbols, and energy. These are incorporated into the system in the manner specified by the organization of the system. Together they generate its structure, which, in turn, allows the fundamental processes of the system to develop, again and again, in accordance with what is established by its organization. In the the formation of the operative structure and putting its main processes into action the constitutive agent acts as the mother unit with regard to financially sustaining the organization, until the time when the nascent system is capable of autonomously generating the financial energy to sustain its operations on its own. We speak of financial energy to mean that funds (money or any other means of payment) are the facilitator of human organizations and the economy in general.

(Insert Figures 1 and 2)

The constitutive operations during the first stages of the sociopoietic process can be seen in Figure 2. If we compare Figure 2 with Figure 1, representing the sequence of the process of autopoiesis, we can note the differences between the two processes. Whereas in autopoiesis the productive processes immediately and directly generate the components of the living system, which, once produced, interact and link in order to reconstitute the same processes that produced them; in sociopoiesis the components (acts) of the social system are generated in the domain of the productive community through interactions, linkages, and feedback from the four classes of elements that make up the community. The acts produced through the interactions (transformations) of these four classes of elements, are constituted in the components of the economic machine or firm in the social domain and finally in the state of the system-firm. The relations of specification, the constituent relations, and the relations of order determine if some of the interactions of the productive community need to be modified in order for the overall system to adjust to the conditions of life (states of the structure) that are required for the viability of the community.

In figure 2, the relationships are shown with regard to the productive community and the economic machine. Both of these unities have different components, which likewise interact in different ways. These interactions join the unities to the human person. In fact, when performing operations of distinction, human beings can conceive one or the other, whether it is the economic machine and/or the productive community, depending on what is needed at that particular moment. The four types of elements, once they are incorporated inside a circumscribed domain or space, begin to interact with each other, generating mechanisms of action. These mechanisms of action perform the activities (transformations in a cybernetic sense) that are necessary for the realization of the products or services that the particular firm produces and the processes that are necessary to maintain the structure and viability of the system. Furthermore, the production of goods and services is what is most obvious and perceivable. However, together with the transformations that are carried out to generate the goods and services, acts are being produced.

The idea that people do not comprise the firm, but rather that they produce the firm is of course not new (Limone, 1977; Morin, 1998). At the same time that the symbols and energy are interacting with the materials to produce the products or services, people are performing acts of various types. This idea of people and particularly acts *performing* the firm, it is firmly tangled with some recent developments within the performative turn in economic sociology and the study of organizations (see Callon, 1998). For this stream of literature, ideas, theories and certainly acts produce human organizations. In our model, among all of these acts, there are three that are necessary and sufficient to produce the socio-economic firm or organization, which emerges as a simple unity in the social domain. These three acts are the labor, technological, and economic acts.

The Fundamental Processes

There are three fundamental processes: the primary process, the decisional process, and the structuring process that appears within the economic community. The primary process is the *set of transformations performed in and by the firm that allow for the regeneration of the funds used in the maintenance of the structure and the recovery of the funds that were used to carry out the transformations* (Limone, 1998: 92). The primary process, in the domain of sustainability, is carried out through this structure, which serves as its support and its vehicle. The primary process may be broken down into four subprocesses or networks of transformations: the network of financial transformations, the network of productive transformations, the network of personal transformations, and the network of commercial transformations. These join with the decisional process

decisional, in the domain of governance, and with the structuring process, in the domain of connectivity, to complete the web of processes that make up the business firm. Each of these transformations in the complete network of processes is activated, regulated, and coordinated by the decisional network through its control of the primary and structuring processes. The process of activation, regulation, and coordination (which we call the steering process) is carried out to keep each fundamental variable or 'essential variable' (5) of each process, within the range of values that the system can bear by means of the regulatory action of the steering module of the basic structural unit (Limone, 1977).

The decisional process is a network of transformations of information which is expressed as a closed conversational network (6). Throughout the entire system, it continuously specifies the operational coherences needed in the production of the technological, labor, and economic relations that constitute the system in the entire network of processes (Limone, 1977). Through the links (steering modules), the decisional process guides and maintains total control of the activities that are executed as part of the primary and structuring processes: that is, it receives and processes the information flowing from each and every transformation that comprise these processes, and then issues signals to correct the situation each time that they do not fall within the operational coherences required for the viability of the system.

The structuring process produces the structural design of the productive community by differentiating and integrating the human, material, symbolic, and energetic elements that are being incorporated into the productive community. Through the processes of differentiation, the four classes of constitutive elements (people, materials, symbols, and energy) are grouped together. They interact with one another generating 'parts:' patterns of action, task groups, and subsystems. Through the processes of integration, interdependent bonds and links are generated among the parts that were created in the process of differentiation. This constitutes the structural web of the productive community. This web arises from the relations that are being generated among the various structural pairings that comprise the basic links of the structure. This link is formed from two coupled parts: the steering module and the technological module, which are depicted in figura 3.

(Insert Figure 3)

Figure 3 shows the basic unit of the structure, which is repeated again and again throughout the entire structural configuration, where each coupled pair is contained in a larger coupled pair, and, in turn, contains one or several smaller coupled pairs, all which have identical constitution. It follows then that the structure of a

business firm is recursive and fractal in nature. Upon being formed by elements that interact with each other, the structural parts produce transformations, which, upon being interconnected with the rest through the process of integration, create various processes. These processes interact and interrelate with one another to form the network or web of processes that go to make up the structural fabric of the productive community. This structure, that is, this web of interactions, is intangible. Even though it materializes in the physical domain, it cannot be perceived by our senses. We cannot see it or touch it in its entirety as a unit. We can only intuit it: that is, we can only understand it and visualize it mentally because its bonds are not material bonds, but rather only relations, behavioral links, and action links.

Final Reflections and Future Possibilities

We have tried to present an explication of human organizations that overcomes the limitations of traditional theory and reflects the current reality of organizations and their environment. We hope to contribute to resolving the concerns and problems that executives have faced since the last decade of the 20th century, which have been pointed out by numerous authors in the field of Organizational and Management Theory.

The current environment cannot be compared with that of the first sixty years of the twentieth century: hence, the need for a revised organizational theory capable of meeting today's challenges, such as the speed of the dynamic of change, the growing complexity, and the new demands that are imposed upon an informed society that is manifesting its discontent and clamoring for its rights.

A new way of understanding the firm as a living system in an abruptly changing dynamical environment; that is, as a self-organizing, self-perturbing, and self-perpetuating system, with little in common with the business-machine of yesterday, makes it possible to find and use new tools provided by cybernetic and theoretical biology.

Although, it is clear that our conceptualization decenter the people from the center and uses acts as the basic units of the firms. It is still important to stress that of the four kinds of elements which, in the unity of interactions, configure the productive community, there is one that plays a central role: *people*. Hence it is essential for future work in this area to explore psycho-sociological aspects of this model. However, what could even more important is an empirically oriented discussion of this theoretical approach. This is a discussion that demands further efforts from our organizational studies colleagues.

FOOTNOTES

(1) The best way to understand the generation of behaviors is to distinguish between ontogenic (acquired during a lifetime) and phylogenetic (acquired via evolution) behaviors of transgenerational transmission (innate) (Maturana & Varela, 1984).

(2) Cybernetically a transformation consists of something passing from one state to another due to the intervention of an operator.

(3) The word comes from the Greek, meaning “auto: oneself” and “poiein”: production, vale decir, systems that are self-producing or produced by themselves.

(4) The term sociopoiesis was coined by our colleague and friend Marcelo Arnold of the Universidad de Chile to make a distinction between biological autopoiesis and social autopoiesis. Here we are using it in a broader sense.

(5) An essential or critical variable is an output variable that provides information about the internal state of the technological module, allowing the steering module to know what the other module is doing, esp. as to whether the outputs are adequate or not.

(6) Cybernetic closure (Ashby, 1956) occurs when a transformation is applied to a set of operands and no element appears in the transforms (results) that is not already in the original operands of the output.

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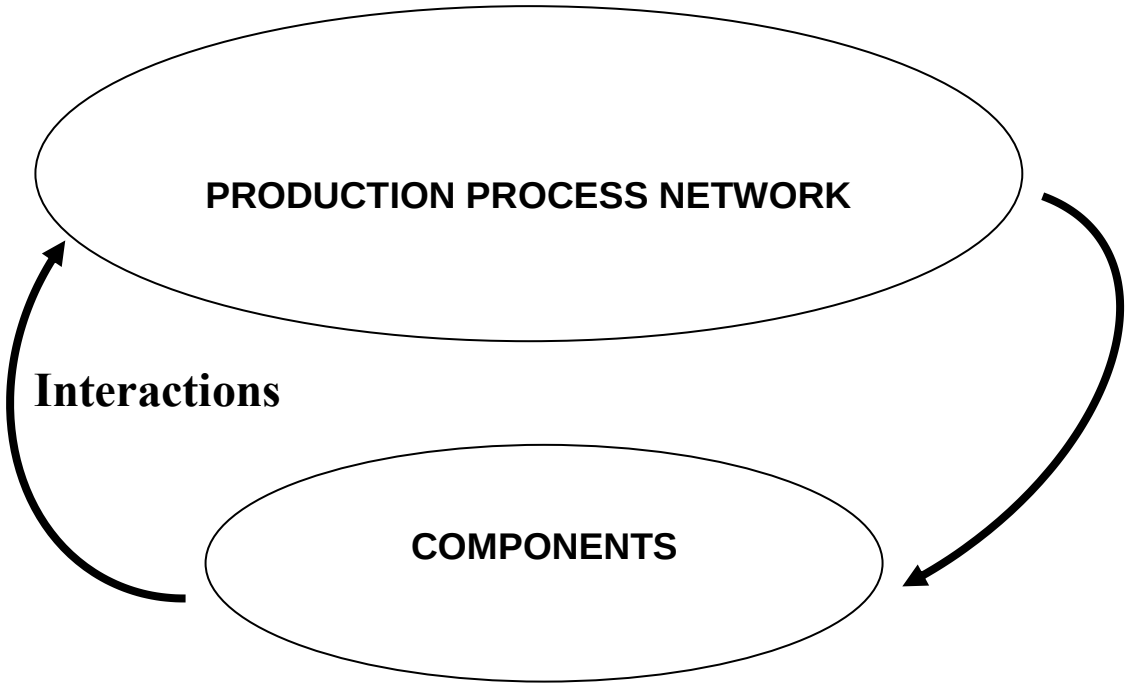
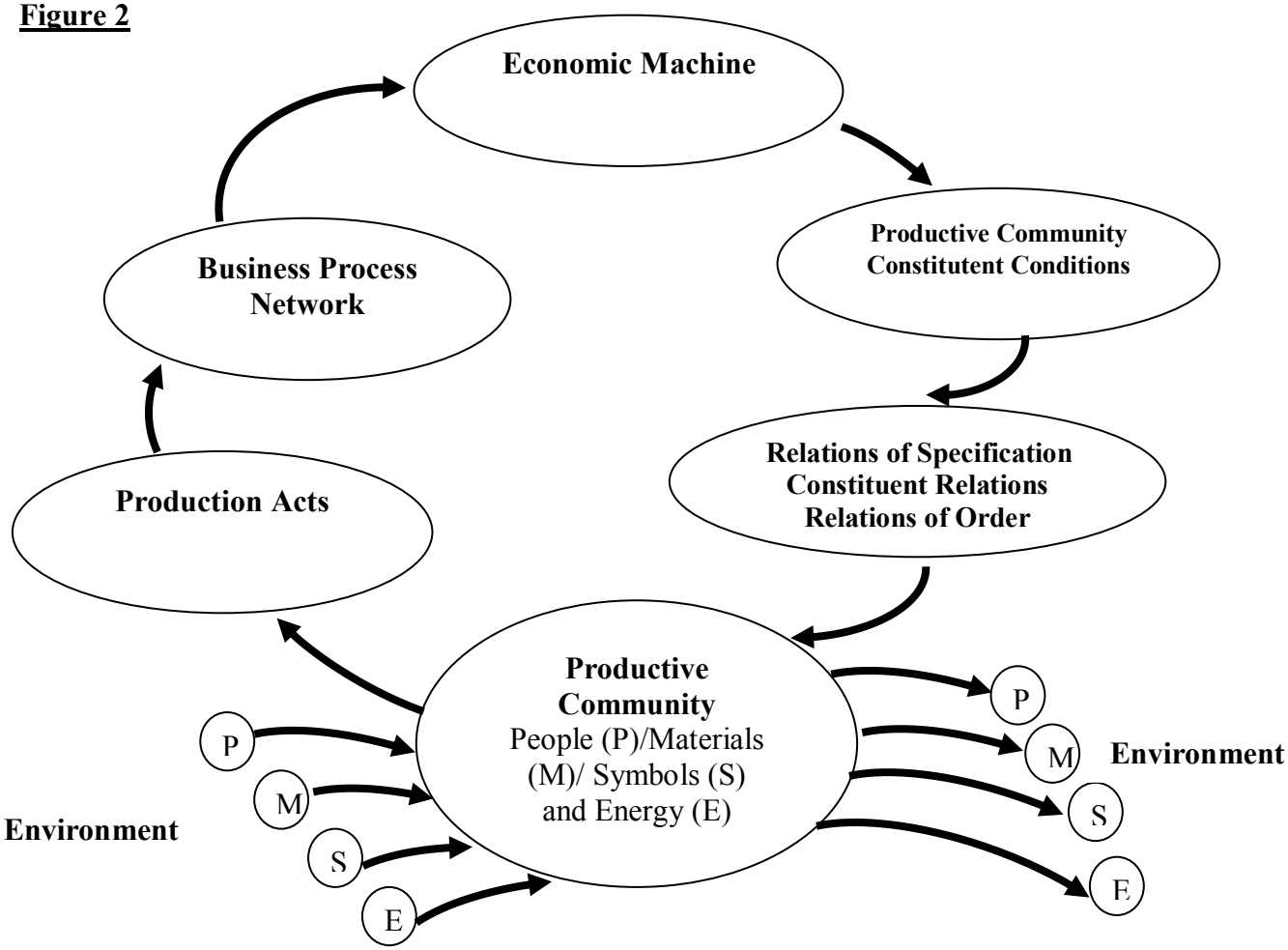
FIGURES

Figure 1



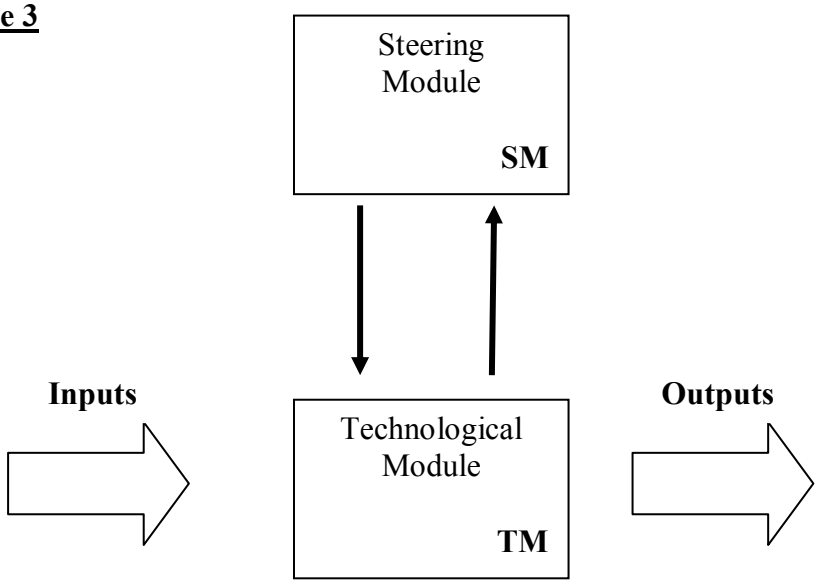
Source: Authors' conceptual representation

Figure 2



Source: Authors' conceptual representation

Figure 3



Source: Adapted from J. Mélèse

Copyright and public interest in the digital context: analyzing the conflict from the cybernetic perspective

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Structured Abstract:

Purpose The purpose of this paper is to analyze the conflict between copyright and public interest law, questioning the original meaning of copyright protection and its relevance in the digital context

Design/methodology/approach The Cybernetic and System theories serve as reflection mode about the social function of copyright protection for the construction of a cultural memory that serves as input for innovation and thus for social development.

Findings It is found that the appreciation of the collection of works in the public domain is a good strategy to value the profession of the artist. The protection period of artistic and literary works should be reduced to make faster to access to the collection in the public domain.

Originality/value Although the topic is the Law, the perspective is communicational, seeking to ventilate a discussion that looks worn and restricted to the world of lawyers.

Keywords: Copyright; Digital Culture; Cybernetic; System theory; Public Domain.

Article Classification:

For internal production use only

Running Heads:

Introduction

reality takes revenge, ignoring the law
Georges Ripert[1]

There is a consensus that copyright law in force cannot cope with the cultural practices that have emerged with the new information and communication technologies. The ease with which we cut and paste on the Internet seems to weaken the legal determination of obtaining the author's permission for any use of his work. Sharing on network and recreating new work from pre-existing ones are already very common habits among young people of the 21st Century. That is a fact. And when facts take enough proportions to discredit the laws, lawyers interpreter as "The rebellion of the facts against the code"[1]. The Network Society imposes a reinterpretation of the standard, a reality recoding. Perhaps the best way to start this difficult task – because the network spreads globally while the law acts locally – is revisiting the meaning of the provision, its original purpose.

All reasoning that will pass here shall be under a systemic approach. This means that society – in an admittedly totalizing sense – will be understood as "a set of interacting elements" (BERTALANFFY, 1975, p. 62). A system in which many subsystems are contained, such as Legal, Cultural, Political and Economic, "all structured and organized, and what organizes your organization is communication" (WILDEN, 2011, p. 109). Norbert Wiener focused on understanding the complex nature of communications because, according to him, "they are [communications] cementing the structure of society" (WIENER, 1968, p. 27). With cybernetics, Wiener proposed a science of communication and control that will serve here as a way of thinking about the problem in question: the relevance of copyright protection in the digital environment and the possible adaptation of the law.

Order

Contrary to closed systems, in which there is no communication with the outside environment, open systems, either the machine, human or society, interacts with the surrounding universe exchanging information: "Information is the term that refers to the content of what we exchanged with the outside world," says Wiener (1968, p. 17), through *input* and *output* operations. According to Anthony Wilden (2001, p 11), apart from its basic meaning, daily – to give structure or form (from the Greek *eidos* or *morphé*) – the concept of information has two distinct meanings. The first has a quantitative character in which the information is understood as a measurable quantity in binary numbers, as in the Mathematical Theory of Information (1949). Although it may be served from the first, the second sense is, however, always qualitative before quantitative:

Information is presented in structures, forms, models, figures and settings; in ideas, ideals and idols; in indexes, images and icons; in trade and merchandise; in continuity and discontinuity; in signals, signs, signifiers and symbols, in gestures, positions and contents; in frequencies, intonations, rhythms and inflections; in presence and absence; in words, in actions and in silences; in visions and syllogisms. It is the organization of variety itself (WILDEN, 2001, p. 11).

According to Wilden, "variety is the most abstract and universal definition of information, in all its forms" (2001, p. 14). Therefore, variety is everything. A supra set in which are subdivided possible information configurations. Information itself has no meaning, so it is not distinguishable from noise. What will define whether information is or is not noise is the context in which the system is inserted. In certain systems, the information represents encoded variety, which is structured, orderly, and noise represents the uncoded variety. These processes of encryption and planning are organization processes. Therefore, information and noise indicate a similar relation to that between order and disorder: "in many contexts, information is, therefore, synonymous with order and noise of disorder " (WILDEN, 2001, p. 16).

In the contemporary social context, the protection of artistic and literary works is an structured information encoded by the legal system, which organizes the economic activity of the cultural sector. According to Wiener, "the first duty of the Law, whichever is the second and the third, is to know what you want" (1968, p. 109). Therefore, what is the aim for copyright protection?

The strategy of legally protect creative activity was originated in 1710, in England. Until then, there was some kind of an agreement between the crown and editors: the monopoly of the means of production was kept in the hands of those who would implement existing monarchical censorship to control the flow of ideas. There wasn't any law yet that would regulate the editorial market in England, nor even in any other country. From the cybernetics point of view, the book market was a disorganized system without clear and equitable rules.

Queen Anne established an exclusivity print period of 21 years for works published before the law and 14 years for works published since then, with the possibility of renewal in case the author was still alive. Therefore, a regime of temporary exclusivity right to copy was created (Lessig, 2005). Anne's Statute was the first attempt to order the book market. But the idea of art as a private good had not been consolidated yet. In fact, the only right attributable to the author in the statute was the power to decide whether or not to renew the grace period for over 14 years. Satisfied, the editors did not realize the propose that the law imposed: “An Act for the Encouragement of Learning, by Vesting the Copies of Printed Books in the Authors or Purchasers of such Copies, during the Times therein mentioned”.

In fact, this purpose was only "coded" by society, in other words, only happened, 21 years later, just when the protection in the first wave of works under the new regulations had expired. Initially, the editors simply ignored the Statute, continuing to insist on the perpetual right to control publications. There was pressure for extension of the period, which triggered the conflict known as *The Battle of the Booksellers*. The lawyer Lawrence Lessig, founder of Creative Commons license, rescues a brochure of the time, with the decision of the English Parliament.

[1]This expression was stamped by Gaston Morin in his book *La révolte du droit contre le code: La révision nécessaire des concepts juridiques (contract, responsabilité, propriété)* and was presented to me by the Justice Attorney of the Rio de Janeiro, Márcio Klang, my dad.

There is no Reason to give a greater period now, so to obligate us to give it forth again, as the Past ones have expired; if this project is approved, in essence it will create a perpetual Monopoly, a very hateful thing to Family Law; it will be a big **Obstruction for Business**, a **Barrier to Learning**, which gives **no Benefit to Authors**, but a **Heavy Fee to the Public**, only to increase **the private Gain of the Booksellers** (LESSIG, 2005, p. 106, emphasis mine).

This interpretation consolidated the original function of copyright protection: build a cultural heritage for the benefit of society, with the granting of a temporary title to the author, enough time to repay him but not so long as to jeopardize the public interest.

In France, author's rights have emerged in the remnant of French Revolution under the influence of Enlightenment thinkers. In 1793 the Law on Regulation of Reproduction Rights was enacted with the heading: "Law on Property Rights of the writings of all kinds, music composers, painters and designers." Reproduction rights, which were no longer limited to books but also to all artistic creations, lasted the entire life of an author and for 10 years after the author's death.

In 1866, the French extended the term of protection from 10 to 50 years after the author's death. Two decades later, this deadline figured in the Berne Convention, the international legal instrument that today underpins the laws of 165 sovereign states.

The industrial modernity expanded the reproducibility of artistic and literary work leveraging the commodification of culture. The late 19th century was marked by the emergence of technologies that allow the reproduction of sound and images, as the phonograph of Thomas Edison (1877), the gramophone of Emil Berliner (1888) and the cinematographer of the Lumière brothers (1895). Incorporated in a technological support, the art is now a material good whose value is given by the logic of capital, in which work quantifies and qualifies the product. One of the first films projected at the movies, *La Sortie de l'usine Lumière à Lyon,* is the record of a time that sees the factory as its social representation.. *The factory was the context.* It is in the context of the factory that the law establishes a system of artificial scarcity that makes artistic creation as a private good, provisionally. For a certain period of time, the author may assign property rights to third parties in order to transform the art into a commodity and virtuosity into work.

Once the period of protection is over, the work is no longer an exclusive right of the author becoming public property. In Brazil, the Law 9.610/98, copyright law in effect, determines the protection for 70 years after the author's death. After this time, the works are under tutelage of the state, integrating the Brazilian cultural heritage, which gives identity to the nation, common to all, our *commons.* When this happens it is customary to say that the work "fell" into public domain. The first Brazilian copyright law, the Medeiros e Albuquerque Law of 1898, had already in the body of its text the verb "to fall". What does this mean? Work that falls from the pedestal? From this extraordinary condition, the expression of the creative spirit? Author-God. So, when the work "falls" into the public domain, it loses its value? What is the value, therefore, of our artistic and literary *commons*?

Memory

Cybernetics teaches us that it is through the input and output of information that a system grasps new information and, this way, can adjust their behavior and improve their operations performance. The new information is combined with those already stored in the memory of the system and this crossing produces new combinations of information that will be released to the outside world, being able to enter the system again. This circular process of input and output data feeds the information memory, structured and coded, in other words, produces knowledge, so that the feedback generates learning and it is learning that ensures the adaptation of the system to the uncertainties of the environment. In the legal system, this circular process of information that produces knowledge is called jurisprudence. Faced with a case, any judge reminisces on past decisions in similar cases to make your own judgment. Wiener states that "the nervous system and the automatic machine are, therefore, fundamentally similar in setting up, both, devices that make decision based on decisions made in the past" (1968, p. 34).

Back to the purpose of the Statute of Anne “For the Encouragement of Learned Men to Compose and Write **useful** Books”, what would the value of a book in the public domain be? Let's take a look at the English parliament's arguments:

1) **Obstruction for business:** Works under public domain are used as input for innovation - free of royalty payments, entrepreneurs can develop new technologies, new business models, which drives the formation of new professionals and, therefore, new markets. The arrival of Amazon Bookstore in Brazil can illustrate this argument. When they began to formulate a strategy for the Brazilian market, Amazon was seeking an agreement with publishers, but also tried dialoguing with the Brazilian government. Why? Because the state has custody of a beautiful literary heritage that the bookstore could distribute with no risk, as it is no longer necessary to pay for the rights to works in the public domain. The books could be made available for almost no cost to the consumer, who would start to become familiar with the dynamics of consumption in the store and the reading experience on Kindle.
2) **Barrier for learning:** The copyright protection ensures the author a way to economically exploit their works and, this way, allows the dedication of time and resources to creation. Therefore, the law grants the author the possibility of making artistic and literary activity, a profession, producing more and more works to be aggregated to this future common heritage, cultural heritage of the nation. Powered by professional artists from the past, this cultural memory will be available in the future for students, teachers, researchers, scientists, and artists who can make use of these works in the creation of new works.

Therefore, even if commercial value supported by the printing monopoly is lost, works in the public domain have important use value, are critical to the production of new knowledge and artistic creations. This is the purpose of copyright protection: serving social development.

Disorder

If copyright protection is coded information, online sharing of cultural goods without the consent of the authors is the "noise", what is not ordered, structured and, therefore, poses a threat to the legal system. However, the Internet age requires the sharing of knowledge. It was to exchange information and discoveries of the *Big Science* that American researchers developed in the mid-60s, the methods of interconnection between computers. Freedom and cooperation are fundamental premises of the Internet because they are the basic values of the culture that created it: "Internet culture is the culture of the creators of the internet" (Castells, 2001, p. 34).

When the young American Shaw Fanning created Napster in 1999, the music industry did not glimpsed any innovation, but threat. Insisted on keeping their form of agency, preferring to face the new technologies of network communication as enemies and concentrate the efforts to its criminalization. The portal for peer-to-peer file-sharing faced the RIAA, Recording Industry Association of America, who accused it of illegally distributing protected songs. The argument for Napster was based on the principle of fair use, guaranteed by "Berne three-step"[2], as part of portal users were sharing products for which they would have paid, plus the fact that the site had nothing to do with the process of reproduction of these products and no one – neither the website nor its members – was profiting from the practice. But in February 2001, the American court found Napster guilty. Even when the portal said in court that it had created a way to block the transfer of 99.4% of the content identified as copyrighted, the American Judge Marilyn Hall Patel ruled that is was not enough. "If 99.4% is not enough, then this is a war against file-sharing technologies, not a war against copyright violations" (LESSIG, 2005, p. 67). The Napster case recalls the battle of the booksellers: what was at stake was not the copyright protection, but the protection of a business model (private gain, as the English said).

However, the resistance to the new did not cause the effect expected by the industry. Instead, new technologies are emerging, and cultural heritages are increasingly unprotected. Instead of absorbing the "noise", the industry continues to exert enormous pressure on National States to guarantee not only the rigorous enforcement of copyright law as well as a more comprehensive regulation. Since its inception in 1886, the Berne Convention has been updated 8 times due to new reproductive technologies that have emerged throughout the time. In addition, several bills have been created early this century to curb file sharing, as SOPA and PIPA in the United States, and ADOPI in France and Azeredo law in Brazil. The American jurist James Boyles believes that "the policy of the Intellectual Property has dangerously the sway of 'maximalist rights culture'" (BOYLES, 2004). Lessig argues that the maximum regulation creates a culture of permission:

A culture of permission means a culture of lawyers, in which the ability to create requires a call to your lawyer. Again: I am not against attorneys, at least not when they are kept in their proper places. I'm certainly not against law. But our profession has lost the sense of its limits. And leaders in our profession have lost sight of the high costs it imposes on others. The inefficiency of the law is an embarrassment to our tradition (LESSIG, 2005, p. 198).

As we increase the coercion we move away from abstract principles that invented this instrument of protection that had a higher purpose. Not even the industry executives, nor artists, nor the users have considered the importance of copyright protection for the construction of a collection of public domain for future use. If the need to adapt the law is consensus, the feasibility of this project is still a dissent. There is a strong tension between the legitimate right of the author's return and the constitutional right to freedom of expression and access to information. Arguments are relevant but that heat debates that have not been proven to be fruitful.

Meanwhile, the contemporary youth continues to ignore the law, after all, a teenager does not share content online to challenge industry, but because it's considered a habit of his generation and because it is simply possible. As John Perry Barlow put it, "we can see the illegitimacy of copyright when trying to explain to a 15 year old boy what intellectual property is" (verbal information[3]). Lyricist of the band Grateful Dead and author of the Declaration of Independence of Cyberspace, Barlow demonstrates that resistance in easing the law may cause a curious semantic inversion: the protection can become a "noise" while sharing acquires the status of "information".

Wilden (2001) points out that the way information-noise and order-disorder are subdivided in time indicatives systemic flexibility, in other words, the capability of the system survival through structural adaptations to the 'noise' or 'disorder '. Therefore, the noise is the only possible source of innovation. The assimilation produces new configurations that will be archived in memory, increasing global structured and coded variety of information, the degree of organization of the system, in other words, its cognition, having a direct influence on its future performance.

However, new ideas go from noise condition to coded information condition "only when the society has the need, not before" (WILDEN, 2001, p. 112). In the passage from the factory to the network, knowledge (scientific, technical, artistic, ideological) "may circulate regardless of capital and labor" (CORSANI, 2003, p. 27). By insisting on a regime of artificial scarcity in a context of abundance, we brake up innovation. The noise resistance risks turn order into disorder. This is the very revenge of reality against the law. Back to Wiener, "each element of phraseology should be put to the test by the custom of the place to which it is relevant" (1968, p. 106). The copyright protection is still relevant in the digital context?

Adjustment

William Ross Ashby (1970) elaborated a fundamental concept to the survival of opened systems: requisite variety. According to this concept, if the variety to which the selected system is subjected is larger than the range that the system is capable of handling, there is no needed variety to face the threat range (ASHBY cited WILDEN, 2001 range. 17). This

[2] According to Article 9 of the Berne Convention, "To the laws of countries of the Union it is reserved the right to permit the reproduction of such works in certain special cases (1), provided that such reproduction does not affect the normal exploitation of the work (2) or cause unjustified harm to the legitimate interests of the author (3) ".

[3] During the opening speech of the II Brazilian Digital Culture Forum, held in São Paulo in December 2009.

means that the noise (new) is greater than the encoded variety (memory of organized information), the system will not be strong enough to survive, as it will have no resources to adapt to what is not known.

Applying this reasoning to the copyright issue means that in 1999, the society was not able to deal with the practice of cultural nonprofit Internet sharing. Napster was still an unencrypted variety, therefore, a noise, a very new information, to the point that the system did not have the resources to deal with it. As stated by Ashby "only the variety could destroy the variety" (1970, p. 2440). The Brazilian government tried to mediate this learning process through public policies that foment the debate about copyright in the digital environment.

During President Lula's administration, the Ministry of Culture (Minc) awarded scientific research on the subject and created spaces for dialogue with the National Forum of Copyright. For two years, several meetings were held bringing artists together, entrepreneurs, lawyers, academics and interested users. Around 10 thousand people participated in the discussions, transmitted entirely in real time over the internet, allowing public participation nationwide. After the Forum, Minc submitted the draft bill to the Brazilian society.

Between June 14 and August 31, 2010 an official blog of the Ministry (http://www.cultura.gov.br/consultadireitoautoral) served as a platform for the realization of the Public Consultation on the Reform of LDA. Any Brazilian citizen could comment on each article of the presented proposal. In the end, 8,431 shares of individuals, legal persons or organized collectives were computed. Based on the input received, the Minc consolidated the final text by sending it to the Civil House in December 2010. The project suffered numerous twists with changes in management of Minc and it's not known for sure what direction it will take.

However, even though Brazil has been greatly celebrated abroad by the laudable initiative to undertake changes in copyright law, and also by engaging the population in the process, the end result was not significant. An analysis of the final text shows us that, regarding the digital environment, there was no satisfactory adaptation. On contrary, the definition of the law for "communication to the public" – "the making available to the public of the work by any means or process, so that anyone can have access to it, in time and place individually chosen" – was maintained to contemplate internet practices and the definition of "distribution" was changed, making it exclusively a commercial activity. In both cases, remained the need expressed permission of the author.

It is also curious that during the forum and the public consultation, little was said about the relevance of copyright protection for the construction of a collection of quality public domain for future use. Our cultural heritage does not seem to be of great importance for the Ministry of Culture, also because it is in the custody of the Ministry of Education (MEC). Portal Public Domain (http://www.dominiopublico.gov.br), is responsibility of MEC which shows us that Minc is responsible for the culture of the present and the cultural of the past, the memory of the nation, serves mainly to education. Actually, works in the public domain are great contents for classrooms but one must take into account that also serve to the development of new products, suitable for copyright protection.

Judging by the appearance of the portal, Brazil does not see in this heritage any potential for innovation, as glimpsed the English in the 18th century. The database is unattractive, with a poorly interface and extremely obsolete search tool. What value does our artistic and literary Commons have, hidden in inefficient system that does not instigates handling these works to experiment new forms of artistic expression? If the Brazilian government wants to lead a reform of the law, to be the first to remind us of what the purpose of the rule is, in this sense, it should propose public policies that encourage the use of this public property. It is by circulating that these works will be valued and will serve as input for new artistic creations, new products, new technologies, new business. The government needs to encourage the appreciation of this memory to improve the system, in other words, to the progress of our society.

If we consider the relevance of copyright protection for the construction of the commons and the importance of the commons for the development of all, the reduction of the term of protection would be a structural change, but not radical. We would keep the notion of ownership of intangible assets but would reduce the grace period. This way, the remuneration of the author via the assignment of property rights would still be guaranteed but the access to the collection of public domain would be faster. Some professional artists would be scared with such a proposal, but only if they wanted to continue taking the position of victims, quite providential to the industry. Because every creator, professional or amateur, makes use of these commons in his works. As former Minister of Culture Gilberto Gil said, "there is no isolated creation. No one is a creator alone, no one creates anything in a vacuum "(verbal information[4]). Everyone part from these commons, of this collectively collection constructed with time, when the protection expires and everyone has access. It is from this cultural ground that any writer risks his first word, any musician risks his first note, a photographer takes the first click. Therefore, this change will only diminish the gains of intermediaries. It would certainly cause strong impact on the system, but not so great as to risk its survival.

In the report produced by Minc about the contributions of population during the Public Consultation, the article on the term of protection appears as the most questionable. It was large the number of claims for the decreased of the period to 50 years – compatible with the Berne Convention. Some proposed even less time, like 14, 20, 25, 30. It was also proposed that it would continue for 70 years, but only during the author's lifetime, extinguishing the transfer of rights to the heirs. But Minc did not risk such change. He argued that this could "cause numerous transition problems, legal uncertainties and not peaceful interpretations, as well as reduce rights granted to authors" (Minc, 2010, p. 77th). Instead, the government's strategy was to include new limitations of copyright, in other words, more fair use possibilities. One of the proposals was to include the "recreational use", which could legitimize, for example, the recombinant practices of remix and mashup of music and videos. But not even this suggestion figured in the final text.

However, more important than creating new exceptions to the rule would be to discuss the rule itself and, thereafter, risk decreased protection period. Discuss the social role of intellectual property is perhaps the best way to value the profession of the artist. How to determine a grace period compatible with the Network Society? Some points should be considered.

[4] In the same lecture where John Perry Barlow was, at the opening of the II Brazilian Digital Culture Forum, held in São Paulo in December 2009.

First of all, life expectancy at the time that the Berne Convention was created was much smaller than today. According to the World Health Organization[5], the average life expectancy in the world in 1900 was 31 years. In 2011, after more than a century, the average global WHO estimate increased to 70 years[6]. It's a 40-year difference. In other words, the author lives much more today, so the protection lasts for much longer.

Secondly, it is necessary to discuss the preservation, or not, of the artist's moral right. If we do not take into account the author's life in this calculation, we could unbalance the public and private interests. The work of the artist still alive when the protection period expires would be under the control of students, researchers and artists, as well as for governments and corporations use. It seems fair that the artist has in life the right to preserve their individuality.

Basing on the premise "after death", the moral rights would close up with the author's life and making intended to the descendants, the property rights for a reasonable period. But any attempt to quantify this time still sounds frivolous. There are manifests for the reduction, several authors aim to this direction, but no one ventured a concrete term.

In any case, this change must be waged on a global level. Although it seems a rather daunting task, it does not make sense, in a world without borders, spend energy in the modification of a local law. If Bern is the starting point for any sovereign legislation, it is in Bern that we should concentrate our efforts. Does Brazil have padding to lead a project of this magnitude?

Keywords
Copyright; Digital Culture; Cybernetic; System theory; Public Domain.

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Environmental cyber-systemic governance and social processes

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Abstract

Giving the worsening global environmental crisis and its mostly negative effects on a whole range of social processes, we argue that the prevailing way of conceptualizing the governance of the relationships between humans and the biophysical world in dualistic terms must give place and be reframed in terms of "cybersystemics", which is a neologism (coined by the late Gary Boyd) that is useful, we argue, not only for breaking out of this dualistic paradigm in environmental governance but also of the dualism associated with the use of systems and cybernetics. We see the global environmental crisis as an emergent outcome of current commitments to dualistic governance choices, and therefore we claim a need for a paradigmatic shift in the way we govern ourselves and our relationship with the biophysical world. We draw on our own research praxis to exemplify how the intellectual lineages of cybernetics and systems have been mutually influencing in our doings, and how new forms of governance practices that explore different framing choices might contribute to building innovative environmental governance approaches, for instance through institutional design for cyber-systemic governance, that are more systemic and adaptive.

Keywords

Cyber-systemic, governance, systemic inquiry, socio-ecological systems

1. Problematique

The prevailing paradigm in the governance of the relationship between humans and the biophysical world is characterized by joint commitments to scientism and dualistic thinking. As a consequence humans not only have become divorced from their biophysical environment but their relationship with it has been characterized by systematic control attempts, like top-down management regulations, rather than by systemic learning based approaches. The evidence from many contexts is that current 'governance systems' are failing citizens and, too often, are not fit for contemporary circumstances (Chapman 2003;

Ringen 2009a,b; 2012; Ison 2010; Kelly 2014). Living in the Anthropocene, regardless of whether it is an adequate framing choice (in the sense of Schön and Rein 1994), means that we are collectively in a period new to human history, one that calls for critically reflexive engagement with our past thinking, practices, institutions, patterns of investment and governance.

In this paper we focus on governance as understood and researched through the Systemic Governance Research Program based at Monash University (Ison et al 2013; 2014). When governance is reframed, and understood as enacting cyber-systemic processes that maintain the quality of relationships between humans and the biosphere, then it can be seen to be failing on many fronts. Examples of governance situations where this occurs are the governance of biodiversity, water catchments and of land use planning, since in these situations governance normally has been focused on the management of features of the biophysical world (for instance in practices of natural resources management based on quantitative approaches) instead of fostering processes towards the improvement of the quality of the relationships between humans and the biophysical world. A good example is the loss of confidence, almost universal now across the globe, that rivers are safe places for swimming by children (the young of the mammal *Homo sapiens*). Importantly this is not a loss of amenity, but a diminution of the quality of being human.

However, momentum is now growing to address the limitations of the prevailing paradigm in the face of a worsening global environmental crisis that threatens water and food security as well as accelerating loss of many vital ecosystems services. Further, this crisis might have unprecedented social consequences triggering dramatic effects like unemployment, migration, outbreak of diseases, affecting the social and productive structure of whole regions. Ultimately such issues that human societies have to tackle can be conceptualized as 'wicked situations' (Rittel & Webber, 1973), demanding alternative governance mechanisms within an overall cyber-systemic governance framework.

This 'problematique' raises two significant questions for praxis: (i) what form of praxis might best contribute to paradigm shift in these circumstances, considering that we may also lack conceptual, institutional and practical tools to move in new directions? and (ii) what constraints and possibilities does a conception of environmental cyber-systemic governance offer to praxis innovations opening up new perspectives for an effective break with dualistic thinking and acting in the governance of socio-ecological systems? As Boyd & Zeman (2007, p. 1255) note "a deeper cyber-systemic understanding of just how people are all parts of one mutually educating and mutually surviving Earth-life system changes the value of everything". This understanding brings with it the possibility of building new framings for how we think and act, allowing us to engage in design processes or innovative practices that are more fit-for-purpose, if systemic governance is to emerge and be effective.

2. Taking responsibility in doing cyber-systemics

The very common confusion within the academic literature over the concept system and whether system is an epistemological device, a way of knowing about the world and thus a choice to be made in context sensitive ways, or an ontological claim, that is, a claim that

systems are ‘real’ and thus describable objectively, extends to the concepts of ecosystem (for more details we refer to Ison, 2011) and of environment. One of the great traps we have created for ourselves is to see the environment as something in and of itself, instead of seeing it arising in a relational dynamic when we distinguish a system (or a foreground from a background). This is a good example of what Wenger (1998, p. 58) has called reification “to refer to the process of giving form to our experience by producing objects that congeal this experience into “thingness””. Reification has become a pervasive practice, and Ison et al. (2015) draw attention to the act of reifying, or creating a ‘thing’, as a practice that we do all the time without understanding and being aware of the implications of this practice for what we do in the world. As with the concepts of systems and ecosystem, the concept of environment has come to be reified as something existing independently of those who make the boundary judgments that distinguish it as a system of interest. This understanding has had and will continue to have profound implications in our praxis in the world unless the cyber-systemic implications are more widely appreciated, especially the responsibility we hold for bringing forth our world (Ison, 2010; 2011). One such implication is how reifying practices might constrain systemic governance, constraining innovation and change. Therefore, a paradigmatic shift to cyber-systemic governance framings has also significant ethical implications since it influences human behaviour towards the biophysical world. The governance choices we make have different ethical entailments regarding for instance our responsibilities to future generations.

In his book Ison (2010, p. 27) presents and discusses a heuristic model (Figure 1) of some of the different influences that have shaped contemporary cyber-systemic approaches and the lineages from which they have emerged. During their development in the last 50-60 years these contemporary cybernetics and systems approaches (cyber-systemic approaches) have become isolated lineages, despite sharing some common foundational understandings. These lineages have been conserved within particular communities of practice, favoured also by particular academic practices and institutional arrangements. Therefore, Ison’s heuristic model has also been developed as an attempt to facilitate a conversation about these isolated lineages, a reason why we see cyber-systemics as a useful neologism for breaking out of the dualism associated with the use of systems and cybernetics concepts, manifest even in social and organizational separations such as different professional societies, as has been claimed by Ison & Blackmore (2014). This neologism has been coined by Gary Boyd for whom “Cybersystemics” is the name for the science of historically and evolutionarily emergent levels of cybersystems (Boyd & Zeman, 2007).

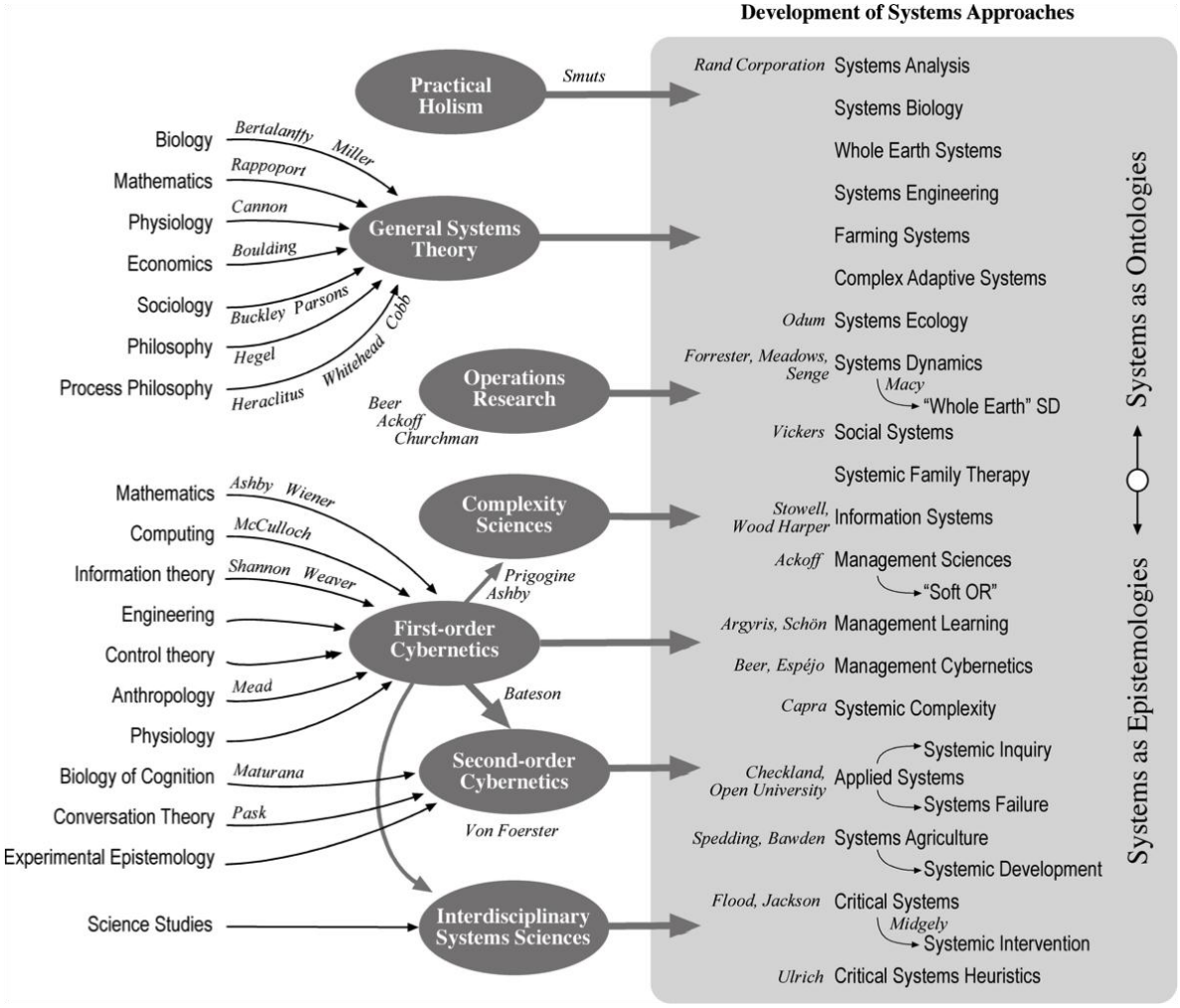

Figure 1. A heuristic model of some of the different influences that have shaped contemporary systems approaches and the lineages from which they have emerged. This Figure is best read from right to left in the first instance. Down the right-hand side are a set of contemporary systems approaches which are written about, put into practice and sometimes taught. Some names of people (systems practitioners) are added who are particularly associated with approaches. The approaches are also organised from top to bottom in terms of what can be perceived to be common commitments, or tendencies, of a majority of practitioners within the given approaches to seeing systems as entities (ontologies) or heuristic devices (epistemologies) (Source: Ison 2010).

Thus cyber-systemics offers a reframing (Shön & Rein, 1994) that, if the past excesses of reification are avoided, has potential to move the conversation of a divided community with different epistemological commitments into a meta-conversation in which differences are articulated and understood at the same time as what is held in common is celebrated and rearticulated in terms of the needs and challenges of the contemporary world (Ison, 2011), desperately in need of new forms of thinking and acting. Therefore our use of cybersystemics is an invitation to recreate the feast – the conversation – so that the opportunities provided by the diverse cyber-systemic lineages might re-emerge with vigor into contemporary society. Cyber-systemic concepts such as feedback, recursion, circularity, variety, autopoiesis and structural coupling offer opportunities to create the circumstances where policy makers might begin to conceptualise socio-biophysical systems

as coupled systems drawing attention to what relations might best be conserved over time (Ison, 2011).

3. From communities of discourse to communities of practice

Although most discourses on environmental governance are dominated by technological, economic and biophysical framings (informed by an instrumental rationality) some attempts at introducing cyber-systemic understandings into environmental discourse go back to the 1970s with the Club of Rome's report "The Limits to Growth". Its approach was based on Systems Dynamics modelling of world resources and despite the fact that "The Limits to Growth" was effective at the level of discourse, it did little to transform praxis. Or to put it into other words, all too rarely has this discourse been capable of operating at the epistemological level or capable of informing transformative governance practices, as it is all too evident when we look at the current state of our biophysical world. It can be argued that existing institutional arrangements with their entrenched practices based on systematic and dualistic thinking have contributed to a large extent to this result.

Furthermore, if we draw on Wenger's definition of communities of practice as "groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (<http://wenger-trayner.com/theory/> September 16, 2014) we necessarily come to the conclusion that communities of practice (CoP) in this field of cyber-systemic governance are almost non-existent. This is a theme that will be taken up in 2015 in Berlin under the rubric of "Governing the Anthropocene", one of the greatest challenges facing humanity.[1] There are also important questions that emerge in policy circles between the ways in which a 'discourse coalition' is now understood (Hajer 1995; 2009) and how a CoP might be understood in Wengerian terms (Wenger 1998; Ison et al 2013b).

4. Crafting and designing cyber-systemic institutions

Current governance practices concerned with the relationship between humans and the biophysical world are based on the conservation of a 'technical rationality' that prevents any substantive governance innovation. Examples can be seen in the case of water governance where framings introduced in the 1970s and 80s, such as Integrated Catchment Management (ICM) and Integrated Water Resources Management (IWRM), despite the use of the term 'integrated,' conserved praxes that were at best systematic, and rarely systemic; in essence rivers were still framed as hydrological or biophysical entities, later ecological but until the present never as structurally coupled social-biophysical systems (Ison and Wallis 2015). Innovation failure includes also a failure of the institutions that mediate our understandings and practices and thus the modality or the quality of our relationship with the biophysical world. Therefore the praxis of crafting innovative institutions needs to be taken into account as a way to create the circumstances to understand and act differently in the way we govern ourselves and our relationship with the biophysical world. As outlined in Ison (2011) the current trajectory of development of ecosystems services institutions poses significant social risk when understood through a cyber-systemic lens. This is also

[1] The 2015 ISSS Conference in the first week of August 2015 will be run under this title.

exemplified by the major financial flows through the current economic system based on financial institutions that have no, or deleterious, relationships with the biophysical world.

Crafting is the work of 'making skilfully' but unless what is made is understood in terms of what it mediates, facilitates, or offers affordances to, then crafting remains a praxis devoid of purpose and the potential for the transformation of experience (Ison et al., 2013). Institutions are inventions we make which establish norms, rules of the game, regulations, polices, etc. Institutions are pervasive in our societies, often operating without awareness of those who are affected by them (Ison, 2011). An institution can also be reframed as a social technology particularly when procedures and rules designed to standardise behaviour are reified or institutionalised. But institutional transformation towards cyber-systemic governance regimes is more than crafting the new. Crafting also requires innovation in understandings and practice of those who do crafting, as well as clearing the situation of old, constraining institutions and appreciating extant institutional complexity (Wallis & Ison, 2011; Ison et al., 2013).

Drawing on the conclusion of Thompson and Warburton (1985) that institutional innovation is central to transform complex issues like those of 'wicked situations', contemporary cyber-systemic approaches might constitute the conceptual foundation of purposeful institutional change to effect transformation towards more systemic governance of social-biophysical systems. Changing institutions is a form of praxis that can be understood as crafting or designing institutions, which in its turn is a governance form (Ison et al., 2013). Attempts to move beyond the dominant framings of GDP towards human wellbeing, or liveability or, as in Bhutan, happiness are all examples of attempts at institutional innovation.

In any situation of governance innovation in relation to the concept of 'wicked problem', the praxis of crafting institutions, although not enough, needs to be considered, offering us new possibilities of embarking on new governance trajectories. However, there is limited evidence that understandings about 'wicked problems' (as well as about cyber-systemics) have been incorporated into institutional innovations; for example will they inform the design and operationalisation of the new UN Sustainable Development Goals now being institutionalised to replace the Millennium Development Goals? (Ison et al., 2014). The great challenge facing cyber-systemicists is regrouping institutionally around what we have in common so as to build a new wave if institutional development around our scholarship and praxis and to facilitate more investment.

5. Towards doing cyber-systemic governance

There is a lack of clarity in the literature and in the policy community in relation to terminology and underpinning epistemology of emerging holistic conceptualizations and models which include socio-ecological systems, social-ecological systems, or coupled human-environment systems. Clarifying these conceptions and teasing out the policy and practice, especially governance implications, is an urgent imperative. Cyber-systemic concepts offer opportunities for policy makers to begin to conceptualize socio-biophysical systems in more promising non-dualistic ways. For example, water catchments or

watersheds could be conceptualized as structurally coupled socio-biophysical systems thus drawing attention to what relations might best be conserved over time, and what mediating functions are, or could be, carried out by current institutions or institutions still to be invented.

It seems not exaggerated to assume that normally there is a lack of awareness about the epistemological basis of governance mechanism choices in place. Further it is necessary to understand that cyber-systemic concepts of governance operate at multiple levels from projects to government ministries and involves crafting institutions and associated praxes that perceive, interpret and respond to feedback processes so that actions can be taken that affect the quality of the relationship between social and biophysical systems. Governance, or more aptly, governing, is thus in our terms also a form of praxis (Ison et al. 2013).

As we have discussed the act of being aware of framing governance choices are central to systemic governance. On the other hand, those who unknowingly frame situations as 'tame' and employ, non-reflexively, the traditional governance mechanisms, engage in systematic rather than systemic governance (Ison et al., 2013). But purposeful framing-choice praxis has yet to be institutionalised into governance activities. This raises the question of how framing processes might be designed so as to contribute to systemic governance innovation.

Ultimately 'wicked situations' such as water managing and climate change are problems of relationship – of human beings with the biosphere. However, in terms of conceptualizing and enacting governance practices out of this relationship we can notice a generalized institutional failure: almost always systems approaches have not taken hold in policy and governance circles; i.e., cyber-systemic explanations and hence practices are not valued in this context. As a result together with institutionalized reification practices, we simply blame "the environment" as the source of concern when confronted with pressing environmental problems. The 2014 severe water shortage in some parts of Brazil (as in the large metropolitan area of São Paulo) is a good example of a failure to institutionalize cyber-systemic integrative and adaptive governance practices, since the effect of powerful feedback processes among land use planning, population growth and climate dynamics on water availability for human consumption have simply been ignored (or not valued) over decades. In this particular situation (as probably in many others around the world), current policies and governance practices are based on the assumption (if not in the belief) that social and ecological systems are isolated, not coupled systems.

6. Final remarks

There are many contemporary issues to which understandings from the field of cyber-systemics offer opportunity and hope. It offers the opportunity to make a critique to current forms of environmental governance, since from a cyber-systemic perspective there seems to be many dangers in pursuing the current trajectory of our relationship with the biophysical world, as for example climate change. Therefore, it is necessary to take a "design turn" towards more cyber-systemic governance of social-biophysical systems, understanding "how underlying cyber-systemic processes generate our experienced world" (Boyd & Zeman, 2007) to inform the design of transformative practices.

The history of the relationship of human beings with their biophysical world, increasingly in modern times, has been shaped by systematic control attempts rather than by approaches towards 'symviability' (Boyd & Zeman, 2007). Therefore, new forms of inquiring are necessary in order to understand and contribute to building environmental governance approaches that are more cyber-systemic and adaptive. As has been claimed by Ison et al. (2013), from the perspective of systemic governance, dualistic thinking is unhelpful, and new forms of governance practices that explore framing choices that act as a duality need to be pursued.

It remains unclear how the arguments of this paper should be enacted. Therefore, the issues we have discussed so far frame an invitation for a systemic inquiry into forms of governance more suited to the contemporary circumstances of humans in their relationships with the biophysical world, and to the need of developing socio-environmental technologies in ways that do not constraint innovations and change and enabling the socio-ecological transformations that are sought. The inquiry purpose is to invent ways of acting in theory-informed ways (i.e., praxis) that gives rise to systemic and adaptive governance at levels ranging from the international to the program or project. In other words, the more general purpose of such a systemic inquiry is to contribute to building innovative environmental governance approaches (for instance through institutional design for cyber-systemic governance) that are more systemic and adaptive. Furthermore, such an inquiry might also contribute to an improved, holistic understanding of socio-ecological systems and how to transform them by fostering new understandings and practices.

This is an invitation to avoid the adoption of simplistic understandings of governance reducing it to the application of techno-scientific knowledge and solutions particularly in times of rapid global change and uncertainty. As outlined by Sonnenfeld & Mol (2011), socio-environmental theory (and governance) needs to adapt itself, reviewing its schemes and theories in order 'to reflect the new social, economic and political architecture underlying both causes and solutions for today´s environmental challenges'. This includes also the design of new institutional arrangements to facilitate cyber-systemics as a basis for social learning based approaches to the governance of socio-ecological systems. The 'new world (dis)order' (Sonnenfeld & Mol, 2011) calls for innovative paradigmatic shifts in the way we govern ourselves and our relationship with the biophysical world.

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Niklas Luhmann and Cybernetics

Even though Luhmann himself never declared his own approach as a *cybernetic* one, and even if the relationship between systems theory and cybernetics is still not clearly defined in every way, it seems to be legitimate to classify Luhmann's *Theory of Social Systems* into the field of cybernetics approaches, more precisely as a *socio-cybernetic* one. Beside the concept of autopoiesis by Maturana and Varela there are various systems thinkers and cyberneticists like Wiener, Ashby, Shannon, Bateson, von Foerster who influenced Luhmanns work deeply. Certainly he fits the cybernetic principles into his theory rather idiosyncratically and partly after some significant revisions, but one can argue that Luhmann's *Theorie of Social Systems* is the conclusion of a confrontation of the mayor issues of cybernetic discourse with the European philosophical tradition.

In my paper I would like to discuss the question in what extent we can include – or not ? - Luhmann's work into the cybernetic tradition. In detail my questions are

- Which are the significant connection-points between cybernetics and Luhmann's work?
- What is the relevance of this connection for Luhmanns own theoretical development?
- Which are the congruences and which are the differences?
- To what extent is Luhmann's *Theory of Social Systems* even though his critical distance - integrable into the spectrum of the approaches of »New Cybernetic« (as Geyer & van der Zouwen formulated in 1986)?

After a short discussion on what is characterizing a theory as a cybernetic one, I want to reconstruct Luhmann's critical debate on the most important theoretical problems of cybernetics and finally I want to sketch out Luhmanns answer to this debate, which he gives in his own concepts.

1. Most authors emphasise the aspect of *control* as the most relevant essential which makes a system to a cybernetic system. But vice versa it is the facet of control, which breeds the idea into the foreground to observe the world's objects as *systems* and brings *system's thinking* into the focus of research. Thus, cybernetics is not limited to particular subject areas, but asserts the claim to overcome the separation of arts and science. Cybernetics does not ask »what is a thing, but what does it?« (Ashby 1956). And from a cybernetic point of view control of a system means always its *self-control.* For Luhmann the fascination of cybernetics consists in explaining the problem of constancy and invariance of systems in a highly complex and dynamical world by observing *communication processes.* This makes cybernetics to a definitive non-ontological approach and brings it near to the functionalistic sociology. Regarding this interlacing between systems theory and cybernetics the following characteristical aspects are to point up:

1. The aspect of systems;
2. the aspect of processes;
3. the aspect of interdependency and reciprocity;
4. the aspect of self-reference;
5. the aspect of information;
6. the aspect of control and regulation.

This list of aspects and the discussion how Luhmann is utilising them theoretically will be used as a guideline to evaluate the cybernetic content of Luhmann's *Theory of Social Systems.*

2. For Luhmann the essential of cybernetic thinking is the idea that a system, which has to perform particular functions, orientates its operations to the continuous feedback of its environment and therefore it is durably able to deal with high and unknown complexity. His dispute with cybernetics

runs - more implicitly than explicitly – by discussing critically some cybernetic basic problems. The issues are: First, the cybernetic model of *equilibrium* and its basic assumptions referring the relation between *stability* and *disturbance*; second, the connection between *system* and its *environment* and the relation of *entropy* and *negentropy* within a theory of open systems; third, the *control of complex and dynamic systems*. A forth critique of Luhmann is how cybernetics utilises the problem of *intentionality (Zweckbegriff)*.

3. The critical discussion of this four issues leads Luhmann to a variant understanding what a *cybernetic system* is and motivates him for a reformulation of the classical basic question of cybernetics: If a system is no longer an *object* (in a classical ontological sense) but a *difference* in which the system is observed on the one side and the environment on the other side, how is this difference generated, maintained, reproduced and evolutionarily modified? In my paper I want to discuss Luhmann's answers to this questions by addressing his modification of the following cybernetic concepts: First, the concept of system; second, the concept of self-reference; third, the concept of information; and forth, the concept of control.

As a result of the argumentation can be shown Luhmanns relation to the cybernetics in a twofold sense: First, the connectivity to the cybernetics is high significant for the »Theory of Social Systems«, and second, Luhmann's system theory as a special type of sociological thinking is integrable into the spectrum of the approaches of the »New Cybernetic« (Geyer & van der Zouwen 1986). Especially through the adoption of Maturana's concept of *autopoiesis* - the principle of *circularity* (Luhmann calles it *self-referentiality*) becomes a central role in his theory, and is therefore – following H. von Foerster (1993) - to qualify as a *cybernetic* one. In respect of the concept of system and the system/environment relation Luhmann follows the modern literature on *General Systems-Theory,* especially L. von Bertalanffy (1968). Referring the role of information Luhmann's position is very differentiated. He takes up the argument of N. Wiener and H. von Foerster that information has an important role for building up structure and order. In this respect he argues against Shannon, who focusses the role of entropy. But Luhmann follows Shannon's argumentation, that information is no substance but only an *event of selection.* And – again contrary to Shannon and based on G. Bateson (1972) - Luhmann emphasises that the selection processes which generate information does not occur in the environment of a system but only in its internal world, »as a difference which makes a difference«.

The environment is internal to the system: the environment is a fold of system

Arantzazu Saratxaga Arregi

Abstract: This article attempts to analyze the entitative nature of a closed system. To do that, we will observe the performance and behavior of the system in relation to its environment, and the relationship between them will be examined. Firstly, we will begin with a general description of the behavior of closed systems. Subsequently, the mechanisms inherent to a closed system will be analytically indicated. Then, the internal problems and the paradox of a closed structure are beinghighlighted. Finally, the structural and functional quality of the environment will be defined, from which we can sketch an ontological property of closed systems.

Keywords:closedsystems, environment, auto-organization, regulation, entropy, matter, information.

It is said that an organization or a system is closed, but not a structure. A system or an organization is defined by its behavior, and it isdeterminedbythewayinwhichitsintegralparticlesinteract. A system or organization is not composed of the sum of its parts, but of communication[1]. A system or organization is characterized by its uniqueness as a complete, whole and single entity.
A system or organization is a dynamic structure, and is defined by a specific behavior for social and biological systems and finite automata[2]: self-organization within the boundaries of the system, that is, *subsist* as a social system, *survive* as a biological system, and *persist* as automaton. The boundaries of a system divide the inside of an organization from its environment. Through learning processes and reproduction[3] the organization rearranges itself, and grows ad intra, and can be explored and differentiated as a unit outward toward the environment.
We will see to what extent the closed structure of an organization responds to a purely epistemological necessity, a distinction of the system relative to other systems. There will be indicated the limits of the cognitive tradition of cybernetics, which means a closed system, and a methodological approach of ontological structure of the observed reality will be highlighted. This article seeks to question the performance and autonomy of the systems in relation to their environment.

1. Closed Machines: Description and Behavior

It is said that a system from an organizational point of view, is a closed system. Before proceeding with an analysis of the properties of a closed system, we have to see what the "organizational" character of a system means, and to what extent it is crucial to consider the closed structure.

1Luhmann, Niklas. Soziale Systeme. Grundriß einer allgemeinen Theorie. Frankfurt am Main: Suhrkamp, 1987.
2Von Neumann, John. „Design of Computers, Theory of Automata and Numerical Analysis“ in Collected Works, vol. V. University of Illinois: Pergamon Press.
3 Wiener, Norbert. „Über lernende und selbst reproduzierende Maschinen“ in Kybernetik. Regelung undNachrichtenübertragung im Lebewesen und in der Maschine. Reinbek: Rowohlt, 1968.

An organization is defined by the relationships between system components, which are necessary for the preservation thereof, and for the same specific belonging to a particular class. A system characterizes the behavior of the components of an institution, it determines the membership of a particular class through the interactions of the components of an organization. Now the question is, what kind of relationships are established between components of an organization.

The correlations of the elements of a system are *conditional*, i.e., "as soon as the relation between two entities A and B conditional on C's becomes value or state then a necessary component of organization is present"[4]. This means that when in a system, there are values that do not make the values of other parts of the system, we speak about a system or structure with a mechanical character, since the elements of the system are separated[5]. The correlations of the organization itself are not causal, but conditional. This semantic difference between causality and conditionality has logical and mathematical implications of great importance for defining the organizational systems[6].

Causality describes a relationship between a cause, a reason or a rationale and an effect. Every action refers to an origin or a foundation that has generated some movement. An event A is the cause and foundation of cause B. The causal relationships are the basis of a bivalent and aristotelian logic. *Conditionality* describes instead a relationship that does not refer to a foundation, but the involvement of actors in the realization of an event. From A doesn't necessarily follow B, but A is a factor that determines the behavior resulting from B. A relation condition escapes aristotelian binary logic, and determines relations and structures of a highly complex organization.

The complexity of a system or an organization is neither given by a large number of system components, nor by a high rate of variables, but the range of possible reactions that is able to compute the system. A system consists of a complex organization, when it potentially has available a wide range of affections. Organization theory studies systems, in respect towards their possibilities and potential, because the gist of the idea of conditionality is the idea of generating mainly the space –of the possibilities- within which some subsets of relationships indicate its relevance.. Machines are potentialities of behavior. As Foerster says: "Tell me exactly what a machine can not do, and I'll design the organization of the machine, which can exactly do that it previously could not"[7] .

A wholeness is closed.

An organization is a whole composed of parts. Given a set with an arbitrarily determined behavior, you can see a variety of "parts" built into them. If we previously have differentiated between system and organization, here we distinguish the organization from the structure.

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4 W. Ross Ashby. „Principles of the self-organizing System" in W. Ross Ashby. Principles of the self-organizing System. In Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992, p. 225.

5 "The converse of 'conditional on' is 'not conditional on', so the converse of 'organization' must therefore be, as the mathematical theory shows as clearly, the concept of 'reducibility'". Ebd, p. 256.

6 "The Degree of conditionality can be measured, and analyzed, and apportioned to factors and interactions in a manner exactly parallel to Fischer´s method of the analysis of variance. Requires only the frequencies with which the various combinations of sates occur". Ebd, .p. 256.

7von Förster, Heinz and Broker, Monika. Teil der Welt. Fraktale einer Ethik - oder: Heinz von Försters Tanz mit der Welt. Heidelberg: Carl-Auer Verlag, 2014.

An organization is therefore a fully configured system, a conditional, mutual, reciprocal interaction that exists between the members and internodal components of the system[8]. An organization is therefore a unit that represents a process, and is composed of a network of relationships and productions, where 1) the parties are related by a type of *retroactive coupling* (feedback), 2) they act *recursively* in the same network of productions 3) so that *new orders* are generated within the system, therefore 4) the system is *self-referential* from the point of view of logik, 5) and *self-reflexive*, from the perspective of vie of conscience9. Feedback, recursion, autopoiesis, self-reference and self-reflexivity are the five key characteristics for the description of a system or an organization treated as a closed whole.

Behavior of a closed machine: A sustainable whole

The wholeness of an organization, therefore, has an *epistemological function* to determine a particular order of relations, from which are taken into account ontogenetic variations. It also has a *machinic function*, to ensure stability in relation to the modifications and variations that have occurred in the ontogenetic level, and define the behavior of the system, determined by the organization of its parts. We must keep in mind that when we speak of machine, it is understood as a model of a system that behaves in a manner determined by the principles of recursion and communication, making it a closed and whole-system. Conversely, the whole-system itself incorporates its organization, its sustainability, and behavior[10].

The development of formal language in the field of mathematics and logic and computational language, has, besides the fomalization, syntactic structures, enabled through the propositional calculus, the formalization of the behavior of the combination of systems, that is, the creation of machines[11]. By machines, we understand computer models, consisting of an alphabet, a set of finite states, a transition function, an initial state and a set of finite states, whose function is to perform computations on an entry. The output is a condition of the entry. The term machine was introduced in the theory of finite state systems, so that scientists rather talk of machines than systems.

The mathematician, engineer and early cybernetic scientist John von Neumann built the first high-powered computers. He was the creator of finite state automata machines, which once they had calculated an operation, may move to another state. That is, the systems, now called machines, are capable, due to a formal application, to move from one state to another. The idea and invention of Neumann, the finite automaton, was the criterion of distinction between trivial and non-trivial systems . A trivial system, or a trivial machine, is composed of a state. A *trivial machine* behaves just one way. These machines are redundant and not predictable, marked as a single state, which is repeated in an automatic way. *Not-trivial* machines,

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8Varela, Francisco and Goguen, Joseph A. The Arithmetic of Closure, in Journal of Cybernetics 8 (1978): 291-324, here p. 292.

9Gotthard Günthers, Das Bewusstsein der Maschinen – Eine Metaphysik der Kybernetik, und Metaphysik. Agis, Krefeld, Baden-Baden 1957. 3. Auflage. 2002

10 Varela, Francisco and Goguen, Joseph A. The Arithmetic of Closure, in Journal of Cybernetics 8 (1978): 291-324, here p. 292.

11Mc Culloch y Pitts presentaron un espléndido trabajo acerca del formalismos del sistema nervioso, „A Logical Calculus of Ideas Immanent in Nervous Activity“. The logic calculation of the nerve activity has disciplinaryimplications: 1) possible interaction transcribe neuronal function logic statements, and inversely, 2) it was possible that the functions of logic statements operations were transcribable nervous system activities . If neural functions can be redescribed as a logical calculus structure, then all that can be thought can be performed through a logical calculus. That is, neurophysiological and philosophical concepts shape neuronal structures and simultaneously create artifacts.

however, with very few internal states, can generate an unimaginable and unpredictable number of different machines, which can be constructed with this operation. Although some machines are not trivial, they are unpredictable and indeterminate from the analytical point of view.

The machines are systemic models whose prototype (function) is the feedback mechanism, present in the initial mechanical engineering phase. Later they were replaced by electronic management systems. The innovation of the second-order cybernetic theory is to bring the theoryof behavior towards machinic systems, whether biological or social. The Macy conferences (1946-1953 in der USA), bearing the title „Circular Causal and Feedback Mechanisms in Biological and Social Systems", were aimed to analyze the extent to which formal languages are applicable to social and biological systems. This way, the ontological base of cybernetics was achieved: The fundamental issue is not to control technology, as is typical for the field of electronics, for example, but the fundamental concept of messages, in which it is transmitted via an electrical, mechanical or nervous medium. The messages is a discrete event, in relation to time, or a successive event when it is divided, in which case it is called time series statistics[12]. How is the transmission of messages formalized in a system? Feedback, recursion, autopoiesis, and self-reflection make formalization possible in a message-transmission system.

Feedback

The sciences concerned with managing systems, i.e., systems theory, cybernetics and engineering determine and describe the feedback mechanisms of a system, organization or machine. The effects generated by feedback systems are characterized by the simple behavior of the parts of the system which are in constant interaction and are couplingretroactively. The parties are not configured dialectically, as the bivalent logic, but by a relation of condition and correlation[13].

Norbert Wiener defined the operation of a cybernetic system as a retroactive coupling mechanism, or feedback. The role of feedback regulation of a circle is simply that the information feeds back from an output, to an input. When outputs of a system are „fed back" as inputs, that affects the system und determines its behavior. Thus a closed system is managed, because the machine-like behavior is governed by the same system performance.

At the same time, feedback control is a mechanism that serves to stabilize the system. Through the communication relationships established within the system, the feedback mechanism serves to stabilize the system through repetition and internal control processes that constitute it.

12„Hinsichtlich der Nachrichtentechnik war es J.H. Bigelow und mir schon klargeworden, dass die Probleme der Regeltechnik und der Nachrichtentechnik voneinander untrennbar waren und dass sie nicht um die Elektronik kreisten, sondern um den fundamentaleren Begriff der Nachricht, ob diese nun durch elektrische, mechanische oder nervliche Mittel übertragen wird". Wiener, Norbert. „Über lernende und selbst reproduzierende Maschine" in Kybernetik. Regelung undNachrichtenübertragung im Lebewesen und in der Maschine. Reinbek: Rowohlt, 1968, p. 125.

13Pask, Gordon. „A Proposed Evolutionary Model", in: In Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992.

Recursion

Retroactively coupling systems share a key quality: they are regulated by a mechanism in recursion systems. As mentioned earlier, a system-whole or an organization is a dynamic entity, subject to the category of time. Systems are modified. System components are subject to an ontogenetic evolution, while the system as an entity evolves and remains an *isomorphic* structure. Ontogenetic variations of system retain and maintain the same isomorphic structure, resulting in a kind of second order, called phylogeny. The conservation of the isomorphic structure occurs due to ontogenetic variations that occur in recursive sequence, that is under the condition that each new term in the sequence is defined as a function of previous terms. A recursion relation links each element with its predecessors, in a relation of conditionality.

Self-referentiality

Recursion is the term in the field of computational logic to describe the process through which abstract machines and self-organizing systems are able to regulate their own variations, and maintain the system as such. The recursion relation, symbolized in the symbolic language of mathematics and logical equations, which has the function of ontogenetic variations, refers to the behavior of the system as a unit, finds its parallel in the notion of "self-reference" to the theory of systems. Self-referentiality is a methodological and systematic approach, which serves as an axiomatic basis for describing the behavior of systems. Self-referentiality is not a problem but a a solution that clarifies the operation of the systems. The father of systems theory, Niklas Luhmann, uses the term "self-referentiality" to express that the conservation and stabilization of a system is due to its own operation. As for the computational language, recursion can integrate ontogenetic variations, determined by the time of the maintenance and upkeep of the system, as does the term "self-referentiality" to systems theory. Change happens, but in reference to itself, within its limits. This is how it preservesits isomorphic relationship and is understood as a whole. Through the self-consistent system of gain and identity, as they separate from their environment, they refer to themselves.

Self-reflexivity

The term self-reflexivity is a notion to indicate the self-referential and logically recursive system capacity in the field of science of consciousness, or modern philosophy. Reflection as a philosophical term arises when the loss of immediacy of knowledge is evident. Following Kant's Critique of Pure Reason, it must be stressed that the problem of reflection in German idealism was analyzed as an activity of the " absolute I", that constitutes an outer, non-physical self, a thoughtless material. It is mainly Hegel, who breaks this duality, this valued logic, where he puts the reflective non-reflective self. With Hegel we already have three elements: the I, the thought, and the thinking. That is, there may be a thinking not necessarily attributable to me. Günther Gotthard, finally, invests this trivalence logic in a multivalued logic, where reflective capacity, and therefore knowledge is not absolutely exclusive to the I. The machines, information managers, manage knowledge, too.

Autonomy / autopoiesis

The conservation of isomorphic structure into the ontogenetic variations generates a phylogenetic chain due to a self-organizing behavior of the system elements through a recursive, self-referential, self-reflective logic. The elements of the system vary, change, and the system persistsand stabilizes. A system, a recursion, self-referential with its elements, has

the ability to self-regulate and self-command in its entirety. If a system has a regulatory mechanism (feedback), consisting of complex and non-trivial structures, it is said that the system is autonomous. The biologists Humberto and Francisco Varela Maturana defined as living self-organized systems, ongoing processes containing recursive[14] interaction systems. This characteristic of self-organization of a living system, or ontological entity, defines a closed system. An autopoietic organization is characterized by a closed organization of its constituent processes.

Feedback, autonomy, recursion, self-reference, self-reflexivity, are the five basic concepts that define the structure of an operationally closed system. It is generated through a logic of recursion, a capacity for self-organization and a retroactive coupling mechanism. The function of an operationally closed system is to ensure the stability and maintenance of a system, within morphological limits[15]. We will see to what extent the structure of a closed system responds to an epistemological criterion to differentiate a totality of another, i.e. morphological criterion, or if its *possible* function consist in making possible new orders, a new class within the system. That is, we will see to what extent the ontological nature of the closed structures follows a morphological principle, or rather is the potentiator of new orders.

2. Closed organizational structures: circular coupling. Regulation and self-organizing function.

Having defined the closed structure of an organization or an expert system as a unit[16], or a non-trivial machine capable of generating ever new states, we will explain briefly what is the function of a closed system. A system or machine as a closed structure represents a homeostatic state, whose function is to produce and circulate such organization to maintain it. The circularity of an organization makes a closed structure, i.e., the system operations performed through the processes of autopoiesis always passed in: the output always becomes recursive on the input. Thus an operational closure of the system is achieved. As Foerster said at the MACY conference, here is born a new philosophical idea: *circular causality:* "The fascination of these ideas, on which they are based, is the idea of the circular causality. This translation is crucial in Western thought. It is a decisive step further to gain new knowledge that the ancient classic philosophers did not have[17]". Circular causality is no rectilinear line. For transcribing a circular causality, a new dimensionality is essential. The circular movement is described via non-trivial coupling machines and therefore a closed organizational structure, the function describing the stability of a steady state, through internal control processes. closed nature of a system, a machine has the function of ensuring the stability of the system, through internal control processes and external differentiation.

14 "When considering autonomous systems, and because of the closure thesis, we have seen that their organization contains 'blootsapping' processes that exhibit indefinite recursion of their component elements" vgl. Varela(1979 und 1981)

15Varela, Francisco and Goguen, Joseph A. „The Arithmetic of Closure", in Journal of Cybernetics, 8 (1978): 291-324.

16„A system is a unity of its organization and structure. The organization of a system identifies it only as a distinguishable unity—independently of the concrete attributes of its components". Zeleny, Milan. Autopoiesis, Dissipative Structure and Spontaneous Social Orders. Westview Press, 1980, p. 34

17Von Förster, Heinz and Broker, Monika. Teil der Welt. Fraktale einer Ethik - oder: Heinz von Försters Tanz mit der Welt. Heidelberg: Carl-Auer Verlag, 2014, p. 164.

Self-organization & Operational Closure

Basing on the cybernetics thesis, all self-regulating systems, whether social, biological, or automaton, treated as a whole as a closed system, we will define the closed[18] structure of the system in relation to its ability to self-order. Self-organization is a concept which applies not only to the field of biology, but also to social structures and machinal systems and helps to elucidate many problems closely connected with artificial intelligence, mechanization of thought, intelligence, cell organization, evolution, growth, intelligence amplification, etc.

A self-organizing system that changes unorganized to organized, or a bad organization to a good organization, it also called a sustainability and balance system. The autonomy of a self-organizing system is closed and the question arises of how a system can generate its own order. A system developes the properties of self-organization when it changes automatically by a circular coupling mechanism or feedback. In fact, according to Ashby, no machine or system changes from a bad to a good organization, but creates its own structures within the system, which stabilizes and balances the system.

Self-organization is a characteristic property of any system of sending signals, but a new feature that was introduced after the second wave of technical posts is the development of electrical communication, and the development in new electronics[19]. Self-organization, as we have said, only exists in systems governed by a circular coupling mechanism where the input is a derivation of output.

Ashby with great discretion describes the field of self-organizing systems:"We start with the set S of states, and assume that f changes, to g say. So we really have a variable, x(t) say, a function of the time that had at first the value f and later the value g. This change, as we have just seen, cannot be ascribed to any cause in the set S; so it must have come from some outside agent, acting on the system S as input. If the system ist o be some sense „self organizing", the „self" must be enlarged to include this variable x, and to keep the whole bounded, the cause of x's change must be in S (or x). Then the part S can be „self organizing" within the whole S + x."[20]

That is, a system has a small number of key variables that serve to keep it functioning in a wide range of environmental conditions. If environmental conditions change, then the range in which the system adds functions each day moves safely, and therefore the machine, the system, is activated towards a "higher level", an "order", or superior„class", in order to randomly restore the lower connections of the internal organization.

All dynamic systems generate their own form of intelligent life, so in this sense they are all self-organizing systems. They generate their own structures in terms of their relationship with the environment. We can see the truth of the statement that every set isolated dynamic system obeying unchanging laws develops a "body" to suit their "environment" in the form of adaptation, or as evolution[21].

18Pias, Claus. Zeit der Kybernetik. Eine Einstimmung. In Cybernetics/Kybernetik. The Macy Conferences 1946-1953. Volume II. Essays and Documents. Edited by Claus Pias. Zürich-Berlin: Diaphanes, 2004.

19Von Foerster, Heinz. „Foreword", in Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992, p. V.

20Ashby in ibid., p, 269.

21W. Ross Ashby. Principles of the Self-organizing System. In Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992, p. 272.

If we mean by autonomy the normative performance criterion of a - social, biological, artificial - closed system, i.e. the creation of structures and orders of the organization within a closed operating system, it can be analyzed to what extent the average environment, or the environment is an external system. We have already discussed what the function of a closed system is: balance, i.e. the morphological structure of difference, while generating new orders ad intra. We will see now, what is the ontological nature, determined by the ratio of the system with its environment. We elucidate the semantic paradox of whether a closed structure involves or implies more than just itself. Naturally we enter a difficult and critical terrain with systems theory, since a system is somewhat distinguishable from its environment, and the environment in turn configures the outside of the system.. We will then see if there is anything called an external environment, or if the environment outside a configured system.

4. Interaction with the environment.

Environment and Autonomy

A complex organizational system, or a non-trivial machine consists of three elements: 1) an environment where it lives, it exist, in which then the system acquires entity, 2) a mechanism which receives inputs from the environment and affects the environment by means of outputs, or feedback. This mechanism produces a large number of functions. 3) Control: measures some or all inputs and outputs of the device and has the means to alter the mechanism. The control is a predictor, i.e. it carries out a search operation in which the search for a desired function is guided by information derived from functions already made or tried. That is, all cybernetic systems operate in an environment, or the entire system has a cyber environment. There are systems that rely more on the outside, and there are systems whose operation does not need the outside and is based on a logic of prediction. As von Neumann tells us, multiple designs within the automata can be distinguished into two groups: a) there are those who are able to make decisions. They do so on the basis of accumulating evidence on the activities of other robots, and possibly on the conditions of their surroundings and distinct changes generated by the activities of their peers. And there are those who b) face unpredictable situations without prior knowledge or cannot learn. These systems are already closed because they depend on the mass of information that is given from *outside*[22].

With this small example, we can imagine that the self-organization of the system has a symmetrical relation to the operationally closed structure, i.e., the more a system learns, the more a system self-reproduces, the more robust will be the structure of closed operationality. Every dynamic system generates its own intelligent life, is self-organizing, by this logic. But this statement is always understood that intelligence is a quality of playing and learning; namely survival and therefore adaptation to the environment.

Now we will see what kind of relationship a closed structure has in relation to the environment.

A closed system is about its internal organization, in reference to its mechanical behavior, according to communicational state news delivery, the system state itself. A closed system is a system with a given semantics. Even if an autopoietic organization is characterized by the

22 Pask, Gordon. „A Proposed Evolutionary Model“, in: In Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992, p. 234-236.

closed structure of its constituent processes[23], it is manifested in a given environment. Because in addition to being informational, the system is located, and must satisfy the principle of legality thermodynamics. The systems are in permanent material and energy exchange with their environment.

As shown, the entire system exists in space / time. Time determines the reproductive capacity of the system, i.e., its ability to generate orders, classes, and creates a recursive relationship with the system, and space determines the place of the hyperclase, from which an isomorphic relationship is established with ist alterity. The systems are not, in cybernetic science, independent of the transcendental categories of space / time. The fundamental issue in this case, to determine an ontology of enclosed spaces, is to see the interconnection between the two transcendental categories of a system: time = organization; space = environment.

5. Operational Closure: Closed for information, open for energy

Diametrically opposite states

We have already said that the environment is a prerequisite for the existence of a system; without an environment no system condition[24]. Now, we have to see what kind of relationship exists between the system and its environment, for systems whose operational structure is closed.

Moreover, we have also mentioned that the notion of space and time, the two basic transcendental categories of the philosophy of consciousness, are in cybernetic science two principles with a diametrically opposite relationship. The system was self-organized and transformed through information unities. Its character is principally semiotic mass of information and symbolized according to their predictive character, which will determine their evolving capacity, i.e., learning and reproduction. Self-organization of a system is possible only if two or more variables share the same isomorphic affiliation.

The mass of particles corresponding to the nodal information system is a measure of order, that depends on algebraic mathematics, a measure of disorder. This measure of disorder is in physical reality, and is called, according to the second law of thermodynamics, entropy. Physical matter has its laws and is governed according to the second law of thermodynamics, for the time axis at a constant de-differentiation, and disintegration of the systems. The end of the universe is predicted to be a sufficiently de-differentiated unit, in which everything is the same temperature, and the potential is exhausted. This law is in the eyes of the cognitive science of information, which is about generating orders, a law that determines a gradual chaos and disorder, as a condition of possibility of a system, called the surroundings.

The greater the disorder in the environment, the greater the chance you have information to generate orders, and to self-organize, therefore the greater the capacity for self-organization of a system. We do not want to establish a causal link between the state of physical and informational, but condition organization. If some processes that contribute to the decrease in entropy of the system are irreversible, then we find a universe with a higher level of entropy,

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23Varela, Francisco and A. Goguen, Joseph. „The Arithmetic of Closure“, in Journal of Cybernetics, 8(1978): 291-324.

24Stafford Beer, „Towards the Cybernetic Factory“, in Principles of Self-Organizing, edit. Heinz von Foerster and George W. Zopf, Jr. Oxford, London, New York: Pergamon, 1992, p. 25.

before our system started to organize itself, therefore, the state of the universe will be more disorganized than before. An increase in entropy in the universe, disorganization, and a decrease in entropy in the organizational system can be defined as organization. The corresponding relationship between the two levels of organization is diametrically opposed: Assuming that the package contains properties of self-organization system, this system becomes not only a disorganized system, but a self-disorganized system. The entropy of the envelope of a system grows, time flows, the system itself is disorganized, although in certain regions, it appears to be self-organizing, parts of our own system.

Conclusion: Envelopes grow inside of a system: From the ontology of envelope to a introscendent cybernetic philosophy

An envelope matches the peripheral part of the system, separating the system from its surroundings. When the entropy within the system increases, envelopes are generated, so that the system self-organizes. A self-organized system is in close contact with the environment. It has properties of order and energy, information and matter, in perpetual interaction, to form life at the expense of the environment.

An exceptional case illustration of functioning homeostatic processes of living systems are the membranes. The components of the membrane forms may be produced continuously. The resulting structure is characterized by membrane limits which identifies the system as a separate component in the space unit. The changes in the middle of the substrate generally create disturbances which cause structural changes, because the organization of the autopoietic cell is invariant. Instead of achieving a constant dynamic model, structural changes have interactural cellular components to the medium or substrate, so that the same organization autopietic preservation is maintained. Therefore, the average of an autopoietic organization consists of a medium or substrate, a catalyst capable of producing high-order components, which are able to build their own envelope.

The stability of a system grows when the growth is driven by differentiation, by internal forces of the system due to random variations. That is, the peripheral effect tends to self-organize the system, depending on the time axis. Self-organization of a system is always given in the dimension of time, because systems are always subject to the law of the transformations and variations, or submission in time.

This explains that due to the peripheral structure of closed systems, the organization is able to self-regulate and self-organaize, contact with the outside. Then we arrive at the problem, that closed systems serve only as an epistemological criterion for defining an organization as a whole, as determination of a new superior order or class towards an outside.

An operational closed system that is cognitively determined by structurally envelopes and systematic boundaries is a result of an ad intra organizational process, a process that takes place inside the system, and whose environment is an unfolding consequence of the event of time.

Self-assesment: Between determination & indetermination

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Abstract

Purpose - Establish a framework for the design of a self-assessment model university. The design is based on philosophical and systemic studies that underlie the phenomenon of self-evaluation and information systems to ensure their operations for such purposes.

Methodology - Philosophical theories of Derrida (1997), Vasco (2013), Restrepo (2013), on the University, systemic studies of Foerster (2002), Beer (1977), Simon (2006) on organizational systems and state of art on the phenomenon of self-assessment, creates a framework for designing a self-assessment model University.

Results - Allows designers of information systems in universities understand the phenomenon of self-evaluation to design or diagnose systemic information systems for the University

Practical implications - The framework guides the design of a Model of Self Assessment through the application of concepts, models, and philosophical and systemic theories.

Originality - This paper attempts to fill the gap of understanding the phenomenonof self-evaluation. The framework presents a methodological reformulation with different concepts, components and methodologies correlated to the overall design of a Viable System Model of self-assessment information to the university.

Keywords - University, Self Assessment, Philosophy, Metaphysics, Systemic, Information, Information Systems.

1. Introduction

The environment in which the University is dynamic, and complex. In Colombia you can see this, from the events of the last four years; last August 4, 2014 the Consejo Nacional de Educación Superior -CESU- submitted to the government and the country's proposal for Higher Education Policy, contained in Acuerdo por lo Superior 2034 (MEN, 2014), which is a response from the government because of retirement and no approval of the Ley 30 de 1992 in 2011.

National and international policy debates on telos to the University, to implement its activities, operations, and research studies are mainly framed by debates on research should be done at the university to focus its efforts and resources. Debates about the causes of the University, for their destination. The University lives in constant conflict of interests and powers[1], leaving her in a difficult

[1] The philosopher C. Restrepo (2013) argues in his studies the relationship between university Biopolitics where the University of the Middle Ages is shown as a function of power and the Papacy and the government. The University has the power of the office of knowledge, therefore it is considered that knowledge has a direct relation to power and that can challenge the other branches (p. 2).

position and in a chaotic space, coerced into self-regulation capacity, otherwise its essential function disappears, becoming a functional means of external agents to this, determined for specific purposes.

The need for a systemic study to explain the phenomenon of self assessment, arises from the need for these public institutions to design a model which as a guide of the system to be regular, that is, to design a model of the University that should be regulated. This design model must arise from the internal environment, as stated by Beer "Without a model system that has been regular you can not use a controller. That's the key point "(Beer, 1977, p. 53). Decisions governing a university are based on the existing model of it, so the quality of the internal decisions is limited to the quality of their models (Pérez, 2010, p. 1529).

Some metaphysical and systemic investigations have interests in the study of teleology (Foerster, 2002) (Simon, 2007) (Derrida, 1997) (Heidegger, 1977) (Restrepo, 2013). The designs of information systems in organizations are based on the implicit and explicit concepts and philosophical assumptions about the nature of these and human organizations. "These dubious assumptions play central role in guiding the information systems development (ISD) process. Dramatically They Also Affect the system itself" (Hirschheim & Klein, 1989, p. 1199), for this reason, it draws on the philosophical study of the university, such as systemic study on organizational systems to understand the phenomenon of self-evaluation.

2. State of the phenomenon of university self -assessment

The phenomenon of self-assessment in universities is a process which aims to render reason over the factors, characteristics and indicators that a university should have a reason arising under a particular interpretation of language on what exists, an interpretation of the mission-. These factors, characteristics and indicators are determined by a conception of truth as established by a paradigm of an era[2].

In Colombia, the phenomenon of self-evaluation to universities aims to ensure the quality of the institution. The phenomenon of quality is determined by the interpretation of the Accreditation of High Quality Education. The model of quality assurance is run by the National Council for Accreditation -CNA-, coordinated executed by the Ministerio de Educación Nacional –MEN-, and developed by the Consejo Nacional de Educación Superior -CESU-. “La acreditación es el acto por el cual el Estado adopta y hace público el reconocimiento que los pares académicos hacen de la comprobación que efectúa una institución sobre la calidad de sus programas académicos, su organización y funcionamiento y el cumplimiento de su función social" (MEN, 1994, p. 1).

The accreditation model, created by the CESU, is aligned with the values and the concept of truth given by UNESCO (MEN, 2014), established by the paradigm of Education for Sustainable Development -EDS- (Unesco, 2013) (UNESCO, nd) and the assurance and quality assessment[3] (Martin & Stella, 2007). The quality assessment is defined as a process of external evaluation on university[4]. Current practices on

[2] Heidegger (1996) in their work The age of the world picture, develops studies on metaphysics and states that "In metaphysics is performed meditation on the essence of beings as well as a decision on the essence of truth".

[3] Martin & Stella (2007, p 35): "Internal quality assurance Refers to Policies and Mechanisms Implemented in an institution or Programme to Ensure That it is fulfilling Its Own ministering purposes and meeting the standards apply to higher education That in General or to the profession or discipline in particular "

[4] Quality Highlights evaluated by Unesco: 1 The context; 2 methods (self-evaluation to assess academic peers); 3 levels (system, institution, department); 4. mechanisms (policies, structures, cultures); 4 quality settings such as: academic values, management values, values of employment (Martin & Stella, 2007, p 35.).

tools, values, principles and models for self-assessment, are designed from the outside environment. That is, the external entity measures the deviations that the institution performs compared to the values seen from the outside.

The latest Internal Model for Quality Assurance in Higher Education, is being promoted as 40 years. Models like ISO, created in 1947, Deming, established in 1951; Baldridge created in 1985; EFQM, created in 1988, are currently in execution for such purpose (MEN, 2014). They are guided through organizations such as United Nations, UNICEF, UNESCO, World Bank, IDB, OEA, etc. The discourse around quality born in Colombia in 1975 in the government of Alfonso López Michelsen (Vasco, 2013). Discussions are related to the same concern for the quality of industrial products, which was imposed by the World Bank, "como si se pudiera trasladar la gerencia de una empresa productora de mercancía a la gestión escolar de una institución educativa" (Vasco, 2013).

The state of art realizes the urgency and need for universities in various countries such as Colombia (MEN, 2014), Chile (Brunner, 2011), Brazil (Almeida & Guimaraes, 2013), Cuba (Borroto & Salas, 2000), Malaysia (Mohd, et al 2011), Vietnam (Thanh, 2010), Taiwan (Yung-Chi, 2010), Hungary (De Witte, 2013), making processes of national and international accreditation under the paradigm of ESD, with order to member of systems that guarantee financial support of reason to account data and information, and satisfy their guidelines and instruments for the University. The external environment determines the telos of the University, and organizes its operations, elements, information, human resources, and other technologies, to adapt and report to these accreditation agencies, otherwise, the results directly affect the financial support.

3. Decision: The essence of truth University

The ultimate purpose of the university is the quality accreditation, this telos, created by a principle of reason given by the external environment, organizes the operations of the university system through the self-assessment model.

In engineering and design, the main interest is in how things should be to achieve the goals and make things work. For this research, the main concern is how should be the model of the University Self Assessment. At this point it is essential for the designer to analyze, understand and interpret the philosophical assumptions that underlie the phenomenon of the self, not as a definition provided by an institution or referee, but as a metaphysical[5] meditation as the decision by the essence of systems the truth, the essence of university self-assessment. To do this it is necessary to first understand the issue for the sake of the university, its reason for being.

Derrida (1997) raises questions about the ultimate cause of the university, based on the socio-economic and political debates in which it is immersed. Beyond the socio-economic and political conditions in which every university is found, the debate is about whether universities must conduct completed investigations or fundamental research, and from this decision, the decision of the telos of the University, are produced configurations operating in a certain way to achieve the purpose, ie, the decision for the final cause of the university generates its teleology[6]. "en la causa final el comportamiento se orienta hacia una meta, hacia un estado futuro de las cosas " (Foerster, 2002, p. 24). Is the telos of the university is determined? or does the ultimate cause is undetermined university?

[5] The studies and interpretations of metaphysics used in this research are made from Heidegger (1977) and Derrida (1997)

[6] Teleology is “aquella operación que se realiza según la causa final: mientras que la causa eficiente se orienta en concordancia con un estado actual de las cosas” (Foerster, 2002, p. 24).

Why these are the issues discussed in the internal and external environment of the university? Given the complexity in which the essence of University is involved it is impossible not to assume the regulation of relations to be preserved, without destroying the system -university- in the regulatory process, the university is also a political dimension, outside academic dimension, which has been characterized since its inception.

The focus of most important argument in the debate between the types of research, is the professionalization of the university, i.e. decide whether the essence of the university consists of competency assurance for professionalization, overlooking useful research and applied for industrial, commercial, military and government sector; or ensuring fundamental knowledge, which generate and develop critical thinking skills and, creation, invention, observation, analysis and interpretation students, with a view to creating new theories and ways of interpreting the world life and understand problems of being, of language, of thinking, of society, among others, without thinking about the utilitarian purposes required by the external environment institutions.

When a decision for the cause about University is takes, its settings and operations in pursuit of realizing its purposes are generated. However, this opposition of the final cause of the university has a real relevance, but limited, says Derrida (1997). When deciding definitively on the final cause of the university, on the basis of the principle of reason University, "cualquiera que sea su aparato conceptual, su axiomática, su metodología […] jamás tocan a lo que en ellas sigue basándose en el principio de razón y, por consiguiente, en el fundamento esencial de la universidad moderna"(Derrida, 1997).

So what is the ultimate cause of the university? Apparently, if we decided definitively by a type of research which characterizes the essence of the university, he goes into the abyss, a throat, says Derrida (1997). The gap is between what is within the University (internal environment) and what is outside of the University (external environment). The research completed has no limits, this can be seen in several areas:

> […] una disciplina como la ingeniería genética no sólo ha provocado nuevos caminos para enfrentar patologías y para mejorar las condiciones de la existencia humana, sino que le propone al hombre retos muy singulares en términos de los modelos teóricos con que habrá que enfrentar la comprensión de lo biológico y la vida como fenómeno para analizar 'científicamente' […] En la medida en que la tecnología compromete todo el ser del hombre, al igual que la ciencia, se vuelve un aspecto que tiene que ser tematizado por la filosofía, obviamente, desde el conjunto de conocimientos que provoque [gnoseología, epistemología, cosmología], pero también desde los efectos que tenga [la ciencia y la tecnología] en la concepción del ser [ética, moral, metafísica] y de su comportamiento [moral, antropología] (Vargas, 2007)

Information and Telecommunications is the land where it is evident that the research completed has no limits, “todo opera dentro de ella ‘con vistas’ a adquirir una seguridad técnica e instrumental” (Derrida, 1997).

To avoid falling into the abyss that live under the university, including its internal environment and its external environment, the abyss to give the reason why the University, the concept of information is presented as the essential principle of reason operator. Information:

> Integra lo fundamental a lo finalizado, lo racional puro a lo técnico, dando así testimonio de esa co-pertinencia inicial de la metafísica y de la técnica […] Bajo la forma de la información […], dice Heidegger, el principio de razón domina toda nuestra

> representación (Vorstellen) y determina una época para la cual todo depende de la entrega de la energía atómica (Derrida, 1997).

Determine a specific telos to the University, with no chance of questioning, a dogma on a conception of truth, unquestionable, as professionalization or humanization as the essence of the university and hierarchical values on metaphysical and technical, is to fall into the abyss. It is not possible to distinguish the technology on the one hand, and other scientific and rational. "La palabra tecno-ciencia debe imponerse […] es imposible, por ejemplo, distinguir entre programas que se desearía considerar 'nobles' o, incluso, técnicamente provechosos para la humanidad y otros programas que se considerarían destructores" (Derrida, 1997).

The fundamental character of the concept of information as the essence of the principle of reason, is to dominate the particular representation of the interpretation of the present University. So, how the concept operates information in a university Self Assessment model?

4. University as an organizational system

Talk about a Self Assessment model for a university system in terms of its purpose, is to ask why exists is ?, Self Assessment model also ask why the University exists? That is, the questions of engineering and design are questions about the telos of the system in order to set up a model system operations as it should be, and achieve their goals, adapting to the external environment and learning in their internal environment . Simon (2006) argues that a model "en términos de organización y funcionamiento –de su interfaz entre el ambiente interno y externo- es un objetivo fundamental de las actividades de invención y de diseño" (p. 11) Now, the first step there is a system design, is to discover the internal system that is capable of operating with the external environment complexity[7].

Cybernetic, and artificial systemic studies (Beer, 1977) (Foerster, 2002) (Simon, 2006) on the design of adaptive systems and organizational systems aim to regulate behavior of a real system, from the design of a model to conduct its purpose. However, the behavior of the adaptive systems depends on the complexity of the external environment in which it is located, but not the internal environment (Simon, 2006, p. 63). That is, there is a correlation in the behavior of the system, determined by the complexity of the external environment. The complexity of the adaptation of a system lies in the external environment "limiting their ability to discover by understanding and calculating the adaptive behavior" (Simon, 2006, p. 9). The increasing complexity is handled reconstructing language:

> reconstruir el lenguaje, pues el hombre es prisionero de su propia forma de pensar, de sus propios estereotipos [representaciones]; una forma de manejar la complejidad creciente del comunicado mundo contemporáneo, es replanteando el mismo concepto de organización. Esto implica, deshacer viejos e inútiles significados e hipótesis que generen prácticas arraigadas y avanzar en la construcción de nuevas interpretaciones que sustenten prácticas de trabajo y de organización más armónicas y eficaces (Beer, 1977).

The relationship with international organizations such as Unesco, with ability to finance institutions through accreditation systems of high quality, create value interpretation and indicators. The university graduates is determined to occur under certain forms conceived under any particular representation of

[7] Simon (2006) finds that this transaction is in the procedural rationalityin charge to discovering knowledge, information and technical security calculations ensuring an appropriate adaptive behavior in the present.

the man[8], determined by external organizations to it, generating alienation dogma[9]. Is the essence of the university is based only on professional recognition or is the essence of fundamental science? This type of organizations with a determination, eg university to professionalize, or in general terms: a given system is called trivial system (Foerster, 2002), characterized in that its behavior can be predicted easily and accurately.

The trivial systems have a hierarchical organizational structure, which refers to what determines the hierarchy etymology: the sacred rules: "el bien supremo envía los mandamientos por todo el sistema hasta los soldados de infantería, que están en la parte inferior de esa jerarquía" (Foerster, 2002, p. 52). Thus, it is created and set everything related to self-evaluation in Colombia and much of the world. The Top-down[10] methods are methods of collecting information for hierarchical organizations. Top-down has failed to collect information, creating great instability in the system and few methods of learning to adapt. This increases the probability that the spaces of democratic and participatory development are closed, creating social problems.

The question of the ultimate cause of the University is an unspeakable question. This is "one in which there is no way to decide who is right and who is wrong" (Foerster, 2002, p. 16). At this time the responsibility for freedom of choice, responsibility of every human being to decide and choose responsibly by the essence of truth is marked.

Heterarchy. organizational Structure

It requires, then, that the model of Self Assessment born from a design university system, ensures not only the achievement of the values and indicators defined by official bodies such as CNA, but also requires that originates a model for building , identification and collection of indicators and information generated from the internal environment in a participatory manner, emancipatory and avoiding the problems that brings the hierarchical structure. To do this, systemic proposes an alternative through a heterarchy organization, understood as the government of neighbors (Foerster, 2002)

It will shift to discuss the stability and viability of a system, rather than talk about quality of an organization,. Non-trivial (. Foerster, 2002, pp 37-38), or indeterminate systems, are characterized by having a heterarchical organization, because they operate in a circular operation logic: "se mete algo y sale otra cosa que, a su vez, puede volverse a introducir [...] se llama cierre circular" (Foerster, 2002, pp. 37-38). Nontrivial systems have predictable behavior, nor is it possible to analyze their behavior. However, it is possible to converge a nontrivial system with a stable behavior and to produce a not trivial operation recursive system[11]. This can be achieved by gating on the operating system[12]. The

[8] Representation of man, is a concept from the studios of Runge & Muñoz (2005, p 78.).): "(…) antropológico es, por un lado, el modo de observación histórico-espiritual [...] que permite elaborar una imagen del hombre –de la que por regla nos es consciente- en un gran poeta, pensador y también educador del pasado y que, a partir de ella, como punto central determinante, se vuelve comprensible la unidad interna de todas las orientaciones particulares. Quizá sería mejor renunciar acá a la pretenciosa palabra de antropológico y hablemos sencillamente de imágenes del hombre"

[9] Here is a point of convergence, with the pedagogical anthropology studies which state that "la reflexión pedagógica podría girar en torno a la pregunta por unos tipos de formación y de educación no afirmativos, por ideas internas y externas de subjetivación que apuesten por concepciones humanas no dogmáticas ni normativas. El ser humano sería el fruto de sus aperturas al mundo" (Runge & Muñoz, 2010, p. 116).

[10] This method essentially means that the guidelines, rules, instruments, decisions and communications are performed in the organization in a sense-in a top-down hierarchical organization, and does not flow from the bottom up. Research by Fraser et al., In 2005, indicate that this top-down approach creates problems by not involving local communities, reinforcing the prejudices of external bodies, fostering a relationship of dominance over the systems and organizations.

[11] A recursive operation: "valor asociado con la operación del operador, y éste está asociado a un valor eigen estable" (Foerster, 2002, p. 40).

restriction is achieved through the principle of redundancy of potential command[13], this provides that information is what constitutes authority (Foerster, 2002, p. 57). In heterarchical organizations information always returns to its origin, as the recursive operation of non-trivial systems.

The operation is directly related to the interpretation given to the language, that is, with what information is considered[14].

5. Information

Studies on the cause of Universidadm to understand its essence and information organization revealed that the concept is essential to overcome opposition operator, barriers and chasms that arise in certain conceptions of truth and unquestionable principle underlying the of reason, facts that directly impact the academic, political and economic decisions on the type of research that a university must perform and therefore in its operations to meet its objectives. It is also evident that information is the only constituting authority in organizational structures, setting forms of learning about language and interpretation of what exists and the interpretation of the concept of truth.

So what is information? According to Derrida, the concept of information depends on the principle of reason-of a certain conception of truth as a principle of total calculability. Information can ensure the safety of the art, and can also ensure the security technique. That is, with the information I can ensure the efficient cause[15] (calculating safety, quality), and the information I can also assure the final cause (the calculation of safety). The information ensures present and future. For the final cause requires a behavior, the efficient cause requires a state of the behavior.

The information is a process that everyone takes, is not given naturally, not discovered, must be invented, as the information is in the interpretation of a language is not an object (Derrida, 1997). The information is not a product, it is not packaged. Thus we have "is one who creates the information in the reading process, absorb what is in these scribbles are the letters written on a sheet of paper. The library does not. You can say metaphorically that there is no information in the sense that you can get there, store it in the brain and create"(Foerster, 2002, p. 74).

Thus it is understood that the self-assessment model should arise from the internal system environment, because information must invent and create from within, guaranteed a configured to adapt the behavior of the system memory, making learning processes to master complexity external environment. Now, one must ask how invent the model and information system that ensures perform in University double gesture posed by Derrida? 1 Ensuring the professional competence and the most serious tradition of the university. 2 Discover humanism and universality, eliminating dogmas and concepts of truth grounded in an era.

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[12] The closed system is an automaton, is static, is determined to perform specific functions, it is predictable, analyzable and its behavior is given by the configuration and internal programming of its elements and actions. An open system bounded -system is nontrivial recursive-man, who despite that we know are born, grow, create projects, and transforms the external environment becomes likewise, can not predict what will be the way how it is, or how it has historically been the best way that will guarantee the end, it is not possible to predict, it is only possible to know where you want to reach, you may know what your mission and create a stable performance to carry it out, for it must knowing yourself.

[13] "La redundancia del comando potencial significa que el mando está diseminado por todo el sistema, todos son comandantes en potencia" (Foerster, 2002, p. 57). An example of heterarchical organizations is the United States naval fleet in the Battle of Midway, where any ship could take over because of the availability of information.

[14] "Bajo la forma de la información, dice Heidegger, el principio de razón domina toda nuestra representación (Vorstellen) y determina una época para la cual todo depende de la entrega de la energía atómica" (Derrida, 1997)

[15] The efficient cause is related to a current state of things. (Foerster, 2002, p. 24)

6. Conclusion: Systemic Information System

Responsibility for the University to be in a community of thought (Derrida, 1997), which has the function not help create boundaries in University completion between research and basic research. This community considers insecure border investigations. It is called community of thought to avoid any value that is subject to the authority, as research science, philosophy. The aim of this community is to question the essence of reason, and to think, how to improve their functioning to carry out its mission, that is, thinking and re-thinking their present and future. The community must discover the ""“trayectos por medio de los cuales, una investigación aparentemente desinteresada puede ser indirectamente reapropiada, empleada de nuevo por programas de todo tipo” (Derrida, 1997) It is the need to define a new training will prepare new analyzes to assess the goals and choice, when it is possible, among them.

Investigations Hirschheim & Klein (1989) (1994) on the paradigms of information systems design, realize the four main approaches to the design, which are founded on the concepts of truth in certain systems. This research diagnoses that the quality system for quality accreditation are under the paradigm of Technical Knowledge -TKI- Interest that have been created under a hierarchical organization of the university system, based on efficient causes, ie, in a state ideal things, focusing on optimization. However, because of the university, is not seeking to optimize their operations to achieve an end, as if in search of stability and viability of the system. "Simulated experimental data on market show that the market equilibrium, the only property of the markets for which has strong empirical evidence, can be achieved without the need to assert that markets produce Pareto optimal" (Simon, 2006, p. 38).

However, the new responsibility of thinking must have a reserve movement and rejection regarding the professionalization of the university and putting it in the system depending on the industry and market. To do so requires making a turn from hierarchical to heterarchical organizations. As this organization ensures the viability and stability of the system, through communication settings that allow participation interests and emancipation of the actors, in addition to technical interests -TKI- to invent and information model that accounts of this behavior and future of the University.

This thought runs the risk of being taken in by socio-political forces that may have interests in any of the situations.

> Un ‘pensamiento’ semejante no puede, en efecto, producirse fuera de ciertas condiciones históricas, técnico-económicas, político-institucionales y lingüísticas […] No digo que este ‘pensamiento’ se identifique con dicha política y que, por consiguiente, haya que abstenerse de él. Digo que puede, en ciertas circunstancias, estar a su servicio. Y todo radica entonces en el análisis de estas condiciones (Derrida, 1997).

The self-assessment model is developed from a systemic approach, to ensure that the learning model of first and second order, that is, learning about the rationale for the system that is made, and thus promote understanding the reality of it, its objectives, its purpose, ensuring technical efficiency for critical operations through Organizational Cybernetics, which guarantees a heterarchical organization to communicate information in the system, between the man-machine relationship. While the second-order learning: focuses on the hermeneutical and emancipatory studies where certain conceptions of the ultimate cause of university in order not to drop into the abyss of determination, which guarantees the correlation between the traded fundamental and completed in the present and future deferred research.

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Second-Order Observation and the Spatiality of Autopoietic Social Systems

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Abstract

Spatial descriptions of reality are a common occurrence in almost all social contexts. As the author of a classic monograph on the general concept of space remarked: "We are constantly reminded of the function of space when we use such expressions in ordinary language such as 'everything has its place' or 'To which one are you referring, this one here, not that one there?' The here, the there, the place refer to part of a spatial framework for knowledge about the world" (Sack 1980: 4).Spatiality thus appears as a universal mode of differentiation by objectification in everyday interactions.

But also at the more abstract level of communication that one encounters when dealing with non-personal entities such as 'the state', 'the market' 'the church' or 'the law', spatial descriptions will appear – for example in the form of national territory, logistics networks, spatially designated places of worship or spatially demarcated jurisdictions: "Physical objects are conceptually imported into the situation as convenient intermediaries" (Quine 2004: 52) – they allow for the presentation of complex social assemblages in an easily understood way that leave little doubt about their ontological character or structural possibilities for interacting with them in a certain fashion. In other words, instead of opening space for contingency in the form of further analytical distinctions, they provide a possibility of fast generalization and normalization of everyday challenges in the form of what might be called "evasive imaginations" (Massey 2006: 90).

One might furthermore encounter more complex descriptions of social systems as concrete, spatial realities; pretending, for example, "as if science were some huge Central Asian empire, governed by a formal and abstract bureaucracy, and protected by an intricate network of outposts at its borders" – to achieve a semantic approximation of the stability of

academic orthodoxy, in this case (Rasch 2000: 15). Often, such spatial imaginations take the form of "*analogic naturalisms*, which hold that the logic of human social systems can be understood as analogous to the operation of natural ones" (Deudney 1999: 28). This is a form of radical reduction of complexity that can most prominently be observed in early modern political geography or 'geopolitics', a mode of thought which sought to explain aggressive political behaviour of states through their ontological identification with the organic growth of biological systems such as animals or plants (Bassin 1987: 476f). With a host of similar semantics re-emerging perhaps in part due to the uncertain political and economic climate in contemporary Europe (cf. Guzzini 2012), with concepts such as a "Western World Order" and "southern solidarity" being common geographical descriptors of large-scale political formations (Stuenkel 2011: 194), and with a "yawning income gap between the richest and poorest nations" still described as a "North-South divide" within the global economy (Moon 2007: 581), it would be hard to argue that spatial differences do not make a difference – even for a theory of *world* society.

It is all the more surprising that a supposedly universal theory of society such as Niklas Luhmann's systems theory apparently has very little to say on the various forms in which spatiality might play a role in the structure and semantics of social systems. The existing considerations of spatial topics appear as "marginal", being "scattered over his oeuvre" (Gren/Zierhofer 2003: 615) – and furthermore, the seemingly absent consideration of physical space in what is, after all, a theory of communication appears to discourage further engagement in an intellectual environment which increasingly seeks to re-integrate more traditional notions of "materiality" into social theory (Walby 2009: 53). Typical reactions of systems theorists to such demands has generally conformed to expectations in that they re-affirmed existing dualistic conceptualizations of space being *either* a physical fact ontologically located outside the realm of the social *or* a purely virtual construct within society – and often one considered to be losing relevance to functional distinctions that, according to more conventional accounts, supersede spatial demarcations in modern society (cf. Stichweh 2000: 190f). After all, of the forms of social differentiation posited by Luhmann, only the historically earlier types of segmentary and centre-periphery differentiation appear as being obvious equivalents to their geographic correlates (Luhmann 2012: 86). In the context of the 1990s, it must have been tempting to read this aspect of differentiation theory simply as a systems theoretical account of more popular globalization theories – as a teleology of de-territorialisation. Such a dismissal would fit well with the obvious notion that Luhmann "attributed only marginal significance to space in social systems" (Koch 2005: 5).

This is, however, far from being the whole story on space in systems theory. Many of Luhmann's accounts of space appear contradictory: On one hand, "systems that operate in the medium of meaning […] are not limited in space at all" (ibid. 38) – but on the other, the notion of "national territory" still appears as indispensable for distinguishing state jurisdiction from "private property" and thereby upholding the external boundaries of meaning of the political and the legal system (Luhmann 1990: 135), as well as for upholding responsibility for segmentary sub-systems within the global political system. The

spatial "plurality of nations" would therefore be not a future victim of de-territorialisation, but rather a consequence of functional differentiation, *vulgo* 'globalization' (Luhmann 2012: 85). Spatial demarcations in this basic form of inside-outside-distinctions would therefore consist of nothing more than of a simple visualization of social differentiations that happen to become relevant in a certain situation.

In my paper, I propose that despite several laudable attempts to arrive at a more determined and satisfactory concept of space within systems theory – e.g. Gren/Zierhofer (2003); Jacobs/van Assche (2014); Koch (2005) – such a concept does not currently exist. I furthermore propose to use the often-cited formula of space as a medium built on the form of the distinction of "place" and "object" (Luhmann 2000: 113) as a starting point, but elaborate this simple concept – which by itself would consist of nothing else than a visualization of the logic of marked and unmarked space – by introducing the notion of space being a mode of second-order self-observation of social systems: Spatial distinctions allow social systems to observe their proprietary distinctions through the form of *actuality* or *potentiality* with the distinction of *material* and *virtual* space, through the form of *self-reference* or *hetero-reference* with the distinction of *voluntaristic* and *deterministic* space, and through the form of *event* or *structure* with the distinction of *rhizomatic* or *choric* space. This enables social systems to reduce internal complexity by generating highly connective descriptions of reality, causality and temporality – examples for this function, drawn from systemic interaction theory, organizational theory and political theory, will be given in the final paper.

Keywords

systems theory; space; autopoiesis; social geography; second-order observation

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