Realizing the Benefits of Enterprise Architecture: An Actor-Network Theory Perspective

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"A great architect is not made by way of a brain nearly so much as he is made by way of a cultivated, enriched heart." – Frank Lloyd Wright

Abstract

There is growing interest among IT practitioners and academics in Enterprise Architecture (EA) as an effective response to increasingly rapid business, economic, and technological change. EA has been proposed as a path towards better achieving and sustaining stronger business-IT alignment and integration, cost reductions, greater agility, reduced time to market, and other important objectives. Yet there is little theoretical basis to explain how EA work can lead to such achievements; moreover, the creation of a holistic and resilient EA remains an elusive goal for most enterprises. In this paper we use concepts from Actor-Network Theory to highlight some important socio-political and socio-technical aspects of EA work in the context of complex organization situations. Specifically, we focus on such challenges as actor identification in EA negotiations, the importance of soft skills, integration and reconciliation of multiple EA representations, discovering hidden interests and reflecting them in EA representations, dealing with misalignments of interests, as well as creating an environment for continuous EA, and thereby enterprise, improvement.

Keywords: *Enterprise Architecture, Actor-Network Theory, Politics, IS Architecture, Technology Architecture, Socio-Technical, Business-IT Alignment, Strategy, Agility, Integration, Complexity, Information Systems, Soft Skills, Systems Analysis, System Design, IS Development, Analysis and Design, Enterprise Architect*

Introduction

"An architect is the drawer of dreams" – Grace McGarvie

The increasing complexity of modern enterprises, as well as the growing heterogeneity of information systems and services used to support business operations, has lead to renewed attention towards Enterprise Architecture (EA) among information system (IS)[1] practitioners and researchers alike (Kappelman, 2010; Ross,

[1] The terms "information systems" and "information technology" and their respective acronyms (IS and IT) are used interchangeability in this paper when discuss-

et al., 2006; Ross 2003; Venkatesh, et al., 2007). EA has been proposed as a necessary condition for attaining and maintaining business-IS alignment (Sidorova & Kappelman, 2011). In addition, several technological and business trends point to the increasingly important role of the holistic EA approach, including enterprise-wide ERP adoption, cyber security, enterprise application integration, virtualization, data warehousing, business intelligence, service orientation in IS, IS and business process outsourcing including cloud computing, to name but a few. Increasing focus on business agility also makes it increasingly important to have a well-defined, yet flexible enterprise architecture. In spite of the recognized importance of EA work, the creation of a comprehensive and resilient EA remains an elusive goal for most enterprises.

In this paper we examine the process of enterprise architecture development and change through the radically relational lens of the Actor-Network Theory (ANT) (Callon, 1986; Latour, 2005, 1992; Law, 2000). Using ANT concepts, we conceptualize EA and EA processes and activities as flexible and constantly evolving. We further define the role of architectural representation in effectively determining both the present and future architectures of an enterprise, and discuss how such representations are created, used, and modified in the process of IS development and implementation. We then discuss the implications of this conceptualization of EA for EA practice and research.

EA Practice, Research, and Theory

"A doctor can bury his mistakes, but an architect can only advise his clients to plant vines." – Frank Lloyd Wright

The importance of Enterprise Architecture and its role in guiding managerial and technological decisions has long been acknowledged by business and IS professionals from industry and governmental institutions. The conceptual foundations of EA evolved from academic and practitioner, public and private, for-profit and not-for-profit, as well as federal, state, and local government efforts. The data modeling techniques and system analysis, design, and development methods developed and promulgated in the 1970s and 1980s by ideas like Ed Yourdon's structured analysis and design methods (DeMarco, 1978; Yourdon, 1975), Peter Chen's (1976) entity-relationship diagrams, and Clive Finkelstein's Information Engineering (Finkelstein & Martin, 1981) laid some of the foundations. EA practice can be traced back at least to IBM's Business Systems Planning (BSP) systems development methodology developed in the 1970s. The development of an enterprise ontology by John Zachman was another important milestone in the evolution of EA theory and practice: Zachman's ontology of the enterprise and its architecture, used inside IBM in the early 1980s in conjunction with BSP, was first

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ing the departments, people, processes, and technologies that process, manage, transmit, and store information for enterprises.

published externally in 1987 (Zachman, 1987; Zachman & Sowa, 1992) and to some extent continues to influence all EA concepts and practices.

Many other major developments have shaped EA practices. In 1992, the US Defense Department (DoD) initiated its Technical Architecture Framework for Information Management (TAFIM) project and developed the Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) Architecture Framework in the mid-1990s to promote interoperability across systems and services. The Open Group Architectural Framework (TOGAF) Version 1 released in 1995 was based on the TAFIM (Hagan, 2004). In 1996, responding to "best-practices" in IS studies conducted by the General Accounting Office (GAO)2, the US Congress passed the Clinger-Cohen Act, which requires that every federal agency have a Chief Information Officer (CIO) responsible for all IS spending, equipment, and personnel as well as the Information Technology Architecture (ITA) for their agency. Since the ITA of an enterprise is a vital part and a reflection of the larger enterprise of which it is a part, for practical purposes ITA has been operationalized as EA in the US federal government. The DoD also developed the Joint Technical Architecture (JTA) in 1997 to facilitate the flow of information in support of warfare and C4ISR evolved into the DODAF (DoD Architecture Framework).

Responding to the need for guidance as federal agencies began to create their EAs, the CIO Council of the Office of Management and Budget (OMB) sponsored the development of the Federal Enterprise Architecture Framework (FEAF) in 1999 (CIO Council, 1999). OMB and the GAO published *A Practical Guide to the Enterprise Architecture* in 2001 to provide guidance on setting up an EA program and for developing and maintaining an EA (CIO Council, 2001). Over the years, many groups have emerged to offer various kinds and qualities of EA-related trainings and certifications, both Gartner and Forrester have EA research practices, and many vendors offer EA-related conferences, services, and products. A Society for Information Management (SIM) EA Working Group (SIMEAWG) was formed in October 2006.

In spite of the significant interest in EA, practitioners acknowledge that EA work is full of challenges, many of which are socio-political in nature. Moreover, notwithstanding enterprise architecture skills being ranked at the top of the "business domain" skills by CIOs (Collet, 2006), evidence suggests that business managers and even senior IT practitioners, treat EA work as belonging to the technical IS domain (Salmans & Kappelman, 2010). This is perhaps not surprising as many practitioners continue to focus on IS architecture, thus undermining the potential of EA to act as a bridge between business and IS.

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[2] GAO has since changed its name to the General Accountability Office.

Throughout the 1990s the term "enterprise architecture" appeared in a number of academic publications; however, such studies either adopted a black-box approach to EA (e.g., El Sawy, et al., 1999), or treated EA as a close synonym to Information Architecture (e.g., Miller, 1997). Academic interest in EA was reinvigorated in the 21st century with EA being proposed as a solution to achieving business-IT alignment and overcoming IT integration challenges. In her 2003 article "Creating a Strategic IT Architecture Competency: Learning in Stages" MIT's Jeanne Ross concluded that "the payback for enterprise IS architecture efforts is strategic alignment between IT and the business" (p. 43). Jerry Luftman's (2003; Luftman & Kempaiah, 2007) assessment of "IT-business strategic alignment maturity" included the degree to which "the enterprise architecture is integrated". Ross, with her MIT colleagues Peter Weill and David Robertson, released the book *Enterprise Architecture as Strategy* in 2006.

Yet in spite of the significant academic and practitioner interest in EA, there appears to be little consensus with regard to conceptualizations of EA. For example, while some treat EA as a description of the status quo, others subscribe to the view of EA as a set of standards and blueprints for the future enterprise and other still include both along with the transition plan between those present and future states. Similarly, some simply equate EA with IS or technology architecture, while others conceptualize EA as enterprise-wide requirements aimed at providing an all-encompassing model or approach for planning and running the business, capturing and providing management with all the knowledge about the enterprise, and serving as a shared "language" to align the ideas of strategy and with the reality of implementation (Kappelman, 2007). Furthermore, the focus among many practitioners and academics is on "doing EA" and so they tend to view EA as a process.

In this paper we adopt the conceptualization of EA as an inscription of aligned interests (Sidorova & Kappelman 2010, 2011), which is based on concepts from Actor-Network Theory. We elaborate on the process of developing EA as a negotiation process among heterogeneous actors both within and often outside the enterprise, and highlight the key challenges of EA development. In the next section we review some concepts from the Actor-Network Theory that are particularly useful for our discussion and elaborate an ANT-based conceptualization of EA.

Actor-Network View of Enterprises and Information Systems

"Architecture is politics." – Mitchell Kapor

Actor-Network Theory was originally proposed in the early 1980s to describe the creation of socio-technical networks of aligned interests (Callon & Latour, 1981) and was later extended to focus on the dynamics of relationships among such networks (e.g., Law, 2000). ANT was also recently further formalized and elaborated upon in the book *Reassembling the Social: An Introduction to Actor-Network-Theory* (Latour, 2005). Actor is the central element of the theory, and in its original conceptualization is defined as "any element which bends space

around itself, makes other elements dependent upon itself and translates their will into the language of its own" (Callon & Latour, 1981, p. 286). Through such translation of interests the actor seeks to create networks of aligned interests, or actor-networks.

The creation of actor-networks by a focal actor through the process of translation is detailed in the study of scallops and fishermen (Callon, 1986). The translation process is defined from the point of view of a focal actor and its goal is to align the interests of other actors and actor-network with the interests of the focal actor. The translation processes is described as a multi-step process involving *problematisation*, *interessement*, and *enrollment* stages (Callon, 1986). Once the alignment of interests is achieved, it is often inscribed into technical artifacts (e.g., a computer application) or other elements that are difficult to change, such as legal contracts, or even such "mundane artifacts" as a car seat belt (Latour, 1992). The inscription process may, in turn require recruitment of yet additional actors (such as programmers or lawyers) and consequently may lead to the need to consider their interests.

The term "actor-network" reflects the fact that the resulting actor-networks are often perceived by external observers as individual actors and their coherency (the internal alignment of interests) is taken for granted, a phenomenon referred to as *punctualisation* (Monteiro, 2000). The heterogeneity of the elements of the actor-networks is only observed by the external actors when misalignment of interests occurs within the actor-network. The Actor-Network Theory takes a "radically relational" approach to defining actors, where "entities […] achieve their significance by being in relation to other entities" (Law, 2000, p. 4). For example, the student registration system can only be defined as such when placed within a larger network of an educational institution. ANT also does not make an *a priori* distinction between human and non-human actors, thereby making it appropriate for examining the role of human entities as well as those that are comprised of social and technical elements (such as information systems or organizations) and purely technical ones (e.g., a server, building, or manufacturing robot).

The flexibility of ANT with regards to the level of analysis and its ability to include both the technical and social dimensions made it attractive for studying problems related to the development and use of information systems (Walsham, 1997). Among the early applications of ANT in IS research, Walsham and Sahay (1999) used ANT concepts for analyzing the case of GIS implementation in India. Recently ANT was used to examine a variety of IS-related phenomena; for example, to examine causes of failure of a large business process change initiative (Sarker, et al., 2006) and to examine issues related to standardization in IS (Hanseth, et al., 2006). ANT was also used for exploring a variety of organizational and business issues (e.g., Newton, 2002). In the next section we apply concepts of ANT to describe EA and its related processes.

The Architecture of Enterprises

"Our architecture reflects truly as a mirror." – Louis Sullivan

If the enterprise exists then the architecture of the enterprise exists whether or not it is known or written down. The same can be said of the architecture of a building, airplane, computer chip, and just about any other object. A modern enterprise, as well as the information systems within the enterprise, can be viewed as examples of complex actor networks. The process of enterprise creation and development can be viewed as a series of translations of interests of the various actors comprising the enterprise actor-network (Sidorova & Kappelman, 2011). Enterprises are often established as a result of a translation process between the interests of entrepreneur(s) and investor(s). The development of an enterprise proceeds with the enrollment of new actors, including employees, physical assets, customers, suppliers, production equipment, and information technologies. The enrollment of each of these actors is usually associated with the creation of artifacts in which the interests of the newly created or expanded networks are inscribed. For example, hiring an employee usually involves the creation of a contract and a job description. Such artifacts usually include references to the design of the enterprise, such as the legal and governance structure, the business model which implies the key entities of interest to and the core business processes of the enterprise, as well as references to technology, personnel, and often location requirements. As the enterprise grows, the enterprise actor-network grows to include vendors, customers, suppliers, employees, production technology, information technology, contracts, facilities, annual reports, SEC filings, and so on.

Thus, when viewed through the ANT lens, an enterprise is typically created through an organic process of multiple translations, as opposed to a planned undertaking where an enterprise is a realization of some pre-defined architectural plan. Consequently, the *architecture of an enterprise is not typically defined a priori, but rather emerges through the translation process and reflects the current state of alignment of the interests of various heterogeneous actors representing the enterprise actor-network*. Thus the process of creating and maintaining the enterprise and its architecture can be regarded as a process of managing the various translation processes that involve the enterprise actor-network. If the architecture of the enterprise is written down, then these architectural artifacts become critical to the communication and translation processes within the actor-network; and thus vital to the creation, management, and evolution of the enterprise. In this way, the role of an enterprise architect emerges largely as a strategic management role.

Why then is enterprise architecture usually discussed in the context of IS management, even by IS professionals (Salmans & Kappelman, 2010)? Perhaps it is because the processes of creating and maintaining information systems have long relied upon written architectural artifacts (e.g., Chen, 1976; DeMarco, 1978; Finkelstein & Martin, 1981; Yourdon, 1975; Zachman, 1987). Moreover, ISs are an essential and mission critical subsystem or component of the enterprise, much as

the circulatory or nervous subsystems are to the human body, and significant human and financial resources are required to create and sustain those ISs. Thus, IS professionals have in effect played an increasingly important role in creating and maintaining the architecture of the enterprise (whether explicitly memorialized or not as architectural artifacts) because the IS artifacts themselves become the immutable mobiles (Latour, 1992) into which the aligned interests of the enterprise actor-network are inscribed. In fact, those information systems often themselves become actors in the enterprise actor network. Thus, one might conclude, that it is largely historical accident by which the responsibility for EA has "landed on the desk" of the IS department. However, because EA is by definition strategic, it is not likely to stay there (Ross, 2010). In the next section we illustrate how enterprise architecture can be shaped in the processes of IS development and implementation.

IS Development and Enterprise Architecture

"We shape our buildings; thereafter they shape us." – Winston Churchill

In order to illustrate the role of enterprise architecture in IS development (ISD), in either a build or buy situation, let us consider a typical procurement process which includes preparing a purchase requisition, preparing a purchase order based on the purchase requisition, sending the purchase order to the vendor, receiving the goods, and receiving and paying the invoice, see Figure 1 (Magal & Word, 2009). The process involves several actors including the buyer (the actor interested in purchasing the goods), the purchasing department, the warehouse, the vendor, the legal department, and the accounting department. While all the actors, perhaps with the exception of the vendor, are a part of the enterprise actor-network, they each have distinct interests. For example, it is in the interest of the buyer to get the goods as soon as possible, and he may have very little concern about the price the enterprise is paying, the vendor selection, or the record keeping associated with the procurement process. On the other hand, the accounting department is primarily concerned with ensuring proper record keeping and disbursement of funds. The interests of the vendor include selling as many goods for the highest possible price and collecting the money as soon as possible. The interests of other actors may include cost minimization, warranties in the purchase contract, and ensuring that enterprise funds are not spent inappropriately.

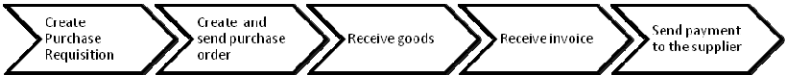


Figure 1. A simplified view of a typical procurement process (Magal & Word, 2009)

For the enterprise actor-network to function efficiently and effectively, these seemingly contradictory interests need to be aligned, which is done by the key actors agreeing on a standard procurement process. For example, the interests of the

buyer and the enterprise are aligned through the process of submitting and approving of the purchase requisition: if the buyer wants to receive his goods, he has to submit a purchase requisition. On the other hand, the enterprise (represented in this case by the purchasing department) has to approve a purchase requisition if it contains legitimate requests. The resulting procurement process becomes a part of the functioning enterprise and its enterprise architecture, regardless of whether it is inscribed into any architectural representations or not. It is however more likely that the process is followed (i.e., the agreement regarding the alignment of interests is enacted, thus making the functioning enterprise more true to its architecture) if it is inscribed in, and thereby memorialized and communicated by, artifacts such as procurement policies, purchase order forms, job descriptions, vendor lists, decision tables, and process maps. In ANT terminology, a procurement actor-network (AN) is created within the enterprise actor-network, which includes human actors and artifacts into which aligned interest are inscribed (see Figure 2). Such artifacts contain information about the enterprise's architecture as it relates to procurement, and thus constitute architectural representations, similar to a mix of drawings, models, bills of materials, and blueprints in building construction (Zachman, 1987).

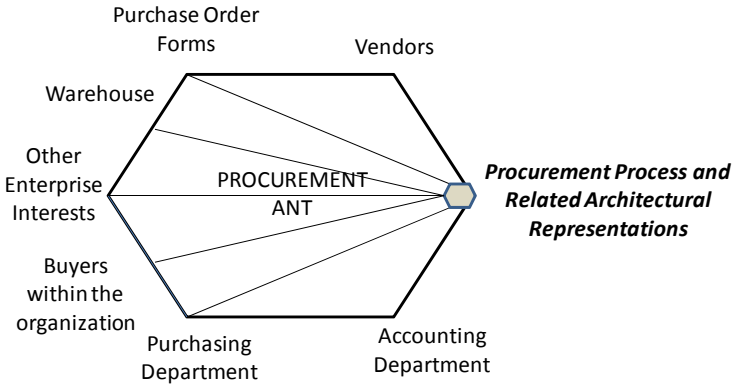
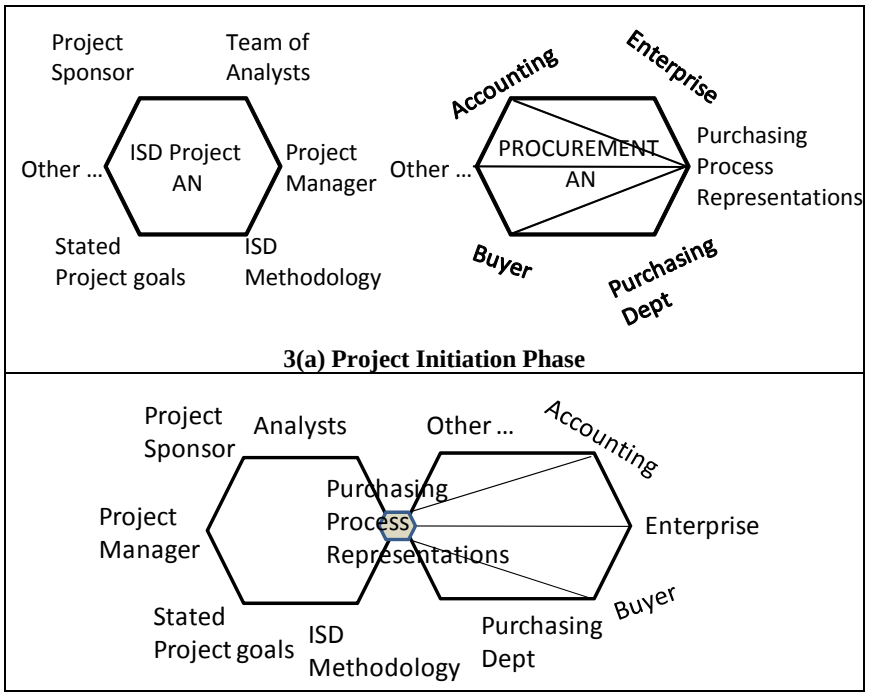


Figure 2. Procurement process as an inscription of aligned interests of the procurement AN.

Let us now consider that a decision has been made to automate the procurement process using information technologies. In EA and ANT terms, the original espoused purpose of such a project could be to further inscribe the existing procurement process into IS artifacts and thus further stabilize the de-facto (i.e., current or as-is) enterprise architecture. Alternatively, the purpose could be to improve the process thus bringing changes in the form of a future (i.e., target or to-be) enterprise architecture. Interestingly, regardless of the original goal, the development and implementation of the IS artifact (e.g., a computer-based information system) is likely to result in changes to the existing EA as it involves the enrollment of new actors, and thus requires a re-alignment of interests inside the

enterprise to accommodate the interests of the new actors (see Figure 3). Initiation of such an automation project typically involves a team of "analysts" (e.g., systems analysts, designers, and architects). The project is also likely to follow some variant of the systems development life cycle utilizing some systems development methodology: This will involve a set of activities, although not necessarily in an entirely linear sequence, centered on (A) architecting (e.g., project initiation, planning, analysis of requirements, system design); (B) instantiation (e.g., coding, procuring, configuring, testing); and (C) deployment (e.g., system implementation, user and technician training, and transitioning the organization to the new system).

During project planning, the development team (whose interests include the successful completion of the project) is likely to align its interests with the project sponsor, who, we will assume for this discussion, represents the aligned interests of the enterprise as a whole. As a result, an actor-network is created, representing the aligned interest of the development team and the enterprise, and the agreement is inscribed into documents such as project charter, statement of work, project goals, and project plans (see Figure 3a). Such logical idea documents correspond to the upper rows in Zachman's enterprise ontology, whereas the later-developed physical architectural artifacts such as screen designs and data record specifications correspond to the lower rows (Zachman, 1987, 2002, 2010a, 2010b), as the project concept moves architecturally from idea to physical reality.



3(a) Project Initiation Phase

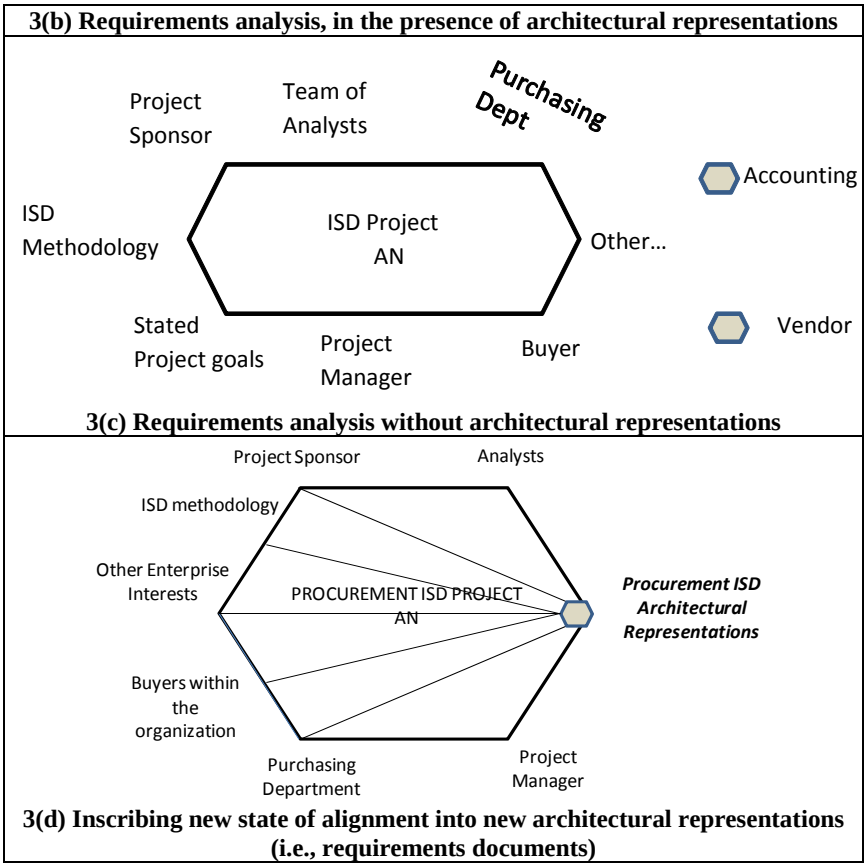


Figure 3. The translation processes associated with IS development projects.

Analysis activities usually involve the recruitment of actors involved in the procurement process, and thus currently belonging to the existing procurement process actor-network. Such recruitment requires the identification of the relevant actors and their interests. Identification of human actors is usually referred to as stakeholder analysis in the systems development and business analysis literatures, whereas identification and recruitment of non-human actors usually involves document analysis (Brennan, 2009). Whereas the interests of human actors may have shifted since the existing procurement process was implemented, the architectural artifacts are likely to be relatively more objective and faithful representations of the alignment of interests embedded into the existing procurement process. Thus, if the goal of a system development process is to stabilize the de-facto enterprise architecture by automating the existing procurement process, existing architectural representations are likely to be particularly helpful. Recruiting the existing archi-

tectural representations, for example in the form of adopting existing job descriptions and process and data models, as a basis for the design of the new procurement information system, is likely to ensure easy enrollment (i.e., minimal resistance) on the part of other actors in the procurement AN (see Figure 3b). The existing architectural representations are also likely to be instrumental in the identification, interessement, and enrollment of human actors. In the absence of such representations, the IS development process is likely to include a lengthy rediscovery and a re-negotiation among the actors involved in the procurement process. Also, in the absence of such representations, important actors and their interests may be overlooked, leading to future misalignment(s) of interests (see Figure 3c).

Even if the new information system development and implementation activities require changes to the existing procurement process, and thus would require a realignment of interests within the procurement actor-network, the presence of architectural representations (artifacts) into which the current state of alignment is inscribed are also useful. Such representations can be "recruited" into the new procurement system actor-network and serve as the "voice" of the current processes and, as the new alignment emerges, serve to facilitate communication, negotiation, and finally the memorialization of the new process. Such recruitment may be easier (i.e., less political) for more abstract and logical representations, such as conceptual models, because relatively fewer modifications may be needed. Moreover, abstract architectural representations are likely to more faithfully represent the interests of the enterprise actor-network, and are likely to be most helpful in the process of IS development and implementation. More specific and physical representations are likely to represent the interest of specific human or technical actors and are likely to be less flexible with regard to enrollment of new actors. Finally, new architectural representations are created as these defining and architecting activities proceed to completion (see Figure 3d).

As a part of physical design (i.e., the creation of architectural artifacts regarding the lower rows of Zachman's enterprise ontology), decisions are made to use specific technologies. Ideally, from the perspective of the enterprise, the design and implementation of a technological solution should faithfully inscribe the alignment of interests achieved during the requirements analysis activities. Of course, in more iterative development situations (e.g., prototyping, agile methods) these architecting and instantiation activities occur more concurrently. In any event, however, each technology represents a complex actor network which includes multiple actors, such as software, hardware, vendors, programming languages, implementation guides, and so on (see Figure 4). Thus, these are the activities by which the interests of the technology actor-network are aligned with the interests of the enterprise procurement ISD project interests. This may require compromises on the part of the technology actor-network, as well as on the part of the enterprise procurement ISD actor-network. In other word, some user requirements may be sacrificed for the system implementation to be completed within project constraints such as time, money, or existing technologies.

The hypothetical system development process discussed here highlights several important aspects of the ANT conceptualization of EA and ISD. These are summarized below:

1. The current architecture of the enterprise, written or not, reflects the current state of alignment of interests in the enterprise actor-network.

2. Architectural representations (such as organizational charts, data flow diagrams, use cases, and process maps) and technical artifacts (such as an IS) are inscriptions of aligned interests, and thus serve to memorialize and stabilize the enterprise architecture at the time of their creation.

3. System development and implementation projects involve recruitment of new actors (e.g., humans, architectural artifacts, technical artifacts), and therefore result in changes to the EA. Such changes are in turn reflected in new architectural representations and finally technological artifacts.

4. The presence of architectural representations inscribing an alignment of interests within an enterprise makes it easier to ensure that all the aligned interests are taken into account during the software development and implementation processes.

5. During system development and implementation processes existing architectural representations need to be recruited into the new actor-network by means of updating the existing representations, such as process maps, data models, as well as existing technological artifacts. Failure to do so is likely to lead to future misalignment(s) of interests.

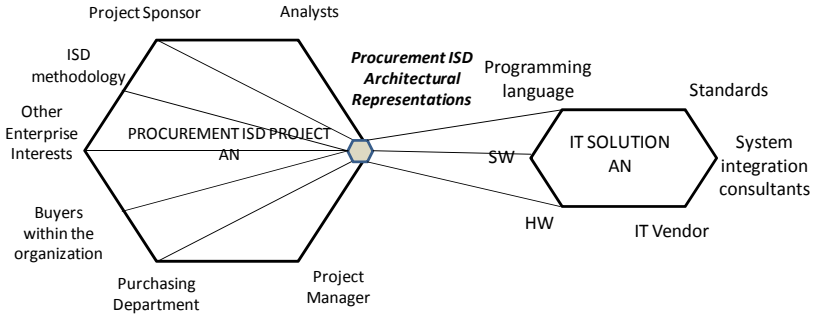


Figure 4. New procurement system actor-network

The ANT View of EA: Implications and Conclusions for Research and Practice

"Architecture, of all the arts, is the one which acts the most slowly, but the most surely, on the soul" – Ernest Dimnet

The proposed conceptualization of EA as the reflection all enterprise interests in their current state of alignment illuminates the political and strategic nature of EA work. It also brings attention to the integration, transparency, actor-identification, and alignment challenges associated with EA. The identification of actors and interests is critical but also challenging. But since the as-is EA is the de-facto alignment of interests within the organization, one of the key aspects of EA work is to ensure that misalignment does not occur, or given that its occurrence is likely, that such conflicts are resolved. Since such conflicts may involve both technical and sociological actors, this points to the critical importance of both soft and technical skills for enterprise architects. Because enterprise architecture reflects the alignment of both human actors and technical artifacts, managing such alignment requires a combination of soft people skills, as well as technical skills. Even if the architectural decisions appear only to concern human actors and their interests, it is likely that realignment of such interests may require making changes to technical artifacts. And, even when the modification to the enterprise architecture may appear purely technical (e.g., switching to a different operating system or type of servers), such change is likely to involve interests of human actors, such as support staff and vendor preferences.

The need for integration of the various interest-inscribing artifacts constitutes another key EA challenge. Broadly, this integration challenge can be decomposed into the identification of all interests and the reconciliation of these interests. While the issue of interest identification is related to the actor identification challenge, identification and reconciliation of all inscribed interests can be a significant advance toward actualizing EA as a reflection of the shared vision of the human actors of the enterprise AN. As the first step, a comprehensive *taxonomy or typology of all such inscriptions* could be developed. Zachman's enterprise ontology (1987, 2002, 2010a, 2010b) can provide insight into the types of inscriptions and inter-relationships among them. In addition to identifying key classification principles, the typology should necessarily imply the hierarchical structure distinguishing among more or less influential inscriptions. The need for such a hierarchy brings the typology development from the primarily data management and knowledge management domains, into the realm of strategy and policy. EA, of course, includes both domains as both are part of the enterprise. The presence of a typology will allow for easier identification of all-important inscriptions, and will also serve as a guide for the resolution of conflicting interests.

Once all the inscriptions of interest are identified and classified, the integration and reconciliation of their content is required. Markup languages, text-mining technologies, and simulation and modeling tools offer a possibility for comparing different inscriptions and thus pave a way for their reconciliation. Clearly the

need for different dialects and specialty vocabularies and models may be required to architect certain aspects of the enterprise, but alignment and integration can only be optimized if the ability to translate and reconcile exists. Thus there is a critical need for building an EA on a complete and comprehensive enterprise ontology and having tools capable of supporting not only model creation but also translation and reconciliation. While useful tools do exist, and are in general improving, in light of the vision of an adaptable, holistic, enterprise-wide, universal modeling, decision-making, simulation, and management EA repository, such capabilities do not exist commercially at this time (Simons, Kappelman, & Zachman, 2010)

In part the transparency challenge arises from the presence of covert interests. The need for the elicitation of such covert interests calls for the development of new architectural and requirements gathering approaches that do not assume that candor be present in such situations. Negotiation and mediation approaches from the conflict resolution literature may also be helpful. The other part of the transparency challenge is related to the need for EA information during negotiations of the enterprise with other actor-networks. Addressing this challenge will require creating appropriate interfaces that could provide limited access to the EA repository. Such interfaces should ensure that only necessary and sufficient EA information is presented in an appropriate format each time it is requested by an actor, including human and non-human actors. In fact, in the ideal situation, such interface should assist in assessing how enrollment of other actors into the enterprise actor-network will affect the alignment of interests inside the enterprise. Here, decision support and expert systems research may offer useful theoretical foundations. Research is needed also to examine the appropriate degree of accessibility to different parts of the EA repository in terms of appropriate practices regarding security, intellectual property, privacy, as well as competitive and other propriety matters.

Considering the aforementioned challenges of EA work would be significantly easier if complete alignment of all interests within the enterprise existed. Unfortunately, as the enterprise grows, the enrollment of numerous actors usually leads to multiple misalignments, and the risk of sub-optimal compromises. Such misalignments are often hidden due to low transparency of interests within the enterprise, and an attempt to create an integrated representation of all interests is bound to uncover such misalignments. As this situation is natural and expected, a certain level of misalignment needs to be tolerated within any enterprise. Therefore EA methodologies and tools should be able to accommodate and reveal it and provide decision tools for optimization in terms of trade offs such as those among the enterprise and its subsystems (e.g., departments, functions) and between long-term and short-term priorities. Research and practical guidance are needed to develop guidelines for the level of misalignment acceptable for different types of interests and actors within the enterprise. On the technical side, to facilitate awareness, understanding, and reconciliation of interests, tools need to be developed with tolerance for misalignments, as well as accommodation for the transitional states of the enterprise, its architecture, and its ANs.

In this paper we have used concepts from the Actor-Network Theory to re-examine the meaning of enterprise and of EA through the lens of interest negotiations and actor-network creation. Such re-examination led us to an idealized definition of EA as an integrated and transparent representation of all interests within the enterprise and their current state of alignment. Thus EA cannot only serve as a negotiation interface between the various actors in the enterprise, but also between that enterprise's actors and external actors (such as vendors, suppliers, or customers). Such a view of EA opens several additional directions for EA research.

First, research is needed to devise approaches for the identification of all significant interests and resolving potential misalignments. Because it is impractical that all interests within the enterprise are included perfectly in the various ANs and thus the EA, criteria for interest inclusion need to be developed, as well as guidelines of the acceptable level of misalignment among such interests. Strategic planning literature, as well as literature on negotiations is likely to provide a source of relevant theoretical frameworks. Second, on a more technical note, research is necessary to develop appropriate capabilities and interfaces to enable digital EA artifacts to serve as an important tool for communication, simulation, and negotiation among internal and external actors. This would include the development of appropriate modeling and storage capabilities, and the user and technology interfaces that would provide internal actors representing the enterprise AN (or any part of it) with access to the EA repository. Moreover, tools need to be developed and tested which would allow for checking the consistency of all interests inscribed within the EA and identifying potential misalignments. Still other capabilities are necessary to check how the proposed alterations to the enterprise actor-network fit into the existing network of interests. Such validation would allow for *a priori* identification of sources of resistance to change initiatives and facilitate making appropriate managerial and strategic choices.

From the practitioner point of view, the ANT view and definition of EA highlights the important and often overlooked political aspect of doing EA. Such a definition should raise an interest in EA among C-level executives and strategists. The definition also highlights the important challenges of EA, which in the absence of necessary tools, including intellectual and conceptual ones, may discourage some business managers from embarking on EA initiatives. We believe this is an ill-advised option given the facts that:

1. the creation of value producing processes and practices best precedes tool procurement (i.e., a fool with a tool is still a fool and likewise automating poor processes);
2. EA practices and programs are still in the early stages and the playing field is still pretty flat and there are many opportunities to create advantage through EA work;
3. maximizing EA's benefits typically involves a significant degree of learning and culture change which takes time (Senge, 1990); and
4. it is of critical importance for public and private management and policy makers in general to have a much more holistic view of their enterprises in light of the plethora of enterprise catastrophes due to the failure of

management to see risks, dependencies, and misalignments (e.g., GM, FNMA, AIG, Bear Sterns, Lehman Brothers, Landsbanki, Allied Irish Bank, Fortis, Northern Rock, and RBS to name but a few).

We hope, however, that the benefits of EA and ANT for understanding the interests of the enterprise in negotiations with fast-changing internal and external environments, combined with the benefits of EA in managing change and complexity, outweigh the perceived risks, and that this article will inspire more organizations to embrace the challenge of EA development. Of course, "No one has to change. Survival is optional" (W. Edwards Deming)[3].

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