ECOSPACE – Towards an Integrated Collaboration Space for eProfessionals

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Abstract

Abstract-**This paper provides an overview on the ECOSPACE Integrated Project that is partly funded by the European Commission in the framework of the Collaborative Work Environments Framework. We present the motivation, goals and research approach of the project.**

Collaborative Work Environments; eProfessional; Reference Architecture; Awareness

I.   1. INTRODUCTION

Within few years, significant social, organizational and economical changes as well as a relentless technology evolution will lead the way of working for eProfessionals into a dramatic change. People will no longer work according to chain production models but rather more as dynamically and spontaneously assembled groups of people working together in a collaboration mode, which means a seamless work to achieve common goals. The social capital will be the main driver, which means that people constitute the best asset of businesses. Professionals will spend more time in people-networking like activities than ever (i.e. on-line professional communities and social networks) [4].

The role of ICT will be essential for supporting this professional and contextual social exchange, and seamless interaction within a complex virtualized world where people are in the foreground, as the centre of all attentions, while supporting technologies are operating in the background, almost invisible. In the academic research community, these trends lead to the Social Computing, Social Desktop, and Social Web or Web 2.0 initiatives.

The "Experts Group on Collaborative Working Environments[1]" of the EC coined the term eProfessional to address workers in such environments. We consider an eProfessional as a professional worker whose business and tasks can only be achieved using modern cooperation technologies. These technologies enable an eProfessional being part of groups and communities as well as

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[1]

http://europa.eu.int/information_society/activities/atwork/work_paradigms/experts_group/index_en.htm

knowledge networks, and being involved in distributed cooperation processes that have not been possible before.

Being an eProfessional is not a profession of its own, but it exists in combination with a business profession such as consultant, engineer, journalist, scientist etc.

An eProfessional:

- Is linked to a normal organization by employment, but may also act in a self-employed way. The work is often performed at mobile workplace.

- Is involved in many different projects within groups, communities, projects, and with external partners in different organizations. Often these projects are constructed around highly complex and creative task that require a high coordination effort. The problems to be solved appear suddenly, they require access to in-formation/knowledge not known before. Thus tasks and processes cannot be anticipated or planned beforehand. They are of different duration and complexity, involving different support tools.

- Requires the availability of the workplace in different situations, locations and places and the ad hoc availability of a cooperation environment.

- Requires support for the ad hoc identification of other eProfessionals based on similar interest and complementary knowledge. Tasks can be solved only gathering and relying on information from different sources (data and people)

- Requires the dynamic ad hoc creation of collaboration with different people and groups.

eProfessionals are both a result of new flexible business models and also the necessary pre-requisite for their implementation. A collaboration environment that can adequately support the needs of an eProfessional must provide services on demand, based on the flexible work tasks of the user.

According to this assumption, our vision is that "The Network" (in fact the Internet and the web of people) will become a global virtualized collaborative workplace where the contextual social exchange will be located through

people-concepts connectivity. In a recent study it is shown that workplace innovations account for 89% of multi-factor productivity gains (source: Black and Lynch, San Francisco Federal Reserve, 2004). This global virtualized collaborative workplace which is one goal of ECOSPACE will enable knowledge workers to get access to both, their individual shared workspace and groups or communities shared workspaces wherever they are, whenever they need it independent of organizational boundaries.

II. OBJECTIVES

To be able to achieve this vision there is a need to research and develop new collaborative working environments. This research must lead to a better understanding of the work environment, the development of an upperware and collaboration services as the collaboration platform, and new innovative user-centric collaborations tools that reduce the complexity of today's techno-centric communication applications.

Accordingly, the objective of ECOSPACE, embedded in an eProfessional living lab with 3 application areas, is to develop:

- Innovative working paradigms through research and understanding of eProfessional work and organization.

- A reference architecture and interoperability concepts for the user-centric integration of collaboration tools. The goal is that shared workspaces become interoperable to avoid the deployment and learning of different solutions for being able to collaborate with people using different solutions.

- Upperware services to ensure seamless and instant collaboration among knowledge workers in group forming networks, beyond organizational boundaries.

- New collaboration aware tools that reduce the complexity of collaboration in dynamic work environments and which enable users for creative and knowledge intensive tasks. Instant collaboration is supported by the integration of asynchronous and synchronous collaboration tools, which results into augmented virtual presence/social networks and rich virtual collaboration.

Achieving these objectives and developing this collaborative platform requires a subtle combination of social, technological (ICT), organizational, legal and business perspectives. It requires R&D to overcome scientific and technical gaps. It requires also experimentation and acceptance by a broad community of users. The specific objectives and vision of ECOSPACE is described in more details in next sections.

III. VISION OF THE ECOSPACE CWE

Future eProfessional collaborative working environments are characterized by flexibility, mobility and ad hoc communication requirements. This raises additional demands on flexible collaboration support for intra- and inter-organizational communication and cooperation processes.

It requires a shift from application oriented developments towards the design of collaboration-aware work environments that support cooperation and interaction in terms of activities instead of technical functions [1].

However, compared to this vision most of our daily cooperation processes are supported using telephones or email with an increasing use of instant messaging. More advanced systems that support distributed task management, shared workspaces or workflows, or real-time collaboration are still in their early adaptor phase compared to the use of email. This leads to the effect that complex and rich cooperation processes are narrowed through simple communication applications. This results in a cognitive overload of the users.

Although the tools should support users in organizing their work, people often complain about information and communication overload and the disturbance of work. Therefore, ECOSPACE will develop concepts for a semantic-rich cooperation support to reduce the workload and complexity of monitoring and organizing the collaboration with different partners in multiple projects and processes. The goal of these concepts is to enable users for creative and knowledge producing tasks.

Due to the increase in inter-organizational cooperation, users form teams and communities across organizational boundaries. This raises the issue of standardization and integration of collaboration tools in a collaboration middleware. Currently email is almost the only communication media that supports inter-organizational cooperation between different systems. Instant messaging, shared workspace systems, or application sharing have not yet reached a status where systems of different vendors can easily be integrated or combined. Thus, often the first decision an inter-organizational team or community has to make is the selection of the supporting collaboration environment. Since users are often involved in different teams, they have to learn and use different collaboration applications for different teams and processes, and to consolidate their own role, tasks, and information across them. Again, this increases workload and complexity and it reduces the availability of time for creativity.

ECOSPACE aims to overcome these problems by applying a paradigm shift from simple cooperation services – currently often stand-alone applications – to user and activity oriented cooperation environment. This implies that we design collaboration applications based on an analysis of the collaboration activities of users in their

working environment. When users want to provide a document to a colleague they should not think in terms of attaching a file to an email, but they should think in terms sharing this document by simply executing a sharing operation. The underlying cooperation environment should then select the appropriate communication application whether this is email, instant messaging or a shared workspace, based on the available technical infra-structure and user preferences.

For example users will no longer think in term of IT such as "exchange or upload this file, open an ftp session, send document as e-mail attachment, set-up a videoconference session". They will rather think in terms of activities such as "share this document with my colleagues involved in the approval procedure", or "give visibility of my publication list, biography and research topics to my colleagues in the professional community", or "revise project GANTT chart together with project partners". No longer users need to know by heart all the details of the single collaboration application tools (functions, configurations, user management), in order to activate and use them properly. No longer must users learn new collaboration tools whenever they participate in a new team that uses different products. ECOSPACE provides the interoperability that enables users to connect their preferred tool to the global workplace similar to the ease by which today users can exchange email between different organizations, using different products. No longer are users drowned by the complexity of multi-channel communication in the dynamic work environment. ECOSPACE empowers users to instantly plan and monitor cooperation activities in different teams and communities using a personalized, dynamic workplace, generated on-the-fly according to the context-specific needs.

ECOSPACE will develop such an environment based on the integration of existing services that the project partners contribute to the project, and which will be also open to include third-party services. For this purpose, a reference model and middleware for collaboration environments will be developed. On top of this middleware, innovative collaboration tools will be developed to increase cooperation awareness for users and tools (Figure 1).

The few basic components for such a cooperation environment is formed by existing cooperation services such as email, shared workspaces and application sharing or task management services. Among the new services presence and awareness services will play an important role. These services are needed in distributed cooperation to support users in their mutual understanding of the status and progress of work as well as the work rhythms of other organizations.

On top of these services an open integration layer enables the horizontal and vertical integration of the services. It supports the interoperability of similar services, e.g. two shared workspace systems from different vendors,

of complementary services, e.g. user management between workspace system and instant messaging system. An important pre-requisite for the realization of such a layer is the development of interoperability standards.
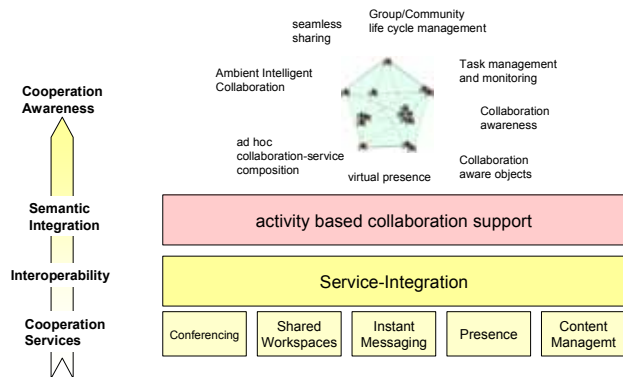

Figure 1. From Cooperation Services to Cooperation Aware Environments

The activity and process support level abstracts from the cooperation application to provide an activity oriented collaboration environment. Within this environment, users can organize their resources according to their processes, activities, teams and communities. I.e. the documents and messages exchanged within a project will no longer be scattered over the attachments of emails in email folders, the local disk and a shared file system or a shared workspace. Based on a semantic integration of the cooperation activities as well as the services, users can organize the environment according to their project, team or community contexts. Within such a collaboration context the cooperation services are offered through so-called activity-functions such as share, inform, notify, send, but not as applications like an email client, or a shared files browser. ECOSPACE will pay special attention to the seamless integration of asynchronous information management tools with synchronous communication and collaboration tools to provide virtual presence/social networks and rich virtual collaboration.

This approach is disruptive and it requires users to adopt a new collaboration paradigm that is not based on an application but on collaboration-activity and task oriented thinking. This also requires that the objects and the applications users deal with become collaboration-aware. This relates to electronic documents that become aware of the cooperation process(es) they are involved in, but also to paper documents or other resources that will be augmented with electronic tracking and identification means, such as RFID-tags. This will enable the association of the real with the electronic contexts, enabling the realization of innovative collaboration support for new working environments.

IV. Tools of a future CWE

The realization of the new collaboration tools is will focus on the following aspects:

- Sharing support: Activity and User-centric vs. application-centric sharing

- Ambient Intelligent Collaboration Collaborative Task Management

- Group life cycle management: Semantic modeling of concepts and people-concepts

- Collaboration aware objects and intelligent content

- Collaboration awareness

- Visualization and Interaction Tools

- Service composition: Collaboration choreography and orchestration

It should be noted that these tools are not restricted to the computer desktop, but that they will also be developed for mobile interfaces when appropriate. The following section explains these tools in more detail.

A. Sharing support: Activity and User-centric vs. application-centric sharing

Standard groupware systems provide several means for the sharing of working material: as attachments to emails or instant messages or through dedicated sharing applications (e.g. BSCW, Groove). However, this kind of sharing support is application and technology-centric. The ECOSPACE collaboration environment will abstract from the cooperation application to provide an activity oriented collaboration environment. Within this environment, users can organize their resources according to their processes, activities, teams and communities. I.e. the documents and messages exchanged within a project will no longer be scattered over the attachments of emails in email folders, the local disk and a shared file system or a shared workspace. Based on a semantic integration of the cooperation activities as well as the services, users can organize the environment according to their project, team or community contexts. Within such a collaboration con-text the cooperation services are offered through so-called activity-functions such as share, inform, notify, send, but not as applications like an email client, or a shared files browser. This approach is disruptive and it requires users to adopt a new collaboration paradigm that is not based on an application but on collaboration-activity and task oriented thinking.

Another important issue in sharing support is that the heterogeneity of knowledge and data models as well as the plurality of collaboration platforms require the management of interoperability issues.

The ATHENA IP and other RTD initiatives are focusing on web-services as the most convenient means for developing Enterprise Applications Interoperability (data ex-change fully and semantically understood by the destination application). In ECOSPACE, we will study Worker-centric interoperability (simultaneous-parallel access and use - not exchange - of shared knowledge by several interactive applications accessed by several users and workers). This new paradigm focuses its attention to-wards the final users. This includes seamless access and sharing collaboration services provided by different platforms and information models actually represented and stored in distributed heterogeneous bodies of knowledge. An example of this paradigm is the case of a pool of experienced Project Managers, each adopting his/her own tool for Project Management and Collaboration Platform. They will be able to work collaboratively on a shared GANTT chart of an inter-organizational multi-project, irrespective of the different GUI selected, of the different tools invoked and of the heterogeneous data model behind them (e.g. relational, object-oriented, file system, text). This working scenario does not imply at all neither a syntactic, nor a semantic interoperability of the data formats exchanged and of the applications involved ("The ability of two or more systems or components to exchange information and to use the information that has been exchanged", IEEE and ATHENA definition of interoperability). But, tries to promote a new definition for user-centric interoperability as "the ability of two or more workers to access and share knowledge, irrespective of users location, interaction devices and co-operation models, irrespective of the collaboration and applicative tools they are using, irrespective of the syntactic and semantic heterogeneity in which such a knowledge has been represented and formalized".

B. Ambient Intelligent Collaborative Task Management

New task management tools will enable end-users to coordinate weakly structured cooperative tasks using ad hoc and flexible work coordination tools. These tools will not require any meta-planning, but will support the planning through the interaction with the collaboration objects as well as easy to use functions for the seamless integration of planning, coordination, monitoring into one tool set.

State-of-the-art standards and solutions for Task-Management (Modelling & Execution) will be properly extended in order to support worker-centric collaboration processes and tasks (e.g. decisional processes, problem solving, brainstorming, ad-hoc meetings, mediated collaboration) and to allow them to be compatible with Ambient Intelligence principles. In particular, the notions of "intelligence everywhere" (intelligent products, machines, tools, materials and of course humans), "actor area network", "adaptivity, proactivity and autopoiesis" (the capability to examine the context and consequently

self-evolving and modifying its own behavior) will be added to traditional BP Management. As an example scenario, we can imagine a Quality Manager of a manufacturing plant who enters a shop-floor and starts interacting with colleagues currently located in the plant, machines, materials and finished goods inside his area of influence to understand eventual problems and collaboratively solve them. The basic challenge we would like to address here in ECOSPACE is not only how to explicitly model such an AmI process, but also how to be able during execution to recognize and analyze the context in order to modify the decisional process accordingly.

C. Group life cycle management: Semantic modelling of people-concepts

Experience shows that users often have problems to organize weakly structured process of collaborative work. This task will perform research and development in methods and tools to enable users to create, manage the collaborative environment for a group. A result of this will be a tool for the semantic modeling of a group, its structure and the involved people (members). This will allow the description of the openness of the group, the policies for interaction within and outside the group, the relationships between groups, the roles within a group, and the life-cycle of the group and its shared work-space over time.

D. Collaboration aware objects and intelligent content

Within this task, we will develop and realize the concept of collaboration aware electronic and physical objects.

Collaboration in a CWE requires that collaboration objects become aware of the collaboration process as well as the community or group they belong to. Today objects, such as documents that are exchanged by email, instant messaging or shared workspaces, do not carry any semantic information about these collaboration activities. However adding this information to collaboration object would enable a whole set of new functionalities from easier search to context aware collaboration functions that can (semi-)automatically associate objects into a collaboration context or is it collaboration process. A simple example is the seamless transfer of a document from an asynchronous shared information management system into a conferencing application. Today the fact that the document has been cooperatively edited in the conferencing application is neither represented in the information management system not in the document itself. Thus the document is not aware of the collaboration processes it has been involved in. This relates not only to electronic documents, but also to paper documents or other resources that will be augmented with electronic tracking and identification means, such as RFID-tags. This will enable the association of the real with the electronic

contexts, enabling the realization of innovative collaboration support for new working environments [2].

E. Collaboration awareness

Nowadays collaboration awareness is mainly restricted to presence awareness (who is online?) and operation awareness (who read a document?). However, in order to stay on top of the cooperation process users need more sophisticated awareness information that aggregates the simple forms of presence and operation awareness to presentations of activity and collaboration awareness. Within this task an appropriate concept for this aggregation will be developed. This concept builds the basis for the development of tools that allow the description of expectations of a cooperation process in form of templates and patterns. This enables users to describe their expectations ("what should happen") and the tools will inform users about the important collaboration steps that have not yet happened (e.g. missing input from partners). Often that information is more important than the presentation of activities that happened. Furthermore, tools will be developed that enable the user to identify and understand the work-rhythms of partners, e.g. to answer questions such as: when can I expect a reply, when is the best time reach a partner. The development of these tools will require the provision of appropriate event and notification services as part of the middleware services.

F. Visualization and Interaction Tools

Today most collaboration applications provide a document-centric or task-centric view. However, collaboration within communities or groups of people should become more person focused, it means person or people-centric collaboration applications. There-fore, this task will focus on the development of new visualization and interaction tools for the objects of an eProfessional collaboration platform. This will enable alternative and parallel views on information that better suit the collaboration within communities and groups of people.

G. Service composition: Collaboration choreography and orchestration

Based on the service oriented architecture and the collaboration services, an environment for the composition and orchestration of the various collaboration services will be developed. This tool will enable administrators and later also end-users to configure a collaboration environment from the set of available collaboration services. The result of this task is the concept and implementation for the composition of collaboration services. Here it should be taken into account, that the finality of this orchestration is not the EAI (Enterprise Applications Integration) or the BPR (Business Process Re-engineering), but the support to collaborative AmI decisional processes through a user-centric interoperability framework.

V. USER INVOLVEMENT

Virtual collaboration is an intricate example for the fundamental link between information and communication technologies and changes in the way we work. There is wide recognition that especially for the disruptive and radical innovation current CWE aim at, traditional models of user involvement entailing formal requirement analysis, demonstrations and concept tests do not provide the immersion necessary for developing new ideas and validating the advanced solutions [3]. ECOSPACE therefore implements a thorough Experience and Application Research approach within four living lab settings, as proposed by the ISTAG Working Group.

We understand a living lab as the combination of

- business users willing to use new technology and ways of working in their real-life operational projects
- a technical and physical infrastructure that allows users to access and experience the new technology both within a simulated distributed collaboration setting (for better observation and reflection/discussion) and in their full real-life setting
- a methodology for engaging with the users (including training, experiment de-signs, workshop designs, evaluation methodologies) for optimal cross-fertilization with the technical work.

Different tasks will prepare the methodology and technical infrastructure for use in all living labs. This provides the necessary efficiency and commonality across the different living-lab scenarios. ECOSPACE will deploy three living lab settings covering a broad, exemplatory spectrum of collaboration tasks, environments, and organizational structures:

- Complex Project Management: This lab targets the rich virtual environment of building engineering and construction together with virtual project management.
- Media Lab: This lab targets digital content and multi-media development.
- eProfessional Community Lab: This lab targets the open liaison, flexible team building and collaboration in professional communities.

The actual living lab research will be conducted in three main phases linked to the innovation cycles of the project.

The first phase has the objective to solicit early ideas and requirements from the lead users in the project. All of them have already experience with at least one of the baseline collaboration systems included in the project. Methodologies for research in this phase include case studies and observations of collaborative working at the user sites, workshops demonstrating new, unfamiliar technology components (e.g. virtual presence, rich-media conferencing, knowledge mapping solutions) with mini experiments, and discussions of the new collaboration ideas envisaged in the technical workpackages. Results are a thorough understanding of collaboration requirements in the different living labs, ideas for the design and specific functionalities, and a prioritization of the technical work

The second phase has the objective to engage with the lead users in rapid technology-push – market-pull experimentation cycles. The methodology during this phase is to have the lead users experiment with real-life scenarios and activities on mock-ups or early prototypes. This goes far beyond traditional presentations and focus group discussions. For example, the engineering design team exercises collaboration tasks like project planning, brainstorming and concept development, or distributed project reviews using the new working environment. The users thus immerse into the new approaches and create new ideas and feedback regarding usefulness and usability. The experiments are typically conducted through workshops in the ECOSPACE living lab environment for better observation, reflection and evaluation, but can already include local deployments.

As more advanced collaboration functionalities as well as the distributed middleware becomes available in the third phase, the focus shifts to more longitudinal experiments involving whole project episodes with different integrated activities and later to full scale, longitudinal demonstrations and case studies within the real-life settings of the different user groups. People change their ways of working supported by related training, which allows studying the complex changes in working organization, routines and productivity and creativity enhancement envisaged in the project.

The experimentation and evaluation methodology across the different lab settings will allow comparison and mutual learning. Each experience and application research cycle consists of selecting and defining the specific real-life scenario and later the project to be used in the living lab. The technology has then to be prepared for the experimentation with e.g. the functionality modules, data required, and user configuration. As experiments and longitudinal cases only become meaningful if users adopt new collaborative working methods and know how to use the environment productively, training becomes a crucial element.

VI. SUMMARY

This paper describes the motivation and objectives of the ECOSPACE project that started in May 2006 with three year duration. After this time we expect the following results:

Collaborative platform prototypes including architecture, implemented collaboration middleware & services as well as extended existing collaboration tools and new collaboration tools integrating both asynchronous and synchronous aspects. This collaboration environment will enable knowledge workers, and especially

eProfessionals, to easily network together, form groups and professional virtual communities for stimulating creativity and innovation while increasing productivity.

A set of three living labs and experiment results for different business sectors driven by Atkins, De Agostini, and FIT/EsoCE-Net, as well as demonstrations and training material. A body of documented experience and methodological know-how gained in their application domains.

A vital community that adopts the results of ECOSPACE and continues to extend them according to their needs using a developer's forum provided at the project web-site.

A collaboration platform reference architecture and corresponding upperware enabling the interplay and interoperability of collaboration services and tools in a collaboration environment as well as business process management, mobile and wearable computing. This result will be contributed to standards and will foster the seamless cooperation of users within and between organizations, teams and communities.

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