eSF: An E-Collaboration System for Knowledge Workers

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ABSTRACT

The aim of our chapter is to contribute to a better understanding of E-Collaboration, especially its intimate connection with knowledge and knowledge processes. We begin by presenting a knowledge-oriented understanding of E-Collaboration and an architecture of an E-Collaboration system (people, processes and technology) based on that understanding; then we describe the eSF system (an implementation of this architecture within our team), our experiences with it and what we have learned about the success factors of E-Collaboration.

1. Introduction & Background

Since their appearance in the 1990s, E-Collaboration technologies have continued to mature and to offer new and potentially better ways to collaborate and communicate but unfortunately adoption throughout this lengthy period has been tepid (Koplowitz et al., 2013); the trend has become even worse over the past few years and points to a rising dissatisfaction with the current systems and initiatives (Drakos, 2013). It seems that, after pausing at the peak of the hype, E-Collaboration (social collaboration, social software and collaboration, social business) is now plunging down into the trough of disillusionment (Burton & Willis 2014; Lavoy 2013).

This could be a good moment to take seriously "*the necessity of attaining a balanced understanding of the strengths and challenges*" (Burton & Willis, 2014) of E-Collaboration and ask questions like "Why is E-Collaboration not working satisfactorily and not being adopted as expected?" or "Why are organisations failing to tap into the full power of E-Collaboration?"

In this chapter we want to contribute to answering these kind of questions in the following way: first we present an understanding of the essence of E-Collaboration that we call "knowledge-oriented" because we are convinced that - like in collaborative e-learning - what matters in E-Collaboration is the construction of shared knowledge (Dillenbourg & Fischer, 2007); then we propose an architecture of what we call an E-Collaboration system - which includes people, processes and technology. This is designed according to the aforementioned knowledge-oriented understanding; and third we describe the implementation of this architecture within our team at the Research Management Unit of FFHS and our experiences with it; last but not least we conclude by proposing some insight derived from our concepts and experiences that could

help others in answering the above questions and implementing their own E-Collaboration initiatives successfully.

2. A Knowledge-Oriented Understanding of E-Collaboration

Our experience with the practice of E-Collaboration suggests that knowledge processes play an essential, relevant role in it. This is in line with the considerations of other authors who claim that knowledge processes serve as the basis of any form of cooperation (Endress & Wehner, 1996; Vollmer & Wehner, 2007), that knowledge should be considered as one of the key elements of E-Collaboration (Kock, 2005) or that the construction of shared knowledge constitutes one of its key processes (Dillenbourg & Fischer, 2007). Unfortunately we do not see knowledge mentioned in most definitions of E-Collaboration and are lacking models of E-Collaboration with adequate emphasis on knowledge processes.

Kock (2005) suggested a broad definition of E-Collaboration as "*collaboration using electronic technologies among different individuals to accomplish a common task*". Let us start from here and see if we can extend and adapt this definition in a way that allows to have "*knowledge*" explicitly mentioned in it. The first part - "*collaboration using electronic technologies*" - explains simply what the "E-" means; the second part - "*among different individuals to accomplish a common task*" tells something more about "collaboration": that different individuals are involved and that they work together on a task. In this way, it is not possible to distinguish between "collaboration" and "cooperation" and the two terms are interpreted and defined (also in theory and dictionaries, for example Merriam Webster) as if they were synonyms. But practice demonstrates that collaboration and cooperation are not synonyms; for example, the term E-Cooperation is used much less than E-Collaboration and the discipline of CSCW (Computer Supported Cooperative Work) has not evolved into E-Cooperation and only includes some of the E-Collaboration research. The distinction that we make between "collaboration" and "cooperation" focuses on the relationship between work and people: cooperative work is accomplished by a division of labour among participants in which work is split into pieces and each person is responsible for a portion of the work (Roschelle & Teasley, 1995:70); in collaboration, instead work and responsibility remain a unit. How?

In order to clarify this, our approach is to focus on the *process* of collaboration and ask for example: how does collaboration actually proceed? This approach can be found in the seminal work by Roschelle & Teasley (1995) that investigates collaborative problem solving. There we find three complementary characterisations of collaboration pointing to 4 essential aspects: "single task", "coordination", "shared construction" and "mutual engagement": 1. "*Collaboration is said to have occurred when more than one person works on a single task*" 2. "*Collaboration is a coordinated … activity that is the result of a continued attempt to construct and maintain a shared conception of a problem*" and 3. Collaboration is "*the mutual engagement of participants*

in a coordinated effort to solve the problem together" (Roschelle & Teasley, 1995, p. 70). The notion of a "shared conception of the problem" is central here. Specifically, Roschelle & Teasley claim that collaboration consists of two concurrent activities: solving the problem together and building what they call a "Joint Problem Space" (Roschelle & Teasley, 1995, p. 75), a shared knowledge structure that supports the problem-solving activity. This means that collaboration does not just happen because individuals interact: individuals must make "*a conscious, continued effort ... with respect to shared knowledge*." (Roschelle & Teasley, 1995, p. 94). And this is not easy to do, it is a fragile process during which the participants have to overcome difficulties of many kinds. Analysis of this process shows that conversation (talk) is the most important resource in dealing with these difficulties. Based on many different forms of interaction (questions and answers, repairs, storytelling, messy talk, etc.), conversation enables us to reach a mutual understanding, to recognise divergent understandings or misunderstandings and to negotiate rectification of the underlying shared knowledge structure with a view to improving joint work. Of particular interest for our system is the conversation known as "messy talk" - an interaction featuring mutual discovery, critical engagement, knowledge exchange and synthesis - because it is a collaborative process that makes the synthesis of knowledge more efficient and effective (Dossick et al., 2012).
Given these elements, we are now in a position to draft our knowledge-oriented definition of E-collaboration (Figure 1): "*a coordinated activity among different individuals who use electronic technologies to* ***work on a single, common task*** *and who, concurrently, are also mutually engaged in a conscious, continuous effort to* ***construct and maintain an underlying shared knowledge structure*** *as a basis for accomplishing their task.*"

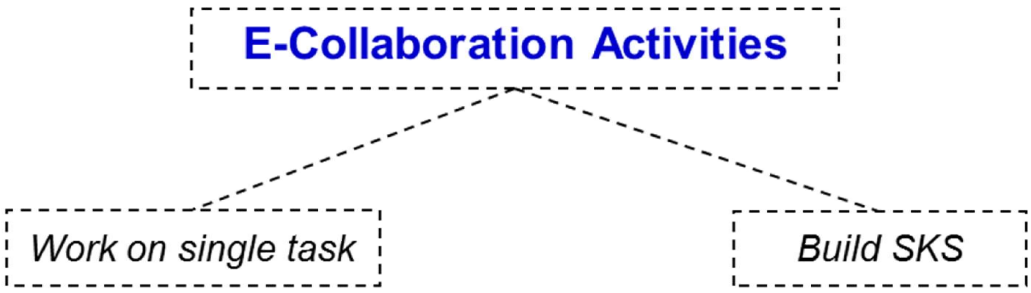

Figure 1. Concurrent activities that define E-Collaboration (SKS = shared knowledge structure)

But if knowledge plays such a relevant role in E-Collaboration then before we design an E-Collaboration System, we need to reflect on the concept of knowledge. Based on previous research in Knowledge Engineering and Knowledge Management, we propose applying an understanding of knowledge that promotes the human factors (HF) to E-Collaboration i.e. basic human elements and tendencies such as identity, meaning, desire to know, free will, social responsibility, mutual acceptance, love, intentions, interests, wishes, hopes, expectations, etc.

(Bettoni & Eggs, 2010). It is, in short, a radical constructivist understanding of knowledge that we see as a logic of experience rather than as a logic of reality.

3. Architecture of an E-Collaboration System

Assuming that our conception of E-Collaboration is viable, according to which E-Collaboration consists of two concurrent activities, one being to work on a single task and the other being construction of a shared knowledge structure (Figure 1), then it follows that the organisational structure (people) and collaboration processes (task, knowledge and social processes) play an important role in making E-Collaboration successful and should be designed accordingly. As a consequence, it is not enough to focus primarily on E-Collaboration technologies; we need to take it seriously that “people” and “processes” also matter and make sure that our design puts all three elements in the right balance. To do this, we suggest introducing the notion of an “E-Collaboration system” which is composed by connecting people, processes and technology to form one unit. This PPT model has been already successfully applied to Knowledge Management elsewhere (Edwards 2009, 2011): “The need is to coordinate people, processes, and technology successfully using some kind of KM system. It is important to realize that here is more to a KM system than just technology, and that any deliberate, conscious attempt to manage knowledge in an organization amounts to a KM system. (Edwards, 2009).

As regards the first element, **people**, we focus on organisational structure as an important aspect because it determines the future function of the whole system; here we concentrate on two main elements - subordination and leadership. Formal subordination defines how responsibilities for different functions and processes are allocated to different organisational entities like functional units, matrix units or teams. For an E-Collaboration system, it does not matter which of these formal structures is in place; what matters is that the system should rely on an "informal subordination" i.e. on participation of all members of the unit in decision-making, like in a social network. The leadership style is another essential aspect of an E-Collaboration system and should be "facilitative" rather than "impositional", indicating a style which promotes choice and an error culture and also pays attention to (Fryer 2012, pp. 37-38): a) creating unrestricted communication; b) legitimate application of power; c) encouraging diversity of expression; d) legitimating leadership status.

As regards the second element, **processes**, the design of an E-Collaboration system should support those methods of interaction among employees which implement the social network required by the people element (see above) and which at the same time are suitable for the knowledge management task of building a shared knowledge structure. One method which satisfies these conditions is the Community of Practice method which defines a very specific type of social structure composed by three fundamental elements: domain, community and practice (Wenger et al. 2002, pp. 27ff and 41ff). In building a SKS, the community of practice will

have to perform all major processes of stewarding knowledge (like acquiring, developing, making transparent, sharing, preserving and using knowledge); for this reason, we will use a model of how to deal with knowledge (now called "Knowledge Collaboration", previously “Knowledge Cooperation”) for our design that we developed in our previous research on Knowledge Management (KM) with the aim of making KM more user-centred (Bettoni & Eggs 2010, pp. 137-138) and consistent with the theoretical foundations of the community of practice model (Wenger, 1998). Our model suggests that dealing with knowledge should be viewed and implemented as a duality of a) participation in knowledge and b) cultivation of knowledge. Cultivation of knowledge is the circular process by which a community collaboratively stewards its knowledge resources (using processes such as acquiring, developing, making transparent, sharing and preserving knowledge) and uses them in daily work. Participation in knowledge is the circular process by which community members build up social capital (establish and take care of personal relationships, develop individual and collective identities, etc.) and “invest” this social capital in collaboratively stewarding the knowledge resources of their community. Finally, as regards **technology**, the design of the E-Collaboration systems should take into consideration the needs implied by the design of the previous two elements, people and processes. The technology should be an enabler for these needs: this is why we have selected a Web 2.0 technology and a Virtual Team Office as a platform for implementing it.

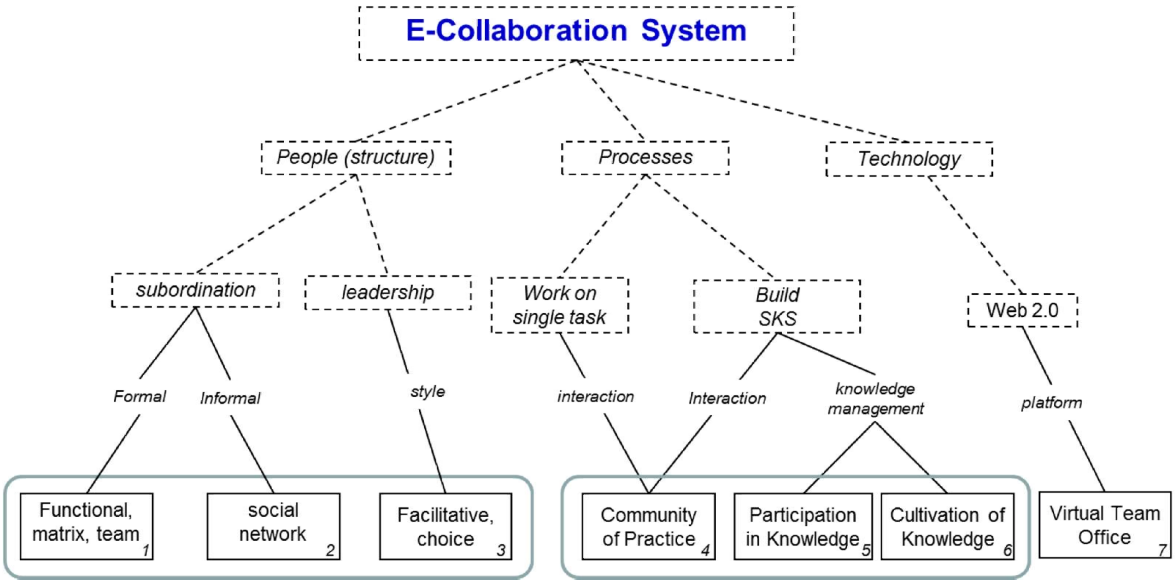

Figure 2. Architecture of a knowledge-oriented E-Collaboration system

This architecture suggests that, in order to construct an E-Collaboration system, you have to design a tree with three branches: a people branch, process branch and technology branch (Figure 2). The people branch is divided into two further sub-branches, "subordination" and "leadership". And the subordination branch divides further into "formal subordination" and "informal subordination". At the end of all sub-branches there are three "leaves": Team, Social

Network and Facilitative Leadership. The 4 leaves found at the end of the other two main sub-branches are: Community of Practice, Participation in Knowledge, Cultivation of Knowledge and Virtual Team Office. Together, these 7 leaves are what you have to design in order to implement the core elements of an E-Collaboration system.

4. Implementation & Experiences

An E-Collaboration system implemented according to the aforementioned architecture can be found within our E-Collaboration team (formerly the Research Management Unit, in German "Stabsstelle Forschung", acronym SF) at FFHS. The motivation for developing, implementing and applying an E-Collaboration system is based on the one hand on the mission of our team, which consists of promoting E-Collaboration as a competence within FFHS by seeing it as complementary to E-Learning, the core business of FFHS as a distance-learning university. On the other hand, we as a team share the conviction that to solving 21st century problems, we need 21st century organisation and want to organise our team accordingly in an innovative way. This is why E-Collaboration became our main way of working.

The first system prototype, called eSF (the acronym stands for "elektronische Stabsstelle Forschung" which means "electronic Research Management Unit"), was drafted in 2005 by team leader Marco Bettoni and was subsequently adapted regularly in collaboration with the team members. Between 2009 and 2011, the whole team - Cindy Eggs, Willi Bernhard, Nicole Bittel and Marco Bettoni – contributed to a first redesign. A second redesign called eSF2 was implemented in June 2013 when a new member joined our team in the role of a part-time office manager.
In this section, we present the implementation of the people, processes and technology components and related experiences in our eSF system: a) social network, b) facilitative leadership (Albatross method), c) CoP interactions, d) cultivation of knowledge and participation in knowledge, e) virtual team office on Moodle, a platform that constitutes the main technological support for the daily work of our team and can be regarded as its primary meeting place.

4.1 People

From a formal point of view, our team is not included in one of the university's departments but rather is organised as an independent Advisory Staff Unit which reports directly to the general director of our university and is responsible for research and consulting in E-Collaboration. We are four people, two senior researchers and two young research associates, each with multifaceted competencies of different types. One of the two research associates (second

author), who joined the team in 2011, has an MA degree in Pedagogy, Religion and Criminology and is responsible for the topic of "Storytelling in Working & Learning", whereas the second research associate, who arrived in 2014, has a degree in Work Psychology, English and German and will take over responsibility for our new topic of "New Working Spaces for Knowledge Work". One of the senior researchers (third author), an electronic engineer who has been member of the team since 2006, is head of consulting and responsible for the topic of "Serious Games". Last but not least, the other senior researcher (first author), a mechanical engineer, software engineer, knowledge engineer and philosopher, is the formal leader of the team and since 2005 has been a member of the board of directors of our university where he represents research.

So far the *formal* aspects are relevant as regards the employment contract, job description, career opportunities, salary ranges, holiday entitlement, telework regulation, etc. But from the viewpoint of how we actually do our job and work together, what is far more important in our team is the *informal* structure (a kind of "informal subordination" or "no subordination") which is based on the principle of promoting participation in decision-making, inspiring initiative and supporting personal ownership for all members of the unit, like in a social network. By social network we understand here a self-organising, emergent and complex set of socially-relevant nodes (people) connected by one or more relationships (Wellman, 1997; Newman et al., 2006; Marin & Wellman, 2011). When, like in our case, the relational focus is on knowledge processes, then we can speak of a "knowledge network team" (or kn-team see 4.2 Processes), a type of team that reminds the *collaborative innovation networks* (COINs) proposed by Gloor (2006). Our team has been designed and implemented as such a collaborative knowledge network: unlike traditional teams, where the individual knowledge of team members has a more instrumental and secondary role, the primary goal of our kn-team is to steward knowledge and to promote learning. Therefore our focus here is not on product creation (for example: a research project) or on the provision of research services (like organising a researchers' colloquium) but on creating the best conditions for performing these activities, which means developing team members' knowledge. Whereas traditional teams are constituted according to predetermined tasks and their relationships are determined by the task structure, in our kn-team it is the knowledge domain which determines the team's constitution (selection of members) and team members are connected in a multitude of ways based on manifold relationships between their individual knowledge areas. Functions and roles of team members are situationally negotiated, based on their individual activities, interests, involvement in team-building tasks and contributions to extending the team's practice and supported by feedback from team colleagues. This concept and practice of a *knowledge network team* also requires a new leadership style, one that is "facilitative" rather than "impositional", "listening" rather than "talking" and

"coordinating" rather than "controlling". The team leader tries to be neutral and not to use the decision-making authority accorded by the formal position. His/her main task is "to help the group increase its effectiveness by improving its process and structure" (Schwarz, 2005), like in group facilitation. An important foundation and tool for implementing this approach is the so-called "Gossamer Albatross Principle" which states that "Choice leads to motivation and innovation" and the related "Gossamer Albatross Method", a management technique derived from the 1978 success of the Gossamer Albatross aircraft, which resulted in man's first flight (across the English Channel) without use of external power, i.e. a self-powered flight (Weidner, 2007; Grosser, 2004). The aircraft was designed and built by a team led by Paul B. MacCready, a US engineer; it was powered by muscular force using pedals to drive a large two-bladed propeller. On June 12, 1979, piloted by amateur cyclist Bryan Allen, it crossed the English Channel (35.8 km between the Warren near Folkstone and Cap Gris-Nez) in 2 hours and 49 minutes. The key to this extraordinary success – after twenty years of attempts by many international teams - was not the technology alone (aerodynamics, engineering, etc.) but also the kind of team leadership MacCready practised. He had developed a new way of distributing the tasks: instead of prescribing who should do what, as is customary, he merely sorted the list of tasks by priority and let the team members choose: each team member could select his/her preferred tasks and the remaining unselected tasks were distributed only afterwards. Our team applies this method in the same way. Each year we develop a list of the tasks that we need for implementing our given team objectives; based on this list, each team member selects his/her preferred tasks; finally the unselected tasks are distributed among all team members by negotiation.

4.2 Processes

The design of the two main processes in our eSF system, i.e. interaction and knowledge management, has been strongly influenced by experiences collected in a previous experiment, a knowledge network called "Community of Research" or CoRe (Bettoni et al., 2011; Bettoni et al., 2007). Viewed as a social structure, CoRe was composed of seven basic elements, seven interaction and cooperation areas which correspond to aspects of community life. The individual elements are: 1) Community, 2) Practice, 3) Domain, 4) Leadership, 5) Individual, 6) Connections and 7) Resource Development. This concept was based on Etienne Wenger's social theory of learning and his international online workshop "Foundations of Communities of Practice". Since CoRe was a distributed community, interactions among its members were supported by an online collaboration platform on MOODLE called 'CoRe Square', a virtual space for meeting and stewarding research knowledge. The main part of community life in CoRe was organised based on three types of interactions which were also three distinct areas of cooperation for stewarding research knowledge: Domain, Community and Practice. These

aspects of community life constituted the central framework of CoRe, viewed as a social structure. *Domain* was that aspect of life in CoRe that collected interactions in which members discussed current topics and shared best practice ideas and lessons learned from past research practice. *Community* collected interactions in which members came together to build connections and cultivate relationships and *Practice* collected interactions in which members engaged in joint activities to solve problems (research or consulting projects) or to build shared knowledge in their domain by telling stories, discussing their own cases and collaborating in projects.

4.2.1 Interaction

In the design of eSF, these same three elements of Domain, Community and Practice are not separated into three independent areas but integrated into any task by means of three types of interaction called “Discuss”, “Describe” and “Document”:

- **Discuss**: this interaction consists of considering or examining issues according to argument, comment, suggestions, etc.; this type of interaction is used in a balanced way for Domain, Community and Practice interactions; a *Domain discussion* is about a topic of our research that we want to explore and better understand; a *Community discussion* is about understanding one another as people, as human beings in our team; it is an opportunity for team members to support each other in exploring who is who, who knows what and how we function together as a team; a *Practice discussion* is about some work, for example a task in a project or a step in case-based problem-solving situation or else is about an experience recounted in the form of a happening or connected series of happenings experienced by one of the team’s members.
- **Describe**: the essence of this interaction consists of representing with words, numbers and/or pictures the outcomes (intermediate, final) of a discussion; it is mainly used for Practice interactions but also includes Domain interactions sometimes. It is seldom used for Community interactions. A *Practice description* can be any intermediary outcome in a project, like the draft of a deliverable or an article. A *Domain description* can represent, for example, the shared understanding of an aspect of our research topic that has been discussed and a *Community description* can be, for example, a list of individual competences, connections or preferences or a table of the team’s weekly office presence, a table of its yearly absences (who is at a conference when, who is on holiday, has plans other such absences) etc.
- **Document**: saving what has been described or collected from external sources to an organised repository; mainly used for Domain and Practice interactions, seldom for Community interactions. A Domain document could be, for example, a declaration of the team’s mission, vision and strategy; a Practice document can be a report in a project or

the final version of a scientific paper and a Community document, a CV of a team member or a plan for a team's outdoor meeting.

Together these 3 types of interactions constitute what we call a "3D task approach" which claims that any collaborative task can be performed by selecting an appropriate combination of these three interaction types.

4.2.2 Knowledge Management

Building shared knowledge structures during team interactions requires that participants deal with knowledge in a way that is at the same time systematic, participative (user-centred) and meaningful to them both as individuals and as a group. In order to comply with these requirements, we chose for our E-Collaboration system a participatory knowledge management model called "Knowledge Collaboration" consisting of two cross-coupled learning loops that activate and sustain one another: "cultivation of knowledge" and "participation in knowledge" (Figure 3).

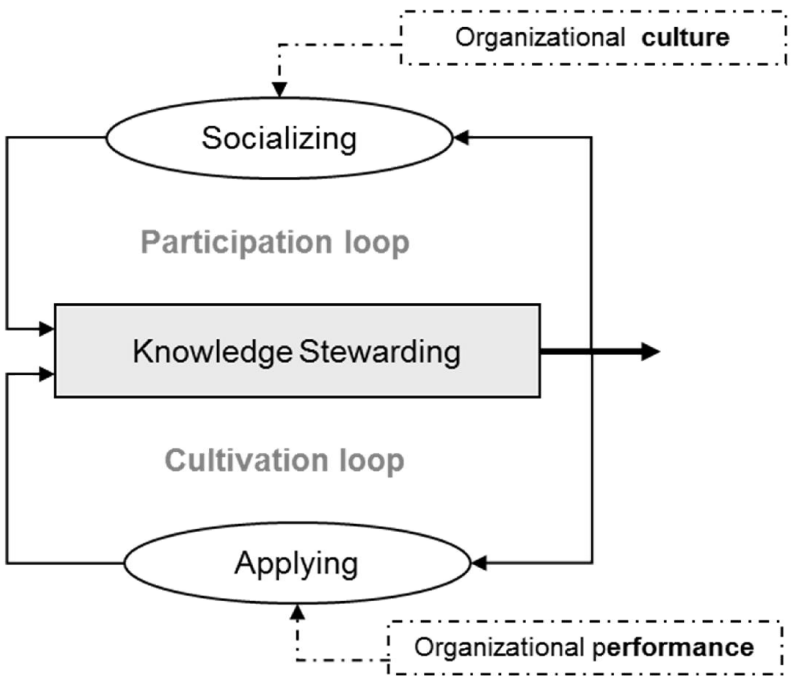

Figure 3: Knowledge Collaboration

The lower loop, cultivation of knowledge, is the circular process by which a community collaboratively stewards its knowledge resources and uses them in daily work. The upper loop, participation in knowledge, is the circular process by which community members build social capital (establish and take care of personal relationships, develop individual and collective

identities, etc.) and "invest" this social capital in collaboratively stewarding the knowledge resources of their community. The three processes or groups of knowledge processes connected by means of the two learning loops are:
a) Stewarding knowledge: this encompasses activities such as acquiring, developing, making transparent, sharing and preserving knowledge.
b) Applying knowledge: activities by which knowledge resources available through knowledge stewarding are used in business processes.
c) Socialising knowledge: activities at a personal and institutional level by which relationships are established and cultivated in view of stewarding and applying knowledge.

To conceive of and implement participation and cultivation as a duality means that they should take place together; they should both require and enable each other. There should not be any cultivation without participation or any participation without cultivation. Participation and cultivation should imply one another. Increasing the level of cultivation should not replace an equal amount of participation; on the contrary it should tend to require an increase in participation.
Cultivation of knowledge should always be based on participation in knowledge: applying knowledge requires a history of participation as a context for its interpretation. In turn, participation in knowledge should also be based on cultivation because it always involves words, concepts and artefacts that allow it to proceed. Finally, the processes of participation (embodied in people) and cultivation (embodied in artefacts) should not be considered just as a distinction between people (human operators) and explicit knowledge (artificial operands, things). In terms of meaning, people and things cannot be defined independently of one another. On the one hand, our sense of ourselves includes the objects of our practice; on the other hand, what these objects are depends on the people that shape them through their experiences.

4.2.3 Task organisation

Within a virtual team there is a strong need to organise tasks in a systematic way which is shared and transparent to every team member; in our case, organising our list of tasks (what we need to do to implement our teams' objectives) in a systematic way led to a classification of our tasks into 14 categories which are combined in 2 groups: A) Knowledge Management Services; B) E-Collaboration Research & Consulting. Group A includes 6 types of tasks: 1. coordination; 2. research services; 3. quality management; 4. e-organisation; 5. administration; 6. team professional development. Group B encompasses the remaining 8 categories: 7. general R&D activities; 8. R&D project preparation; 9. R&D project execution; 10. general consulting

activities; 11. consulting project preparation; 12. consulting project execution; 13. knowledge transfer in general; 14. knowledge transfer within our institution (teaching).

4.3 Technology

In our approach, technology is primarily an enabler for satisfying the needs that emerge when the "People" and "Process" elements have been designed; their characteristics provide the required guidelines for selecting and designing technological components. Without these premises, technology becomes easily an illusion or worse, an inhibitor. In terms of the architecture visualised in Figure 2, this means that to design technology, we have to take into consideration the needs that emerge from the design of the 6 leaves of the branches "People" and "Processes" : 1.Team, 2. Social Network, 3. Facilitative Leadership, 4. Community of Practice, 5. Participation in Knowledge and 6. Cultivation of Knowledge. Let us have in the following a closer look at the main aspects of our technological design: 1) Web 2.0 approach ; 2) Moodle platform; 3) Virtual Team Office; 4) Support for KM; 5) Support for the 3D task approach.

4.3.1 Web 2.0 approach. Although the concept of Web 2.0 was coined 15 years ago (Darcy DiNucci[1]) and popularised 10 years ago, it is nevertheless worth mentioning it explicitly for the design of our system. For knowledge workers who collaborate on building a shared knowledge structure, the shift from a passive viewing of content to interaction and active generation of content is a kind of quantum leap and not merely jargon, as Tim Berners-Lee claimed (Laningham, 2006). So, we need to take this step seriously and understand what it means. By providing users with the technology for supporting the two loops of Participation in Knowledge and Cultivation of Knowledge, a Web 2.0 approach constitutes a necessary condition for making the Virtual Team Office a collaborative space.

4.3.2 Moodle platform. The reasons for selecting Moodle as a platform for implementing our Virtual Team Office are summarised in the following objectives (Bettoni et al., 2006):

- allows us to have our Virtual Team space easily integrated with the teaching space of our University (which uses Moodle as LMS)
- allows team members to easily commute between the teaching and the team environment
- allows team members to easily commute between the research platform for all researchers (which is also a Moodle space) and the team environment.

[1] http://en.wikipedia.org/wiki/Web_2.0

Other advantages of MOODLE can be found in its flexible user administration, good accessibility of the space for private uses (open source) and the large community of users worldwide (with about 59,000 registered sites and 76 million registered users on August 2015[2]).

4.3.3 Virtual Team Office. Just as clubs have a clubhouse or other sorts of meeting places (for example the "Mermaid Tavern" in London in the Elizabethan era[3]), likewise we are convinced that a virtual team of knowledge workers needs a fixed and well-organised place which reifies its ties as a team and which provides facilities for supporting collaboration and the two loops of knowledge stewarding (Figure 3). This shared space is a fundamental condition for enabling the construction of a shared knowledge structure. Like in the Japanese concept of "ba", this virtual team office "... can be thought of as a shared space for emerging relationships" (Nonaka & Konno, 1998).

The layout of our Moodle Virtual Team Office has a so-called "topics format", meaning that the space is organised into topic sections that can be given titles and include various tools. In former versions, each section was used to encompass all the tools needed for one of the 14 task categories, so we had 14 sections; this approach was more 'task-oriented' in the sense that orientation within the sections was determined by the type of task; for example to ask a question about a template for a project proposal, you had first to decide if this task-object was better classified as belonging to a "research service task" (section 2) or to a "quality management task" (section 3) and then find the correct tool within that section.

In the current version instead, each topic represents one type of interaction and its section contains only the tool that enables it; as a consequence we now have seven sections: 1. Forums; 2. Wikis. 3 Folders; 4. Google Docs; 5. Internet links; 6. Individual tools; 7. Archive. Within these sections, the tools are differentiated by the 14 task categories; so for example we have a forum for coordination, one for research services, one for the preparation of R&D projects, etc. With this approach, we wanted to implement a more "interaction-oriented" orientation because we felt that it would be more consistent with our 3D task approach and as such enable us to make orientation in the Virtual Office more effective. The same question about where to find a template for a project proposal would easily lead to the "folders" section and then here, to find the correct folder, you would have to decide if this task-object was better classified as belonging to a "research service task" (section 2) or to a "quality management task" (section 3).

[2] http://moodle.org/stats/
[3] http://en.wikipedia.org/wiki/Mermaid_Tavern

4.3.4 Support for Knowledge Management. According to our model (see 4.2.2), we understand Knowledge Management in E-Collaboration as Knowledge Collaboration by means of two learning loops: the Cultivation loop and the Participation Loop. Technological support for these loops is achieved by means of a "negotiation triad", a set of three tools: a forum tool, a wiki tool and a file folder tool. The forum is a tool for enabling participation in knowledge: creating new discussion threads, reading posts and replying to them supports participation as the social experience of being connected with others and being actively involved in a collective enterprise (stewarding research knowledge). The wiki is a tool for enabling cultivation of knowledge that preserves the results of conversations (new ideas, insight, best practices, lessons learned, definitions, procedures, etc.) by organising them in a structured way and independently of time. Finally the file folder is a tool for storing the documents referenced either in the associated forum or in the associated wiki.

4.3.5 Support for the 3D task approach. For each of the 3 main types of interactions ("Discuss", "Describe" and "Document") needed to perform a collaborative task, our virtual office provides a specific technological tool: a forum discussion for supporting asynchronous "discuss" interactions, a wikipage or a GoogleDocs document for "describe" interactions and a file folder for "document" interactions. In the current version of the platform, where these tools are placed in different topic sections, there needs to be some way to connect them (thus showing that they belong as a unity to the same collaborative task) and to facilitate shifting along the connections. This is achieved by including hyperlinks, for example from forum posts to wikipages or from wikipages to documents in folders. Synchronous interactions supported by tools like Skype or Adobe Connect are usually understood as the main form of E-Collaboration; we also use them in our team, but their impact is limited to a small percent of our total interaction time, probably less than 10%.

5. Solutions and Recommendations (The Full Power of E-Collaboration)

Business value depends not only on the quality of business processes and their outcomes but is increasingly being influenced by the quality of knowledge collaboration. But what do "knowledge" and "collaboration" mean in a business context? Our definition of E-Collaboration - as a process consisting of two concurrent activities, one being to work on a single task and the other to build a shared knowledge structure - suggests that knowledge and collaboration are intimately connected in a peculiar way that needs to be well understood in order to accomplish effective and efficient E-Collaboration. This is the first main success factor, but how should it be implemented?

Our answer to this question consists of the architecture of an E-Collaboration system conceived as a tree with three branches: a people branch, process branch and technology branch. And this, as far as we can see from our experience, is the second main success factor in achieving high quality E-Collaboration. But this is not enough and so we come to the third main success factor: the selection of appropriate sub-branches and leaves for the main 3 branches.
The “Social Network” leaf is appropriate because the process of building a shared knowledge structure requires a type of subordination among people that is typical of a network structure where everyone can be a leader, depending of the task to be performed. On the one hand, the members of the social network must be well integrated in the conventional hierarchical structure of the company: this is accomplished by selecting the “team” as a conventional, formal structure. On the other hand, the social network needs a facilitative kind of leadership (the third leaf of the people branch) and a community-oriented organisation of its interactions (Community of Practice, first leaf on the process branch) and its ways of dealing with knowledge (Participation in Knowledge, Cultivation of Knowledge, second and third leaves on the process branch). Finally a Virtual Team Office is appropriate as an online enabler of the aforementioned activities.

Thus we can summarise our recommendations under the following 3 key points:

1. CONCEPT: find a definition of E-Collaboration that is knowledge-oriented: see the one that we have given as a source of inspiration
2. DESIGN: when designing your solution, consider the PPT model (people, process and technology) and make sure that your design puts all three elements in the right balance and with appropriate relationships. Compare your design with our tree architecture, particularly from the point of view of its knowledge orientation
3. IMPLEMENTATION: last but not least, when selecting the elements that implement your design, make sure that they are consistent with the knowledge-oriented concept and with the PPT model.

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