TOWARDS ENHANCED E-COLLABORATION IN ACADEMIA
A HOLISTIC MODEL FOR DEVELOPMENT OF E-COLLABORATION SOFTWARE

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Abstract
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E-collaboration is an inherently complex activity that encompasses many factors that supplement the pivotal technical elements. This paper investigates the various aspects of e-collaboration from an academic viewpoint, and reiterates the call for a holistic approach towards e-collaboration research and development. Moreover, the use of collaboration tools by IT students is surveyed, which substantiates the belief that e-collaboration needs to be further promoted in academia. We present a conceptual model that hopefully can provide some guidance for further research on e-collaboration and development of e-collaboration suites.
Keywords: E-collaboration, Academia, Requirements, Boundaries, Holistic

1. Introduction

1.1 Background

Groupware is collaborative software that is used to aid communication and productivity. They are effective in providing a common environment in which to carry out collaborative tasks.
Although the number of tools available on the Web has greatly increased in recent years, much effort is often required in combining a number of these in order to obtain sufficient support for a specific type of project. These tools are often incompatible, resulting in certain tedious tasks having to be reproduced in multiple places. Furthermore, development tends to be predominantly technology-driven, and inadequate consideration is given to other factors that affect e-collaboration.
Also, as development becomes progressively more accessible with the migration of software to the Web, there has been a certain degree of haste in the development of these tools without proper consideration for the needs of certain user groups (Tomek, 2003). One such group is university students. Although groupware applications were first made popular by students on college campuses, the academic needs of those students are yet to be fulfilled; and the groupware is yet to be integrated into the student-student relationship and the student-professor relationship (Frees & Kessler, 2004).

1.2 Research problem

Although there is a lack of comprehensive empirical studies providing support for this claim, we posit that e-collaboration is not a prevalent practice by university students. What are the reasons behind this? What do current e-collaboration tools and suites lack in functionality? Are there other factors at play?

1.3 Research goal

Our research, first of all, aims to understand a situation: why e-collaboration is not more prevalent between university students. There is an evident need for students to be able to work in decentralized environments—like distributed teams—not only in the industry, but also in academia.
By investigating the current status of e-collaboration usage among students, and by identifying the basic needs related to collaborative work in an academic setting, we intend to deliver a conceptual model that considers all aspects of e-collaboration. Our hope is that this may, to a modest degree, expand the conceptual boundary of e-collaboration, further research, and improve development of such technologies. Finally, we hope that e-collaboration will eventually be promoted more extensively in academia for the betterment of education in itself, and in order to better prepare students for the realities of the globalized world we live in.

1.4 Research methodology

Our approach is derived from various types of research methodologies. Our primary aim is to understand a situation, namely the employment of e-collaboration software by IT students. This is achieved through a survey. Based on previous research and by integrating technical and social factors with expressed user requirements, we develop a conceptual artifact. This model can hopefully be used to guide development of e-collaboration software.
The research primarily takes on a qualitative approach. The process is mainly inductive, by inferring a set of conclusions from particular instances.
The survey was sent out to Master students at the joint IT University of the Royal Institute of Technology (KTH) and Stockholm University. The survey aims to test the extent to which these students are using e-collaboration tools and suites; their awareness of the developments in this area; and their interest in increasing the usage of such software in academia.

1.5 Limitations

The first and foremost concession is tied to the limited time frame (4 weeks) of this project, which was done as part of the "Scientific Communication and Research Methodology" course given at the Royal Institute of Technology (KTH).
Secondly, although the survey was sent out to 270 students, we only managed to collect 72 sets of responses. This is a relatively small number; therefore, empirical studies are needed to consolidate some of the findings of the survey.
Finally, the research is targeted towards the usage of e-collaboration tools by IT students. However, we hope that the findings here will be of some, limited, use to the whole e-collaboration community.

1.6 Target audience

The research that we conducted is targeted towards the whole research community interested in e-collaboration at large, and in particular its application in academia. We also hope that it can provide some tangible value for the e-collaboration industry.

2. Background

2.1 The evolution of e-collaboration

A common misconception is that electronic collaboration is limited to computers. The term is often used interchangeably—and rather carelessly—with concepts such as CMC (computer-mediated communication) and CSCW (computer supported collaborative work). Contrary to that belief, definers of the term seem to have agreed that it merely entails collaboration using electronic technologies. In fact,

one can argue that e-collaboration dates back to the mid-1800s when the telegraph was first used as a means of communication.
However, neither the telegraph nor the succeeding telephone came close to realizing the potential of e-collaboration, as we know it today. Not even the first commercial computers, commonly referred to as mainframes, did much to help the cause. Arguably the first true form of e-collaboration came with the fruition of a project sponsored by the US Department of Defense, namely ARPANET. A byproduct of the project was an early form of e-mail, and in the 1970s and 1980s, it became a popular collaboration tool in computer science circles.
The subsequent advent of personal computers and LANs led to the emergence of a myriad of early e-collaboration technologies in the 1980s. The first were extensions of e-mail systems, but then so-called group decision support systems (GDSSs) began to appear. The purpose of such systems is to improve "same room, same place" group meetings by providing anonymous voting and generation of ideas.
In the early 1990s, ARPANET was transformed into the Internet, and in turn the World Wide Web came into existence. Today, e-collaboration is associated with such tools that were enabled by these developments. Contemporary e-collaboration technologies are thus almost invariably Internet-based and come in two forms: browser-based and non-browser-based (Kock & Nosek, 2005). As web-based applications seem to be gradually replacing desktop applications, many of today's e-collaboration tools are of the browser-based kind.

2.2 E-collaboration as a research area

Research on topics closely related to that of e-collaboration dates as far back as the end of the 1970s. Kock and Nosek (2005) identify two distinct traditions within the e-collaboration research community. The first research tradition is that of CSCW, which tends to focus on the more technical aspects of e-collaboration issues. The other research tradition came into being with the emergence of GDSSs and has, conversely, explored behavioral issues related to e-collaboration.
The distinct communities associated with these traditional lines of research were surprised when, with the emergence of the Internet, researchers from various different fields–ranging from marketing to education–became interested in the e-collaboration domain. Kock and Nosek (2005) argue that this led to the development of two disparate directions that subsequent e-collaboration research work would take. One preferred to remain within the boundaries of its own community, resulting in a large number of independent communities of inquiry. The other, instead, acknowledged the common cause of their research, which led to an amalgamated community of researchers from various different backgrounds. Kock and Nosek (2005) believe that e-collaboration research predominantly needs to take the latter direction.

2.3 E-collaboration in academia

Academia constantly needs to find ways of improving. Firstly, it has been concluded that the best way of pursuing that goal is through assessments that emphasize individual comprehension, making students choose an acute approach (Scouller cited in Siqueira et al, 2003). Secondly, there have emerged proponents of a way of teaching based on constructivist principles, where there is a high degree of interactivity between the participants (Siqueira et al, 2003). This became the basis for distributed collaborative work in the academic world (Lowry et al, 2004).
The academic environment not only cultivates knowledge, but also prepares students for the industry. While most work is still individual in academia, the professional work is very much collaborative (Lowry et al, 2004). For instance, organizations are aware that distributed teams contribute to their success by allowing sharing of knowledge across organizational boundaries, and helping to develop new products and services (Nidiffer & Dolan, 2005).

Working within teams is not only a reality for managers, educators and organizations, but it also adds value to society at large. Therefore, in a globalized society it should be a priority to train students in the use of collaboration tools; in analyzing their collaborative needs (Brown et al, 2007); in the management of work; as well as in adapting to cultural and time zone differences (Swigger et al, 2006). Yet, so far there has been a lack of widespread appreciation for collaborative technologies by instructors and professors (University of Wisconsin-Madison, 2006).

2.4 Related research

Even when talking about a category of e-collaboration as established as Collaborative Writing, empirical research in an educational setting has not been substantial (Lowry et al, 2004). There are calls for integrating e-collaboration in the student-professor relationship (Frees & Kessler, 2004), but case studies show that there is a reluctance to do so (University of Wisconsin-Madison, 2006), as well as very little engagement from professors (Frees & Kessler, 2004).
Although many of the e-collaboration applications were first advertised and used by students (Frees & Kessler, 2004), it appears that little has been done to enhance e-collaboration in the student-student relationship.

3. E-Collaboration Usage in Academia

3.1 Survey

The responses from 72 Master students in IT programs confirmed many assumptions about their use of e-collaboration, yet also uncovered some interesting facts.
The first conclusion is that students are fairly aware of the concept and have at least some personal experience with e-collaboration software. Their attitude is also generally positive towards the activity. Not surprisingly, more than 80% of them revealed that

- they were familiar with the term ‘collaboration tool’;
- they had used e-collaboration in an academic group project;
- they would like e-collaboration to be promoted in academia;
- they believe academic e-collaboration suites should be either publicly available and free of charge, or provided by the university.

As can be inferred from these results, students are not only aware and engaged in e-collaboration, but they would like it to be even more predominant in academia. This is in clear agreement with the fact that adoption of e-collaboration tools is weakened without proper promotion and support (Frees & Kessler, 2004). Going further with the analysis, students are simply not prepared to pay for the use of collaboration tools.
While their positivity towards e-collaboration is beyond doubt, 83.33% of them seemed to be aware of either the limitations of and risks associated with e-collaboration—e.g. potential loss of trust—or of the added value that face-to-face collaboration brings—like communication richness (Nidiffer & Dolan, 2005).
An analysis of the survey responses shows that the single-most fundamental requirement is file sharing, followed by instant messaging. Most e-collaboration suites today have some form of the former, but usually not the latter. Other basic requirements identified by more than half the students are the presence of a real-time document editor and the need for a web-based and free of charge suite.

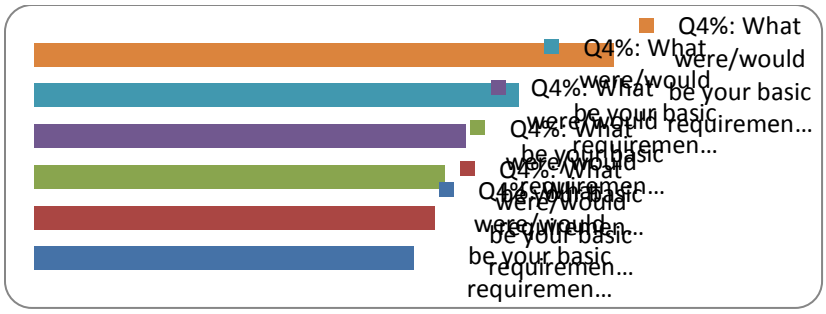

Figure 1 - Most common features reported as requirements for an academic e-collaboration suite

Although many of the respondents had used Google Docs, more comprehensive e-collaboration suites are not used extensively. Looking at the answers, only 13.89% of the respondents always used a suite for a group project, while up to 62.5% had issues with using an e-collaboration suite. Except 3, all respondents answered that the major reasons for not using a suite were the overhead with the setup or the management of the suites; the lack of awareness that such software products existed in the first place; or the lack of suites that fulfilled their requirements. The final question, asking what the reason was for not using an e-collaboration suite during one of the group projects, provides a clear insight into the situation.

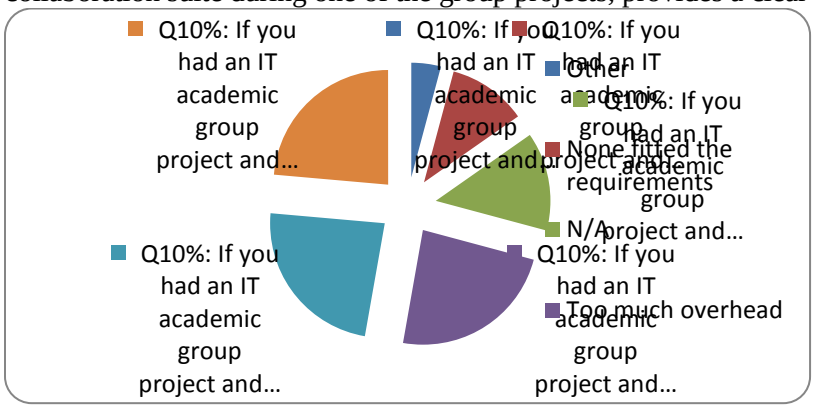

Figure 2 - Students' reasons for not choosing e-collaboration for their group projects

To conclude, students are aware of and have a positive attitude towards e-collaboration. However, due to the needs of students not being addressed adequately, e-collaboration tools are merely being used in isolated instances (62.5%).

3.2 E-collaboration boundaries

Before one delves into the intricacies of a particular research topic, it is important to be aware of the boundaries that surround and affect the field as a whole. In one sense, boundaries direct future exploration, which in turn transforms existing boundaries. These boundaries are not rigid fences separating disparate areas, but rather fluid and hazy lines that surround highly interrelated areas. Research can consolidate understanding within existing boundaries, expand and contract existing boundaries, and even create new boundaries. Kock and Nosek (2005) identify four types of boundaries that need to be expanded in order to further research in the e-collaboration domain: theoretical, technical, use, and conceptual.

Theoretical boundaries are difficult to expand in the e-collaboration domain as it involves formulating and testing explanations for phenomena that are inherently complex. One must remember that e-collaboration involves humans; it aims to comprehend and ultimately improve the process of people working together.

Improving technology is often seen as the core means of expanding e-collaboration boundaries. However, technology in itself does not warrant an expansion: substituting one technology for another, for instance,

does not necessarily ameliorate the collaboration process. Thus, it is critical that technology-driven research is conducted with the ultimate goal in mind—otherwise the users will reject it.
Use is an important group of boundaries as it takes into account the users of the e-collaboration software. As people experience new technology, their expectations of essential and desirable functionality invariably change. It is also important to note the existence of different levels of use. Not everyone is exploring the periphery of the technical boundaries, but may instead be stuck with older technologies. The resulting question is then how to get people, groups or organizations to adjust their level of use. Is the level of use nearest the technical periphery necessarily the best? These are issues that belong within the use boundaries, but which of course also affect the others boundaries.
Finally, the conceptual boundaries are those that likely have the greatest impact on the other boundaries. To exemplify this—but also to show the mutual interrelatedness of all the identified boundaries—we may consider the following historical scenario: A use boundary in e-collaboration was expanded when users of an early form of e-mail system expanded the conceptual boundary by conceiving an alternative application for it. This had only been enabled in the first place by the expansion of a technical boundary that had resulted from the creation of ARPANET. This in turn allowed researchers to expand the theoretical boundaries in e-collaboration.
This clearly shows the significance of the second line of research identified by Kock and Nosek (2005): that which acknowledges the effect of various distinct factors, no matter how foreign to one's own background, in the ultimate endeavor to enhance collaboration between people.

3.3 Technical factors

At the core of software products lies technology. Although more attention needs to be given to other factors, expansion of the technical boundary remains critical to the progress of e-collaboration. It is often the driving wheel behind the product, whether it is related to features, usability or maintainability.
As a consequence of the conceptual and use boundaries, e-collaboration software is usually modeled based on how face-to-face group meetings take place. As Greenberg et al (1992, p.5) put it, they include "a process where participants express, discuss and develop ideas. It is a creative forum where people are encouraged to present their thoughts to the group for feedback, to build upon the ideas presented by fellow members, and to solve problems". Thus, it is hard to ignore the human factor even when discussing technical factors of e-collaboration.
Speed and availability are two such technical factors. In the Internet era, with 1,463,632,361 Internet users world-wide recorded by July 30, 2008—nearly a quarter of the global population, and with a growth of 305.5% in the last 8 years (Miniwats Marketing Group, 2008)—and with so many services offering incredible amounts of data at an incredible speed with nearly no downtime, it is a must to aim for such standards, even in e-collaboration.
With so many Internet users, and with the migration of software to the Web, the term 'cross-platform' has almost become synonymous with 'web-based'. As was uncovered through the survey, most IT students expect e-collaboration tools to be provided on the Web for them to consider using such software. This is a factor that developers of e-collaboration will need to consider when targeting academia.
Flexibility is another important technical factor. E-collaboration modules need to communicate using open standards for better cohesion and integration. This will eliminate unnecessary duplication of work and avoid the existence of mutually incompatible software products (Tomek, 2003). Ultimately, this addresses issues with overhead in setup and management of the e-collaboration suite. It should also enable seamless interaction with the complex information space created by both web-based and desktop environments (Whitehead, 2007).
One final leading technical factor has to do with coordination. Even group projects that are driven by face-to-face group meetings do not imply always working at the same place and at the same time. Members of the group are present during the meeting, but their work probably exceeds the space and time boundaries of that meeting. In technical terms, this can be handled by allowing synchronous and asynchronous access to work-related information through e-collaboration software.

Features enabled by technology are the face of software. However, it is important to acknowledge that expansion of the technical boundary is to a large degree dependent on the expansion of the adjacent boundaries.

3.4 Other factors

Although technology is at the core of e-collaboration, there are many other factors which affect the process and that need to be taken into consideration. Team size is one such factor that greatly impacts various aspects of e-collaboration, e.g. technology choice. Bradner et al (2005) found that larger teams require tools to support coordination of asynchronous work, whereas smaller teams require the use of collaboration technology. One can explore a number of other social variables such as leadership, trust, culture, and identity. However, the two theories that have had the greatest impact on the e-collaboration literature are Social Presence Theory and Media Richness Theory.

Social Presence Theory was proposed by John Short et al. in 1976 (cited in Kock, 2004). They classified communication media according to their ability to make manifest the presence of others in communication interaction. The theory states that a communication medium is only effective if it possesses the right amount of social presence required for the level of interpersonal collaboration needed to accomplish a certain task. On a scale of social presence, face-to-face communication ostensibly has the most social presence, while written, text-based communication has the least (Kock, 2004).

Media Richness Theory was proposed by Richard Daft and Robert Lengel in 1986 (Daft & Lengel, 1986). This theory shares some characteristics with Social Presence Theory but classifies communication media according to their 'richness' rather than social presence. A medium's richness is evaluated based on its ability to provide instantaneous feedback, and to convey non-verbal cues and personality traits. In other words, it is measured by its ability to emulate face-to-face communication, in which it is very much like Social Presence Theory (Kock, 2004). This appears to oppose CMC technologies since they often suppress many face-to-face characteristics (Cai & Kock, 2009). It should be noted, however, that Media Richness Theory–much like Social Presence Theory–does not advocate rich media for all tasks; instead, the medium needs to be fitted to the task (Daft & Lengel, 1986).

Despite the fact that these theories have been opposed, they still form the foundation for much of today's e-collaboration literature. However, the 1990s has witnessed the development of several other theories that emphasize technology, such as the Gains and Losses model and the Task-Technology Fit theory. Kock (2004) believes that such theories can complement social theories.

4. E-Collaboration Development Model

4.1 Assimilation of e-collaboration factors

We have taken into account all the factors that affect e-collaboration and incorporated them into a conceptual model. The four corners of the outer pyramid are based on the e-collaboration boundaries identified by Kock. This encapsulates the current limits of e-collaboration. Unlike physical pyramids, this pyramid constantly changes shape as the boundaries expand or contract on their own, or as they influence each other.

From this outer pyramid, a pyramid within the boundaries of e-collaboration can be yielded. We suggest that this inner pyramid be used as an elementary blueprint when developing e-collaboration software, taking into account all related factors.

From the technical boundary, the ubiquitous features of the software are drawn. This is positioned at the top of the pyramid, as it is the part that is de facto noticed when looking at e-collaboration software. More important is the fact that these features are built on top of a solid foundation: a foundation which takes

into account the target users and their needs; current concepts and the users' ability to grasp them; as well as current theories that explore other critical factors, such as social presence and media richness.

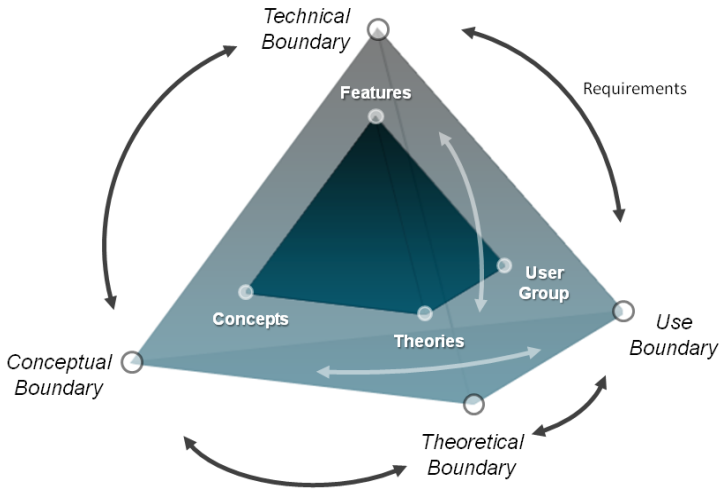

Figure 3 - Conceptual model for e-collaboration development

There has been a tendency in some research circles, and especially in the industry, to not consider all aspects of e-collaboration. This has sometimes limited the potential of e-collaboration (Kock & Nosek, 2005). If this model is used as a reference point in the development process, it will provide a more holistic perspective. This, in turn, may expand the boundaries of the inner pyramid and bring it closer to the foundation boundaries of the outer pyramid.

4.2 Application of conceptual model in academia

Now that we have a conceptual model for e-collaboration development, we can explore its applicability in development targeted towards IT students. The user group, which is drawn from the use boundary, becomes IT students. While one may assume that IT students ought to be at a fairly advanced level of use, this should generally be assessed. Additionally, their needs should be assessed and the desired features should be identified indirectly or directly, which we did through our survey. Since we now have a specified user group, the other boundaries will, as they should, be affected.
The conceptual boundary will need to take into account which concepts IT students can grasp and are comfortable with. Going beyond emulation of real world entities and situations should be considered. Students, for instance, given the positive attitude shown in the survey, may very well be open to new concepts. Similarly, existing theories, drawn from the theoretical boundary, also need to be considered when developing e-collaboration software. As e-collaboration involves humans, this entails a number of social theories. How do these social theories affect students collaborating online? How can issues regarding student collaboration be alleviated? Technology and the selection of features are subsequently affected by these two boundaries, along with the aforementioned user group.
By adhering to this instantiation of the conceptual model, e-collaboration development targeted at university students will take place with a solid foundation, and technology isolation will be avoided.

5. Conclusion & Discussion

5.1 Conclusion

Employment of e-collaboration suites is not common between students in academia. This seems to be the general case regardless of the surveyed students' purported awareness of the concept, previous experience

with tools, and positive attitude towards its potential. There is an evident gap between the needs of tertiary students and currently available e-collaboration software. Much of the explanation for this lies in the industry's unfortunate neglect of assuming a holistic perspective of e-collaboration. Hence, we put forth a conceptual model incorporating the various factors that we believe should be taken into consideration when developing e-collaboration software.

5.2 Discussion

As we live in an increasingly globalized world, the ability to collaborate in geographically distributed locations has become essential. Academia needs to prepare students for this new reality; thus, this element needs to be incorporated into tertiary education. For this to be feasible, the industry needs to address the specific needs of university students when developing e-collaboration software.

5.3 Future research

Due to its dynamic boundaries, e-collaboration is not only going to be part of collaborative work in the future, but it will also change the way it supports communication, sharing, handling and development. Whilst trying to enhance e-collaboration conceptually, research should also investigate present-time e-collaboration, its concepts, its users and its implementations.
More empirical studies need to be conducted in educational settings. We call for this type of research to explore the results present in this paper and for exploration of our conceptual model.
Last, but not the least, research needs to be deepened and broadened with regards to student-student e-collaboration. This will attempt to improve the academic effort in general, and the education of students in specific. The industry and the society as a whole may benefit from quicker and more efficient studentship collaborative work.

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