



Classification of IS Functionalities for Workplace E-Collaboration

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davidmayrhofer@unisg.ch**ABSTRACT**

The interest in virtual teams, virtual communities, and collaboration is increasingly growing and technological improvements are providing enhanced web-based support for collaboration across time and space. Hence, a lot of tools with different functionalities are assigned to several existing categories and sold under the umbrella of e-collaboration. Within this paper the authors identify typical IS functionalities, build a classification to assign these functionalities, and categorize software tools to be found on the market. First, the state-of-the-art on functionalities and classifications for e-collaboration is presented and shortcomings are highlighted. Second, typical functionalities for e-collaboration are identified by analyzing existing literature as well as several software products, being sold under the label of e-collaboration. Third, a classification for the identified functionalities is developed, based on a meta model for business engineering as well as further literature on taxonomies and classifications. Finally, the paper closes with a summary, conclusion as well as some calls for further research.

INTRODUCTION

The interest in virtual teams, e-collaboration and electronic meetings is continuously growing, not only since the terrorist attacks and the SARS crises. According to a survey of (Wainhouse, 2002), there has been a relative growth of 61.5% of web-conferencing use after 9/11.

It is not only these developments leading to increased interest in this topic. Even from a business point of view all these topics are attracting a great deal of attention.

In response to the current situation where tasks are becoming more complex and require heterogeneous expertise, organizations are increasingly implementing team based business processes with multi-disciplinary teams (Meier, 2001). Therefore, horizontal organizational structures and team-based work units have become increasingly prevalent and experts of different geographical locations have to be put together in "cross-regional project teams". With advances in technology, there has been an increasing emphasis on far-flung, distributed, "virtual" teams as organizing units of work (Bell & Kozlowski, 2002, p. 41).

(Susman et al., 2003, p. 141) argue, that the introduction of collaborative technology does not necessarily enhance collaboration among employees. This is in line with the opinion of (Mayrhofer & Back, 2003a, p. 410), that a holistic approach – taking strategy, processes, and culture into consideration – is needed for e-collaboration. Nevertheless, this paper is focusing on the technological aspects of e-collaboration.

Taking a look at the technological support for collaboration – the collaborative technologies – numerous tools already exist being sold under the label of collaborative software. E.g. (Think of it, 2002) provides a list of hundreds of freeware, shareware and commercial tools to support collaboration. These products range from internet forums to more complex ones for real-time collaboration.

Hence, the aim of this article is to identify the most important functionalities of collaborative technologies and create a classification for these functionalities and tools.

STATE OF THE ART AND RESEARCH OBJECTIVES

An extensive amount of research exists on e-collaboration and virtual teams (Holton, 2001; Kimball & Eunice, 1999; Lipnack & Stamps, 1993; Mahoney, 2001; Poltrock & Engelbeck, 1999; Zigungs, 2003) etc. and several software tools are already sold under the label of "e-collaboration". For detailed listings see (Bafoutsou & Mentzas, 2002; Mayrhofer & Back, 2003b; Meier, 2001; Meier & Schneider, 2002; Think of it, 2002).

Several classifications already exist for collaborative technologies, especially originating from the CSCW/groupware research (e.g. (DeSanctis & Gallupe, 1987; Ellis et al., 1991; Johansen, 1988; Nunamaker et al., 1995; Teufel et al., 1995)). Due to the rapid change of technological functionalities (new technological possibilities due to increasing bandwidth, etc.) new classifications for collaborative technologies are needed as well. The classification by (Bafoutsou & Mentzas, 2002), which explicitly takes new web-based technologies into account, has been the only comparable work available.

Traditional schemes are based on: 1. the time and place of the interaction, 2. who or what has the center of control, and 3. functions and features (Coleman, 1993, p. 28).

The most common taxonomies for collaborative technologies are distinguishing functionalities and tools by the time (1) and place (2) of interaction and are using the attributes of same and different (DeSanctis & Gallupe, 1987; Ellis et al., 1991; Johansen, 1988), resulting in a 2x2 matrix.

(Ellis et al., 1991, p. 41f) also provide another classification based on application-level functionality with the intention to give an idea of the breadth of collaborative technologies.

(Nunamaker et al., 1996) even present a groupware grid, which could be used for classifying IS functionalities and tools, as well.

Another classification by (Teufel et al., 1995) uses the basic support functions of collaboration (communication, coordination and cooperation). The continuous nature of this classification allows assignments not only to one specific kind of support function, but also to a focus resulting in a mixture of these dimensions.

(Stoller-Schai, 2003, p. 89ff) categorizes e-collaboration tools according to different needs (individual, collective, process-oriented).

Based on media richness theory (Daft & Lengel, 1984, 1986) or media synchronicity theory (Dennis & Valacich, 1999), taxonomies of e-collaboration are possible as well.

Therefore, several "traditional classifications" already exist, but none of these is able to also capture all the new functionalities and hence, to also build categories of new software products.

Although (Coleman, 1993, p. 28) states, that "products do not always easily classify themselves, and often fall into multiple categories, no definition or classification scheme is perfect" and "they are only structures and guidelines to help make some sense out of the (...) products on the market", this paper tries to provide some support for getting an overview of and classifying e-collaboration software and functionalities.

Accordingly, the research questions to be answered within this paper are: "Which technological functionalities are supporting work-

place e-collaboration and how can they be assigned to a suited classification? How can software product categories be defined?"

METHODOLOGY

As already mentioned above, the authors are conducting research on the development of a holistic model for implementing and maintaining workplace e-collaboration. Therefore, this paper is only a part of the research program and is generally consisting of the following:

Firstly, the general topic has been described and the research question has been framed. Secondly, artifacts are built by means of identifying IS functionalities and building a classification to assign these functionalities. Based on existing literature and functionalities to be found in so-called e-collaboration software tools, a list of functionalities will be provided. Furthermore, the meta-model for business engineering (see Figure 2) as well as existing literature on taxonomies will be used to build a conceptual classification.

The next steps, not being part of this paper, are to connect the results with the authors' further research on e-collaboration and validate the holistic approach.

IDENTIFICATION OF FUNCTIONALITIES AND DEVELOPMENT OF A CLASSIFICATION

Background

First of all the term e-collaboration should be clarified. The authors clearly distinguish between business collaboration in a sense of business networking (e.g. (Österle & Winter, 2003)) on the one hand and workplace e-collaboration on the other hand.

Based on the definitions of (Stoller-Schai, 2003, p. 34ff) for communication, cooperation and collaboration, (Mayrhofer & Back, 2003a, p. 409) similar to (Kock et al., 2001, p. 1) have already defined workplace e-collaboration as following:

"Workplace e-collaboration is the computer mediated process of two or more (dislocated) people working together on a common purpose or goal, where the participants are committed and interdependent and work in a common context using shared resources, supported by web-based electronic tools."

The main difference of this definition to definitions of groupware (e.g. (Nunamaker et al., 1995)) is, that the focus of e-collaboration is on a process rather than on the technology. Furthermore, a focus is laid on web-based technologies to support this process. (Stoller-Schai, 2003, p. 2) also argues, that CSCW and groupware are strongly technology oriented, whereas e-collaboration is application oriented. Based on the above working definition the objective of e-collaboration functionalities should be to only use a web-browser (including plug-ins or at the utmost a thin client) to execute any functionality.

Hence, non-web-based technologies and functionalities will a priori not be part of the research in this paper (e.g. telephone, video-conferencing, face-to-face communication, etc.).

Existing Approaches and Shortcomings

As already mentioned above, extensive research has been conducted in regard to e-collaboration in general, but only a small part focused on identifying and classifying e-collaboration functionalities.

(Bafoutsou & Mentzas, 2002) provide the most "complete" view on collaborative systems and their technologies. Their work also aims at identifying functionalities and providing a classification and categories of collaborative tools. Although their collection of collaborative functionalities, analyzing 47 systems, seems to be quite complete, the developed classification as well as the categories of systems do have several shortcomings. Regarding the depiction of the classification (Bafoutsou & Mentzas, 2002, p. 291), a two dimensional graph is used. The X-axis represents the level of "Collaboration" and the Y-axis represents the level of "Document Management". This representation in a graph implies a measurable level of collaboration represented by the level of interaction and document management. Furthermore, the definition of categories poses several questions: According to the representation, electronic meeting systems would not support synchronous work on documents, which should be one of the most important functionalities of meeting systems? Electronic workspaces and com-

puter conference software would not have polling as a functionality? Finally, looking at the categorized systems, a differentiation between computer conferencing software and electronic workspaces seems to be hardly possible. Nevertheless, the functionalities have been properly analyzed and will provide a stable basis for this paper.

Another comprehensive list of e-collaboration functionalities is presented by (Stoller-Schai, 2003, p. 89ff). Starting with collective, individual, and collaboration-process needs he identified several groups of tools to support e-collaboration. This enumeration of functionalities according to needs is most suited for practical application, although (Stoller-Schai, 2003) does not provide an overview or a complete classification.

Regarding the aspects of synchronous collaboration technologies, (Meier, 2001; Meier & Schneider, 2002) present typical functionalities, analyzed in products of 20 providers.

After reviewing these existing approaches, the following objectives can be derived for this article, elaborating the above posed research question:

- Presentation of a comprehensive list of functionalities for the purpose of e-collaboration
- Definition of a classification / overview being able to capture all of the above identified functionalities.
- Definition of categories of software applications executing certain functionalities, depicted in the classification.

Analysis of IS Functionalities for E-Collaboration

According to related work described above and the authors' analysis of collaborative functionalities, the following list of functionalities especially used for workplace e-collaboration could be created:

Bulletin board, discussions, e-mail, e-mail notifications, online paging/messaging, chat, whiteboard, audio/video conferencing, task management, contact management/address books, screen sharing, surveys/polling, meeting minutes/records, meetings scheduling tools / team calendars, presentation capability, project management, file & document sharing, document management, synchronous work on files/documents (application sharing), workflow support, status- ("buddy") list, co-browsing, bookmark archive, mailing lists, desktop sharing, pin board, interaction, and feedback mechanisms in synchronous tools.

Comparing this list with research regarding groupware and CSCW (e.g. (Nunamaker et al., 1995)), there may not be too many differences. (Nunamaker et al., 1995) already list a number of technologies being used for groupware: CSCW, GDSS, GSS, coordination software, group memory, information filtering, electronic conferencing, groupware, group scheduling, team calendar, group development tools, team database, e-mail, project management, group conferencing, video conferencing, electronic brainstorming, shared drawing, electronic meetings systems, workflow automation, electronic voting, shared edition.

In order to create a concise representation of e-collaboration functionalities, several similar functionalities could be substituted or aggregated to a group of functionalities (in alphabetical order):

- *Application sharing (application / desktop sharing)* means to concurrently work on the same application or view the same screen/file. *Presentation capabilities* as well as *co-browsing* are also part of most web-conferencing tools and can also be realized by application sharing of presentation software or web-browser.
- *Audio/Video conferencing* (e.g. VoIP = Voice over IP) is the Internet protocol based communication medium, most common for synchronous communication.
- *Awareness utilities* represent an aggregation of several functionalities like e-mail notifications, online paging/messaging and "status lists" in order to point to information and be informed about the current status/role/activity of members. Feedback mechanisms can even inform about feelings of participants.
- *Bulletin, discussion and pin boards* for asynchronous discussions or for leaving messages or notes, to be read and answered by others (publicly or private) later on.
- *Chat / instant messaging* are synchronous, text based discussions (either public or private).

- *Contact management / address books* for managing contacts and addresses (name, address, phone, mail, and often personal details like hobbies, interests and expertise).
- *E-Mail* functionality as well as *integration of e-mail* and mailing lists. E-Mail is still the most wide spread basic functionality of collaborative systems (Eversheim et al., 2000, p. 374).
- *File and document sharing* as well as enhanced functionality of document management (check in/out, versioning, security aspects, etc.) are used for exchanging and organizing documents. *Meeting minutes/records* as described by (Bafoutsou & Mentzas, 2002, p. 287), can as well as *bookmarks* be shared by means of file sharing.
- *Meeting scheduling tools* and *team calendars* for coordinating and scheduling meetings and tasks.
- *Surveys and polling* are a way of supporting decision making in a group by conducting either a synchronous or asynchronous voting. This voting can also be realized by interaction functionalities.
- *Task lists* are mostly integrated into calendars and provide an overview of pending as well as completed tasks either of the team or individuals.
- Online *whiteboards* are substitutes of real whiteboards in meeting rooms. Either an individual or the team can draw on a virtual whiteboard in order to visualize their ideas.
- *Workflow Management support* is used to control, coordinate, assist and execute activities that must be performed in a specific order. This functionality mostly makes sense in conjunction with team calendars and task lists.

Project management will not be treated as a single functionality, as it is seen as a further combination of team calendars, task lists, workflow support, document sharing, and several more.

Classification of Functionalities

As the reference model for workplace e-collaboration (see Figure 1) is based upon the approach of business engineering, developed by (Österle & Winter, 2000, 2003), the methodology of business engineering should also be taken into consideration. One part of this method engineering is a meta model (see Figure 2), which is a data model of business engineering used for describing the single elements and relationships between them.

As this paper concentrates on e-collaboration functionalities and classifications, the systems layer and its relationships have to be taken into consideration. Even more specifically, the focus is on "Function" and its relationships.

Therefore, as functions are supporting processes – or more specific tasks – they should be assigned to tasks and the classification should be task/process-oriented in one dimension. (Zigurs, 2003, p. 346) also argues, that performance of a group can be enhanced by matching the support to group tasks and processes. Hence, the related work of (Stoller-

Figure 1: Reference Model E-Collaboration (acc. to (MAYRHOFFER & BACK, 2003A, p. 410))

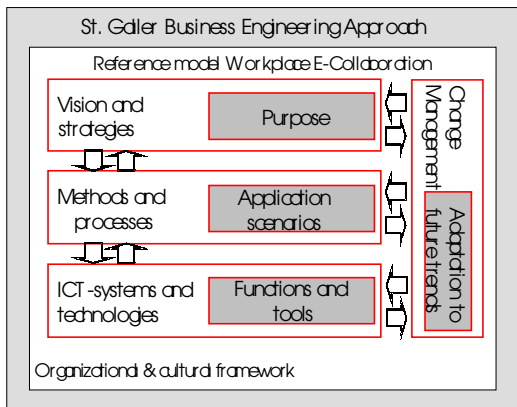
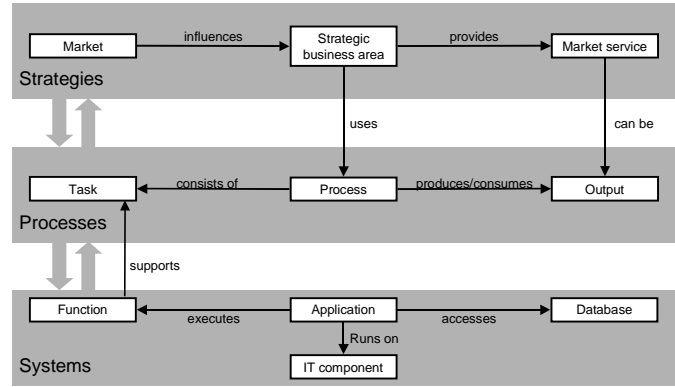


Figure 2: Meta Model Business Engineering (acc. to (ÖSTERLE & WINTER, 2003, p.81))



Schai, 2003) provides a good basis. On the other hand, functionalities are executed by applications. Therefore, a categorization of application types, fulfilling certain functionalities, is required as well.

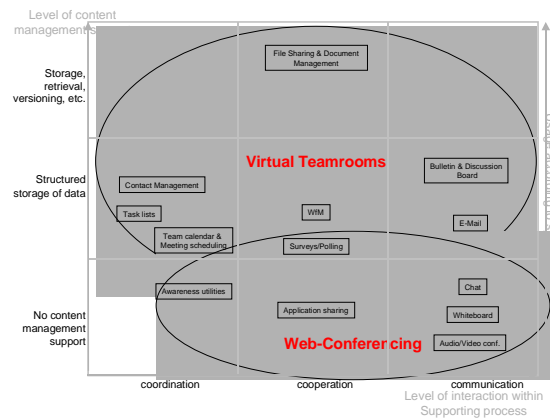
Regarding the process-orientation of one dimension of the classification, the existing classification of (Teufel et al., 1995) can be used. Furthermore, (Stoller-Schai, 2003) is presenting collective needs within e-collaboration, which can also be referred to as basic support processes of collaboration. These are communication, coordination and cooperation. Following the classification of (Bafoutsou & Mentzas, 2002) and media synchronicity theory (Dennis & Valacich, 1999), these three basic processes are arranged according to the increasing level of interaction, starting with coordination, cooperation and finally communication.

According to (Susman et al., 2003, p. 146) collaborative technologies exist of two components, a communication medium and a database. Communication, as a basis for any co-action (Stoller-Schai, 2003, p.35) is already covered in the dimension of supporting processes.

The second dimension should cover databases, or even more enhanced: content management support. Hence, the authors have selected the dimensions of their classification similar to those of (Bafoutsou & Mentzas, 2002, p. 291). Nevertheless, the second dimension of this classification describes the degree of content management support, which can be provided by a functionality. This means to store, categorize, version, check-in/out, and retrieve content.

Therefore, Figure 3 depicts the graphical representation of the classification, having two dimensions of interaction (on the X-axis) and content management support (Y-axis), and being split into a 3-by-3 portfolio. Furthermore, it shows the assigned functionalities identified in chapter 4.3.

Figure 3: E-Collaboration Portfolio



Categories of Tools

Additionally, the graphical representation identifies two major “clusters” of tool categories consisting of virtual teamrooms and web-conferencing tools (electronic meeting systems). In contrary to (Bafoutsou & Mentzas, 2002), referring to four categories, this classification results in two major categories, with an additional category as a combination of both (“Smart Enterprise Suites”). (Think of it, 2002) basically use three categories (real-time conferencing, collaborative work environments, and forum software/hosting services) in their comprehensive guide to collaborative software, containing approximately 260 products/vendors in the first two categories (real-time conferencing and collaborative work environments), which can be equated with the two major categories used in this paper.

Focusing on the time aspect of time/space classifications it could be assumed, that the more asynchronous the collaboration, the more content management is required. In other words: Synchronous collaboration does not necessarily require content management support.

Each of the product is typically focusing on a specific set of functionalities. Table 1 shows the categories of applications and supported functionalities. It indicates typically supported functionalities (also see in Figure 3) by most tools/products of a category (X), or optionally supported ones (O).

Web-Conferencing

Web-Conferencing software tools focus on synchronous communication and collaboration by providing an integrated set of functionalities to support meetings of geographically distributed people.

Virtual Teamrooms

Compared to (Bafoutsou & Mentzas, 2002), virtual teamrooms cover the categories of group file and document handling, computer conferencing as well as electronic workspace. The focus is on asynchronous collaboration.

Smart Enterprise Suites

Smart Enterprise Suites can be seen as the combination of web-conferencing and virtual teamrooms. They cover enterprise needs for content management, knowledge management and collaboration, and support the extended virtual workplace – inside and between companies. Most of the products within this category have their origin in the area of knowledge management tools and are now integrating collaboration functionalities. They are often the result of integrating a number of existing components of one provider. Especially IT analyst GARTNER is predicting, that “The Smart Enterprise Suite Is Coming” (Gilbert et al., 2002).

Table 1: Software categories and supported functionality

Functionality	Web-Conferencing	Virtual team room	Smart Enterprise Suite
Application Sharing / Document sharing / multi-authoring	X	O	O
Audio- / Video conferencing (VoIP)	X		O
Awareness utilities	X	O	X
Bulletin and discussion boards		X	X
Chat / Instant messaging	X	O	X
Contact Management / address books	O	X	X
E-mail integration (Mailing-lists)	O	X	X
File and document sharing / document mgmt.		X	X
Surveys / Polling	X	X	O
Task lists		X	X
Team calendar	O	X	X
Whiteboard	X	O	O
Workflow Management Support (WfM)		O	O

CONCLUSION

General Discussion

Within this paper the authors have worked on the topic of workplace e-collaboration as the process of two or more persons working together, being mutually dependent, and using shared resources as well as web-based electronic tools. Using the meta model for business engineering as well as existing approaches and studies, the focus was on detailing the technological aspects of e-collaboration and identifying a comprehensive list of e-collaboration functionalities as well as developing a classification in order to assign those functionalities.

Furthermore, the authors used the classification to define two major categories of applications.

Therefore, the research question, “Which technological functionalities are supporting workplace e-collaboration and how can they be assigned to a suited classification? How can software product categories be defined?” could be answered, although the results do not allow generalization. For this purpose more empirical evidence has to be collected and statistically analyzed.

For the purpose of giving an overview, the list of functionalities as well as the classification and categories of software applications seems to be relevant as well as applicable.

Future Research

As already stated, the authors hold a holistic approach of implementing and maintaining workplace e-collaboration. Therefore, this work only represents one piece of a puzzle and only a part of the whole approach. Furthermore, the system layer of the reference model may not be seen as separated. Although the authors have already integrated a process and task view by applying the meta model for business engineering, there are still questions like:

- Which functionalities to choose for which kind of task?
- Which soft-facts do influence the choice of functionalities (group size, group age, individual expertise, etc.)?

Finally, the longer the authors conduct research in the area of e-collaboration, the more similar terms with similar strategies, processes and objectives can be found.

Comparing the e-collaboration functionalities list with existing lists of groupware technologies, a qualified question would be: What is the difference between e-collaboration functionalities and technologies for groupware? The difference is in the details and a large part of so called groupware technologies can also be used as e-collaboration functionalities. Groupware even creates the technological basis, but is limited to, respectively expanded by web-based technologies. Nevertheless, an extended review of recent IS research literature regarding definitions of e-collaboration, groupware, virtual community, virtual teams and electronic networks is currently underway in order to clarify the difference and commonness of these. It will be interesting to find out how recent IS research is distinguishing these terms.

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