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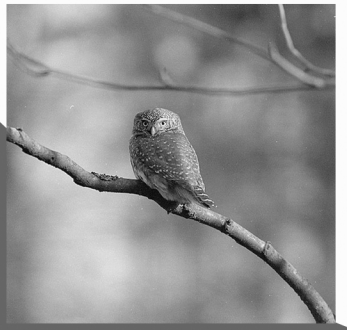

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Pernille Bjørn, cand.mag.
Roskilde University

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Pernille Bjørn
Roskilde University
pbr@ruc.dk

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All Illustrations are by Mille Rude.

Resumé: Samarbejde over afstand er ikke noget nyt, da mennesker har samarbejdet over geografiske afstande gennem tusindvis af år. I løbet af de sidste to årtier har den teknologiske udvikling forbedret betingelserne for tætkoblet samarbejde mellem geografisk distribuerede personer. Alligevel er samarbejde over afstand stadig en kompleks størrelse, der ofte resulterer i misforståelser funderet i de begrænsende muligheder for teknologi-medieret kommunikation. Misforståelser, der i værste fald fører til, at samarbejdet bryder sammen. Samarbejde over afstand involverer derfor både sociale og teknologiske udfordringer. For at forbedre vilkårene for samarbejde over afstand er det derfor nødvendigt at udforske de betingelser og behov, der gør sig gældende, når geografisk adskilte personer skal samarbejde. Derfor er genstandsfeltet for denne afhandling de sociale og teknologiske udfordringer, der opstår i virtuelle projektgrupper med geografisk adskilte projektdeltagere, der indgår i et tætkoblet samarbejde over afstand. Formålet er at lokalisere de specifikke faktorer, betingelser og udfordringer, der gør sig gældende i virtuelle projektgrupper med det mål at medvirke til at forbedre vilkårene for samarbejde over afstand. Det empiriske grundlag for afhandlingen består af tre casestudier af i alt seks virtuelle projektgrupper. To af grupperne er situeret i en industriel organisation, og de resterende fire er situeret i en uddannelseskontekst. Metodisk benytter afhandlingen fortolkende casestudier og aktionsforskning som tilgange til at analysere det empiriske materiale. Selve afhandlingen består af en sammenfatning og en samling af syv artikler, der hver bidrager med dybdegående analyser af specifikke dele af det empiriske materiale. Således er de specifikke resultater fra undersøgelserne præsenteret og argumentet i de specifikke artikler, hvorimod selve sammenfatningen søger at sammenkoble resultaterne fra artiklerne til et samlet hele. I sammenfatningen udforskes to hovedforskningsspørgsmål. Det første forskningsspørgsmål retter sig imod de organisatoriske aspekter, der gør sig gældende i den proces, hvorved groupware-teknologi bliver en del af virtuelle projektgruppers samarbejdspraksis. Her er et af hovedresultaterne, at processen, hvorved groupware bliver en del af samarbejdspraksisen, kan anskues som en udvidelses- og opretningsproces af deltagernes teknologiske perspektiver og rammer, hvilket inkluderer gensidig tilpasning af samarbejdspraksis og teknologi i tre trin. Det andet forskningsspørgsmål retter sig imod etableringen, udviklingen og transformationen af den sociale kontekst i virtuelle projektgrupper. Her er et af hovedresultaterne, at den sociale kontekst i virtuelle projektgrupper bliver etableret gennem forhandling af fælles mening på tre niveauer, der medvirker til at bygge bro mellem kulturelle, arbejdsmæssige, faglige, tidslige og teknologiske forskelligheder, hvilket er de aspekter, der typisk bliver associeret med geografisk adskillelse.

Abstract: Humans have been collaborating across geographical boundaries for thousands of years. Nevertheless, distant collaboration today remains problematic, complicated and prone to failures. This thesis investigates distant collaborative practice in a particular setting: closely coupled collaboration in virtual project teams whose members are spread across various geographical locations. The aim is to understand the specific factors, conditions and challenges underpinning such situations. This thesis describes, analyses and discusses three in-depth empirical studies on the practices and use of groupware technology in six real-life virtual teams, two in industry and four in education, applying interpretative research and action research methods. Two main lines of investigation are pursued: the first involves an examination of the organisational issues related to groupware adaptation in virtual project teams, while the second looks at the social context and practices of virtual project teams. Two of the key findings are 1) that the process of groupware adaptation by virtual project teams can be viewed as a process of expanding and aligning the technological frames of the participants, which includes mutual changes in both the technology structures and the collaborative practice; and 2) that establishing the social context within virtual project teams comprises negotiations of shared meaning bridging discontinuities typically associated with geographical distribution such as culture, work practices, professional disciplines, time differences and technology. This thesis comprises a general introduction, referred to as the summary report, and seven research papers, which deal in detail with the results and findings of the empirical cases. The summary report provides a general introduction to the research methods used, the empirical cases conducted, the research field on virtual teams and, last, it relates the findings and results across cases and papers in respect to the two main lines of investigation: organisational issues of groupware adaptation and the challenges of establishing and developing the social context within virtual project teams.

PART I: SUMMARY REPORT

PART II: RESEARCH PAPERS

1. Introduction

Humans have been collaborating across geographical distance for thousands of years. With the Mediterranean basin as its centre, the Roman Empire was far-flung and disparate, stretching north, south and east almost three thousand miles from England, the Atlantic and Germany to the Nile, Syria and Armenia (Boatwright 2000). Early on, the Romans realised that controlling this huge empire by simply using violence was not sustainable; instead, the norms of law, religion, politics, economy and cultural values were applied to consolidate the Roman Empire. In this way, collaboration across distances was already an important issue for modern civilisation at the beginning of the first century. Nevertheless, collaboration across distances is still today a quite complicated affair, difficult to manage and comprises highly multifaceted settings that are prone to failures.

Currently, geographically distributed organisations are motivated towards global cooperation, seeing it as providing the opportunity to have a presence in local markets, creating economic advantage and allowing the development of localised talent around the globe (Chudoba et al. 2005). Global organisations with geographically distributed expertise see collaboration across distance as a mean of providing focused attention to a particular local problem without physically relocating individuals (Kayworth and Leidner 2000; Malhotra and Majchrzak 2004). Team-based structures and computer-based communication systems are of particular interest as they replace traditional forms of organisation and management in global companies (DeSanctis and Jackson 1994; Lipnack and Stamps 1994). Thus, people now collaborate across boundaries of all kinds, including geographical distance, time and culture, while technology extends the possibilities and opportunities for closely coupled interdependent cooperation (Chudoba et al. 2005; Lipnack and Stamps 2000; O'Hara-Devereaux and Johansen 1994; Townsend et al. 1998). Even though distributed collaboration has received substantial attention in both popular and academic literature (Townsend et al. 1998), mastering the art of collaboration across distances and employing relevant technologies is yet to be learned.

This thesis complements and expands current research on collaboration across distances by comprising research into a specific kind of collaboration across boundaries, namely closely coupled collaboration in projects conducted by geographically dispersed participants: *virtual project teams*. While virtual team research is a current and growing research topic, the definition of the concept 'virtual' is still being debated (Bell and Kozlowski 2002; Fiol and O'Connor 2005; Watson-Manheim et al. 2002). Researchers generally agree that the universal assumption behind the use of 'virtual' is distance, as in the challenges people face to communicate, resolve conflicts, and maintain social interaction across time and

space (Chudoba et al. 2005). 'Virtual' does not mean 'unreal', but rather refers to geographical distance. Other concepts have been proposed to capture this specific organisational form, e.g. far-flung teams (Majchrzak et al. 2000), but in this thesis, the concept of virtual teams is chosen because in this field of research it is generally conceived of as being teams comprising geographically distributed participants. Virtual teams do in fact exist in reality despite the fact that participants are dispersed in time and place. Virtual teams transcend geographical distance, time zones and organisational boundaries, while consisting of people with interdependent roles in a web of relationships revolving around a shared purpose (Lipnack and Stamps 2000). Being placed at different geographic locations does not automatically mean that participants never meet face-to-face (Maznevski and Chudoba 2000), even though some researchers reserve the concept of 'virtual' for teams who never physically meet (e.g. Jarvenpaa et al. 1998), suggesting the concept of 'hybrid' for teams who seldom meet face-to-face (Griffith et al. 2003a). The virtual teams investigated in this thesis are teams engaged in a hybrid work arrangement comprising geographically distributed team members who *rarely* meet face-to-face, so most of the interaction takes place mediated by technology.

Virtual *project* team is a narrower concept than virtual team. Virtual project teams are time-limited, non-repetitive groups of geographically distributed participants charged with producing a one-time output (Massey et al. 2003). In this dissertation virtual project team refers to two to ten geographically distributed participants engaged in time-limited (six to 12 months), non-repetitive, closely-coupled collaboration producing a one-time output, who rarely meet face-to-face, thus most of their interaction is mediated by technology. This dissertation contributes with analyses of specifically the above-mentioned type of distant collaboration, i.e. virtual project teams, an organisational form providing the opportunity for geographically distributed participants to be engaged in closely coupled distant collaborative practice.

The technology supportive of mediating the interaction in virtual project teams is groupware technology. Groupware technology constitutes a web of resources mediating group work (Ngwenyama and Lyytinen 1997), and is in general expected to support collaborative activities in groups, such as coordination, document exchange, use of a shared repository, online negotiations, communications and decision making. The groupware technology investigated in this thesis does not include all of the various kinds of groupware technologies, but rather focuses particularly on virtual-workspace applications labelled place-based systems (Spellman et al. 1997). Place-based systems are characterised as being location independent, location transparent and persistent, while simultaneously being open-ended, generic, context-specific and reconfigurable (see section 3.4). The place-based systems investigated in this thesis are Basic Support for Cooperative Work (BSCW), Lotus Notes and Virtual

University (Virtual-U). The fundamental functionalities of these applications include the possibility of constructing various folder-structures, of uploading, downloading and revising various documents, negotiating or exchanging opinions structured in the threads of an asynchronous message board and finally, the possibility for monitoring others' actions though awareness features. The use of 'groupware' in this thesis thus refers to place-based systems with the above-mentioned characteristics.

Research on groupware technology can broadly be classified as having two main lines of investigation. One direction investigates the organisational issues related to groupware adaptation and use (e.g. Orlikowski et al. 1995), while the other one investigates the design of groupware application, focusing on aspects such as configuration and tailorability (e.g. Teege 2000). This dissertation does not investigate the design of groupware applications. Instead, groupware technology is investigated in relation to the organisational issues of adaptation and use. The concept of 'adaptation' is chosen in this summary report because it reflects that introducing, integrating and facilitating groupware into the practice of virtual teams is a transformation process that changes both the technology and practice to suit a new situation. The concept of 'integration' might, to some, indicate a primary focus on the technical aspects of groupware, whereas 'adoption' or 'acceptance' might give connotations that groupware adaptation is simply a choice made by the participants to use the technology and not a process of change. The concept of 'appropriation' is similar to adaptation since it refers to the act in which someone adapts the technology for their own use; however, the transformation of the practice led by the technology is emphasised less with regard to appropriation. As a result, even though the concepts of integration, adoption, appropriation and acceptance are used in the published papers of this thesis, it is important to keep in mind that these concepts should be understood as adaptation.

This thesis is entitled *Virtual Project Teams: Distant Collaborative Practice and Groupware Adaptation* and comprises research investigating how the social context of virtual project teams is established, developed and continuously challenged as well as how groupware is adapted into the practice of virtual project teams. The social context of virtual teams is a conglomeration of pieces that participants bring from their local social contexts, for example, norms, beliefs, values, language and routines (see section 4.1). Investigations of the social context in this thesis comprise examinations of the factors challenging the establishment and development of the social context embedded in various discontinuities typically associated with geographical distribution, such as diversity of work practices (Chudoba et al. 2005).

Adapting groupware demands more effort and commitment from the people adapting the system than single-user systems (Grudin 1994b), thus groupware requires much more focused support for organisational adaptation than

traditional information systems (Bansler and Havn 2006). Research on groupware adaptation in this thesis comprises examinations of the factors enabling or constraining participants' abilities to meet the challenges of embedding the technology in the social context by transforming and aligning the work practices and the technology structures.

1.1 Research Questions

The pre-assumption behind this dissertation is that project work in teams has the best conditions in collocated settings. In collocated settings team members perform their best when working in closely coupled work arrangements that provide good opportunities for establishing common ground (Olson and Olson 2000). However, collocation of team members is not always an option, which means that we need to improve the conditions for collaboration in distant project settings.

Groupware technology plays a dominating role and affects collaboration across distance in important ways (DeSanctis and Jackson 1994). For example, the ability of participants to adapt groupware has been found to positively influence distance collaboration (Finholt et al. 1990). Moreover, the process of adapting groupware is not only a question of providing the technology, but includes proactive engagement by the participants based on their willingness to change their work processes to include groupware (e.g. Grudin 1994b; Karsten 1999). On this basis, the first research question investigated in this dissertation is:

1) How is groupware technology adapted into the collaborative practice of virtual project teams?

Social groups comprise a collection of people who share a social context, which provides a reservoir of rules and resources enabling people to act and make sense of others' actions (Ngwenyama and Klein 1994). Likewise, virtual project teams need to establish shared assumptions, beliefs, values, routines and language to make sense of others' actions and to adjust their own actions accordingly. However, geographical distance makes the establishment of a common social context in a virtual project team difficult, since shared understanding requires negotiations, which researchers generally agree are best performed in collocated settings (Hollingshead et al. 1993; Kirkman et al. 2004). Fundamentally, these observations call for research concerning, how distant collaboration is experienced by distributed participants with respect to establishing, developing and maintaining a social context. Thus, the second research question investigated in this dissertation is:

2) How is the social context of a virtual project team established, developed and continuously challenged?

1.2 The Seven Research Papers

This dissertation includes a collection of papers investigating different perspectives on the two main research directions. The findings and results of these papers are gathered and related across cases in the chapters of this summary report, providing coherent answers to the two main research questions. The following seven research papers are included in this paper collection:

Paper no. 1: Bjørn, Pernille. "Re-Negotiating Protocols: A way to Integrate Groupware in Collaborative Learning Settings," ECIS 2003, New Paradigms in Organizations, Markets and Society, Proceedings of the 11th European Conference on Information System, Naples, 19-21 June 2003.

Paper no. 2: Bjørn, Pernille and Ada Scupola. "Groupware Integration in Virtual Learning Teams: A Qualitative Analysis based on the TAM-model," IT Innovation for Adaptability and Competitiveness, IFIP 8.6, Kluwer Academic Publisher, Leixlip, Ireland, 2004, pp. 289-312.

Paper no. 3: Bjørn, Pernille, Ada Scupola and Brian Fitzgerald. "Expanding Technological Frames Towards Mediated Collaboration: Groupware Adoption in Virtual Teams," *Scandinavian Journal of Information Systems* (SJIS) (18:2), 2006, to be published.

Paper no. 4: Bjørn, Pernille and Jesper Simonsen. "Joint Enterprise and the Role of the Intermediator: Challenges Managing Groupware in Virtual Teams," 5th International workshop on web based collaboration (W10-WBC'05), 16th International Workshop on Database and Expert Systems Application (DEXA'05), IEEE, Copenhagen, 2005, pp. 609-615.

Paper no. 5: Bjørn, Pernille and Ojelanki Ngwenyama. "Virtual Team Collaboration: Building Shared Meaning, Resolving Breakdowns and Creating Translucence", *Information Systems Journal* (ISJ), under second review.

Paper no. 6: Bjørn, Pernille and Morten Hertzum. "Project-Based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams," 5th Conference on Human Computer Interaction in Southern Africa (CHI-SA), ACM SIGCHI, Cape Town, South Africa, 2006, pp. 6-15.

Paper no. 7: Bjørn, Pernille. "Medieret Vejledning af Problemorienteret Projektarbejde: Udfordringer for Vejledning i Problemformuleringsfasen [Technology-mediated Supervision of Problem-Oriented Project Work: Supervision Challenges in the Problem-formulation Phase]," *UNEV: Tidsskrift for Universiteternes efter- og videreuddannelse*, vol. 9, 2006.

1.3 The Structure of the Thesis

The rest of this thesis is structured as follows. In Chapter 2 the empirical data material and research approaches are presented. This includes reflections on the differences between virtual team cases situated in the field of education and cases situated within an industrial organisation. There is also a brief introduction to the three empirical studies comprising the six cases of virtual project teams investigated. Last, Chapter 2 gives an overview of the data material and sources from each case while presenting how the analyses of the empirical material have been handled. Chapters 3, 4 and 5 are closely connected and present an overview of previous research relevant for investigations of virtual project teams. In Chapter 3, the theoretical background literature related to collaborative practice is presented. This includes reflections concerning the specific attributes of collaborative practice such as articulation work, awareness, coordination, negotiation and groupware. Chapter 4 presents the theoretical background literature in respect to distance. Distance is normally associated with geographical distance, however, distance can also be conceptualised as different types of discontinuities in collaborative work, such as distance in professional disciplines, work practices, time zones, technology and culture. Chapter 5 relates collaborative practice and distance as discontinuities by presenting the main challenges of distant collaborative practice familiar from previous research on virtual teams. The main challenges are identified as building trust, developing temporal rhythms, establishing common ground and developing communication norms.

Chapter 6 presents the contributions of the first four papers (Papers no. 1, 2, 3 and 4), which are related to the first research question investigating groupware adaptation. This includes presenting the main findings of each paper and relating these to a coherent answer of how groupware technology is adapted into the collaborative practice of virtual project teams. Chapter 7 presents the contributions of the last three papers (Papers no. 5, 6 and 7), which are related to the second research question concerning the social context of virtual teams. Here, the specific findings and results of each paper are presented and related to a coherent answer of how the social context of virtual project teams is established, developed and continuously challenged. The reader might also use the sub-sections of Chapters 6 and 7 as short summaries of the seven research papers after reading the full text of the papers. Chapter 8 draws conclusions regarding both research questions, while the full text of the seven research papers ends this thesis.

2. Research Approaches and Empirical Data

2.1 Empirical Research Approach

Approximately only two decades old, research on virtual project teams is still in its infancy, thus theoretical categories and concepts useful for explaining and theorising upon empirical observations are still in the process of being identified. Also, research on groupware adaptation and use in collaborative situations based upon experimental settings has produced confusing and inconsistent results (Davison et al. 2000), because it is difficult, if not impossible, to simulate real-life collaboration (Grudin 1994b). In the early stages of research where still too little is known about a particular social phenomenon to fill out relevant theoretical categories explaining empirical observations, an interpretative case study approach is especially relevant (Eisenhardt 1989). Interpretative research can help researchers to understand human thought and action within real-life social contexts, while it has the potential to produce deep insights into how technology is adapted, managed and used within specific situations (Klein and Myers 1999). One research method that focuses particularly on how humans interpret and construct meanings in specific situations is in-depth case studies involving frequent on-site field visits over an extended period of time (Walsham 1995). In addition, generating valid interpretative knowledge requires examinations of human behaviour within real-life social settings (Orlikowski and Baroudi 1991). Moreover, the most widely used method in information systems research when investigating organisational issues of adaptation, especially when the unit of analysis involves group rather than individual adaptation, is the case study approach (Choudrie and Dwivedi 2005). Therefore, the overall research approach of this dissertation is empirically driven interpretative case studies on distant collaborative practice in real-life situations of virtual project teams. The aim of conducting the case studies was to understand participants' thoughts and actions as related to a particular social and organisational context, which then provides the potential to produce deep insight into the social phenomenon of virtual team practice.

As implied by the two main research questions presented in section 1.1 of this thesis, the general research interest is the specific collaborative situation of virtual project teams, where geographically distributed participants are engaged in a time-limited, non-repetitive, closely coupled hybrid work arrangement producing a one-time output. Virtual project teams exist in various domains, for example, education, research, industry and government. All virtual project teams face the challenge of establishing and developing a social context while adapting groupware to support their collaborative practices, therefore the two research questions of this thesis are formulated in general terms. However, it was

impossible within the time-frame of the research for this Ph.D. to investigate virtual project teams in all domains, therefore a choice was made to investigate specific cases of virtual teams in two settings, namely education and industry.

The choice of these particular domains was primarily made based upon the research interest and secondly due to convenience and accessibility. Initially the research interest was on the adaptation and use of groupware in virtual project teams. In this process contact was made with various organisations to locate an empirical opportunity to investigate cases of virtual project teams. Some of those contacted were interested because they believe that this type of work was important to their organisation, but after reviewing the empirical opportunities more carefully many of these organisations did not have virtual project teams as defined by this thesis. Instead, they had geographically distributed special interest groups or relocated geographically distributed employees in a 'project hotel' for the duration of the projects. Then, the opportunity arrived to investigate two virtual project teams in a global transportation organisation, which is what is referred to as the Industrial-case in this thesis. As it turned out, the empirical observations from these two virtual project teams did not provide much data in respect to groupware adaptation and use, instead the data from this study provided empirical observations of the nature and practices of virtual project teams. Thus, on the basis of this, the second research question investigating the social context of virtual project teams was formulated. While still surveying new empirical contacts for investigating groupware adaptation and use, it became obvious that they would be difficult to locate. At the same time, empirical material from my previous studies in the field of education concerning groupware adaptation and use in virtual project teams were available. So a decision was made to begin conducting new theoretical analyses of this data material, referred to as the MV- and MIL-cases in this thesis. The MV-case provided rich empirical observations concerning groupware adaptation. However, since the groupware application adapted in the MV-case was highly malleable and re-configurable, the participants changed, revised and modified the information items throughout the entire project period, which meant that the folder structures, notes and documents visible in the application at the end of the project period did not capture in detail the use of the groupware application during the whole process. Only traces of the use were left within the awareness features of the application in the form of lists of the information items deleted, revised or moved. As a result, the specific groupware application limited what could be studied in the MV-case. The groupware application in the MIL-case was very different in nature with respect to re-configuring, since in this application the participants did not have the opportunity to revise, move or delete information items. Thus, the MIL-case provided rich empirical observations of the actual use of the application throughout the whole process of three virtual project teams, which neither of the two other cases provided. Summarising all

three case studies provided the opportunity to investigate virtual project teams related to groupware adaptation, use and the social context. However, the extent and nature of empirical observations related to the two main research questions were diverse. Thus, the specific cases provided various kinds of rich data material, some primarily related to the first research question, while others were primarily related to the second research question. By investigating virtual project teams in two settings rather than one, the opportunity for identifying more relevant factors and issues related to groupware adaptation and the social context improves. As a result, the investigated virtual project teams within the domains of education and industry should be perceived as being exemplary and as a reflection of virtual project teams in general. By investigating an individual part, we gain insight into the whole (Ulriksen 1997).

One of the strengths of this thesis is that the case material is of a heterogeneous nature, because it comprises data from different organisational settings. However, there are differences between cases situated in the field of education and cases from industry; therefore, each of the seven papers only refers to cases within the same setting. When relating the findings across cases and papers in this summery report, it is thus necessary to be aware of the differences. However, one should keep in mind that generalisation in interpretative case studies from one domain to a population is not the aim, instead the intent is to understand the deeper structure of the phenomenon in the belief that it can be used to inform other domains (Orlikowski and Baroudi 1991). Therefore, the aim of comparing the empirical observations and findings across cases of virtual project teams located in the two settings of education and industry is to identify and construct a deeper structure of theoretical categories and concepts useful for understanding and explaining empirical observations, thus informing the general setting of virtual project teams.

2.2 Differences between Virtual Teams in Education and Industry

The teaching method in the educational cases reported upon in this dissertation is problem-oriented project work in groups. Problem-oriented project work is a particular way of teaching students to learn by focusing on problematic issues relevant to the learning objective as well as to the students. In this process, students negotiate a research question, decide which literature to use, conduct empirical work and finally co-author a joint project report comprising their analysis and reflections on the subject matter[1]. The teacher's role in problem-

[1] For further information about problem-oriented project work see, e.g.
Berthelsen, J., Illeris, K., and Poulsen, S. C. *Grundbog i Projektarbejde: Teori og Praktisk Vejledning [Textbook in Project Work: Theory and Practice]*, Unge Pædagoger, Copenhagen, 1993,
Dirckinck-Holmfeld, L. "Designing Virtual Learning Environments Based on Problem Oriented Project Pedagogy," in: *Learning in Virtual Environments,* L. Dirckinck-Holmfeld and B. Fibiger (eds.), Samfundslitteratur, Frederiksberg, 2002, pp. 31-54,
Olesen, H. S., and Jensen, J. H. (eds.) *Project Studies: A Late Modern University Reform?* Roskilde

oriented project work comprises product and process supervision. Conducting product supervision concerns activities such as proposing introductory literature and relevant journals, explaining subject-related problems and concepts while providing feedback on oral and written proposals from the students (Kaae 1999). Conducting process supervision concerns activities facilitating the group work such as selecting a problem domain, identifying and defining research questions, handling conflict and providing overall support of group processes (Kaae 1999).

This specific kind of teaching is similar in some ways to project work in industry because the participants (students and employees) in both settings are engaged in a time-limited, non-repetitive, closely coupled collaboration producing a one-time output. However, fundamental differences exist between virtual teamwork in industry and group work in education. Basically, the primary objective of group work in education is for the students to learn, while the primary objective of teamwork in industry is to create a product. Figure 1 illustrates that the primary outcome in industry is the product in the form of, for example, new technologies, tools or other commercial benefits, while reflections, learning and the use of IT are considered as by-products. In education, in contrast, the primary objectives are reflections, learning and the use of IT, while the product is considered to be a by-product.

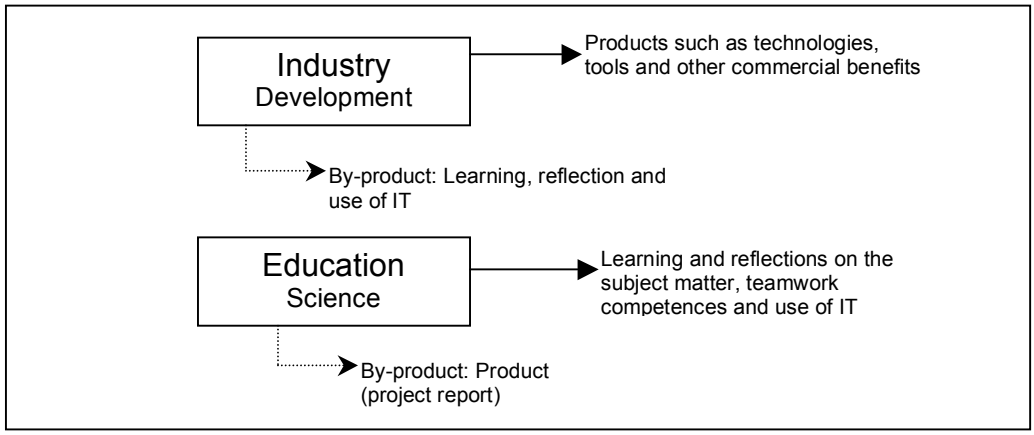


Figure 1: Differences between education and industry, inspired by Allen (1988)

Industrial organisations do find learning and reflection useful and important, also from an economic perspective, but the main emphasis is on the products' usefulness. The focus shifts in educational settings, where the primary outcome is reflection and learning. Choosing and reading literature, collecting empirical data while discussing important issues are all activities that stimulate learning and reflection with respect to a particular learning purpose. In addition,

University Press, Frederiksberg, 1999,
Olsen, P. B., and Pedersen, K. *Problem-Oriented Project Work: A Workbook*, Roskilde University Press, Frederiksberg, Denmark, 2005.

teamwork and the use of ICT can be a part of explicit learning objectives that foster reflection. In this regard, the product report is a by-product, however, writing the project report is considered an important part of reflection (Borgnakke 1999).

Besides the differences concerning the primary outcome, aspects such as hierarchy, leadership, resources and reward systems differ. Teams in industry usually have a formal hierarchy inside the team comprising, e.g. leaders, specialists and team members. In addition, teams in industry report to a formal entity comprising top management, which are in control of allocating resources and rewarding participants in terms of higher pay and new assignments. Top management also controls the decision to abandon a project if the team does not produce the expected results. Learning groups typically have an informal hierarchy inside the team based on interpersonal relations. Students do not relate to a formal hierarchy despite their relation to the teacher. To some extent, students do choose projects and group members based on their personal preferences and interests, while being in charge of allocating resources (how many hours to put into the project). The reward system is typically based on grades or passing exams, and projects are more often abandoned due to interpersonal conflicts arising from various personal interests and not from a lack of results.

2.3 Interpretative Research and Action Research

Two main research methods have been applied in this thesis: interpretative research (e.g. Klein and Myers 1999) and action research (e.g. Davison et al. 2000). Some researchers argue that action research is a specialisation of interpretative research (Walsham 1995), because the action researcher also interprets social human behaviour and the interpretative researcher can choose to be involved in the research field conducting actions. However, the two research approaches in this thesis are presented as having equal status, because of their distinct important differences.

The aim of *interpretative research* is to understand how members of a social group enact their particular realities creating meaning to show how meanings, beliefs and intentions constitute their social actions (Orlikowski and Baroudi 1991). Interpretative researchers find that universal laws are inappropriate for the study of human behaviour, because individuals and groups all are unique and therefore demand idiographic theorising instead (Lee and Baskerville 2003). The interpretative researcher investigates complex social phenomena by investigating how people articulate and interact in particular social settings with the overall aim of creating descriptions of the observed practices and of building theoretical concepts and constructs useful for explaining the observed practices. The interpretative research approach was chosen to investigate both research questions of this thesis, however, especially the second research question of how

the social context of a virtual project team is established, developed and continuously challenged. This choice was made because the interpretative approach provides the opportunity for investigating the meanings and intentions behind the social actions of collaborative participants, which constitute the social context. The subject matter in interpretative research comprises the meanings that people create, modify and communicate in the real world of a particular setting, also referred to as first-order data (Walsham 1995). First-order data are the understandings held by the observed people and are observable in their behaviour and language. It is the job of the interpretative researcher to explain patterns and relationships between the observed first-order data to construct second-order theoretical constructs (Lee and Baskerville 2003). Interpretive research seeks to understand peoples' interpretations and constructions of their practice through various kinds of data collection and analysis techniques. Data in interpretative research are not just waiting to be gathered like rocks on a beach, instead are facts produced through the social interactions between the researcher and the participants (Klein and Myers 1999). The material a researcher brings back to the office in various forms, sounds, pictures, documents, electronic communication etc. are not just something from the real world waiting to be recorded. In taking pictures, interviewing people, interpreting the meaning of documents as well as electronic communications, the researcher constructs elements and stories about the real world. Several techniques for data gathering can be applied in interpretative research, e.g. observations, interviews, http-logs and document analysis (Blomberg et al. 1993; Bødker et al. 2004a; Bøving and Simonsen 2004; Kvale 1997). Nevertheless, interviews are typically the primary source of interpretative research, since it is through this technique that the researcher can best gain access to the interpretations of the participants (Walsham 1995). Also, the interpretative position asserts that the language used by the participants to describe their social practices actually constitutes those practices (Orlikowski and Baroudi 1991).

The interpretative research approach in this thesis is applied to examine the data from one of the educational cases and the case from industry. Investigating the virtual team members' own interpretations of their collaborative-practice difficulties, conditions and challenges, both with respect to the social context and groupware adaptation, we come closer to understanding the particular issues and aspects contributing to the establishment and development of the social context in virtual project teams. The results of these interpretative investigations comprise the identification of conditions, factors and negotiation strategies influencing the social context of virtual project teams and are presented in four of the papers in this thesis (Papers no. 4, 5, 6 and 7).

Action research examines and acts upon the world to understand complex human processes instead of searching for a universal prescriptive truth (Baskerville and Wood-Harper, 1996). Action research seeks to contribute both to

the practical concerns of the particular case as well as to the goals of science by taking initiatives towards a joint collaboration between researchers and practitioners (Rapoport 1970). The action research approach was chosen to investigate the research question of how groupware technology is adapted into the collaborative practice of virtual project teams in one of the empirical cases in the field of education. Knowing that the success of groupware adaptation is highly dependent upon the initial facilitation (e.g. Karsten 1999), the action research approach provided the opportunity to apply theoretical considerations to concrete intervention activities through facilitation, thus making it possible to reflect upon how various initiatives affected the groupware adaptation process. This increased the possibilities for producing new important insights into groupware adaptation based upon theoretical assumptions acted out in real-life settings. Applying action research provided a unique opportunity for an in-depth understanding of enablers and the constraints of groupware adaptation. Action research in Information Systems (IS) research has become more common, and even though different IS action researchers describe different kinds of action processes, the fundamental elements and issues are similar (e.g. Avison et al. 1999; Checkland and Holwell 1998; Mathiassen 1998; Susman and Evered 1987). The basic steps in action research involve iterative cycles of activities in a two-stage process: diagnostic and therapeutic. The diagnostic stage involves the analysis of the social situation by both the researcher and the practitioner, while the therapeutic stage involves the introduction of changes and the analysis of the effects of these changes (Baskerville and Myers 2004). The action cycle applied in the educational case comprises problem identification, planning interventions, executing actions, observing the outcome, reflecting upon the result, while simultaneously collecting data about the situations and actions for all activities (Davison 2001). In the action research study the problematic issues were diagnosed as students' lack of actions between campus seminars, which resulted in projects beginning late while complicating the supervision process. Applying groupware in the educational programme was seen as offering the potential for interaction between students between the campus seminars, thus a joint venture was formulated in respect to groupware adaptation (see Paper no. 3). In the problem diagnosis activities, especially mapping techniques were used (Lanzara and Mathiassen 1985). The data in the action research study took various forms, e.g. audio recordings, drawings, observations on the use and non-use of the groupware system, posters, notes and Dead Sea scrolls (Bødker et al. 2004a). The knowledge developed in this action research study concerns the practical issues of groupware adaptation in the specific case as well as the theoretical reflections on the factors influencing groupware adaptation in virtual project teams in general.

The role of the action researcher is to some extent similar to that of a consultant, since an action researcher cannot be a disinterested observer, but acts

in practice to solve a problematic situation and simultaneously observes herself acting (Iversen et al. 2004). A consultant also solves problems by applying existing expertise to a real world problem. However, there are distinct differences between a consultant and an action researcher. The action researcher applies expertise rooted in the academic world and is not only interested in solving the problematic situation, but also has an interest in investigating research issues relevant for the problematic situation as well as for the scientific community. In contrast to the researcher, a consultant is mainly rooted in her experiences and tacit knowledge developed through her career and her main interest is to solve the practical problems (Mårtensson and Lee 2004). The action researcher requires rigorous documentary records and theoretical justifications while being engaged in cyclical processes. Consultants, in contrast, only require empirical justifications and consultation processes are usually linear – engage, analyse, action, disengage (Baskerville and Wood-Harper 1996). The researcher's role in the action research study conducted as a part of this thesis took various forms in different activities at different stages. In the problem diagnosis stage, the role was to facilitate, structure and manage the debate among the teachers to identify the core problematic issues while providing guidance regarding the choice of groupware technology and adaptation initiatives (see Paper no. 3). In the collaboration with the student group concerning groupware adaptation, the role comprised facilitation of an initial workshop in how to manage the negotiation of the project and the future collaborative practice, while simultaneously introducing the functionalities and mature use of the technology. The purpose of this facilitation was to aid the students in exploiting the functionalities of the technology related to their specific project, and thus actively influence how the group applied the technology (Davison 2001). Throughout the adaptation process with the student group, the researcher's role shifted back and forth between being, for example, an observant-participant, facilitator, supervisor, technical-consultant, process-consultant and researcher, while the students acted as reflective practitioners by reflecting upon their own practices to improve the situation (Iversen et al. 2004). The action research study is presented in the three papers that apply different theoretical perspectives on the same empirical data constructed within the action research project (Papers no. 1, 2 and 3).

2.4 The Empirical Cases

The empirical work conducted as a part of this research comprises three case studies of six virtual teams, two situated in industry and four in the field of education. In this section, the three cases and the six teams are presented briefly, providing the reader with enough background to read the rest of this summary report without having read the papers. The amount of details given here will be limited, because each paper has dedicated sections providing in-depth

descriptions of the particular case(s) investigated. The three case studies are referred to as the *Industrial-case* comprising *Team 1* and *Team 2*, the *MIL-case* (acronym for Master's of ICT and Learning) comprising *Group 1*, *Group 2* and *Group 3*, and the *MV-case* (MV is the Danish acronym for Master's in Adult Education) comprising the *MV-group*.

The *Industrial-case* was conducted in a global transportation company with 100,000 employees located on all seven continents. The organisation develops and builds all kinds of vehicles from scooters to trains, which includes developing the software built into, e.g. electronic train doors or automatically controlled metro systems. Due to mergers, the company develops software in different geographical locations such as Scandinavia and Asia, applying various software developing methods. As a result, the software development department is a geographically distributed organisation with sites all over the world. The company views one significant step for moving in the right direction for business as the implementation of common software processes and work practices. Therefore, they began initiatives for developing common software processes in 2002. Team 1 and Team 2 were parts of this initiative. *Team 1* consisted of ten participants located in Denmark, Germany, Thailand, Finland and Sweden. The participants were chosen representative of the expertise from the various geographical locations and their objective was to develop a set of common processes for developing software within the company. This task was overwhelming and difficult for Team 1 and they failed to produce the expected results. Team 1 had set up a Lotus Notes database, but they never succeed in adapting this groupware into their collaboration. For further information and details about Team 1, see Papers no. 4 and 5.

Industrial-case: Team 1

Number of participants: 10
Locations: Denmark, Germany, Finland, Thailand and Sweden
Goal: Develop one set of common software development processes
Result: Failed in producing the expected product
Groupware: Failed to adapt groupware (Lotus Notes)

Industrial-case: Team 2

Number of participants: 5
Locations: Canada, United Kingdom, United States and Sweden
Goal: Develop a common software configuration management process (SCM)
Result: Succeed in producing the expected product
Groupware: Failed to adapt groupware (Lotus Notes)

Team 2 consisted of five participants located in Canada, the United States, the United Kingdom and Sweden. The goal of the team was to define and pilot a common software configuration management (SCM) process. The participants, who were chosen based on their expertise in configuration management, were all highly experienced and typically worked on contracts based on bonus systems. Despite

communication difficulties, Team 2 succeeded in producing the expected results. Team 2 had access to a shared Lotus Notes database, but they were unable to adapt the groupware into their collaboration, instead they mainly used email and telephone. For further information and details about Team 2, see Papers no. 4 and 5.

The *MIL-case* was conducted in the Master's of ICT and Learning programme offered in collaboration between Aalborg University, Århus University, the Danish University of Education and Roskilde University under the auspices of the IT-University of Western Denmark. The master's programme is a two-year, part-time vocational education for adults active on the labour market. One semester is spread out over a year. The students attend four campus seminars in September, November, January and May. In the fall, students attend virtual courses, while in the spring students collaborate in groups, where they conduct problem-oriented project work supervised by an academic supervisor. In addition, both teachers and students in the MIL programme focus on the use of ICT in learning, because technology use is a part of the overall learning objective for the program. This affects the motivation for interacting with technology. The empirical work, which was conducted during the spring part of the semester, investigated the collaborative practice of problem-oriented project work in student groups. *Group 1* in the MIL-case consisted of five students. Four students lived in different parts of Denmark and one lived in Norway. Their goal was to investigate 'virtual dialogues'. They experienced many difficulties and conflicts when attempting to reach an agreement regarding the research question, causing the group to split up into three sub-groups after the first month. However, all three sub-groups succeeded in finishing a project report and in passing their exams. Group 1 employed the groupware system Virtual-U, which was offered by the master's programme to support course teaching as well as group collaboration and project supervision.

MIL-case: Group 1

Number of participants: 5
Locations: Denmark and Norway
Goal: Investigate 'virtual dialogues'
Result: The group ended up being sub-divided into three sub-groups, each of which succeeded in producing their project.
Groupware: Success with groupware adaptation (Virtual University)

Group 2 consisted of three students investigating 'ICT support for communities of teachers'. Here, one participant lived in Norway, while the other two lived in Denmark. In this

MIL-case: Group 2

Number of participants: 3
Locations: Denmark and Norway
Goal: Investigate 'ICT support for communities of teachers'
Result: Succeed in producing the project report and passed the exam, even though one team-member was inactive for periods of the collaboration.
Groupware: Success with groupware adaptation (Virtual University)

group, one group member immediately emerged as the leader, partly because she had access to an empirical case that became the pivotal element of their project. Group 2 succeeded with their project and all the group members passed the exam, even though one group member was inactive at times, bringing into question how much he actually contributed and learned. Group 2 employed the groupware system Virtual-U, which they used to support their distributed collaboration.

Group 3 consisted of four students who lived in different parts of Denmark. They investigated 'newcomers entering virtual communities' and succeeded in conducting the project, writing the report and they all passed the exam. While group members were enthusiastic about the project, their collaboration in Virtual-U was very limited during the first month. At this point, the supervisor stepped in, thus spurring a process in which the students became more focused in their negotiations and in which their diplomatic abilities were tested. For further detailed information about the MIL-case, see Papers no. 6 and 7.

MIL-case: Group 3

Number of participants: 4
Locations: Denmark
Goal: Investigate 'Newcomers entering virtual communities'
Result: Succeed in producing the project report and passing the exam
Groupware: Success with groupware adaptation (Virtual University)

The *MV-case* was conducted in the Master's of Adult Education programme offered by Roskilde University. The master's program is a two-year, part-time vocational education for adults active on the labour market. One semester is spread out over a year, where the students attend six campus seminars in September, November, January, March, April and May. At the campus seminars, students attend lectures and collaborate in groups. Between the seminars, students prepare the seminars while collaborating in project groups conducting problem-oriented project work. The master's degree programme has a long tradition for vocational teaching of adults, but has no tradition for using ICT in teaching or to support collaboration within the groups. The MV-group consisted of three students studying 'Learning and teaching'. Group members lived in different parts of Denmark and only met face-to-face at the campus seminars. The MV-group succeeded with their project, passed the exam and adapted the groupware system BSCW[2]. For further information on the MV-case, see Papers no. 1, 2 and 3.

MV-case: MV-group

Number of participants: 3
Locations: Denmark
Goal: Investigate 'Learning and teaching'
Result: Succeed in producing the project report and passing the exam
Groupware: Success with groupware adaptation (Basic Support for Cooperative Work)

[2] For further information on BSCW see
Bentley, R., Horstmann, T., and Trevor, J. "The World Wide Web as Enabling Technology for CSCW:

The below table summarises the three cases.

Team	Members	Locations	Field	Main goal	Result	Groupware
Team 1	10	Denmark, Germany, Finland, Thailand, Sweden	Industry	Product	Failure	Failure
Team 2	5	UK, US, Sweden, Canada	Industry	Product	Success	Failure
Group 1	5	Denmark, Norway	Education	Learning	Failure	Success
Group 2	3	Denmark, Norway	Education	Learning	Success	Success
Group 3	4	Denmark	Education	Learning	Success	Success
MV-group	3	Denmark	Education	Learning	Success	Success

TABLE 1: OVERVIEW OF THE THREE CASES COMPRISING THE EMPIRICAL WORK

2.5 Data Sources and Analysis Methods

Analysing data can be done in various ways depending on the data material at hand and the research purpose. The data material from the three case studies is different in form and content.

2.5.1 The MV-case

The MV-case provided access to active participation in the groupware adaptation process, thus the action research approach was applied. The data materials comprise various rich data sources from, e.g. workshops, interviews, documents, field notes and events captured within the groupware application BSCW (see Table 2).

Analysing the empirical data from the MV-case was done in different ways. During the actual adaptation process, the analysis took form as a collective process involving the practitioners (teachers and students). Each activity was pre-planned based on diagnosis of the problem, while each intervention and observation was reflected upon in diary notes kept by the researcher. The primary objective for the analysis was to solve the practical problems of student communication and coordination between campus seminars by facilitating groupware adaptation activities.

The Case of BSCW," *Computer Supported Cooperative Work (CSCW): An International Journal*, (6:2&3), 1997, pp 111-134.

MV-case: Data sources
Initial activities establishing contact and creating a contract agreement, September 2001, include: 1. Presentation of research interest to the teacher group 2. Document analysis of the teacher's project proposal for applying groupware to the master's programme made to the institutional board 3. Interview with the key author behind the project proposal 4. Presentation of research interest to the students at a weekend-seminar in September – one group volunteered to participate 5. Document analysis of the book: A different way to university: "Report concerning the master's programme in educational studies at Open University" [En anden vej til universitetet: En undersøgelse af den treårige universitetsuddannelse i Voksenpædagogik under Åben Universitet] (Christensen 2000) 6. Documents analysis of: Master's in Adult Education (Master i Voksenpædagogik), Roskilde University, Department of Educational Research
Problem diagnosis activities with the teacher group, September 2001, include: 1. Diagnosis of problems using mapping techniques 2. Articulation of the pedagogical practice using Dead Sea Scrolls 3. Investigation of how IT might help resolving problems 4. Presentations on the possibilities for IT support of group work 5. Summary of workshop given by a teacher 6. Diary notes made by the researcher before and after the workshop
Planning intervention activities, November 2001, include: 1. Document analysis of the MV-group's initial project proposal 2. Diary notes concerning the research purpose in general, the purpose of the first intervention activity, and specific planning activities 3. Technical preparations, including passwords etc. for BSCW
Workshop with the teachers' group, November 2001, includes: 1. Observation of their discussion concerning a new description of the master's program 2. Document analysis of the official rules and content of the master's program 3. Facilitation of discussion on IT use in the master's program
Intervention activity, November 2001, includes: 1. Presentation of the purpose of the activity 2. Questions for the group to discuss, creating common ground while planning and coordinating the project, e.g.: "What are your expectations for this group work?", including decisions concerning time, collocated and mediated collaboration; "What are the concrete collaborative activities of the project?", including decisions concerning meetings, working papers, readings, empirical work, analyses, how often to log on BSCW and what it mean to logon; and "How should folder structures created within BSCW support your work?" 3. Presentation of an example of a project contract, a project plan and different examples of folder-structures. 4. Document analysis of summary made by the group, including their plan and project contract and folder-

structure 5. Hands-on introduction to BSCW 6. Tape recordings, drawings, pictures and maps were used to capture the rich activities 7. Diary notes made immediately after the session including evaluation of different interventions
Observation activities, December 2001-January 2002, include: 1. Observations of the use of BSCW 2. Diary notes
Evaluation, second diagnosis and planning activities, January 2002, include: 1. Diary notes made before the session 2. Questions for the group comparing the decisions negotiated in November to the actual practice experienced between November and January 3. Facilitation of articulation of specific work practices 4. Tape recording of the session 5. Diary notes made immediately after the session 6. New planning for the project 7. New hands-on introduction 8. Revising folder-structure 9. Technical explanation document about the functionalities of BSCW
Observation activities, January-March 2002, include: 1. Observation of the use of BSCW 2. Status session in March 2002 in which the group received questions to articulate and in which they evaluated their collaborative practice from January to March 3. Tape recording of activity 4. Diary notes made immediately afterwards and as follow up questions using BSCW
Reflective session with the group on the groupware adaptation process as a whole, April 2002, includes: 1. Observation of the use of BSCW 2. Diary notes made before and immediately after the session 3. Questions for the group 4. Tape recording of the activity
Document analysis, May 2002, includes: 1. The group's description of the project period, including their engagement with the action research project officially handed in to the master's programme 2. The project report made by the group

Table 2: Data Sources from the MV-case

Paper no. 1 presents the results from the MV-case by applying a perspective on the groupware system as a coordination mechanism (Schmidt and Simone 1996, see section 3.3), thus analysing the data material comprised re-examinations of all the audio-transcripts, field notes, pictures, drawings and observations collected during the action research process focusing on all aspects related to the use of groupware as a coordination mechanism. Since coordination mechanisms consist of a protocol (how to coordinate) objectified by an artefact (the groupware system), the material was examined by locating empirical observations connected

to the use and non-use of groupware. This analysis process was thus a re-investigation of all the material with respect to how the participants developed and applied protocols for using the groupware system.

The second analysis of the empirical data from the MV-case, which is presented in Paper no. 2, focuses on the perceived usefulness and the ease-of-use of the groupware system BSCW and applies the theoretical perspective on technology acceptance proposed by the Technology Acceptance Model (Davis 1989, see section 4.4). This analysis comprises new examinations of all the data material, especially the transcripts from the workshops identifying and locating all aspects related to how the participants perceived the usefulness and ease-of-use of the technology. In this analysis, the earlier technologies like the telephone and email are included since students' perspectives on email and the telephone influenced their opinions about groupware. When re-investigating the data material, quotes were marked each time an empirical observation revealed information related to the constructs of the TAM-model. During this analysis, a number of TAM-models were constructed representing the students' perspectives at different points in time. Each model was connected directly to quotes from the data material. At the end of the analysis, the overall process of groupware adaptation in the MV-case was constructed based upon the various TAM-models developed through the analysis, which represents the process of groupware adaptation at different points in time.

The last analysis conducted on the data material from the MV-case has a much broader focus on groupware adaptation, as is presented in Paper no. 3. In this paper, the aim was to view the groupware adaptation process as a transformation process of both the participants and the technology, especially related to an expansion and alignment of the participants' technological frames (Orlikowski and Gash 1994, see section 4.4). This analysis comprised yet a new re-examination of the data material, however, the focus was to identify empirical observations related to how the participants changed, modified, aligned and expanded their technological frames concerning groupware.

For each analysis of the data material from the MV-case, the research interest remains on groupware adaptation, but the theoretical perspective changes how the data material was examined and analysed. The theoretical standpoint forms the 'readings' of the empirical observations and draws attention to specific aspects of groupware adaptation. The action research approach during the data collection process also brings in highly rich data material, thus providing the opportunity for a different analysis because the data comprise the practical situation viewed from different perspectives (documents, workshops, interviews and observations) at different points in time, allowing the possibility for triangulation. Triangulation across various techniques for data collection is perceived as beneficial in case studies providing multiple perspectives on issues (Orlikowski 1993). Triangulation across observations of practice and the

participants' descriptions of their actions was possible in the MV-case as well as in the MIL-case. This made it possible to address the complexity of the say/do problem by weighing intentions and impressions against actual behaviour (Blomberg et al. 1993; Orlikowski and Baroudi 1991).

2.5.2 The MIL-case

The MIL-case comprises data material related to the collaboration process and use of groupware in the three project groups (Groups 1, 2 and 3). The MIL-case provided three main perspectives on collaboration processes: the students' perspectives, which were primarily captured by interviews with the three groups; the teachers' perspectives, which were mainly captured by interviews/reflective conversations with the supervisor during the project period; and finally, the possibility of observing each interaction made within the groupware system, Virtual-U, captured within the complete online messages exchanged between the students and between the teacher and the students (see Table 3).

MIL-case: Data sources
Complete printout of messages (80) exchanged during the technology-mediated group formation process in December 2001
Document analysis of the schedule for the collocated seminar in late January 2002
Presentation of project work in general for all the students at the seminar in January 2002, which included a presentation of questions made for groups to establish common ground, planning activities and the structuring folders at Virtual-U
Observations at the collocated seminar in January 2002, which included: 1. Observation of group formation process 2. Casual encounters with the students
Interview with Group 1, January 2002
Interview with Group 2, January 2002
Document analysis of the style guide for writing an academic text written by the master's program
Interview/reflective conversation with the supervisor of the three groups, January 2002
Observations of the groups' use of Virtual-U, January-June 2002
Interview/reflective conversation with the supervisor of the three groups, February 2002
Document analysis of Group 1's project contract and plan
Document analysis of Group 3's project contract and plan
Printout of email correspondence concerning the split-up of Group 1, late February 2002
Interview/reflective conversations with the supervisor of the three groups, March 2002
Observation of the second collocated seminar in May 2002
Interview with Group 3, May 2002
Interviews/reflective conversations with the supervisor of the three groups, May 2002
Access to the complete messages exchanged by the three groups within Virtual-U (1,833 messages)

TABLE 3: DATA SOURCES OF THE MIL-CASE

The first analysis of the MIL-case was based on a research interest about why the most active and committed group was the one that split up. This analysis and interpretation of the data material builds primarily upon a close reading and coding of the complete number of messages exchanged within the groupware system, as presented in Paper no. 6. All the messages were read with the purpose of identifying different kinds of negotiation strategies. To supplement the qualitative analysis approach, this huge volume of data was analysed by applying the categories suggested by Searle's taxonomy of illocutionary acts (Searle 1979, see section 3.3) as a coding scheme to investigate how commitment was negotiated and mediated by groupware. By combining the statistic analysis of the various types of messages based upon the coding scheme with qualitative observations of the content and context of the messages, the results are in-depth descriptions related to the impact of groupware on the different kinds of negotiation strategies applied by the three groups. One interesting aspect of this kind of data material was that we had the opportunity to code and quantify the *actual* practices captured by the electronic traces of the groupware system. It was thereby possible to trace actual use in patterns over time, which would not have been possible without the use of quantitative techniques and the level of persistence regarding the groupware application. As a result, this strengthened the qualitative analysis by connecting quantitative techniques (Eisenhardt 1989).

The second analysis of the data material from the MIL-case comprises investigations of the teacher's perspective on the groups' collaboration processes as presented in Paper no. 7. The primary data sources were the four interviews/reflective conversations with the supervisor conducted during the actual project period. The strength of this data is that the interviews document a development process in the supervisor situation, while the actual data collection process provided a forum for the teacher to reflect upon his own practice – supervision – as a reflective practitioner. In reflective conversations the practitioner reflects on action by reflecting on the construction of experienced problems, the strategies for action, or the model of the phenomena, which have been implicit in his acting in practice (Schön 1983). Also, the in-depth understanding developed in the former analysis of the groups' negotiation strategies further provided a nuanced perspective on what the teacher had and did not have access to when supervision was mediated by groupware. This analysis comprises re-examinations of the interviews with the supervisor and locates all passages related to the changed conditions for supervision when mediated by asynchronous groupware. All quotes explaining or describing difficulties were marked and related to the status of the groups at that particular point in time. Initially, the intention was also to mark quotes explaining enabling conditions, however, while examining the interviews with the teacher it became apparent that the teacher mainly reflected upon the experienced difficulties, thus the final analysis focused on the difficulties in conducting product and process

supervision mediated by groupware. Both of the analyses done for the MIL-case data material were thereby not particularly guided by theories as in the MV-analyses, but rather primarily guided in a manner dictated by the empirical data material.

2.5.3 The Industrial-case

The Industrial-case was of a different nature compared to the educational cases. First, the data material was not as rich, since the data collection was done in the final stage of the two projects investigated instead of during the actual project period. The Industrial-case provided access to interviews with participants and the project managers of the two teams. In addition, access to selected documents and access to the Lotus Notes database of Team 1 was authorised. The Industrial-case did not authorise access to email communication[3] and since most of the mediated interaction was done through email in Team 1 and Team 2, no primary electronic traces of the two teams' interactions were available. Thus, where both educational cases provided the possibility of observing the mediated practice within the teams, interpretations of the collaborative practice had to rely upon the participants' descriptions of their mediated practice in the Industrial-case (see Table 4).

Industrial-case: Types of data	Team 1	Team 2
Participation in top management meeting, November 2002	X	X
Observed one CMM assessment where CMM-consultants from Canada interviewed 15 software engineering employees about their work at the Danish site, November 2002	X	
Individual interview with the Danish team member from Team 1, including diagnostic mapping of problems, November 2002	X	
Conducted one two-hour group interview with the project manager of Team 1 and the project manager of Team 2, November 2002	X	X
Interview/reflective conversation with project manager of Team 2, November 2002		X
Analysis of the content of Team 1's Lotus Notes database, November 2002	X	
Informal observation at the local German site, December 2002	X	
Individual interview with the German team member from Team 1, including diagnostic mapping of problems, December 2002	X	
Interview/reflective conversation with project manager of Team 1 in Germany, including diagnostic mapping of problems, December 2002	X	
Print-out of email correspondences between two participants from Team 1, labelled 'email-waste-of-time' by the Danish participant from Team 1, December 2002	X	
Participation in Top Management meeting, January 2003	X	X
Interview/reflective conversation with the project manager of Team 2, January 2003		X

[3] Except on printouts of the email communication marked 'email-waste-of-time'.

Observations at the local Danish site within the organisation through informal conversation with employees and by observing the organisation, January 2003	X	X
Informal observations at the local Swedish site, January 2003		X
Conducted one three-hour group interview with two participants (US and Swedish team members) from Team 2 in Sweden, including diagnostic mapping of problems, January 2003		X
Document analysis of company's official information material 1. Internal magazine 2. Key corporate values 3. Common systems & processes: Getting it right 4. Slides: Software within research and products 5. About the organisational structure	X	X
Document analysis of material related to the two teams 1. Capability Maturity Model – description 2. Slides: A proposal for a simplified software engineering process & tools group – SEPTG 3. One example of a weekly Flash report from Team 1 4. Slides: Software processes, methods and tools in two versions 5. Slides: Software processes, methods and tools – communication rules 6. Slides: External communication interfaces 7. Slides: Software engineering process group (SEPG) in two versions 8. Project mandate for Team 2 9. Schedule for the CMM assessment in Copenhagen 10. Lessons learned from the CMM assessments in Stockholm, Helsinki, Copenhagen and Braunschweig	X	X
Field and diary notes reflecting expressions and experiences. These were made all the way through the process, November 2002 – March 2003	X	X
Validation of findings in the form of a presentation given to top management and the two project managers of Team 1 and Team 2, March 2003	X	X

Table 4: Data sources of the Industrial-case

In the Industrial-case, the interpretations had to rely primarily on interviews as the data sources. Interviews are usually the primary source in interpretative studies (Walsham 1995, see section 2.3), since conducting interviews is an attempt to understand an event through the meanings people assign to it (Klein and Myers 1999). Relying solely on interview material, one must however be aware of getting different perspectives on the same issues from different participants by asking into particular events in different interviews. Awareness of multiple interpretations is a critical issue of interpretative studies, which prescribes that the researcher must be sensitive towards possible different interpretations of the same events by multiple actors (Klein and Myers 1999). The observation data in the Industrial-case consist mainly of observations of local practice at the Danish site, including observations of a CMM assessment and

participation in top management meetings, combined with two informal observations made at the German and Swedish sites. Thus, the observation data do not include observations of the actual practices in Team 1 and Team 2. The observations, however, provided insights into the organisational culture (the stories told, their work routines, their perspectives of other sites within the organisation, their relation to management, etc.), while supporting trust building between the organisational members and the researcher. The latter was very useful for the participants' openness in interviews.

Analysing the data material from the Industrial-case took form in two ways. First, the data material was examined with respect to groupware adaptation failures, as presented in Paper no. 4. All the quotes that provided empirical observations of why the groupware adaptation failed in the two cases were marked and later related to the concepts of joint enterprise (Wenger 1998, see section 5.3) and intermediator (Markus 2001, see section 3.4) in order to identify empirical explanations of the groupware adaptation failures. When re-examining the interview transcripts from the two teams in respect to groupware adaptation, it also became evident that these interviews provided interesting empirical descriptions of the specific conditions for collaborating in virtual teams in industry. Therefore, a second analysis of the interviews was conducted.

In the second analysis, the data was not pushed in a particular direction, but rather was allowed to point in directions regarding what was important for understanding this kind of collaboration. Therefore, this analysis was inspired by the grounded theory approach (Glaser and Strauss 1967), and was conducted by first printing new copies of all transcriptions of the interviews related to Team 2 and then re-examining the quotations by attaching low level categories for each quotation. Friendship, profession, social relations, power, hierarchy and technology are examples of these low-level categories. During this creation of low-level categories, memos were written to capture the nature and relationship of the categories. Later in the process, all low-level categories were written on a whiteboard to determine connections between them. In this process, high-level categories began to emerge. Communication and collaboration are examples of high-level categories. These high-level categories were connected to the quotation through the low-level categories, so the high-level categories comprised a nest of low-level categories. During this process, the principle of constant comparison was applied (Eisenhardt 1989; Glaser and Strauss 1967), which meant that each time evidence was located supporting a category, an attempt was also made to challenge the category by identifying when the opposite was presented. At the end of this coding procedure, the data pointed to the concept of translucence in communication structures as one important and influential factor for the success of virtual teamwork (Bjørn 2005). At this point, the analysis perspective was turned upside down. A theoretical perspective on virtual project teams was applied by developing a theoretical framework of the

social context of virtual teams based upon literature. All the data from both Team 1 and Team 2 were re-examined, this time using the application Hyber Research[4], which made it easier to connect categories to the quotations. This time the communication breakdowns and their connections to the framework were marked in the material, while reflections were made on how translucence could be addressed in each of the situations identified within the material. Relating the quotations of the participants using their own words, an attempt was made to interpret these descriptions of work practices in terms of the theoretical model of shared meaning (see section 4.1) now guiding the study. Theoretical interpretations allow the researcher to restate the specific findings more generally by deriving general interaction patterns that may be meaningful beyond the particular case (Orlikowski and Baroudi 1991). The final analysis, as presented in Paper no. 5, is thus a proposed theoretical framework of the social context of virtual project teams and translucence in communication structures using the empirical observations as illustrations of the framework, even though the idea originally emerged from the empirical data.

[4] http://www.researchware.com/

3. Collaborative Practice

This thesis investigates the collaborative practice in the specific situation of virtual project teams. However, before turning to the particular situation of virtual teams we need to establish a conceptualisation of the concept of collaborative practice at a more general level, asking what constitutes collaborative practice. The nature of work is associated with the task that has to be solved. Tasks that need to be accomplished through cooperative efforts are defined a priori as shared work tasks requiring collaboration. If it were possible to solve the task individually, there would be no need for a team structure, thus no need for collaboration. People engaged in collaborative work are mutually dependent regarding the work that requires cooperation in order to get the task completed (Schmidt and Bannon 1992). "Cooperative work is constituted by the interdependence of multiple actors who, in their individual activities, in changing the state of their individual field of work, also change the state of the field of work of others and who thus interact through changing the state of the common field of work" (Schmidt and Simone 1996). Engagement in closely coupled work causes mutual interdependence between the participants, and tasks that are ambiguous by nature are tightly coupled until clarification is achieved (Olson and Olson 2000). To solve a shared task, participants need a common understanding of the work involved in achieving clarification of the interdependent activities. Collaboration can generally be characterised by complex and intense interdependencies of activities dependent on participants' shared understanding of the work and the social context; thus collaboration is distinctly different from other types of work in its form and content due to the spatial, time and social distribution of the tasks involved (Lyytinen and Ngwenyama 1992). Suchman (1983; 1987) provides the distinction between practical action and procedural specifications. Procedural specifications or plans are the formal descriptions of work processes. The practical and situated actions are influenced by, but not equal to, the procedural specification, instead practical actions emerge in the actual collaborative situation. Understanding collaboration in context, we need to investigate the practice actions rather than the procedural specifications (Suchman 1983), since it is in the emerging situated action that the actual organisational structures of collaboration exist. This perspective on collaboration has guided the research in this thesis to emphasis on the emergent situated actions as they appear in actual practice of virtual team collaboration and technology use, rather than focusing on the plans for collaboration and technology use.

3.1 Articulation Work

Collaborating in a close work arrangement requires work extraneous to the activities leading directly to the common field of work, such as coordinating, scheduling and planning the individual yet interdependent tasks and activities. This extra work is conceptualised as articulation work (Gerson and Star 1986). There is an important distinction between cooperation and articulation; cooperative work increases the amount of work involved for distributed tasks, while articulation manages the consequences of the distributed nature of work (Star and Strauss 1999). In this way, articulation work is a part of all collaborative activities involved in dealing with the complexity. If participants must engage in articulating individual activities extraneous to activities contributing directly to the common field of work, they are engaged in collaborative practice.

The language used and applied in cooperative work influences collaboration. Understanding how language influences collaboration, we can turn to the notion of double-level language identified as formal and cultural language (Robinson, 1991). People working in collaboration have a formal language, as in the text document produced in a collaborative act, but they also have a certain language at a cultural level that supports the local understanding and interpretation of the particular text. Work and articulation work are communicated at both levels, but it is important to notice that significant parts of the communication are invisible in the formal representation (the final documents, slides and reports). The socially significant information of the objects at the cultural level is not included, however important for interpretation (Paper no. 5). Basically, the groupware systems employed in the empirical cases of this thesis are applied with the aim of supporting articulation work, e.g. in the form of negotiation (Paper no. 6) or coordination (Paper no. 1). Furthermore, one of the main constraints of asynchronous interaction supported by technology is identified as the lack of support for communication and interpretation of the socially significant information at the cultural level (Paper no. 5 and Paper no. 7).

3.2 Awareness and Translucence

Awareness is understood as the relationship between visibility and monitoring. In collaborative work, participants are not only obligated to fulfil their individual tasks, but also to make their individual tasks visibly available to collaborative partners not directly involved with the activity (Heath and Luff 1992). Drawing attention to individual activities by making them visibly available to others brings the opportunity for others to monitor the work and thus adjust their own work accordingly. Mutual awareness exists in collaborative practice where participants are aware of the state and content of each other's activities while being aware of the relations between their own activities and the activities of others.

Awareness has been found to be an important aspect of collaborative practice, supporting tacit and seamless collaboration. Awareness is not a state of mind, but a feature of collaborative practice, which can be accomplished through ongoing emerging collaborative activities (Heath et al. 2002). Awareness is an attribute of collaborative action, which means that collaborative partners are not just simply 'aware', but are aware of something, and in this respect, awareness is a practice in which the actors tacitly and seamlessly align and integrate their scattered distributed and yet interdependent activities (Schmidt 2002).

Awareness as a concept can be characterised into different categories, e.g. social awareness, task-oriented awareness, availability awareness, process awareness and perspective awareness (Prinz 1999; Steinfield et al. 1999). Social awareness comprises information about the presence of people and their activities, similar to the information received via casual, informal talk at the office, while task-oriented awareness focuses on the activities performed to achieve a shared task promoted by notifications or information about the state of shared documents (Prinz 1999). Both of these awareness types are relevant when investigating virtual teams. Availability awareness is relevant in synchronous interaction, since it provides knowledge of whether a particular person is available at a specific point in time (Steinfield et al. 1999). This type of awareness is not directly relevant for the teams investigated in this thesis, because they mainly collaborate asynchronously. Process awareness can be found in groupware systems stipulating a specific workflow and provides people with a sense of whether their individual activities fit into the overall workflow at the right point in time (Steinfield et al. 1999). The groupware applications investigated in this thesis are characterised by being open-ended and *not* connected to an explicit workflow, thus process awareness is not directly relevant for the empirical cases in this dissertation. Perspective awareness provides information helpful for making sense of other's actions and includes, for example, background information about team members' beliefs and knowledge (Steinfield et al. 1999), and is thus closely connected to the development of the social context of virtual teams. In this thesis, one specific kind of awareness has been identified as an important enabler of groupware adaptation in virtual project teams. This awareness type combines social and perspective awareness and defines social perspective awareness as giving group members information helpful for making sense of each others' actions so that the information received is similar to the information gathered informally at the office (Paper no. 2).

The invisibility of collaborative work processes might lead to communication breakdowns and is thus an awareness problem. According to Flores et al., a "breakdown is any interruption in the smooth unexamined flow of action" including events that participants assess as being either negative or positive new opportunities (Flores et al. 1988). Translucence in collaborative work situations

may reduce the risk of breakdowns (Paper no. 5) and is characterised by three characteristics: visibility, awareness and accountability (Erickson and Kellogg 2000). Visibility refers to the socially significant information providing participants with the opportunity to notice and monitor the existence and actions of others. Awareness, as a part of translucence, refers to the opportunity for monitoring visible socially significant information bringing the possibility for adjusting individual activities accordant to others' actions. The possibility of monitoring the activities of others combined with the knowledge that others might monitor your activities fosters accountability, i.e. you know your future actions will be judged by your past actions (Paper no. 5).

3.3 Coordination and Negotiation

Aligning, scheduling and integrating interdependent activities are core aspects of collaboration, thus coordination is a vital activity of collaborative practice. Coordination as a concept and as an important activity in cooperative work has been investigated in many studies, e.g. in terms of coordination mechanisms (Schmidt and Simone 1996). Coordination mechanisms consist of coordinative protocols embedded in coordinative artefacts. The protocol is an integrated set of procedures and conventions stipulating the articulation of interdependent activities, while the artefact is a symbolic construct objectifying the protocol (Schmidt and Simone 1996). Groupware systems can be viewed as supporting the exchange of documents and messages, and thus supporting coordination. To apply coordination mechanisms, the users of the groupware system must negotiate and develop protocols that can be objectified within the technology stipulating use. Computer-based systems are seen as having the potential to reduce coordination costs, enable rapid and responsive communication across time and across space barriers and bring structure to unstructured dialogue between dispersed participants (DeSanctis and Jackson 1994). However, complex systems supporting coordination will only be perceived as useful when relatively complex coordination structures apply, while in situations characterised by simple coordination structures, simpler systems will be perceived as useful (DeSanctis and Jackson 1994). Thus, choosing the right model for coordination depends on the kind of coordination problem one wishes to solve. Coordination in the empirical cases in this thesis typically is associated with the activities involved in exchanging different versions of documents during collaborative revision processes. At the same time, the technology supporting the document exchange does not automatically support coordination. Thus, establishing coordination mechanisms is highly dependent upon the participants' abilities in negotiating protocols for coordination while relating the protocols to the use of the technology objectifying the protocols (Paper no. 1).

Negotiation comprises two or more people's interactions with the aim of reaching agreement upon a specific issue and is thus an important part of

collaborative practice. Negotiation tasks can be divided into three types: collaborative, cooperative, and mixed-motive negotiation tasks (O'Connor et al. 1993). Collaborative-negotiation tasks are defined as situations where participants without conflict or trade-offs may combine their contributions additively. In cooperative-negotiation tasks, participants must combine their contributions under various constraints in order to attain, from a group perspective, a high-quality product or agreement. During mixed-motive negotiation tasks, participants must combine their individual contributions in situations where they have reasons to both cooperate and compete with each other regarding their interest in the expected outcome (O'Connor et al. 1993). The complexity involved in reaching an agreement increases between the three types of negotiations, with the highest level of complexity found in mixed-motive situations. When groups collaborate on a mixed-motive task, they are in a delicate situation requiring diplomacy and negotiation skills.

Negotiation is about establishing shared meaning in a specific social context, and in collaborative situations participants becomes engaged in continued negotiations about shared meaning and focus (Wenger 1998). Negotiating shared meaning in communities of practice involves two interrelated processes, participation and reification (Wenger 1998). Participation refers to the social experience of being connected to a specific social group in terms of membership and active involvement, while reification refers to the process of giving form to experiences by producing objects such as tools and symbols, thus embedding a negotiated shared meaning. Virtual project teams can be viewed as communities of practices, thus negotiations include the processes of participation and reification (Papers no. 1 and no. 6). Establishing shared meaning requires participants to interpret the meaning of others' actions and utterances, including interpretation of explicit feedback, such as 'yes', 'hmm' and 'ok', and implicit feedback, such as assuming acceptance in the absence of explicit denial or retraction (Baker 1995). Participants are highly dependent on contextual information to interpret the feedback of others. However, in virtual project teams working asynchronously, the construction, communication and interpretation of feedback are constrained, e.g. because the character of asynchronous messages typically contains multiply intertwined issues. Intertwined issues can lead to participants accidentally or purposely overseeing requests and not providing feedback on their commitment to essential issues. Researching negotiation in mixed-motive situations mediated by asynchronous technology, an analytic framework is necessary to distinguish the content of particular messages with respect to requests and commitment from a language discourse perspective. At the utterance level, Searle's (1979) taxonomy of illocutionary acts can be used as a tool to analyse how commitment is negotiated by helping to identify requests and clarify whether they lead to commitment or whether they go unnoticed by providing categories such as assertives, directives, commissives, expressives and

declarations. Connecting these categories to the complete number of messages exchanged during mixed-motive negotiations, the opportunity arises to investigate the impact of asynchronous technology on negotiation (Paper no. 6).

3.4 Groupware Technology

Since virtual teams by definition rarely meet, technology is an embedded part of the definition of virtual teams. Various technologies can be applied in virtual team situations. However, the specific kind of technology in focus here is labelled groupware technology. Groupware technology can be categorised as an open-ended technology (Ngwenyama and Klein 1994; Orlikowski and Hofman 1997), where its application initially does not stipulate a specific workflow thus must be customised to support the particular context in which it is adapted. Groupware can in this way be viewed as a set of resources designed to support collaboration (Ngwenyama and Lyytinen 1997). The main goal of groupware technology is to support collaborative work between collaborative partners and in this way support important aspects of the collaborative practice. Groupware technology manage task dependencies such as articulation work, coordination, awareness and negotiation, while providing a common information space (Carstensen and Schmidt 1999). Common information space is a concept that refers to the possibility of sharing and archiving documents in a common repository and requires participants to actively construct meanings of the shared objects through negotiations to be able to interpret the shared information items and their locations (Hertzum 1999). Groupware should provide a shared work space, a kind of social "sphere" where social actions are propagated and "objects-of-work" are used (Ngwenyama and Lyytinen 1997).

Groupware technology is a broad definition of the various kinds of technologies supporting work in groups, including email and synchronous videoconferencing. However, not all kinds of groupware technology use are investigated in this thesis. One well-quoted taxonomy of groupware comprises a two-by-two matrix between group size and place (DeSanctis and Gallupe 1987). Grudin further develops this framework into a three-by-three matrix between time and place (1994a). However, these taxonomies do not aid in distinguishing the specific type of groupware investigated in this thesis. Categorising groupware technologies developed by vendors in the commercial world, Spellman et al. (1997) propose three primary types: meeting-centric, document-centric and place-based systems. Meeting-centric groupware consists of synchronous technologies that provide tools for audio, video and data conferencing, where document-centric groupware provides various kinds of document management tools typically supportive of asynchronous interaction. Place-based systems are characterised as persistent (continue to exist), location independent (can be accessed regardless of location), location transparent (possibility of interacting without knowing others' locations) and stateful

(providing a context where users can interact with selected documents or people) (Spellman et al. 1997). The groupware technologies (BSCW, Virtual-U and Lotus Notes) used in the empirical cases in this dissertation can be labelled place-based systems. Furthermore, the systems investigated are characterised by being small, generic, open-ended reconfigurable systems with a context-specific nature (Bødker et al. 2004b; Orlikowski and Hofman 1997), providing a shared repository, while mainly supportive of asynchronous interactions. A summary of three different collaborative place-based groupware applications investigated in this thesis is given below in Table 5.

	BSCW	Virtual-U	Lotus Notes
Persistent	Yes, with option of modifying, revising and deleting folder structures, messages and documents	Yes, without the option of changing or revising structures – only by deletion	Yes, with the option of modifying structures
Location independent	Yes, web-based	Yes, web-based	Yes, application-based. Company laptop required
Location transparent	Yes, can interact without knowing the other party's location	Yes, can interact with others without knowing their location	Yes, as long as participants have access to the company's local network via laptops with Internet access
Stateful	Yes, since the developed folder structures have the ability to provide a context related to the negotiated shared meaning concerning the structures	To some extent, since the thread structure of the messages might provide context information dependent on the usage of the system – no separate structures exist for documents	Yes, since the developed folder structures have the ability to provide a context related to the negotiated shared meaning concerning the structures
Open-ended, small and generic	Yes, does not stipulate a particular workflow initially, is a small application and is developed as a generic system	Yes, does not stipulate a particular workflow initially, is a small application and is developed as a generic system	Yes, does not stipulate a particular workflow initially, is a small application and is developed as a generic system
Reconfigurable and context-specific nature	Yes, needs to be customised or re-configured to support the context-specific practice	Yes, needs to be customised or re-configured to support the context-specific practice	Yes, needs to be customised or re-configured to support the context-specific practice
Asynchronous	Yes, mainly supportive of asynchronous interaction	Yes, mainly supportive of asynchronous interaction	Yes, mainly supportive of asynchronous interaction

TABLE 5: COLLABORATIVE PLACE-BASED GROUPWARE APPLICATIONS

BSCW is persistent by nature, thus actions may continue to exist even though no one is logged on to the system. BSCW is location independent and location transparent, since participants have access to the system as long as they have access to the Internet and a web-browser and because participants can interact with each other regardless of location. BSCW is also stateful, since the system provides the opportunity for participants to develop and modify the folder, link and message structures within the system, thus, providing a context for the users to interact with selected documents and people. In addition, BSCW is a generic product comprising a small application typically containing only one folder at the initial stage, thus the system is open-ended and must be reconfigured to support the context-specific needs of the users. Finally, BSCW mainly supports asynchronous interaction.

The next collaborative place-based groupware application looked at is Virtual-U, which mainly supports asynchronous interaction and is a generic, small, open-ended and reconfigurable application. Virtual-U requires customisations to establish and develop a folder structure supportive of the specific contextual needs of users. Virtual-U is persistent while being location independent and transparent, since messages continue to exist and because users have access to the system as long as a web-browser is available, regardless of location. The statefulness of Virtual-U exists but is minor, since its functionalities support building up a thread structure for the exchange of messages, thus providing context information to a certain level. However, if the users do not continually follow the structure and indicate the subject matter explicitly for each message, there is a risk that the complexity of the navigation increases. In addition, Virtual-U does not provide the option of developing a separate structure for a document repository, thus the documents are attached instead to messages, increasing the difficulties in archiving and retrieving documents.

Finally, the collaborative place-based groupware application called Lotus Notes is open-ended, persistent and stateful, since users have the option of developing separate structures for both document and message repositories, still they need to develop a useful folder structure to suit their context-specific needs. Lotus Notes is location independent and transparent as long as its users have access to applying it via company laptops with Internet access. Moreover, Lotus Notes mainly supports asynchronous interaction.

It is important to note that in the empirical cases of this thesis the geographical distribution and different working hours of the participants made the technology use of the place-based groupware systems predominantly asynchronous. All the teams from the empirical cases supplemented their use of groupware with other kinds of technologies such as instant messaging, email and telephone. However, in this dissertation the groupware technology under investigation only concerns place-based systems. Because of the open-ended nature of place-based systems, it is impossible to predict how participants will adapt the system in the initial stages. Thus, doing ongoing re-evaluation of technology use causing structural changes in the system is essential, which points to the fact that place-based systems should be, to some extent, configurable over time (e.g. Carstensen and Schmidt 1999; Wang and Haake 2000).

The impact of place-based groupware technology on collaborative practice depends upon 1) the nature of the technology, 2) how the technology and other group structures such as tasks, hierarchy, organisational setting are appropriated, and 3) how new socially emerging structures are constructed over time (DeSanctis and Poole 1994). Developing shared repositories requires a great deal of effort from the participants to produce the content (e.g. documents), while building and revising appropriate structures for others to locate, reuse or revise the content. In addition, it seems that participants often lack motivation

and resources for conducting this extra work of developing appropriate structures within the groupware technology (Paper no. 4). Therefore, it is argued that in cases of successful adaptation, these activities should be preformed by an intermediator, who can prepare exchange of knowledge by eliciting, indexing and summarising the knowledge content (Markus 2001) constructing and reconfiguring the technology use (Paper no. 4).

3.5 Summary of Collaborative Practice

Collaborative practice consists of complex and intense interdependencies between activities dependent upon participants' shared understanding of the work and the collaborative practice. Collaboration is constituted by the interdependence of multiple actors, who by changing the state of their individual work also change the state of the common field of work. Collaboration is investigated in this thesis by focusing on the emergent situated actions of actual collaboration, while plans for collaboration and technology use are viewed as influential but not equal to the practical actions. Collaborative practice requires activities extraneous to producing the expected result in order to manage the consequences of the distributed activities, also referred to as articulation work. Articulation work includes coordination and negotiation activities.

Coordination is defined as the process of aligning, scheduling and integrating interdependent activities, and groupware systems are seen as having the potential to reduce coordination efforts. Negotiation tasks come in three forms: collaborative, cooperative and mixed-motive, where negotiation in mixed-motive situations requires diplomatic abilities and is prone to communication breakdowns.

Awareness is an important attribute of collaboration that facilitates tacit and seamless collaboration. Communication breakdowns interrupting the smooth flow of action might decrease in situations characterised by translucence of the collective work processes. Translucence triangulates visibility, awareness and accountability by making visible the collaborative activities, thus providing a possibility for the collaborative partners to monitor each other's actions. This is also defined as mutual awareness and fosters accountability between the actors.

The specific type of technology investigated in this dissertation is place-based groupware technology. The place-based systems used in the empirical cases in this thesis are characterised by having a context-specific nature, being persistent, stateful, location independent, location transparent, open-ended, generic, reconfigurable and mainly support asynchronous interaction.

4. Distance

The definition and characteristics of collaboration presented in the previous chapter are not particularly related to collaboration in virtual teams, but are of a more general nature and are thus applicable in situations of conventional collocated teams as well as in virtual teams. The trait that differentiates virtual teams from conventional teams is that while the spatial distance in conventional teams is proximal, bringing the possibility for regular face-to-face communication, the spatial distance in virtual teams is scattered, thus most of the communication is technologically mediated (Bell and Kozlowski 2002). Spatial distance is thus a key factor influencing collaboration in virtual teams in specific ways compared to conventional teams. The effects of geographical distribution are difficult to isolate because of the other factors associated with distance, such as diversity of cultures, time zones and organisations that also influence distant collaboration in essential ways (Espinosa et al. 2003). Geographical distribution in itself does not impact team performance, but rather aspects such as cultural and work process diversity typically associated with geographical distribution impact performance negatively (Chudoba et al. 2005). Distance in collaborative practice is typically associated with geographical distance, however distance in collaborative practice includes other dimensions of discontinuities between the dispersed participants, thus the conceptualisation of distance is much broader. Distance understood as discontinuities comprises gaps or a lack of coherence in aspects of the work and can arise in factors such as the location of participants, where and how the work is accomplished and in the basis for the relationships between participants (Watson-Manheim et al. 2002). Discontinuities can be temporal, in the form of a break in some kind of logical succession, or they can be cross-sectional, in the form of a lack of coherence in various aspects of the collaborative work (Watson-Manheim et al. 2002). We need to conceptualise the concept of distance as discontinuities to fully understand the social context of collaborative practice in virtual teams. From this perspective, the distance for a team cannot simply be defined as either collocation or geographical distribution. Instead, distance should be perceived as a continuum with variations in respect to the extent of face-to-face encounters combined with various degrees of discontinuities in professional disciplines, work practices, time zones, technology and national culture (Chudoba et al. 2005; Watson-Manheim et al. 2002; Windsor 2001). In this chapter, the concept of distance is thus examined and used in two ways. One way involves the geographical distributions of participants, while the other way is metaphoric and involves various kinds of discontinuities between participants that influence the collaborative practice of virtual teams.

4.1 Discontinuities within the Social Context

To improve conditions for distant collaboration within virtual teams despite the limited possibilities for face-to-face interaction and the constraints of place-based groupware technology, it is necessary to investigate how to improve the conditions for establishing and developing the social context while adapting groupware to support the situated collaborative practice of the virtual team, while simultaneously understanding how different discontinuities impact the social context. Establishing and developing the social context of virtual teams is highly influenced by the degree of discontinuities related to the professions, work practices, time, technology and culture of the team members. Therefore, we need to conceptualise how the different forms of discontinuities are connected and related to the social context of virtual teams. Conceptualising distance in respect to virtual teams, it is necessary to examine the social context in which distance occurs. However, first it is necessary to conceptualise what constitutes the social context of a virtual team.

Every action in an organisation is socially oriented and takes place in a predefined social context (also called the organisational context) (Ngwenyama and Lee 1997). Analytically, the social context can be conceptualised as comprising the team participants' lifeworlds, institutional structures and work practices (Paper no. 5), as shown below in Figure 2.

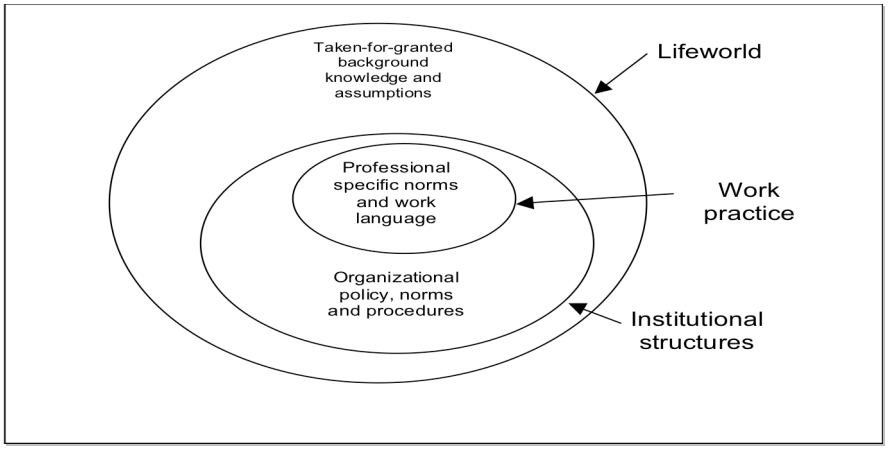


Figure 2: The three analytical levels of the social context, adapted from Bjørn & Ngwenyama (Paper no. 5).

Lifeworld comprises the taken-for-granted inter-subjective reality of participants, which is built upon interpretations of all personal work experiences combined with the collective work experiences of collaborative actors (Ngwenyama and Klein 1994). Lifeworld elements are the unarticulated background assumptions, knowledge, culture, beliefs and values that provide implicit guidelines for shaping the individual's interpretation of events and situations. *Institutional structures* are the articulated norms and roles of the organisation visible in terms

of policies, symbolic artefacts, stories, ritual activities and patterned behaviour. *Work practices* comprise the profession-specific norms, practices and languages, including the usage of technology. Developing common work practices is a process in which various sub-languages are in constant contact, influencing each other and creating new language forms and meanings (Holmqvist 1989). The social context of virtual teams is a conglomeration of pieces of lifeworlds, institutional structures and work practices that participants bring from their local social contexts. Establishing and developing a social context for virtual teams thus comprises negotiation processes in which various discontinuities related to the local social contexts at all three levels serve as a foundation for building shared meaning (Paper no. 5). Using this model of the social context as a base, it is possible to investigate the particular characteristics of distance in respect to the six discontinuities: culture, geography, time, professional practice, work practice and technology by placing the discontinuities at the different analytical levels in the social context of virtual teams.

4.2 Discontinuities of Culture, Geography and Time

In the social context model, discontinuity of culture is located at the lifeworld level and can arise in the form of organisational culture and/or national culture. Culture is generally perceived as a group-specific collective phenomenon within a shared social context, which is shared through values, opinions, approaches and patterns of behaviour (Vallaster 2005). In collaborative situations where participants experience discontinuities in respect to culture, the transaction costs and communication difficulties may increase (Windsor 2001). In addition, the amount of cultural discontinuity represented within a team is negatively associated with the establishment of trust (Gibson and Manuel 2003). Country-of-origin discontinuity in groups is, however, not automatically associated with negative consequences since discontinuities between national cultures seems to matter only in stressful and conflicting situations, where cultural diversity becomes salient (Vallaster 2005). In one of the empirical cases, cultural discontinuity was salient especially when the team was collocated, which caused stressful and conflicting situations (Paper no. 5).

Discontinuities in terms of geography and time are located at the institutional level. Here the organisational structure of teams across locations and even time zones influence the participants' perception of themselves as one coherent organisational unit. The challenge of bridging geographical distance is to prevent team members from feeling isolated from important decisions and social interactions (Paper no. 5). One should also recognise that team members are located in various social contexts because they are connected to different social groups. The social contexts of geographically distributed participants includes their local collocated social contexts and their virtual team context, which challenge team members to bridge these different contexts. Additionally,

geographical distribution challenges the organisational structure in creating rules and resources supportive of participants' existence in various social contexts across geography and time.

Time constitutes a major dimension of social interaction and can be conceptualised by three temporal criteria: timing, timeliness and allocation. Timing has to do with whether participants' various activities are synchronised, while timeliness has to do with whether activities are finished (scheduling) within the appropriate amount of time (not too soon and not too late) (McGrath 1990). Allocation is an activity where resources are assigned according to the overall motives of the project and can be in the form of staff-hours or other types of resources (Bardram 2000). When participants work asynchronously the complexity of time increases as related to synchronisation of activities and tasks; planning and scheduling the work; and finally, allocating resources. The collaborative situations within the empirical cases of this thesis are characterised by discontinuity in time, since the participants did not work synchronously, either because of their location in different time zones or because of their commitments in their various social contexts. Increased complexity arises from asynchronously technology use, since the lack of implicit feedback makes it difficult to represent and interpret the socially significant contextual information required for mutual understanding (Paper no. 7). Should the absence of an explicit denial to a particular request be interpreted as acceptance or have the others simply not yet read the request?

4.3 Discontinuities of Professions and Work Practices

Discontinuities in professional disciplines and work practices are both placed within the social context model at the work practice level. These two types of discontinuities are not only related to virtual teams, but affect the establishment of the social context in any kind of teams, including both conventional and virtual teams. Discontinuities between professions are embedded in cross-disciplinary teamwork, where people with different professional backgrounds collaborate to produce a common product, which requires various competences, for instance, when a new rocket engine design requires competences in the areas of engineering, combustion analysis, manufacturing engineering, stress and thermal analyses (Malhotra et al. 2001). In situations with embedded professional diversity, the use of discipline-specific or product-specific language might fail since members are not equally versed in all disciplines and all products (Malhotra and Majchrzak 2004). Thus, a key activity for cross-disciplinary teams is to develop a shared professional language useful for expressing their professional competence in respect to a particular goal.

Teams comprised of participants from one single profession might have an easier time developing a shared language, since they can use the language and concepts grounded in their professional background, thus lowering the

complexity of the collaboration. Single-profession teams might experience misalignment of work practices, especially in a situation where participants are located in different departments, organisations or even countries. In organisational groups, people develop different sub-languages based on the nature of their functions. Organisations are involved in ongoing processes to remake themselves through the use of language by continuously negotiating meaning and understanding (Klein and Truex 1996). Developing a common work-language makes up a process in which various sub-languages are in constant contact, influencing each other, while creating new language forms and meanings (see section 4.1). Experiencing a high level of diversity between team members' various sub-work practices calls for intense negotiation of both language and work processes to develop a common work language. This ongoing negotiation of work-language, both in cross-disciplinary and single-profession teams, is essential for bridging distance and discontinuities between various professions and work practices.

4.4 Discontinuities of Technology Use and Adaptation Issues

Collaboration across geographical distances would be impossible to some extent without technology. Today, the use of email and the telephone is mundane in almost every work situation, however, the use of more advanced groupware systems, such as Internet-based shared applications or place-based systems, is yet to become appropriated and widespread (Chudoba et al. 2005). Discontinuities in respect to technology can be conceptualised as *in*congruencies in the participants' technological frames. Technology frames comprise the individual's perception of a specific technology, while incongruence between team members' individual technology frames exist when participants view the nature, strategies and use of a particular technology differently (Orlikowski and Gash 1994). Resolving discontinuities of technological frames is a process of ensuring that prospective users have a shared understanding of the nature, strategies and use of a technology, thus aligning the structure and content of their individual technological frames on key elements and categories regarding a certain technology (Paper no. 3). In this way, the challenge of bridging the discontinuities of technology use in virtual teams can be viewed as a process of groupware adaptation.

In the social context model, technology plays a role both at the institutional and work practice levels. Technology at the institutional level comprises the perspectives of the organisation (top management) on the strategic motivation behind implementing and using specific technologies within the organisation. This can be in terms of technology policies (e.g. the policy of using email as the company's primary communication channel) or as patterned behaviour (e.g. that all internal company documents are archived in a shared repository). Technology at the institutional level may also comprise non-policies in respect to using

technology, which again affect employee perspectives on the role of particular technologies in the organisation. This suggests that by formulating policies concerning groupware, organisations might affect employee perspectives on groupware as the first step toward groupware adaptation.

At the work practice level, the perspective on technology is influenced by the strategic motivation formulated at the institutional level. Moreover, the profession-specific norms, the collaborative practices and the work languages also affect the technological frames of the participants. If participants are used to complex IT-systems in their professional practice, they might have an open attitude towards adapting advanced groupware systems to support their common practice, thus exploiting new windows of opportunity (Tyre and Orlikowski 1994). However, if they do not perceive that the technology will support their practice in new and useful ways, they might be reluctant to spend time and effort on adapting the system (Robinson 1991). In these situations participants will often rely on their former technology use patterns and routines (Huysman et al. 2003; Tyre and Orlikowski 1994). Moreover, groupware technology requires that all team members fully adapt the system, because sporadic use will lead to failure (Grudin 1994b). If participants cannot depend on the latest version of a document being available in the shared repository, then they will not rely on the system at all, but find alternative ways for exchanging documents. Experiencing distance as discontinuities in relation to technology at the work practice level can thus be in the form of irregularities or a misfit between the groupware technology and the collaborative practice or in the form of asymmetry between technological frames of team members (Paper no. 3).

Discontinuity in respect to technology adaptation can also be understood as the participants' acceptance of a particular technology. Investigating groupware adaptation as an acceptance process applying the Technology Acceptance Model (TAM-model), discontinuity in respect to technology can be conceptualised as a misalignment between participants' perspectives in different categories related to the constructs of the TAM-model: ease-of-use, perceived usefulness, intentional use and actual use (Davis 1989). Thus, the discontinuities form the participants' different views of, e.g. the usefulness or ease-of-use related to a particular technology. The TAM-model was originally developed to quantitatively measure the acceptance of technology at a particular point in time. However, the model is useful for freezing complex qualitative data at particular points in time, and thus provides the opportunity to investigate how, e.g. the participants' perception of the usefulness of the groupware change from initially being the primary factor influencing the intention to use groupware, to being pushed aside by the ease-of-use factor when the collaborative process eventually is interrupted by a dead-period causing premature rejection of the groupware system (Paper no. 2).

4.5 Summary of Distance as Discontinuities

Distance in teamwork is usually understood as geographical distance; however, distance can also be understood as various kinds of discontinuities between team members. In this thesis, distance is examined in respect to six discontinuities embedded in the collaborative practice of virtual teams: culture, geography, time, professions, work practice and technology. These discontinuities are related to the different parts (lifeworld, institutional structures and work practice) of the social context of teamwork. Discontinuity in culture (national as well as organisational) challenges virtual teams to bridge their various lifeworlds. Bridging cultural discontinuities by developing shared meaning includes negotiations of the taken-for-granted assumptions, beliefs and values at the most fundamental level.

The discontinuities of geography and time are located within the institutional structures of the social context. Geographical discontinuity exists in collaborative situations, where participants simultaneously exist in various social worlds at different geographical locations, including their local collocated social contexts and their virtual team context. The main challenge of geographical distribution is to prevent participants from feeling isolated from the decision-making and social relations related to the virtual team context. Discontinuity in time exists in asynchronous collaborative situations characterised by the participants being located in different time zones or by participants being engaged in various social contexts, causing them to work at different work hours during the day.

Discontinuities in professions and work practices are located at the work practice level. Discontinuity related to professional practices can be found in cross-disciplinary collaboration, typically comprising situations characterised by the lack of a common professional work language. The main challenge in situations of professional discontinuity is for participants to negotiate a shared work language useful for expressing various competences needed for reaching the goal of the project. Discontinuity related to work practices exists in collaborative situations where participants are familiar with particular work routines and patterns, however different from each other's. These situations are characterised by a lack of common language, routines and behavioural patterns, and bridging various work practices require negotiation efforts to establish a shared meaning for the interdependent activities.

In virtual teams the process of becoming one organisational unit is fragile (Hinds and Mortensen 2005) and prone to failures because participants come from and are socialised into various lifeworlds, institutional structures and work practices. However, the influence of distance depends upon the degree of diversity experienced related to discontinuities at all three levels of the social context. For each virtual team, the degrees of distance in respect to specific discontinuities are interrelated, but high diversity in one category does not automatically lead to high diversity in another category. Nevertheless, high

diversity related to geographical discontinuity (a low amount of face-to-face interaction) might more often include situations of high diversity related to the discontinuities of work practices, time zones and national cultures. Belonging to different national cultures, participants located in various parts of the world typically rarely meet face-to-face, though they simultaneously exist in various social groups, work different office hours, and employ work routines and patterns from their local social contexts, which are different from other local social contexts.

Distance as a geographical boundary is easy to locate, but the most interesting part of geographical distribution is to investigate conditions enabling the establishment and development of the social context despite the limited possibilities for face-to-face interaction and the constraints of place-based groupware technology. Geographical distribution in itself does not affect collaboration since locality has been found to be less important in conveying common practices (Chudoba et al. 2005). Instead, the effects of geographical distribution are located in people's perceptions of each others' locations rather than in the actual locations (Bradner and Mark 2002). Thus, examining cases of geographically distributed collaboration provides the opportunity for investigating the primary challenges for the establishment of a social context in distant collaborative settings; namely, discontinuities in culture, work practices, time, professions and technology, since these forms of discontinuities often are associated with geographical distribution.

5. Distant Collaborative Practice

Distant collaborative practice is constituted by the interdependence of multiple geographically distributed actors, who by changing the state of their individual work also change the state of the common field of work. Distant collaborative practice dependent upon the participants' shared understanding of the work and the social context, is thus dependent upon the participants' abilities in bridging possible embedded discontinuities. Researchers generally agree that geographically distributed teams are more fragile and prone to breakdowns than collocated teams (e.g. Griffith et al. 2003b; Hinds and Mortensen 2005; O'Connor et al. 2003). Thus, virtual teams require proactive attention from managers or others to detect discontinuities that cause conflicts at an early stage, especially since communication patterns and technology use patterns established in the beginning have a tendency to last for the entire project (Huysman et al. 2003; Jarvenpaa and Leidner 1999; Tyre and Orlikowski 1994). Previous research on virtual teams proposes four main challenges in respect to managing distant collaboration: the development of trust, temporal rhythms, common ground and communication norms. Since this thesis mainly contributes to research on virtual team in the areas of common ground and communication norms, the sub-sections of this chapter only briefly present the areas of trust and temporal rhythms.

5.1 Trust in Distant Collaboration

Creating relationships between dispersed participants is a primary challenge for virtual teams, and one of the main components that holds interpersonal relationships together is trust (O'Hara-Devereaux and Johansen 1994). Collective trust can be identified as a shared psychological state characterised by an acceptance of vulnerability based on expectations of the intentions and the behaviours of others within the team (Gibson and Manuel 2003). Creating and maintaining trust is a process that involves preventing the geographical distance from leading to a psychological distance (Jarvenpaa et al. 1998). Sources of trust are primarily based upon perceptions of other team members' integrity and, second, upon perceptions of generosity in previous phases of teamwork (Jarvenpaa et al. 1998). Moreover, it has been suggested that trust is created "swiftly" in virtual teams, which means that it is based on the tendency of members to initiate or to respond to the first electronic communications (Jarvenpaa et al. 1998; Jarvenpaa and Leidner 1999). This suggests that the first communication event in a virtual team generates patterns of trust that may last the lifetime of the team.

5.2 Temporal Rhythms in Distant Collaboration

Synchronising, scheduling and allocating are important challenges to be addressed in virtual project groups. The complexity of synchronising activities and tasks, planning and scheduling work, while allocating resources for the project increases when team members work in different time zones and are scattered geographically (see section 4.2). The increased complexity caused by asynchronous interaction challenges the mediation of different temporal rhythms using technology. In asynchronous technology-mediated interaction, the increased complexity gives rise to the difficulties experienced in determining how to interpret silence (Cramton 2001), as well as the difficulties caused by the blurred distinctions between past, present and future in asynchronous interaction when interpreting the socially significant contextual information behind messages (Sarker and Sahay 2004). Investigating global virtual team dynamics and effectiveness, Maznevski and Chudoba (2000) propose that to meet the time challenge, effective teams should develop a temporal rhythm structured with regular physical encounters rich with intensive communication, followed by less intensive interaction mediated by various technologies. Empowered virtual teams with a collective experience of having potential to complete their project and autonomy in doing so while conducting meaningful work that significantly contributes to organisational goals need less frequent face-to-face encounters compared to teams characterised by an absence of empowerment, where frequent periodic face-to-face encounters are essential (Kirkman et al. 2004). Thus, a major challenge regarding time in virtual project teams is to determine the appropriate number of collocated events and how best to employ the planned collocated events related to the project goal. Moreover, applying and enacting temporal coordination mechanisms is found to enable virtual teams to collaborate in a temporally efficient flow of work, thereby reducing the time needed for conveying ideas and managing the process (Massey et al. 2003). Thus, the time required for critical discussions essential for performance increases.

5.3 Common Ground in Distant Collaboration

Common ground is defined as the language, beliefs and knowledge participants share to successfully engage in collaboration (Olson and Olson 2000). To engage in beneficial communication, participants need to assume a vast amount of mutual knowledge, language and beliefs. Grounding is a process in which actors try to reach a mutual understanding in the language discourse perspective of the subject matter involved, including a mutual belief that the other party has sufficiently understood the message for the purpose of the conversation (Clark and Brennan 1991). In project teams, establishing common ground includes developing language and knowledge about the project, which can also be

referred to as a joint enterprise (Paper no. 4). A joint enterprise comprises the continuous negotiations of meaning (the project goals and plans) as defined by the participants in the very process of pursuing the goal though the interrelated processes of participation and reification (see section 3.3). Thus, the joint enterprise is not only intentional, but it becomes an embedded part of the collaboration by creating relationships of mutual accountability (Wenger 1998).

Researchers generally agree that developing and maintaining common ground is essential for success in virtual teams, and that it takes time and effort to establish it. The concept of common ground was originally developed in respect to synchronous face-to-face interaction from a language discourse perspective. When bringing the concept into geographically distributed asynchronous settings, the common ground activities become mediated by technology. Thus, common ground comprises the development of a shared language discourse but also includes the development of shared protocols and conventions for using the technology (see section 3.4). This is especially relevant for place-based groupware systems, since they do not embed a well-defined workflow due to their open-ended nature (see section 3.4). Therefore, it is up to the user to negotiate protocols stipulating future use in terms of procedural specifications or plans (see section 3), and then to later re-negotiate the initial protocols, thereby turning the protocols into practical protocols emerging from situated actions (Paper no. 1). Therefore, one key aspect of common ground in virtual teams is the development of and commitment to shared conventions for using technology in the team (Mark 2002). Mark (2002) reports that technology-use conventions evolve over time, and in virtual collaboration the formation of implicit conventions is difficult to achieve because participants seldom meet face-to-face. This suggests that the essential implicit conventions for using technology articulated at the cultural language level (see section 3.1) are difficult to develop since grounding calls for face-to-face interactions. Likewise, the development of a shared language discourse is constrained by the asynchronous technology-mediated interaction that delays feedback (Paper no. 7), since participants are highly dependent on the contextual information communicated at the cultural level to interpret the feedback of others (see section 3.3).

The failure to establish and maintain mutual knowledge has been found to have serious consequences for the viability in distributed collaboration (Cramton 2001). Two of the main consequences of a lack of mutual knowledge are the failure of information exchange (resulting in members being unaware that they had different information) and the failure of interpretation (resulting in misunderstandings regarding, e.g. silence). In addition, it has been found that feedback is essential when developing shared knowledge (Cramton 2001). In one of the most important successful rich case studies in the field of virtual teams, the case of the Rocket-dyne project team, the team investigated comprised cross-disciplinary experts located in different organisations, who needed to collaborate

to develop a new rocket engine design (Majchrzak et al. 2000; Malhotra and Majchrzak 2004; Malhotra et al. 2001). The team never met face-to-face until the final delivery of the design. As a cross-disciplinary team, they were highly prone to failure, because the team members were located in different companies and had a variety of work practices. Nevertheless, they managed and the authors argue that three main management practices contributed to the success of sharing knowledge: 1) the strategy settings (assuring each member could share all information despite being located in different companies), 2) the technology use (a specially made groupware system, which was modified during the process based on the needs of the participants) and 3) the restructuring of work (an openness to sharing unfinished work, which was not common practice for the engineers) (Malhotra et al. 2001). Through dedicated facilitation, the team managed to develop a common ground, including shared language discourses and technology-use conventions for their collaboration.

The amount of time and effort spent on grounding activities in a specific situation should be determined by the purpose of the collaboration. It is argued that managers should weigh the importance of common ground in a particular project to determine whether it makes sense to invest in building a common understanding or if it makes sense to let participants operate in a sea of mutual ignorance (Postrel 2002). Either way, it *does* make sense to invest effort into establishing common ground in virtual project teams, because these teams are dependent on closely coupled collaboration to reach their goal; thus common ground it essential. "Knowledge-sharing for purposes of informing others cannot be distinguished from consensus-building, since it is in the process of consensus-building that knowledge is shared and visa versa" (Malhotra et al. 2001).

5.4 Communication Norms in Distant Collaboration

Communication norms in virtual project teams refer to the negotiated emergent agreement between participants related to decisions on how to communicate and manage articulation work at both the formal and cultural levels (see section 3.1), including which type of media to employ in specific situations, e.g. in coordination or negotiation situations (see section 3.3). Researchers generally agree that establishing communication norms is essential for successful communication in virtual teams, and best practices enabling communication are suggested, for example, frequent communication, spontaneous communication, norms for face-to-face interactions and norms for technology-mediated communication (Hinds and Mortensen 2005; Malhotra and Majchrzak 2004). Given adequate time groups, who exchange enough social information, will develop strong relational links, which in turn contribute to the effectiveness of information exchange (Warkentin and Beranek 1999). Moreover, people who have to collaborate mediated by technology benefit from activities focusing on

social and personal information (Zheng et al. 2002), for instance, by exchanging social perspective awareness (see section 3.2 and Paper no. 2).

Research into the mediation of different collaborative tasks in teamwork shows the proportion of email devoted to scheduling and task assignment is higher in teams, than the proportion of face-to-face interactions devoted to these topics (Finholt et al. 1990). Furthermore, research shows that problem-solving issues were detected more often in face-to-face interactions than in email messages. In addition, high use of email is found to increase performance (Finholt et al. 1990). These results provide evidence that the choice of media does in fact influence communication.

Researchers generally see negotiation tasks (see section 3.3) as requiring a maximum amount of transmission of rich information that includes not only facts, but also information about values, emotions and expectations (e.g. Hollingshead et al. 1993). Awareness of social clues is restrained in asynchronous dialogues, and studies indicate that the possibility of successful technology-mediated asynchronous negotiation is low. In general, negotiation is perceived as detrimental to asynchronous collaboration in geographically distributed situations and many researchers propose that such activities should be conducted in collocated settings (e.g. Cramton 2001; Finholt et al. 1990; Jarvenpaa et al. 1998). This suggests that negotiations can be seriously constrained when asynchronous groupware applications are used, especially since negotiation activities in mixed-motive situations (see section 3.3) have been found to perform significantly worse in geographical distributed settings than in collocated settings (Hollingshead et al. 1993). Face-to-face negotiation is found to involve fewer misunderstandings. While investigating negotiation in mixed-motive situations mediated by groupware, we found that the asynchronous nature of the technology caused the participants to be engaged in multiple parallel discussions at the same time, because when participants sat down in the evening to work, they usually read and responded to new messages in each discussion-thread in turn, thus creating a batch of messages (Paper no. 6). Responding in batches like this caused the participants to read messages out of sequence compared to when they were written, thus increasing the difficulty of interpreting the content of the messages due to the lack of context (Paper no. 6).

In respect to technology-mediated negotiations, audio-only communication is suggested as beneficial compared to face-to-face because it reduces pressure tactics, which may cause hostility; computer-mediated negotiations compared to face-to-face negotiations may also allow more even participation among participants (Bazerman et al. 2000). Furthermore, it is proposed that expanding negotiation mechanisms by providing technology that encourages participants to work on intertwining multiple perspectives will support computer-mediated negotiations, since participants thus have the opportunity to continue working on their own perspective while awaiting the results of the negotiations (Stahl and

Herrmann 1999). However, in general, identifying and resolving miscommunications and conflicts in distributed work are important aspects to address in virtual teams, since the ability to work smoothly is viewed as based on tacitly shared understanding normally developed over time and by means of collocation (Chudoba et al. 2005). The question then is how to improve conditions for the development of shared understanding *without* collocation.

5.5 Summery of Distant Collaborative Practice

Previous research proposes four main challenges for distant collaboration in virtual teams: the development of trust, temporal rhythms, common ground and communication norms. The development of trust is found to be dependent on the nature of the first electronic interaction, which suggests that the initial stages of virtual teamwork are critical to the success or failure of the collaboration. In addition, trust and common ground are interrelated aspects, since grounding is a process in which actors establish mutual understanding of each other's utterances and actions. Establishing common ground at the initial stage may also foster the building of trust, which in turn may support the development of shared conventions, language and technology use between the participants. This is, however, quite a difficult process, since shared understanding normally is developed by means of collocation. This suggests that collaboration within virtual teams should be planned as a process with regular intervals of intensive collocated events. However, when planning and executing collocated events, one must be aware that major lifeworld discontinuities emerge during these events and thus might serve as the reason for communication breakdowns (Paper no. 5). This suggests that even though face-to-face encounters positively influence collaboration, they may simultaneously be the reason for the miscommunication and conflicts rooted in the discontinuities between lifeworlds.

In summary, distant collaborative practice in virtual teams comprises participants engaged in a common field of work conducting and managing activities of articulation work, coordination and negotiation while being geographically distributed, which challenges the ability to construct bridges between discontinuities related to culture, professions, work practices, technologies and time differences. Previous research suggests that bridging the discontinuities establishing and developing the social context of the virtual teams requires the team to use time and effort to build trust, common ground and to adapt groupware technology, while negotiating appropriate work patterns, temporal rhythms and communication norms. This thesis provides new, important insights into the factors influencing the establishment and development of the social context by investigating factors such as common ground (Papers no. 1, 4, and 6) and communication norms (Papers no. 1, 3, and 5). In addition, this thesis provides insights into the adaptation of place-based groupware-technology in virtual teams (Papers no. 1, 2, 3 and 4) and finally,

insights regarding the impact of asynchronous groupware on collaborative activities such as negotiation and supervision (Papers no. 6 and 7).

6. Groupware Adaptation in Virtual Project Teams

The first research question asked in this thesis is: How is groupware technology adapted into the collaborative practice of virtual project teams? Different perspectives on this question have been examined in four of the papers comprising this dissertation. Three of the papers use different theoretical perspectives on the same empirical case (the MV-group in educational setting), and one of the papers comprises examinations of groupware adaptation failures in two virtual project teams in an industrial setting (Team 1 and Team 2 from the Industrial-case). In this chapter, these four papers are presented briefly in sub-sections before relating the findings of the papers across cases and papers, thus leading to a coherent answer of the research question regarding groupware adaptation.

6.1 Re-negotiation of Protocols

Paper no. 1: *Re-negotiating Protocols: A way to Integrate Groupware in Collaborative Learning Setting* (Bjørn 2003) investigates the development of shared protocols and conventions for using groupware technology examining groupware adaptation (see sections 4.4, 5.3 and 5.4). In this paper groupware is perceived as a coordination mechanism (see section 3.3), thus developing conventions for technology use is examined as a process in which students negotiate protocols for using groupware, while continuously modifying the structures of the system embedding the protocols into the artefact. The paper uses the theoretical framework of communities of practice (Wenger 1998) to understand the underlying processes of establishing shared meaning through negotiation with respect to groupware technology (see section 3.3). Groupware adaptation is viewed as a reification process in which the technology becomes a negotiated object connected to a shared meaning in the particular context. However, for groupware to become a reification, the technology must be adjusted to the practice while adjusting the practice to the technology, which requires negotiation processes. Since the actual collaborative practice is comprised of situated actions rather than procedural specifications (Suchman 1983), the groupware adaptation process must take the practical situated actions into consideration (see section 3).

Grounded in the empirical observations from the action research project comprising groupware adaptation in the MV-group, this paper argues that technology has inscripted protocols stipulating how to use the technology as intended by the designer. Furthermore, successful groupware adaptation requires modifying the collaborative practice to the inscripted protocols of the technology, while adjusting the technology structures to fit the actual situated

practice. Since groupware is an open-ended and reconfigurable technology (see section 3.4), the inscripted protocols are highly malleable and in this way protocols for use are highly dependent upon how the users negotiate their adaptation of the system. Moreover, to fit practice the protocols stipulating use of the technology should take form as negotiated situated reifications of the collaboration instead of being based on procedural specifications for future work practice. The protocols should emerge from practice. This cannot be done initially, since at the initial stage; practice is still yet to come. On this basis, the paper concludes that re-negotiation of protocols for using groupware technology is essential for successful groupware adaptation, because it is only in this process that procedural protocols evolve into practical protocols (Paper no. 1).

6.2 The Need for Social Perspective Awareness

Paper no. 2: *Groupware Integration in Virtual Learning Teams: A Qualitative Analysis based on the TAM-model* (Bjørn and Scupola 2004) investigates groupware adaptation by applying the concepts of the TAM-model (see section 4.4) to the empirical case of groupware adaptation in the MV-group. In this paper, the aim was to do additional analyses on the case material identifying other factors important for successful adaptation besides the importance of re-negotiating protocols. Complementing the framework of TAM, the concept of awareness was applied. In this paper awareness is viewed as a feature of collaborative practice (Heath et al. 2002) that provides the possibility of making actions visible for others to monitor, thus continuously mediating the social context useful for making sense of collaborative actions. Awareness is investigated in the paper as social perspective awareness (see section 3.2), which is defined as giving group members information helpful for making sense of the actions of others, so that the information received is similar to the information gathered during causal, informal contact with colleagues at the office (Prinz 1999; Steinfield et al. 1999).

The data observations suggest that in the initial stage of groupware adaptation, the participants' high perceived-usefulness might supersede the importance of ease-of-use resulting in the participants' high intention for using groupware. However, when it comes to actual-use, the factor ease-of-use is vital; if the barrier of ease-of-use is too high, it will most likely lead to failure of groupware adaptation. New initiatives to solve the barriers with respect to ease-of-use, such as facilitating regular use immediately after training sessions, were found to increase the intentional use of groupware. Thus, it can be concluded that both ease-of-use and perceived-usefulness positively influence the intentional-use and actual-use leading to successful groupware adaptation. Additionally, one of the initiatives taken to solve the problem of ease-of-use stimulating regular use also supported an unarticulated need for social interactions in the virtual team. In this way, the use of the system was applied much more widely than first intended (DeSanctis and Poole 1994). Thus, it is

further argued that groupware technology providing support for social perspective awareness might be perceived as bringing a new capability to the collaborative practice, thus increasing the willingness for participants to engage in an extra effort to adapt new technology (Paper no. 2).

6.3 Expanding Technological Frames

Paper no. 3: *Expanding Technological Frames towards Mediated Collaboration: Groupware Adoption in Virtual Learning Teams* (Bjørn et al. 2006) is a further expansion of the two previous papers on groupware adaptation analyzing the MV-case. However, here, the aim is much broader. Instead of focusing on one particular factor influencing the positive outcome of the groupware adaptation process, this paper seeks to suggest a conceptualisation of groupware adaptation, including the development of common ground related to the development of technology-use conventions (see section 5.3). The conceptualisation of groupware adaptation suggests that groupware adaptation is a process of expanding and aligning participants' technological frames (see section 4.4). The paper also identifies both technical and social factors influencing the expansion of the participants' technological frames towards groupware. Additionally, new empirical observations are included in this paper compared to Papers no. 1 and 2, e.g. activities conducted with the teachers at the master's degree programme in the first action cycle of the project.

The action research project is theoretically informed by the concepts of technological frames (Orlikowski and Gash 1994). It is argued that shared technological frames emerge from an alignment process of individual frames creating congruence on key elements and categories. Understanding groupware adaptation as an expansion of the participants' technological frames focuses on the participants' particular interpretations about the technology. This includes the nature, strategies and use of the technology (see section 4.4), and should be perceived as a continuum that includes various steps towards adaptation. The empirical observations viewed from this perspective on groupware adaptation suggest that the adaptation process is a three-step process.

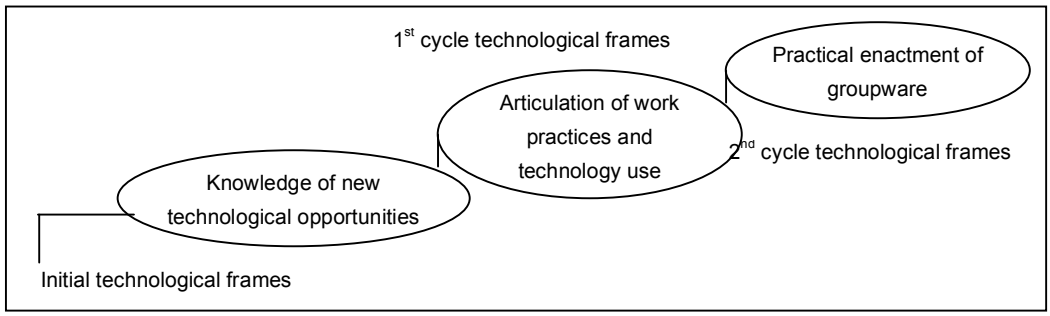


FIGURE 3: EXPANDING TECHNOLOGICAL FRAMES IN THREE STEPS

The three steps are 1) knowledge of the new technological opportunities, 2) articulation of concrete work practices and technology use, and last 3) practical enactment of groupware. As one might notice, the second step is closely inspired by the argument of re-negotiation of protocols (Paper no. 1). Besides suggesting a theoretical framework of technological frame expansion, the paper additionally identifies technical and social factors influencing the expansion of frames.

The empirical observations point to a technologically related factor influencing the expansion of frames comprised the nature of the technology in the form of the new capabilities offered by the technology. Two new capabilities, which are identified as influencing groupware adaptation positively, were the visible representation of the project embedded in the emerging structures of the system and the capability for mediating social relations (Paper no. 3). Here one might notice that the technological factor of mediating social relation is closely inspired by the argument for social perspective awareness (Paper no. 2). Additionally, the empirical observations point to three specific socially related factors influencing the expansion of technological frames and groupware adaptation. First, the introductory session presenting the functionalities of groupware while facilitating the clarification process of goals and plans for the project was an influential social factor. This clarification of goals and plans also included the development of a common work language (see sections 5.3 and 4.3), which facilitates the expansion of technological frames. Second, knowledge about the nature of the technology and the strategies for using technology were presented in the introductory session, which forms an important social factor influencing the expansion of the technological frames of the participants. Finally, the reflective episode including articulation and re-evaluation of actual practice and use of technology positively influenced the groupware adaptation process as a social factor, since this activity supported the participants in negotiating how to use the technology on a day-to-day basis (Paper no. 3).

6.4 Joint Enterprise and the Intermediator's Role

Paper no. 4: *Joint Enterprise and the Role of the Intermediator: Challenges Managing Groupware in Global Virtual Teams* (Bjørn and Simonsen 2005) investigates the two cases of failed groupware adaptation from the Industrial-case. This paper has a dual focus. First, the paper focuses on common ground in respect to developing shared knowledge and language about the project, which is referred to as a joint enterprise (see section 5.3). Second, the paper focuses on common ground in respect to technology-use mediation (Orlikowski et al. 1995), as in facilitating the reconfiguration of the groupware system to support the collaborative practices of the virtual teams, referred to in the paper as the intermediator role (see section 3.4).

Examining the two cases of failures using the concepts of joint enterprise and intermediator, this paper suggests two propositions. First, that managing the

adaptation of groupware in virtual teams is a process dependent on the negotiation of the joint enterprise for the project. This includes how to collaborate and how to use groupware. The lack of joint enterprise seriously constrains collaboration as well as the groupware adaptation. The second proposition states that managing groupware adaptation includes processes of structuring the groupware system as well as facilitating the use of the system. This process is seriously constrained if no one fulfils the role of the intermediator (Paper no. 4).

6.5 Groupware Adaptation Contributions and Future Research

How is groupware technology adapted into the collaborative practice of virtual project teams? Geographically distributed project teams must rely upon technology to mediate their distant collaborative practice. Distant collaborative practice comprises the interdependence of multiple geographically distributed actors who by changing the state of their individual work also change the state of the common field of work. Being engaged in distant collaborative practice, participants need to manage the consequences of the distributed nature of the work; they need to manage articulation work (Star and Strauss 1999). Groupware is adapted into the collaborative practice of virtual teams to reduce the effort required for articulation work in a geographically distributed setting. Previous research points to that awareness (Heath et al. 2002), translucence (Erickson and Kellogg 2000), coordination mechanisms (Schmidt and Simone 1996) and common information spaces (Carstensen and Schmidt 1999; Hertzum 1999) all comprise important aspects of managing articulation work, and in this way, propose that these aspects should be addressed by the functionalities of groupware technology. Researchers moreover agree that proper execution and facilitation of the groupware adaptation process is vital if the technology is to be integrated into collaborative practices (Bansler and Havn 2006; Karsten 1999; Tyre and Orlikowski 1994), and that the adaptation process requires the development of shared conventions for use (Mark 2002). However, few researchers (Majchrzak et al. 2000) have conducted in-depth investigations of the actual groupware adaptation process in virtual project teams.

This thesis extends previous research on groupware adaptation in virtual teams by contributing with in-depth investigations of the actual groupware adaptation process and proposes that groupware adaptation should be viewed as a three-step process for expanding and aligning the technological frames of the participants. The three steps involve knowledge of the new technological opportunities, articulation of the concrete work practices and technology use and, finally, the practical enactment of groupware (Paper no. 3). The first step refers to the process of bringing knowledge about new technological opportunities to the team by relating the nature of the groupware to the strategies and motivations behind the adaptation in the particular context. This step opens the first window of opportunity for the participants (Tyre and

Orlikowski 1994). The second step involves the importance of re-negotiating protocols (Paper no. 1), while the third step refers to the situation where participants commit and enact the groupware.

Technology that provides participants with new capabilities is likely to be appreciated (Robinson 1991). The technologically related factor influencing the expansion of shared technological frames is thus embedded in the nature of the technology, just as in the new enabling capabilities offered by the technology (Paper no. 3). One of the new capabilities influencing groupware adaptation positively was identified as the possibility to mediate social perspective awareness within the team (Paper no. 2), which in turn increased the participants' motivation for enacting the system. Moreover, previous studies suggest that groups exchanging social information develop strong relational links contributing to the effectiveness of information exchange (see section 5.4). Providing awareness of the social context by referring to the physical social contexts of the participants (Paper no. 2), the social perspective awareness becomes a practice used by the participants to tacitly align their distributed activities. Additionally, three socially related factors were identified. First, the facilitation of the initial introduction to the technology was an important social factor. Second, the process of relating the nature of the technology to the goals and plans for the project required facilitation of the participants in negotiating their goals and plans, which was found to be an important social factor. Finally, the re-evaluation session after a period of collaboration was an important social factor (Paper no. 3). All these social factors comprise the processes in which participants negotiate, develop and modify shared conventions or protocols for using the technology as both a coordination mechanism (Schmidt and Simone 1996) to mediate social awareness (Prinz 1999) and as a common information space (Hertzum 1999).

These findings are all derived from one single case study of groupware adaptation in one virtual project team within educational settings. This is of course a limitation for the findings, even though previous research supports the findings. It is however not possible to supplement these findings with empirical observations from the three groups of the MIL-cases, since all these groups had adapted the groupware system before, in this case, the fieldwork was conducted. Thus, no observations exist of their groupware adaptation process.

One could also ask whether these findings on groupware adaptation hold true for virtual team cases outside the field of education. A first step here is trying to relate the findings from the MV-case to the findings from the Industrial-case. The two virtual teams in industry are examples of groupware adaptation failures. Following the suggested conceptualisation of technology frame expansion, failure cases would lack the suggested factors expanding the frames. Applying the theoretical conceptualisation of technological frame expansion for the empirical observations from the Industrial-case, we find that in Team 1 the lack

of introduction to groupware relating use to the future work stipulated by the goal for the project was seriously constrained by their inabilities in negotiating objectives stated by top management. This caused the team not to perceive the nature of groupware and the embedded new opportunities as supportive for their distributed work, since they did not know what their project was about. Thus, Team 1 did not have shared technological frames concerning the use of groupware in their particular project. In Team 2, they did manage to negotiate objectives given by top management and they were engaged in interdependent activities, however, they lacked shared technological frames concerning groupware. This was evident since participants, including the project manager, perceived the groupware differently. At least one team member stated she believed they should have adapted the groupware, since advocating appropriate technology use was an embedded part of their assignment. Defining and piloting the SCM-process, they advocated that software developers within the organisation should apply structural use of technology for planning and executing their deliverables (Paper no. 4). The team member actually found it embarrassing that they never adapted the groupware. The project manager never really perceived the use of groupware as important, even though he, at one time, lost his entire local repository of documents, so that team members had to mail him copies of their documents. In this way, the individual technological frames in Team 2 were characterised as incongruent and misaligned concerning the nature, strategies and use of groupware.

The above observations from the two virtual teams in industry indicate that the technological factor comprising the understanding of the nature of the technology embedded in new capabilities might also be important in industry for groupware adaptation. In Team 1, all technological factors were missing due to their lack of joint enterprise, which is also indicated by the missing social factor comprising the processes of clarifying the goal, aim and project plans. In Team 2, at least one person explicitly stated that they should have adapted the groupware initially. However, this observation concerns only one participant's individual technological frames and the data indicate that the members of Team 2 did not have shared technological frames related to groupware. In addition, the team members of Team 2 never became engaged in any kind of negotiation processes supportive of expanding and aligning their technological frames.

In respect to the social factors, it is evident that Team 1 missed all the social factors, including the initial introduction to the technology, the facilitation of negotiating goals and plans and the re-negotiating of work practices and technology use after a period of collaboration. Team 2 did succeed in negotiating goals and plans (their joint enterprise), however the team members never engaged in initial introduction - nor in re-negotiation activities. This indicates that initial facilitation and later re-negotiation of groupware use also are important for groupware adaptation in industry. This is further supported by

previous literature based on empirical work from industry, where it is argued that groupware adaptation requires technology-use mediation (Bansler and Havn 2006; Orlikowski et al. 1995).

Since the empirical basis for this dissertation does not include empirical cases of successful groupware adaptation in industry, new research is required to fully investigate the conceptualisation of technological frame expansion outside the field of education. Nevertheless, the two failure cases of groupware adaptation in industry point to the fact that identified factors supporting successful adaptation from the educational setting were missing in the failure cases, e.g. the social factor of re-negotiation. Further, the observations from Team 1 point to the fact that the social factor of clarifying the joint enterprise determines whether groupware technology could even be considered. Team 1 never reach an agreement about their shared purpose, thus their capabilities for entering a process for groupware adaptation were minimal. One could question whether Team 1 was a special case of virtual teams, however similar observations of teams from industry have been reported on in the literature, e.g. DeSanctis and Jackson (1994), who refer to a team spending, "[m]uch time [...] on structural and procedural matters, such as trying to define the purpose of the roundtable forum and its operations and objectives" (DeSanctis and Jackson 1994, p. 7). Likewise, the uncertainties concerning the goal of Team 1 caused the lack of cohesiveness necessary for the participants to commit to their common project and overcome the difficulties in working remotely.

Additionally, observations related to Team 2 point to the fact that even when succeeding in articulating the goals and objectives (the joint enterprise), other factors are still important for the expansion and alignment of shared technological frames concerning groupware. Here, especially the lack of the social factor comprising the initial introduction to groupware functionalities by illustrating its mature use and the lack of re-negotiation activities seem to constrain the process. This was identified as the need for external facilitation of groupware use or the role of an intermediator (Paper no. 4). Similar observations further propose that mediators have significant influence on the nature and effectiveness of electronic communication, and that technology-use mediation is an emergent, complicated and unpredictable process (Bansler and Havn 2006).

Relating the intermediator role to the groupware adaptation process in the MV-team, the active role of the researcher in this action research study included facilitation activities concerning groupware, such as the initial facilitation of the students in managing the structure of the system, including building appropriate folder structures. Later in the process, the intermediator role was turned over to the students themselves; however, they received ongoing support from the researcher in how to intermediate their shared workspace. The empirical observations from Groups 1, 2 and 3 from the MIL-case with respect to the intermediator role confirm that all three groups explicitly negotiated and

employed the intermediator role (referred to as the moderator), and in two groups (Groups 1 and 3), different participants took on the role at different times during the project, while in Group 2, the role was taken by the leading student. Additionally, the two groups (Groups 2 and 3) who succeeded in adapting the groupware and conducting the project were both able to negotiate their joint enterprise, while the Group 1, who split-up, never reached an agreement upon a joint enterprise. This indicates that a joint enterprise, including negotiated goals and plans, is a basic condition for group work, influencing groupware adaptation, but is not solely related to adaptation, because Group 1, who failed in negotiating a joint enterprise, succeed in adapting the groupware system.

Even though the empirical observations from the two failure cases from industry do not provide evidence rejecting the conceptualisation of expanding technological frames as a perspective of groupware adaptation, the empirical evidence here is not enough to determine whether the identified technological and social factors also are essential for groupware adaptation in industry. Likewise, the empirical observations from the educational cases supporting the findings from the Industrial-case are not strong enough to cross bridges between the findings from the different settings. What we have are only indications of the relationships. To resolve these matters further research must be conducted on successful groupware adaptation using the conceptualisation of expanding technological frames in real-life settings other than in the field of education. Similarly, new studies of groupware adaptation in various contexts of virtual project teams are needed to provide a further in-depth description of the factors of joint enterprise and intermediator. Moreover, new studies are needed to test the conceptualisation of groupware adaptation as expanding and aligning technological frames in various settings of virtual project teams. These new studies might expand our understanding and definitions of the different factors leading to successful groupware adaptation, which is required for improving conditions for virtual project teams.

7. Establishing and Developing the Social Context

The second research question asked in this dissertation is: How is the social context of a virtual project team established, developed and continuously challenged? Different perspectives on this question have been examined in three of the papers comprising this dissertation. Paper no. 5 comprises examinations of the communication breakdowns in two virtual teams in industry (Teams 1 and 2 from the Industrial-case). Paper no. 6 comprises investigations on the negotiation processes in three groups of virtual teams in education (Groups 1, 2 and 3 from the MIL-case), and last, Paper no. 7 comprises reflections of the changed conditions for the supervision of problem-oriented project work researching teacher experiences when supervising three groups in education (the MIL-case). In this chapter, these three papers are briefly presented in sub-sections before relating the findings across cases and papers, thus leading to a coherent answer of the research question regarding the social context.

7.1 Building Shared Meaning and Creating Translucence

Paper no. 5: *Virtual Team Collaboration: Building Shared Meaning, Resolving Breakdowns and Creating Translucence* (Bjørn and Ngwenyama under review) investigates communication norms related to the establishment and development of a social context for virtual teams. The social context is conceptualised as building shared meaning at three analytical levels: lifeworld, institutional structure and work practices (see section 4.1). It is suggested that the shared meaning context of a virtual team is a conglomeration of pieces of lifeworlds, institutional structures and work practices that the participants bring from their local organisational contexts. The empirical work behind this paper forms Teams 1 and 2 from the Industrial-case.

Communication breakdowns (see section 3.2) affect the work situation at all three levels of shared meaning, however they usually manifest themselves at the work processes level either as the breakdown itself or as the consequences of a breakdown at another level. The paper argues that new virtual teams are prone to communication breakdowns due to sense-making failures at all three levels. Further, the paper argues that translucence (see section 3.2) in the very work situations may reduce the number of communication breakdowns.

The empirical observations presented in this paper suggest that creating translucence in virtual teams at the work practice level is a negotiation process of the specific professional norms and work processes, including the development of a shared work language (see sections 4.1 and 5.3), which builds a shared meaning for the common project related to the professional context. Further, the empirical observations point to that creating translucence at the lifeworld level

comprises negotiation processes between the participants about the most fundamental issues of their collaboration. This includes establishing the new virtual team context, which is different from the existing local organisational contexts of the participants (see section 4.2). Last, creating translucence at the institutional level consists of negotiation between the top managers and, to some extent, the team members deciding the appropriate explicit structures and visible decision patterns surrounding the social context of the team.

In addition, the paper argues that email, as a groupware technology, does not automatically bring translucence, especially because it does not provide the technological possibility to innovate upon the application while making the innovation visible for others. This finding further supports that the technological factor comprising a visual representation of the project embedded in the emerging structures is likely to be appreciated by the participants, thus increasing the chance of successful groupware adaptation (Paper no. 3). Finally, the paper challenges previous research (e.g. Kirkman et al. 2004) by stating that periodic face-to-face encounters not only impact the social context positively, but also challenge the social context by serving as a ground for communication breakdowns since it is during collocated events that major discontinuities at the lifeworld level become salient (Paper no. 5).

7.2 Negotiating Commitment

Paper no. 6: *Project-based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams* (Bjørn and Hertzum 2006) investigates the development of common ground in the language discourse perspective (see section 5.3) particularly related to the negotiations of identifying, formulating and maintaining a shared focus for the project. Commitment to a specific project focus and commitment from participants to take specific actions are both important parts of the establishment and development of the social context within virtual project teams. The empirical material consists of the complete online textual messages between participants of three virtual teams in the field of education (MIL-case). Applying Searle's taxonomy of illocutionary acts (see section 3.3) as a theoretical conceptualisation of commitment, analysing the empirical material provides the opportunity for investigating how commitment is negotiated in virtual project teams using a collaborative place-based groupware application (see section 3.4). Coding the empirical material, two subcategories of commitment were used. Commitment for future actions was applied to messages containing utterances in which the sender, to various degrees, commits to take a future action. Post-hoc commitment was applied to messages containing utterances in which the sender, to various degrees, provides the outcome of a self-initiated course of action.

The empirical observations suggest that in groups where the balance between the two subcategories of commitment was unevenly distributed with more post-

hoc commitments than commitments for future actions, the negotiation process was more fragile, thus challenging the social context of the virtual team. Where commitment for future actions tends to occur in replies to requests, post-hoc commitments indicate proactive behaviour where participants voluntarily provide the results of self-initiated actions. Furthermore, the empirical observations suggest that in teams where all participants display this pattern of negotiation behaviour, the consensus building process establishing the social context of the team is constrained.

The empirical observations also indicate that in teams where one student maintains a strong individual position conversely makes other group members assume subordinate roles, which might also makes the negotiation process fragile. Since continuous feedback from the subordinated members stimulates the development of a common language (see section 3.3), this development might decrease. Thus, the risk of group members believing they share an understanding of the project even though they have different perspectives increases. This perception of shared meaning might then later collapse when the subordinated members gradually learn the content of their agreement. Last, the empirical observations point to the fact that establishing and developing the social context of virtual teams by initially spending time and effort on teambuilding activities might be beneficial for later conflict situations, such as when time pressure increases.

By providing a permanent record of all previous messages, the groupware technology impacted the social context. The empirical observations suggest that in groups with proactive behaviour the permanent record became a vehicle for basing new arguments on their own previous messages constraining the development of a shared social context. However, in groups who apply a consensus building strategy, the permanent record provides additional opportunities for developing a common language and shared social practices (Paper no. 6).

7.3 Changed Conditions for Supervision

Paper no. 7: *Medieret Vejledning af Problemorienteret Projektarbejde: Udfordringer for Vejledning i Problemformuleringsfasen [Technology-mediated Supervision of Problem-Oriented Project Work: Supervision Challenges in the Problem-formulation Phase]* (Bjørn 2006) investigates how place-based groupware technology (see section 3.4) changes the conditions for interaction related to the specific situation where an outsider (the supervisor) enters the collaborative practice. The empirical material comprises the MIL-case. The paper investigates the teacher's experiences of the changed conditions for conducting supervision of three virtual teams (Groups 1, 2 and 3). Supervision situations are conceptualised as the emergence of a new social context including both students and the teacher as participants. This social context is different from the social context of the virtual team, thus new norms

and language are needed for the participants to develop a shared understanding of the very situation (see section 5.3). Like teamwork situations, technology-mediated supervision situations are constituted by the interdependence of multiple geographically distributed actors, who by changing the state of their individual work also change the state of the common field of work (see section 3). The common field of work in supervision situations is for the supervisor and the team to jointly reach an agreement concerning the team's common field of work (their project). The work of the supervisor influences, challenges and changes the team's common field of work. However, the common field of work in the supervision situation is not equal to the project, but instead comprises a different purpose (providing supervision). As a result, supervision situations constitute a new social context in which participants (students and teacher) need to develop shared meanings about the students' project. In this way, supervision situations comprise complex and intense interdependencies of activities dependent on the participants' shared understanding of the work. The conditions for conducting both product and process supervision (see section 2.2) is challenged in a specific way when mediated by place-based groupware technology.

The prime challenge for both product and process supervision is identified as the complexity of constructing, communicating and interpreting contextual information significant for the particular supervision situation. This includes the difficulties in interpreting silence and difficulties in the interpretation of the context caused by the blur of distinctions between the past, present and future as embedded in asynchronous technology (see section 5.2). The limited disposition of asynchronous groupware increases the complexity for developing a shared meaning context in supervision situations, because of the lack of implicit feedback (see section 3.3). Therefore, the complexity for conducting supervision increases. In this way, the social context of supervision is challenged due to the technological constraints embedded within the groupware system. Three challenges for technology-mediated supervision were identified and include 1) the reduced possibility for developing and maintaining an understanding of the collaborative process of the groups; 2) the reduced feeling of awareness in synchronous supervision situations mediated by asynchronous groupware; and last 3) the reduced possibility for insight into the contextual information behind written proposals combined with the increased difficulties in communicating and interpreting contextual information (Paper no. 7).

7.4 Social Context Contributions and Future Research

How is the social context of a virtual project team established, developed and continuously challenged? In this thesis, the social context of virtual teams comprises a conglomeration of pieces of lifeworlds, institutional structures and work practices that participants bring from their local social contexts and is

established through the development of shared meaning at all three levels (Paper no. 5). The main challenge for establishing the social context is to bridge the discontinuities between the participants' culture, time differences, professional disciplines and work practice typically associated with geographical distribution (see section 4.5). Furthermore, establishing a shared meaning context in respect to technology and bridging the discontinuities of participants' perspectives on technology includes expanding and aligning the technological frames of the participants through a groupware adaptation process (Paper no. 3). Establishing the social context also includes building trust, common ground, communication norms and the temporal rhythms of regular encounters (see section 5). Furthermore, this thesis argues that an important factor in establishing common ground when establishing the social context of a virtual team is the negotiation of the joint enterprise (Paper no. 4), which facilitates a work organisation of tightly coupled collaboration between geographically dispersed participants.

Tightly coupled collaboration increases the complexity of collaboration across geographical distance, therefore it has been argued previously that tightly coupled collaboration should be assigned to collocated sub-groups rather than being performed in remote settings (Olson and Olson 2000). In contrast, this thesis argues that even though tightly coupled collaboration increases the difficulties of e.g. coordination, it is nevertheless vital for creating the necessary commitment from the dispersed participants to overcome the challenges of working remotely. Empirical studies from the literature also provide empirical observations of successful tightly coupled collaboration over distance comprising multiple discontinuities (e.g. Malhotra et al. 2001), and previous empirical observations point to the fact that virtual teams comprising weak relations lack the necessary cohesiveness for involved participation (DeSanctis and Jackson 1994). Moreover, it has been found that in teams with loosely coupled work, the degree of overlap between participants' mental models decreased over time; there was less agreement about group processes at the end of the project than in the beginning (Levesque et al. 2001). In this study, the participants divided the work between them and then worked separately, reducing interdependence. Since overlap in mental models are perceived as important for developing the social context of virtual teams, these observations further support the fact that closely coupled collaboration supports the establishment and development of the social context of virtual teams. However, more research is needed on this matter to resolve how closely coupled collaboration influences the social context of virtual teams.

The social context of virtual teams is established through negotiation processes in which the organisational language of the participants is in constant interaction, influencing each other while building up a new common work language (Baker 1995; Holmqvist 1989; Klein and Truex 1996). Previous research has argued that negotiation tasks require the maximal transmission of rich

information (Bell and Kozlowski 2002; Hollingshead et al. 1993). On the other hand, it is argued in this thesis that negotiation activities, also in a mixed-motive situation, can be conducted successfully by using place-based groupware technology, since the empirical observations from the MIL-case show that two groups (Groups 2 and 3) out of the three groups succeed in their original constellations, while the sub-groups of Group 1 also eventually succeed in negotiation mediated by asynchronous technology (Papers no. 6 and 7). This does not mean that place-based groupware technology does not provide constraints for executing negotiation tasks. Negotiation processes related to the goal of the project are seriously hindered if all participants act proactively and voluntarily provide the outcome of self-initiated activities before the group has had a chance to agree on what needs to be accomplished. Especially, empirical observations suggest that participants in situations characterised by mixed motives and proactive behaviour are less likely to be open towards consensus building, and instead insist on individualistic perspectives (Paper no. 6). This finding questions the technological solutions of computer-mediated negotiations proposed by Stahl and Herrmann (1999). They suggest that negotiation mechanisms encouraging participants to work on intertwining multiple perspectives provide the opportunity to continue working on their own perspective while awaiting the results of the negotiations will support negotiation. However, this type of application would also support proactive behaviour, thus providing a constraining factor on consensus building. These conflicting results call for future research on this issue of technology support for negotiation.

It is argued in this dissertation that resolving communication breakdowns and thus establishing and developing the social context of virtual teams is a negotiation process of creating translucence at the three levels of shared meaning bridging the discontinuities of culture, professions, work practice, time and technology. In virtual teams, technology is embedded in the very definition of the term, thus we must also understand the development of the social context with respect to the technological opportunities and existing constraints. Here, it is argued that for virtual teams to create translucence they need a shared workspace or a common information space (Hertzum 1999) in which they have the possibility to represent their actions, providing others with the opportunity to interpret these actions (Paper no. 5). Additionally, the groupware system should provide the possibility of making local modifications upon the application that are visible to others, since modifications of e.g. the folder structure also communicate an interpretation of the work, and thus should be represented for interpretation by others (Paper no. 5). This finding is further supported by the empirical observation from the MV-group, where the opportunity to visually represent the project within the folder structures of the groupware system was perceived by the participants as a visualisation of their

collective project useful for interpretations of the interrelated actions (Paper no. 3).

Groupware technology is adapted in various ways depending on the participants' views and perspectives, thus the same technology can be either a platform for individualistic behaviour or a platform for shared reflection (Paper no. 6). On this basis, one can suggest that social factors highly influence how the groupware is adapted and whether or not the technological opportunities enable or constrain the establishment and development of the social context. This is further supported by previous research stating that use of technology is influenced by how the social actors appropriate the technology and not determined by the technology itself (DeSanctis and Poole 1994; Kiesler 1986; Mark and Poltrock 2003).

The supervision situation emerges as a new social context different from, but closely related to, the social context of the virtual team. In the social context of supervision, participants need to develop a common language and shared meaning for the purpose of providing supervision. However, the frequency of interaction is less in supervision situations than in the virtual team itself. Thus, the possibility for establishing shared meaning is constrained by fewer interactions, since frequent communication and spontaneous communication previously have been found to support successful communications in virtual teams (Hinds and Mortensen 2005; Malhotra and Majchrzak 2004). In addition, the opportunity for establishing shared meaning is also constrained by the technological possibilities (or lack of possibilities) for representations of actions fostering mutual interpretations (Paper no. 7). Three technologically related constraints on the social context of supervision are identified as 1) the reduced possibility for developing and maintaining an understanding of the common field of work (the students' project); 2) the reduced feeling of awareness in synchronous supervision situations mediated by asynchronous groupware; and 3) the reduced opportunity for insight into the contextual information behind written proposals combined with increased difficulties in communicating contextual information (Paper no. 7). These findings also indicate the importance of bringing translucence to virtual team situations as it is argued in Paper no. 5, analysing the empirical observations from the Industrial-case.

This thesis has only scratched the surface for understanding the social context of virtual teams, since this phenomenon is a highly complex, changing and challenging issue within distant collaborative practice. Moreover, the social context is highly influenced by the particular setting, which means that aspects such as the primary outcome, hierarchy, leadership, resources and reward systems affect the social context. This points to the fact that one should be careful when relating or connecting cases from different settings such as education and industry when investigating the social context, since precisely these factors are often very different in the two settings (see section 2.2). Therefore, each of the

papers in this thesis only examines cases from one particular setting, thus the relations between the findings from the papers proposed in this thesis should be viewed as indications of relationships rather than stated facts.

The main contributions in respect to the social context in this dissertation are the important insights into the practices of virtual teams and how groupware and discontinuities enable or constrain the social context. These new insights can be used for both improving the social context of particular virtual teams as well as the groupware technologies of the future. The limitations of the findings with respect to the social context are that they are primarily based on three virtual teams from the field of education and two virtual teams from industry. Thus, even though previous findings from the literature further support the empirical observations of the cases, there is still a need for future research investigating the social context of virtual teams. Rich new insights concerning the lives and practices of virtual teams are still needed to understand 1) how groupware influences and transforms the social context, and 2) how different discontinuities influence the social context. Without these new insights, we will not be able to improve conditions for virtual team collaboration in the future.

8. Conclusion

Technological advances of the last two decades have provided new opportunities for bridging geographical distance in collaborative situations. Nevertheless, we still have much to learn before mastering the art of distributed collaboration. This research complements and expands current research on geographically distributed collaboration by providing empirical observations and findings from investigations into a specific form of distant collaboration, namely virtual project teams. The dual focus of this research has been on investigating the organisational issues related to groupware adaptation, while also examining social and technological issues related to the establishment of a social context. Two main research questions representing this dual focus have been investigated through empirical studies of six virtual project teams. The six teams (two in industry and four in education) were geographically dispersed and engaged in time-limited, non-repetitive, closely coupled collaborative practice, producing one-time outputs. Rarely meeting face-to-face, they relied on technology to mediate their interactions. Different methodological approaches have been employed within the cases, namely, action research and interpretative research, each chosen on the basis of its appropriateness for the specific research questions under investigation. The results and findings of the research are argued in the enclosed seven research papers, while this summary report has discussed the cases and papers in relation to the general themes of groupware adaptation and the establishment of a social context in virtual project teams.

8.1 Groupware Adaptation

Groupware technology is adapted into the collaborative practice of virtual project teams through the processes of aligning and modifying both the technology and the collaborative practice. In this dissertation, it is argued that groupware adaptation processes can be viewed as a three-steps process of expanding and aligning the technological frames of the participants. The first step involves bringing awareness and knowledge to the participants of new technological opportunities facilitated by an intermediator. This facilitation includes a hands-on introduction to the application functionalities and illustrations of mature use. Illustration of mature use includes processes of connecting technology use directly to the project by relating the functionalities to the planned activities and deliverables, thus presenting the strategies behind groupware adaptation to the team. By connecting mature use directly to the project, the use of groupware might be perceived through the joint enterprise of the project. In situations characterised by unclear goals and objectives, it is important that the team initially is aided in negotiating their joint enterprise

related to the negotiations of procedural protocols for using groupware. Initially, groupware adaptation processes are influenced by the nature of the system and participants' understanding of the motivation behind spending time and effort in adapting the system. Participants perceive the nature of the system as either enabling or constraining for their collaborative practice, thus perceived usefulness is more influential at the initial stage of groupware adaptation, than ease-of-use. New technological opportunities that are likely to be appreciated as enabling factors of distant collaborative practice within virtual project teams are comprised of the capability to mediate social relations and the provision of a visual representation of the project embedded in the emerging folder structures within the technology.

The next step expanding technological frames involves articulation of the experienced collaborative practice related to a re-negotiation of protocols for using groupware. This step can only be taken after a period of collaborative practice, since articulation of collaboration requires concrete experiences. It is in this re-negotiation process that the initial procedural protocols for using groupware evolve into practical protocols emerging from situated actions. The third step of expanding technological frames comprises practical enactment of groupware. Here, participants commit themselves to using the groupware based on a shared understanding of its day-to-day use by enacting the practical protocols negotiated in the second step. At this stage the groupware adaptation process has reach a plateau. Nevertheless, new situations can emerge along the way with respect to technology, the social context or the project that require new attention on the use of groupware.

8.2 The Social Context

The social context of virtual project teams is established through negotiation processes of shared meaning, bridging the discontinuities of culture, time differences, professional disciplines, work practices and technology, thus preventing the negative effects of the geographical distribution. In situations characterised by discontinuities in culture, shared meaning requires negotiations of the unarticulated background assumptions, knowledge, beliefs and values, providing guidelines for shaping participants' interpretations of events and actions. In situations characterised by discontinuities in time and geographical locations, shared meaning requires negotiations articulating the norms and roles visible in terms of policies, symbolic artefacts, ritual activities and patterned behaviour. Here, the main challenges are to prevent team members from feeling isolated from decisions and social relations, while simultaneously supporting individual team members in their co-existence in various social contexts.

In situations characterised by discontinuities in professions and work practices, shared meaning requires negotiations on specific professional norms, collaborative practices and language. This includes developing a shared work

language useful for the articulations and interpretations of the interdependent collaborative activities. Discontinuities in technology require negotiation activities facilitating the development of shared technological frames, as in groupware adaptation. An important factor for establishing the social context within virtual project teams is a negotiated joint enterprise facilitating a shared commitment towards tightly coupled collaboration. Even though tightly coupled collaboration increases the difficulties of e.g. coordination, it is nevertheless vital for creating the necessary commitment from the participants to overcome the challenges of working remotely.

The social context of virtual project teams is continuously challenged by both the behavioural patterns of the participants and the available technological possibilities. Behavioural patterns characterised by pro-activity are usually perceived as an important characteristic for geographically distributed team members. However, proactive behaviour may also constrain consensus building, thus challenging the social context. Technology that provides the opportunity for building a shared workspace while making local modifications upon the application, visible to all participants, enables the social context by supporting translucence. In this way, technological inventions may improve the conditions for virtual project teams. Still current employed technology in real-life situations of virtual project teams challenge the social context in different ways. Thus, based upon the findings in this thesis, one could propose that new groupware designs might benefit from increasing the opportunity for translucence in work situations. Because this would increase the possibility of maintaining participants' understanding of the shifting, changing collaborative processes, while improve the possibility to construct, communicate and interpret contextual information.

8.3 Future Work

This thesis contributes with important new insights into the practices of virtual project teams in real-life settings thus complements and extends current research. However, there is still much more to learn about groupware adaptation and the social context of virtual project teams. It is evident that fundamental differences exist between virtual teams in education and virtual teams in industry, e.g. the primary objective, hierarchy and reward systems. Therefore, even though each of the papers in this thesis only relates to empirical work in either education or in industry, the discussions and conclusions of this summary report try to relate findings from both settings into coherent answers of the main research questions. It is important to note that bridging the findings here is only meant as a suggestion, while new research is needed to determine fully whether the findings are complementary between settings.

New research should therefore investigate the proposed framework of groupware adaptation as expanding and aligning technological frames in

empirical studies outside education. In addition, new studies in various settings of virtual project teams should be conducted to refine and test the framework. Likewise new research on the social context of virtual teams is needed. Here, it would be obvious to conduct new empirical investigations emphasising factors such as the primary objective, hierarchy, resources, leadership and reward systems, since we know these differ between settings. These new studies could then determine the influence of these factors on the social context of virtual teams. Moreover, new groupware technology repeatedly changes the basic conditions for virtual teamwork. Thus, new studies investigating the adaptation of new technologies in the settings of virtual teams should be conducted to identify enablers and constraints combined with unanticipated use. Last, new studies of groupware designs should examine how translucence might be implemented in the systems, providing better opportunities to construct, communicate and interpret socially significant contextual information, thus improving the conditions for virtual teamwork.

Certainly, more research is needed to fully understand the complex and continuously changing conditions for collaboration across distances to further extend and enhance the opportunity to improve the situation for virtual project teams.

References

Allen, T. J. "Issues in Motivating Professionals: Distinguishing Engineers from Scientists," in: *Managing Professionals in Innovative Organizations: A collection of readings*, Ballinger Publishing Company, Cambridge, Mass, 1988, pp. 3-18.

Avison, D., Lau, F., Myers, M., and Nielsen, P. A. "Action Research," *Communications of the ACM*, (42:1), 1999, pp 94-97.

Baker, M. "Negotiation in Collaborative Problem-Solving Dialogues," in: *Dialogue and Instruction: Modeling Interaction in Intelligent Tutoring Systems,* R.-J. Beun, M. Baker and M. Reine (eds.), Springer, 1995.

Bansler, J. P., and Havn, E. "Sensemaking in Technology-Use Mediation: Adapting Groupware Technology in Organizations," *Computer Supported Cooperative Work (CSCW): An International Journal*, (15), 2006, pp 55-91.

Bardram, J. E. "Temporal Coordination," *Computer Supported Cooperative Work (CSCW): An International Journal*, (9), 2000, pp 157-187.

Baskerville, R., and Myers, M. "Special Issue on Action Research in Information Systems: Making IS Research Relevant to Practice - Foreword," *MIS Quarterly*, (28:3), September, 2004, pp 329-335.

Baskerville, R., and Wood-Harper, A. T. "A Critical Perspective on Action Research as a Method for Information System Research," *Journal of Information Technology*, (11), 1996, pp 235-246.

Bazerman, M., Curhan, J., Moore, D., and Vally, K. "Negotiation," *Annual Review Psychology*, (51), 2000, pp 279-314.

Bell, B., and Kozlowski, S. "A Typology of Virtual Teams: Implications for Effective Leadership," *Group & Organization Management*, (27:1), March, 2002, pp 14-49.

Bentley, R., Horstmann, T., and Trevor, J. "The World Wide Web as Enabling Technology for CSCW: The Case of BSCW," *Computer Supported Cooperative Work (CSCW): An International Journal*, (6:2&3), 1997, pp 111-134.

Berthelsen, J., Illeris, K., and Poulsen, S. C. *Grundbog i Projektarbejde: Teori og Praktisk Vejledning [Textbook in Project Work: Theory and Practice]*, Unge Pædagoger, Copenhagen, 1993.

Bjørn, P. "Re-Negotiating Protocols: A way to Integrate Groupware in Collaborative Learning Settings," ECIS 2003, New Paradigms in Organizations, Markets and Society, Proceedings of the 11th European Conference on Information System, Napoli, 19-21 June 2003, 2003.

Bjørn, P. "Transforming Virtual Teams: Translucence and Pittbull Mentality," Scandinavian Conference on Information Systems (IRIS), Kristiansand, Norway, 2005.

Bjørn, P. "Medieret Vejledning af Problemorienteret Projektarbejde: Udfordringer for Vejledning i Problemformuleringsfasen," *UNEV: Tidsskrift for Universiteternes efter- og videreuddannelse*, (9), 2006.

Bjørn, P., and Hertzum, M. "Project-Based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams," 5th Conference on Human Computer Interaction in Southern Africa (CHI-SA), ACM SIGCHI, Cape Town, South Africa, 2006, pp. 6-15.

Bjørn, P., and Ngwenyama, O. "Virtual Team Collaboration: Building Shared Meaning, Resolving Breakdowns and Creating Translucence," *Information Systems Journal*, (x), under review.

Bjørn, P., and Scupola, A. "Groupware Integration in Virtual Learning Teams: A Qualitative Analysis based on the TAM-model," IT Innovation for Adaptability and Competitiveness, IFIP 8.6, Kluwer Academic Publisher, Leixlip, Ireland, 2004, pp. 289-312.

Bjørn, P., Scupola, A., and Fitzgerald, B. "Expanding Technological Frames Towards Mediated Collaboration: Groupware Adoption in Virtual Learning Teams," *Scandinavian Journal of Information Systems*, (18:2), 2006.

Bjørn, P., and Simonsen, J. "Joint Enterprise and the Role of the Intermediator: Challenges Managing Groupware in Virtual Teams," 5th International workshop on Web Based Collaboration (W10-WBC'05), 16th international Workshop on Database and Expert Systems application (DEXA'05), IEEE, Copenhagen, 2005, pp. 609-615.

Blomberg, J., Giacomi, J., Mosher, A., and Swenton-Hall, P. "Ethnographic Field Methods and their Relation to Design," in: *Participatory Design: Principles and Practices,* D. Schuler and A. Namioka (eds.), Lawrence Erlbaum Associates Publisher, London, UK, 1993, pp. 123-155.

Boatwright, M. *Hadrian and the Cities of the Roman Empire*, Princeton University Press, Princeton, New Jersey, 2000.

Borgnakke, K. "Group Work and Learning Processes: Viewed Practically and Analytically," in: *Project Studies - A late Modern University Reform?* J. H. Jensen and H. S. Olesen (eds.), Roskilde University Press, Roskilde, 1999, pp. 78-92.

Bradner, E., and Mark, G. "Why Distance Matters: Effects on Cooperation, Persuasion and Deception," CSCW, ACM, New Orleans, Louisiana, 2002, pp. 226-235.

Bødker, K., Kensing, F., and Simonsen, J. *Participatory IT design: Designing for Business and Workplace Realities*, The MIT Press, Cambridge, Massachusetts, 2004a.

Bødker, K., Pors, J., and Simonsen, J. "Implementation of Web-based Information Systems in Distributed Organizations: A Change Management Approach," *Scandinavian Journal of Information Systems*, (16), 2004b, pp 85-116.

Bøving, K. B., and Simonsen, J. "Http Log Analysis: An Approach to Studying the Use of Web-Based Information Systems," *Scandinavian Journal of Information Systems*, (16), 2004, pp 145-174.

Carstensen, P., and Schmidt, K. "Computer Support Cooperative Work: New Challenges to System Design," *CTI working paper*, (43), February, 1999.

Checkland, P., and Holwell, S. "Action Research: Its Nature and Validity," *Systemic Practice and Action Research*, (11:1), 1998, pp 9-21.

Choudrie, J., and Dwivedi, Y. K. "Research Design: Investigating the Research Approaches for Examining Technology Adoption Issues," *Journal of Research Practice*, (1:1), 2005, pp 1-12.

Christensen, L. *En Anden Vej til Universitetet: En Undersøgelse af den Treårige Universitetsuddannelse i Voksenpædagogik under Åbent Universitet [A Different Way to University: Report Concerning the Master Programme in Educational Studies at Open University]*, Roskilde Universitetscenter, Roskilde, 2000.

Chudoba, K. M., Wynn, E., Lu, M., and Watson-Manheim, M. B. "How Virtual are We? Measuring Virtuality and Understanding its Impact in a Global Organization," *Information Systems Journal*, (15), 2005, pp 279-306.

Clark, H., and Brennan, S. "Grounding in Communication," in: *Perspectives on Social Shared Cognition,* L. Resnick, J. Levine and S. Teasley (eds.), American Psychological Association, Washington DC, 1991, pp. 127-149.

Cramton, C. D. "The Mutual Knowledge Problem and its Consequences for Dispersed Collaboration," *Organization Science*, (12:3), May-June, 2001, pp 346-371.

Davis, F. "Perceived Usefulness, Perceived Easy of Use and User Acceptance of Information Technology," *MIS Quarterly*, (13:3), September, 1989, pp 319-349.

Davison, R. "GSS and Action Research in the Hong Kong Police," *Information Technology & People*, (14:1), 2001, pp 60-77.

Davison, R., Qureshi, S., Vreede, G. J. d., Vogel, D., and Jones, N. "Group Support Systems through the Lens of Action Research: Cases in Organisations," *Journal of Global IT Management*, (3:4), 2000, pp 6-23.

DeSanctis, G., and Gallupe, B. "A Foundation for the Study of Group Decision Support Systems," *Management Science*, (33:5), May, 1987, pp 589-609.

DeSanctis, G., and Jackson, B. "Coordination of Information Technology Management: Team-based Structures and Computer-based Communication Systems," *Journal of Management Information Systems*, (10:4), Spring, 1994, pp 85-111.

DeSanctis, G., and Poole, M. S. "Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory," *Organization Science*, (5:2), May, 1994, pp 121-147.

Dirckinck-Holmfeld, L. "Designing Virtual Learning Environments Based on Problem Oriented Project Pedagogy," in: *Learning in Virtual Environments,* L. Dirckinck-Holmfeld and B. Fibiger (eds.), Samfundslitteratur, Frederiksberg, 2002, pp. 31-54.

Eisenhardt, K. M. "Building Theories from Case Study Research," *The Academy of Management Review*, (14:4), 1989, pp 532-550.

Erickson, T., and Kellogg, W. A. "Social Translucence: An Approach to the Designing Systems that Support Social Processes," *ACM Transactions on Computer-Human Interaction*, (7:1), March, 2000, pp 59-83.

Espinosa, J. A., Cummings, J. N., Wilson, J. M., and Pearce, B. M. "Team Boundary Issues Across Multiple Global Firms," *Journal of Management Information Systems*, (19:4), Spring, 2003, pp 157-190.

Finholt, T., Sproull, L., and Kiesler, S. "Communication and Performance in Ad Hoc Task Groups," in: *Intellectual Teamwork: Social and Technological Foundations of Cooperative Work,* J. Galegher, R. E. Kraut and C. Egido (eds.), Lawrence Erlbaum Associates Publisher, Hillsdale, New Jersey, 1990, pp. 291-325.

Fiol, C. M., and O'Connor, E. J. "Identification in Face-to-Face, Hybrid, and Pure Virtual Teams: Untangling the Contradictions," *Organization Science*, (16:1), January-February, 2005, pp 19-32.

Flores, F., Graves, M., Hartfield, B., and Winograd, T. "Computer Systems and the Design of Organizational Interaction," *ACM Transactions on Office Information Systems*, (6:2), April, 1988, pp 153-172.

Gerson, E. M., and Star, S. L. "Analyzing Due Process in the Workplace," *ACM Transactions on Office Information Systems*, (4:3), July, 1986, pp 257-270.

Gibson, C. B., and Manuel, J. A. "Building Trust: Effective Multicultural Communication in Virtual Teams," in: *Virtual Teams that work: Creating Conditions for Virtual Team Effectiveness,* C. B. Gibson and S. G. Cohen (eds.), Jossey-Bass, A Wiley Imprint, San Francisco, 2003, pp. 59-86.

Glaser, B. G., and Strauss, A. L. *The Discovery of Grounded Theory: Strategies for Qualitative Research*, Aldine De Gruyter, New York, 1967.

Griffith, T., Sawyer, J., and Neale, M. "Virtualness and Knowledge in Teams: Managing the Love Triangle of Organizations, Individuals, and Information Technology," *MIS Quarterly*, (27:2), 2003a, pp 265-287.

Griffith, T. L., Mannix, E. A., and Neale, M. A. "Conflict and Virtual teams," in: *Virtual Teams that work: Creating Conditions for Virtual Team Effectiveness,* C. B. Gibson and S. G. Cohen (eds.), Jossey-Bass A Wiley Imprint, San Francisco, 2003b, pp. 335-351.

Grudin, J. "Computer Supported Cooperative Work: History and Focus," *IEEE Computer*, (27:5), May, 1994a, pp 19-26.

Grudin, J. "Groupware and Social Dynamics: Eight Challenges for Developers," *Communications of the ACM*, (37:1), 1994b, pp 92-105.

Heath, C., and Luff, P. "Collaboration and Control: Crisis Management and Multimedia Technology in London Underground Line Control Rooms," *Computer Supported Cooperative Work (CSCW): An International Journal*, (1), 1992, pp 69-94.

Heath, C., Svensson, M. S., Hindmarsh, J., Luff, P., and Lehn, D. v. "Configuring Awareness," *Computer Supported Cooperative Work (CSCW): An International Journal*, (11), 2002, pp 317-347.

Hertzum, M. "Six Roles of Documents in Professionals' Work," Sixth European Conference on Computer Supported Cooperative Work, Kluwer Academic Publisher, Copenhagen, Denmark, 1999, pp. 41-60.

Hinds, P., and Mortensen, M. "Understanding Conflict in Geographical Distributed Teams: The Moderating Effects of Shared Identity, Shared Context, and Spontaneous Communication," *Organization Science*, (16:3), May-June, 2005, pp 290-307.

Hollingshead, A., McGrath, J., and O'Connor, K. "Group Task Performance and Communication Technology: A Longitudinal Study of Computer-mediated versus Face-to-face Work Groups," *Small Group Research*, (24:3), August, 1993, pp 307-333.

Holmqvist, B. "Work, Language and Perspective: An Empirical Investigation of the Interpretation of a Computer-Based Information System," *Scandinavian Journal of Information Systems*, (1), 1989, pp 72-96.

Huysman, M., Steinfield, C., Jang, C.-Y., David, K., Veld, M. H. I. T., Poot, J., and Mulder, I. "Virtual Teams and Appropriation of Communication Technology: Exploring the Concept of Media Stickiness," *Computer Supported Cooperative Work (CSCW): An International Journal*, (12), 2003, pp 411-436.

Iversen, J., Mathiassen, L., and Nielsen, P. A. "Managing Risk in Software Process Improvement: An Action Research Approach," *MIS Quarterly*, (28:3), September, 2004, pp 395-433.

Jarvenpaa, S. L., Knoll, K., and Leidner, D. E. "Is Anybody out there? Antecedents of Trust in Global Virtual Teams," *Journal of Management Information Systems*, (14:4), Spring, 1998, pp 29-64.

Jarvenpaa, S. L., and Leidner, D. E. "Communication and Trust in Global Virtual Teams," *Organization Science*, (10:6), Nov.-Dec., 1999, pp 791-815.

Kaae, A. "Vejlederrollen ved Projektarbejde [The Role of the Supervisor in Project Work]," in: *Om Voksenundervisning - Grundlag for Pædagogiske og Didaktiske Refleksioner,* C. N. Jensen (ed.), Billesø & Baltzer, Værløse, 1999, pp. 383-403.

Karsten, H. "Collaboration and Collaborative Information Technologies: A Review of the Evidence," *The DATA BASE for Advances in Information Systems*, (30:2), 1999, pp 44-65.

Kayworth, T., and Leidner, D. "The Global Virtual Manager: A Prescription of Success," *European Management Journal*, (18:2), 2000, pp 183-194.

Kiesler, S. "Thinking Ahead: The Hidden Messages in Computer Networks," *Harvard Business Review*, (1), January-February, 1986, pp 46-60.

Kirkman, B., Rosen, B., Tesluk, P., and Gibson, C. "The Impact of Team Empowerment on Virtual Team Performance: The Moderating Role of Face-to-Face Interaction," *Academy of Management Journal*, (47:2), 2004, pp 175-192.

Klein, H., and Truex, D. "Discourse Analysis: An Approach to the Investigation of Organizational Emergence," in: *Signs of work: Semiosis and Information Processing in Organisations,* B. Holmqvist, P. B. Andersen, H. Klein and R. Posner (eds.), Walter de Gruyter, Berlin, 1996.

Klein, H. K., and Myers, M. D. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly*, (23:1), March, 1999, pp 67-93.

Kvale, S. *Interview: En Introduktion til det Kvalitative Forskningsinterview [An Introduction to the Qualitative Research Interview]*, Hans Reitzels Forlag, København, 1997.

Lanzara, G., and Mathiassen, L. "Mapping Situations within a Systems Development Project," *Information and Management*, (8:1), 1985, pp 3-20.

Lee, A., and Baskerville, R. "Generalizing Generalizability in Information Systems Research," *Information Systems Research*, (14:3), September, 2003, pp 221-243.

Levesque, L. L., Wilson, J. M., and Wholey, D. "Cognitive Divergence and Shared Mental Models in Software Development Project Teams," *Journal of Organizational Behavior*, (22), 2001, pp 135-144.

Lipnack, J., and Stamps, J. *The Age of the Network: Organizing Principles for the 21st Century*, John Wiley & Sons, Inc., New York, 1994.

Lipnack, J., and Stamps, J. *Virtual Teams: People Working Across Boundaries with Technology*, (2 ed.), John Wiley & sons, Inc., New York, 2000.

Lyytinen, K. J., and Ngwenyama, O. K. "What does Computer Support for Cooperative Work Mean? A Structurational Analysis of Computer Supported Cooperative Work," *Accounting Management and Information Technology*, (2:1), 1992, pp 19-37.

Majchrzak, A., Rice, R. E., Malhotra, A., King, N., and Ba, S. "Technology Adaptation: The Case of a Computer-Supported Inter-Organizational Virtual Team," *MIS Quarterly*, (24:4), December, 2000, pp 569-600.

Malhotra, A., and Majchrzak, A. "Enabling Knowledge Creation in Far-flung teams: Best Practice for IT Support and Knowledge Sharing," *Journal of Knowledge Management*, (8:4), 2004, pp 75-88.

Malhotra, A., Majchrzak, A., Carman, R., and Lott, V. "Radical Innovation without Collocation: A Case Study of Boeing-Rocketdyne," *MIS Quarterly*, (25:2), June, 2001, pp 229-249.

Mark, G. "Conventions and Commitment in Distributed CSCW Groups," *Computer Supported Cooperative Work (CSCW): An International Journal*, (11), 2002, pp 349-387.

Mark, G., and Poltrock, S. "Shaping Technology Across Social Worlds: Groupware Adoption in a Distributed Organization," GROUP, ACM, Florida, 2003, pp. 284-293.

Markus, M. L. "Towards a Theory of Knowledge Reuse: Types of Knowledge Reuse Situations and Factors in Reuse Success," *Journal of Management Information Systems*, (18:1), 2001, pp 57-93.

Massey, A. P., Montoya-Weiss, M. M., and Hung, Y.-T. "Because Time Matters: Temporal Coordination in Global Virtual Project Teams," *Journal of Management Information Systems*, (19:4), Spring, 2003, pp 129-155.

Mathiassen, L. "Reflective System Development," *Scandinavian Journal of Information Systems*, (10:1&2), 1998, pp 67-134.

Maznevski, M. L., and Chudoba, K. M. "Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness," *Organization Science*, (11:5), Sep.-Oct., 2000, pp 473-492.

McGrath, J. "Time Matters in Groups," in: *Intellectual Teamwork: Social and Technological foundations of Cooperative Work,* J. Galegher, R. E. Kraut and C. Egido (eds.), Lawrence Erlbaum Associates, Publisher, Hillsdale, New Jersey, 1990, pp. 23-61.

Mårtensson, P., and Lee, A. "Dialogical Action Research at Omega Corporation," *MIS Quarterly*, (28:3), September, 2004, pp 507-536.

Ngwenyama, O. K., and Klein, H. K. "An Exploration of the Expertise of Knowledge Workers: Towards a Definition of the Universe of Discourse for Knowledge Acquisition," *Information Systems Journal*, (4), 1994, pp 129-140.

Ngwenyama, O. K., and Lee, A. S. "Communication Richness in Electronic Mail: Critical Social Theory and the Contextuality of Meaning," *MIS Quarterly*, (21:2), June, 1997, pp 145-167.

Ngwenyama, O. K., and Lyytinen, K. J. "Groupware Environments as Action Constitutive Resources: A Social Action Framework for Analyzing Groupware Technologies," *Computer Supported Cooperative Work (CSCW): An International Journal*, (6), 1997, pp 71-93.

O'Connor, G. C., Rice, M. P., Peters, L., and Veryver, R. W. "Managing Interdisciplinary, Longitudinal Research Teams: Extending Grounded Theory-building Methodologies," *Organization Science*, (14:4), July-August, 2003, pp 353-373.

O'Connor, K., Gruenfeld, D., and McGrath, J. "The Experience and Effects of Conflict in Continuing Work Groups," *Small Group Research*, (24:3), August, 1993, pp 362-382.

O'Hara-Devereaux, M., and Johansen, R. *Globalwork: Bridging Distance, Culture, and Time*, Jossey-Bass Publisher, San Francisco, 1994.

Olesen, H. S., and Jensen, J. H. (eds.) *Project Studies: A Late Modern University Reform?* Roskilde University Press, Frederiksberg, 1999.

Olsen, P. B., and Pedersen, K. *Problem-Oriented Project Work: A Workbook*, Roskilde University Press, Frederiksberg, Denmark, 2005.

Olson, G. M., and Olson, J. S. "Distance Matters," *Human-Computer Interaction*, (15), 2000, pp 139-178.

Orlikowski, W., and Baroudi, J. "Studying Information Technology in Organizations: Research Approaches and Assumptions," *Information Systems Research*, (2:1), 1991, pp 1-28.

Orlikowski, W., and Hofman, D. "An Improvisational Model for Change Management: The Case of Groupware Technologies," *Sloan Management Review*, (38:2), Winter, 1997, pp 11-21.

Orlikowski, W., Yates, J., Okamura, K., and Fujimoto, M. "Shaping Electronic Communication: The Metastructuring of Technology in the Context of Use," *Organization Science*, (6:4), Jul.-Aug., 1995, pp 423-444.

Orlikowski, W. J. "CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development," *MIS Quarterly*, (17:3), September, 1993, pp 309-340.

Orlikowski, W. J., and Gash, D. C. "Technological Frames: Making Sense of Information Technology in Organizations," *ACM Transactions on Information Systems*, (12:2), April, 1994, pp 174-207.

Postrel, S. "Islands of Shared Knowledge: Specialization and Mutual Understanding in Problem-Solving Teams," *Organization Science*, (13:3), May-June, 2002, pp 303-320.

Prinz, W. "NESSIE: An Awareness Environment for Cooperative Settings," Sixth European Conference on Computer Supported Cooperative Work, Kluwer Academic Publisher, Copenhagen, Denmark, 1999.

Rapoport, R. N. "Three Dilemmas in Action Research," *Human Relations*, (23:6), 1970, pp 499-513.

Robinson, M. "Double-level Language and Co-operative Working," *AI & Society*, (5), 1991, pp 34-60.

Sarker, S., and Sahay, S. "Implications of Space and Time for Distributed Work: An Interpretive Study of US-Norweigian System Development Teams," *European Journal of Information Systems*, (13), 2004, pp 3-20.

Schmidt, K. "The Problem with 'Awareness'," *Computer Supported Cooperative Work (CSCW): An International Journal*, (11), 2002, pp 285-298.

Schmidt, K., and Bannon, L. " Taking CSCW Seriously: Supporting Articulation Work," *Computer Supported Cooperative Work (CSCW): An International Journal*, (1:no. 1-2), 1992, pp 7-40.

Schmidt, K., and Simone, C. "Coordination Mechanisms: Towards a Conceptual Foundation of CSCW System Design," *Computer Supported Cooperative Work (CSCW): An International Journal*, (5), 1996, pp 155-200.

Schön, D. *The Reflective Practitioner: How Professionals Think in Action*, Basic Books, A Division of Harper Collins Publishers, United States of America, 1983.

Searle, J. R. "A Taxonomy of Illocutionary Acts," in: *Expression and Meaning: Studies in the Theory of Speech Acts*, Cambridge University Press, Cambridge, 1979, pp. 1-29.

Spellman, P., Moiser, J., Deus, L., and Carlson, J. "Collaborative Virtual Workspace," GROUP, ACM, Phoenix Arizona, USA, 1997.

Stahl, G., and Herrmann, T. "Intertwining Perspectives and Negotiation," GROUP, ACM, Phoenix Arizona, 1999, pp. 316-325.

Star, S. L., and Strauss, A. "Layers of Silence, Arenas of Voice: The Ecology of Visible and Invisible Work," *Computer Supported Cooperative Work (CSCW): An International Journal*, (8), 1999, pp 9-30.

Steinfield, C., Jang, C., and Pfaff, B. "Supporting Virtual Team Collaboration: The TeamSCOPE System," GROUP Conference, ACM, Phoenix Arizona, USA, 1999.

Suchman, L. "Office Procedure as Practical Action: Models of Work and System Design," *ACM Transactions on Office Information Systems*, (1), 1983, pp 320-328.

Suchman, L. *Plans and Situated Actions. The Problem of Human Machine Communication*, (1 ed.), Cambridge University Press, Cambridge, 1987.

Susman, G. I., and Evered, R. D. "An Assessment of the Scientific Merits of Action Research," *Administrative Science Quarterly*, (23:4), December, 1987, pp 582-603.

Teege, G. "Users as Composers: Parts and Features as a Basic for Tailorability," *Computer Supported Cooperative Work (CSCW): An International Journal*, (9), 2000, pp 101-122.

Townsend, A. M., DeMarie, S. M., and Henrickson, A. R. "Virtual Teams: Technology and the Workspace of the Future," *Academy of Management Executive*, (12:3), August, 1998, pp 17-29.

Tyre, M., and Orlikowski, W. "Windows of Opportunities: Temporal Patterns of Technological Adaptation in Organizations," *Organization Science*, (5:1), 1994, pp 98-118.

Ulriksen, L. *Projektpædagogik - hvorfor det? [Project pedagogic - why?]*, Erhvervs- og voksenuddannelsesgruppen [Vocational and Adult Education Group], Roskilde University, Roskilde, 1997.

Vallaster, C. "Cultural Diversity and its Impact on Social Inactive Processes: Implications from an Empirical Study," *International Journal of Cross Cultural Management (CCM)*, (5:2), 2005, pp 139-163.

Walsham, G. "Interpretive Case Studies in IS Research: Nature and Method," *European Journal of Information Systems*, (4), 1995, pp 74-81.

Wang, W., and Haake, J. "Tailoring Groupware: The Cooperative Hypermedia Approach," *Computer Supported Cooperative Work (CSCW): An International Journal*, (9), 2000, pp 123-146.

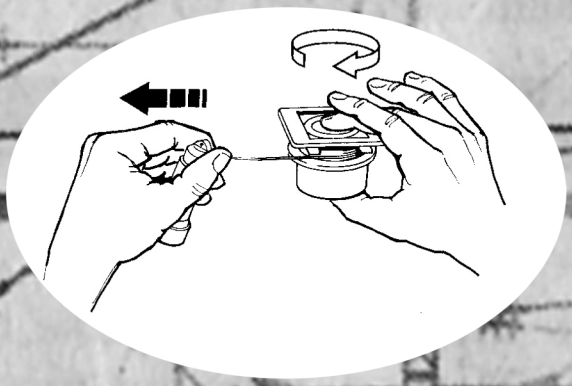
Warkentin, M., and Beranek, P. M. "Training to Improve Virtual Team Communication," *Information Systems Journal*, (9), 1999, pp 271-289.

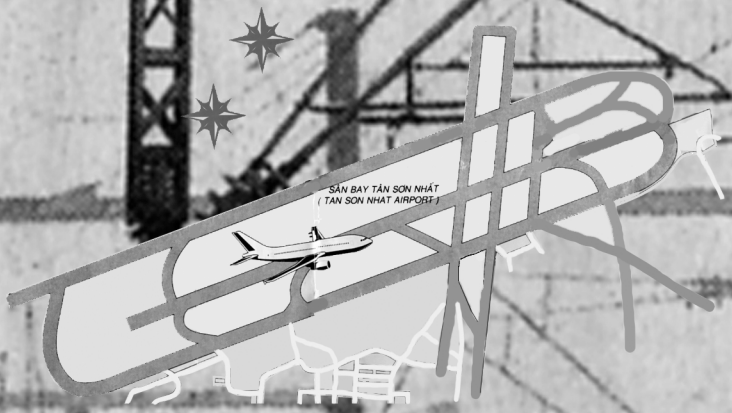
Watson-Manheim, M. B., Chudoba, K., and Crowston, K. "Discontinuities and Continuities: A New Way to Understand Virtual Work," *Information Technology & People*, (15:3), 2002, pp 191-209.

Wenger, E. *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press, 1998.

Windsor, D. "International Virtual Teams: Opportunities and Issues," in: *Advances in Interdisciplinary Studies of Work Team: Virtual Teams,* M. M. Beyerlein, D. A. Johnson and S. T. Beyerlein (eds.), Elsevier Science Ltd, Oxford, 2001, pp. 1-40.

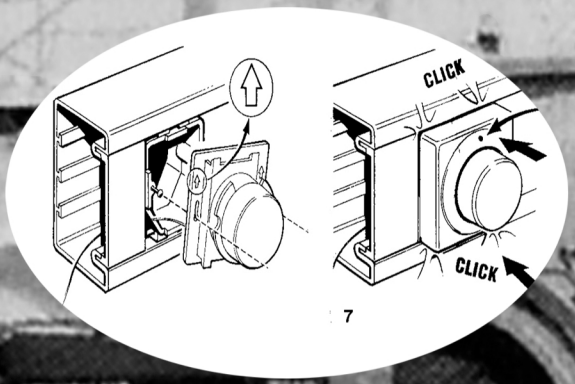
Zheng, J., Veinott, E., Bos, N., Olson, J., and Olson, C. "Trust without Touch: Jumpstarting Long-distance Trust with Initial Social Activities," Computer Human Interaction (CHI), ACM, Minneapolis, Minnesota, USA, 2002, pp. 141-146.





Re-Negotiating Protocols

A Way to Integrate Groupware in Collaborative Learning Setting



Bjørn, P. "Re-Negotiating Protocols: A way to Integrate Groupware in Collaborative Learning Settings," ECIS 2003, New Paradigms in Organizations, Markets and Society, Proceedings of the 11th European Conference on Information System, Napoli, 19-21 June 2003.

Re-Negotiating Protocols

A way to Integrate Groupware in Collaborative Learning Setting

Pernille Bjørn
Roskilde University
pbr@ruc.dk

Abstract: Research is being done within the Computer Supported Collaborative Learning community to investigate how to apply the approach of Problem Oriented Project Pedagogy in distance learning using groupware. Successful implementation of groupware in distributed collaborative settings is not without difficulties. We need to investigate different problems to find how to get distributed groups in educational settings to collaborate using groupware. This paper addresses the question: How do we successfully implement groupware in distributed groups? The paper reports from an empirical action research study of four geographical distributed project groups within two different Master Education programs in Denmark, and argue that re-negotiating protocols for collaboration is essential for success with organizational implementation of groupware in distributed project groups.

1. Introduction

Lisa, Thomas and Emma comprise a geographically distributed group participating in a Master Education program based on Problem Oriented Project Work in groups. They have full-time jobs, and families, and have little opportunity to meet and discuss the essential topics of the project they are engaged in. To facilitate group work, they use a web-based groupware system, which is supposed to support their need for collaboration in the distributed setting. This is the case and setting this paper addresses.

Problem Oriented Project Pedagogy has been the pedagogical cornerstone of Roskilde University and Aalborg University since the early 1970s (International Conference on Project Work in University Studies, 1997; Salling Olesen et al., 1999). In Problem Oriented Project Work the students collaborate in groups throughout a semester, defining and exploring real-life problems through theory and empirical work. The teacher's role is to supervise the students' work through critical questions to stimulate reflection and learning. The pedagogy is based on the constructivism perspective. At Roskilde University 50 percent of the education is based on Problem Oriented Project Work and 50 percent on courses and other teacher-controlled activities. In the 1990s the Danish government took initiatives to enable adults active on the labour market to attend university; consequently the universities teaching Problem Oriented Project Work developed part-time Master programs based on group work.

The Master programs started by offering computer-supported collaborative learning systems to increase the possibility for collaboration irrespective of the geographical distribution of the groups. The challenge for research in the Information Systems (IS) context begins here. When applying an IT-system in a group context, the general question is: How can we encourage the group to increase collaboration? Introduction of a new IT-system often temporarily disrupt efficiency, even under the best circumstance (Grudin et al., 1995: p. 56). Organizational implementation of groupware is especially difficult if the mental models that promote collaboration are absent (Orlikowski, 1992). This means that people's cognitions influence organizational integration of the groupware technology. Buying only 'off-the-shelf' groupware is not enough to secure collaboration, and such a strategy is likely to fail. Success with groupware depends on the introduction; without a good introduction the strategies of knowledge management, collaboration and more efficient work will fail (Grudin, 1994). This is why I explore the question: How do we successfully implement groupware in distributed groups?

The 1990s saw the emergence of an international community within the Computer Supported Collaborative Learning (CSCL) investigating the social collaborative nature of learning (first conference in 1995). The community's approach was in line with the approach behind Problem Oriented Project Pedagogy. Investigating collaborative learning needs a social learning theory, and George et al., 2001; Dirckinck-Holmfelt et al, 2002a; Dirckinck-Holmfeld et al., 1999; Dirckinck-Holmfeld et al., 2002b, Svensson, 2002 turned to Lave and Wenger's community of practice theory (Lave et al., 1991). Following their work the overall approach of this investigation has been Wenger (1998). My goal when studying the education setting has been to establish and maintain the group as a community of practice. This necessitates creating a common understanding of the collaboration including both explicit and tacit knowledge. The strategy has been to assist the group to develop *reification* for their collaboration over time.

In this research the protocol-concept grounded in the research community of Computer Supported Cooperative Work (CSCW) are applied in a collaborative learning setting. When collaborating, participants must engage in activities extraneous to the activities that contribute directly to the work (Schmidt et al., 1992: p. 14). These activities are referred to as articulation work. Reducing the complexity of articulation work is a major issue within research of CSCW, and one perspective is the work on coordination mechanisms. Coordination mechanism consists of protocols of coordination embedded in a computational artefact (Schmidt et al., 1996; Pors et al., 2002). We have learned from the debate of 'the coordinator' (Suchman, 1994) that IT-systems have inscripted categories (protocols) embedded in the technology (artefacts). This means that groupware has inscripted protocols that stipulate how to use the technology the most efficiently. My strategy in using the protocol-concept was to assist the group to establish and maintain *protocols* for collaboration that may be supported by the groupware system. In Wenger terms protocols are reifications for the collaboration. Protocols are 'images of collaboration'.

When trying to stipulate working procedures through protocols, it is essential to understand the character of the work setting. Behind all collaboration is an underlying structure for actions (Suchman, 1983). The underlying structure is typically represented as knowledge or information flow when identified by IT-designers, and observed 'misunderstanding of the information flow' is characterized as the incompleteness of the procedural specifications. Suchman suggests changing this view and instead see the problematic nature of procedural specifications as a reflection of some enduring structure that stands behind the work. Her concept is to find the meaning of organizational plans by investigating practical actions. Suchman suggests that structures of an organizational unit are located in the organization of practical action, rather than in procedural specifications. Following the work of Suchman (1983, 1987) the investigation differences between *practical protocols* and *procedural protocols*, where practical protocols references to practical actions and procedural protocols references to procedural specifications.

The overall strategy for investigating organisational implementation of groupware in geographically distributed groups in Master Education programs, was to assist the group to become a community of practice, reducing the complexity of articulation work through explicitness of emerging practical and situated protocols for collaboration. Reduction of articulation work is essential for part-time education, because every time learners have to use extra effort coordinating; time to study are reduced. When effort needed to coordinate decreases, time for learning increases and this is why re-negotiation of protocols is an important contribute to research within the CSCL. Owing to the lack of good examples of how to successfully implement groupware in organizations, an Action Research project was conducted aiming to implement groupware in

collaborative learning settings, and the implementation was a success! The investigation exposed different factors for success, and one of the main observations was the importance of re-negotiating protocols in the project groups.

I argue that efficient use of groupware technology requires adjusting the collaboration to the inscripted protocols in the technology, and if a protocol is to be integrated in a community of practice, it is a critical condition, that the protocol is a situated reification for the collaboration. It is essential that the protocol emerge from practice. Emerging protocols are implicit and tacit, and we need to make them explicit, when using them to reduce the complexity of articulation work. Because practical protocols are located in organization of practical actions, the explicitness needs to be grounded in practical actions. This means that the negotiation of protocols, when establishing a project group, is not enough to integrate the protocols, because at this stage there are no practical actions. This is why *re-negotiation of protocols* is essential for success in organizational implementation of groupware in geographically distributed groups in educational settings.

The rest of this paper has three parts. First is the research method and the activities conducted during the investigation briefly presented. Followed by an in-depth description of the empirical research findings, which are the main part of the paper. Last is the conclusion presented in a discussion of the findings, relating them to the framework of situated actions.

2. Research Method

2.1 Action Research, the Case Study and BSCW

Using the Action Research approach in the IS community is well known (Mathiassen, 1998 and 2002; Avison et al. 1999). The IS Action Research approach combines theory and practice through change and reflection in a problematic real-life situation. In the empirical study, the Action Research approach investigated the overall research question: Which conditions, challenges, problems and needs exist in organizational implementation and use of groupware in geographical distributed groups at Master Education programs?

This question was studied within two different Master Education programs: The Master of Adult Education program at Roskilde University and the Master of ICT and Learning at the IT-university of western Denmark. Through the research process four project groups was followed from their establishment until the exams, in some periods closer than others. The study exposed different factors important for organizational implementation of groupware in distance educational settings. One factor was the importance of re-negotiation of

protocols, and this paper illustrates this factor by extracting empirical findings from one of the groups. The group consists of three members: Lisa, Thomas and Emma. Lisa and Emma lived in east Denmark but far from each other, and Thomas lived in west Denmark. The research was conducted during their last year at the university. They all had first hand experience with Problem Oriented Project Work but not with groupware.

The groupware system used in the investigation was Basic Support for Cooperative Work (BSCW, bscw.gmd.de), one of the most well known CSCW systems in the academic world (Bentley et al., 1997). The BSCW system is a web-based CSCW system, which supports advance file-management, asynchronous and synchronic dialogs, collection of URLs and calendar functions. The BSCW system also supports different awareness functions (Prinz, 1999) such as monitoring which documents, folders and notes are new, read, revised or moved. It is also possible to get direct notifications by email, when different events occur within the system. Because there are great possibilities to adjust the conceptual structures in BSCW, it is a strong tool, when needing to collaborate and coordinate different tasks within a distributed group.

2.2 The Activities and Intervention

The research took place from September 2001 to June 2002. During the year four physical activities was conducted to integrate BSCW in the group. The activities were a project establishment session in November 2001, and three reflective evaluation sessions in January 2002, March 2002 and April 2002. Besides the physical activities the virtual collaboration within the BSCW was observed. The activities was captured and turned into empirical data for analysing by combining workshops and group interviews inspired by Kensing et al. (1998), using wall graphs, diagrams, drawings and tape recordings. These results were combined with a personal log with observations of the virtual collaboration.

3. Empirical Study

3.1 Negotiation of Future Procedural Protocols

The Master students began their last year of the Master program in September 2001. From September to November they followed physical seminars and formed project groups, and the venture with Lisa, Thomas and Emma began.

In November 2001 the group was supervised in doing the activity called *establishment of the project group*. Here, the group negotiated a procedural protocol for future work and developed a common understanding for the use of BSCW. The understanding was based on the groups earlier experience with Problem

Oriented Project Work in groups combined with presentation of examples in how to use BSCW efficiently in the setting. The understanding was then used to design the conceptual structures of the BSCW e.g. which folders under which names should exist, and more important, *how* the participants should use the different folders. The result of the activity was a project contract describing the protocols, an overall plan for the project period, and a designed BSCW workspace.

3.2 Re-Negotiating Protocols – From Procedural to Practical Protocols

Common understanding of described and negotiated protocols is not a static aspect. It evolves over time and is flexible for local interpretation. This is why evaluation of the collaboration process is needed. The group needs to articulate the situated actions occurred in the period, to be able to re-negotiate the procedural protocols and turn them into practical protocols, to increase the common understanding of the collaboration. So the group received supervision to do an reflective evaluation activity in January 2002. Here the group was encouraged to articulate the actual collaboration process experienced from November to January, and assisted to use the result to redefine the plan and re-design the conceptual structures in BSCW.

The activity was crucial to the integration of BSCW in the group, and had a huge impact on the future work. First of all, when the activity was performed the group had *not succeeded* in integrating BSCW in their collaboration. As an outsider to the group, only knowing their work through events at BSCW, their project and collaboration was a mystery with no clues to, what the group had been doing in the period. The main reason was the missing activity in BSCW. So what had the group been doing in the period, and why had they not used BSCW? An obvious answer was, that the group had no need for the technology due to absent coordination-tasks in the period. But this was not the case.

The group explained, that they had a 'dead period' just after the activity in November. A 'dead period' is when all are busy with family and work leaving little time for the project. Around Christmas the need for communication emerged, because of the forthcoming meeting with their teacher in January. They had to produce a document, presenting their problem statement and method. When the deadline approached, the group held a phone meeting planning the coordination assignment.

> "Around Christmas we held a phone-meeting, about the document to our teacher, because Lisa and I had to make something fast, we agreed on using email instead of BSCW – and that's what happened." (Thomas, in the evaluation meeting in January 2002).

Apparently the group had chosen phone meeting and email over BSCW for coordinating the document process, but why? The group explained, that during the establishment activity in November, a clear image of their project, and how

BSCW could support their collaboration emerged. The following 'dead period' blurred that clear image, and the BSCW became a 'stranger out there'.

> "That thing with the BSCW. It is like, that when you are not there – as long as the working process is not continuously –it gets like you logon and look, but nothing happens – and after a short while, it's like a stranger out there." (Emma, in the evaluation meeting in January 2002)

The blurred image of the collaboration, caused by the 'dead period', had two results. First the group forgot the technical functions in BSCW, due to lack of regular use. They did not get the technology 'under the skin', which was an obstacle in the implementation process of the groupware. Second the group forgot the procedural protocols negotiated in November, due to the same reason. Because the group did not collaborate straight after the establishment meeting in November, the organizational implementation failed. The clear image of the project, process and technology from November got blurred. When communication was required for coordinating the document, the blurred image made the combination of both producing the document and integrating the BSCW in the collaboration, a too large mountain to climb. Consequently they chose a known technology for the purpose: email.

So did the coordination through email worked satisfactorily? The answer is no. The group expected to have a common understanding of the process around- and content of- the document produced. But discussions triggered by the supervision exposed differences of both process and content. It was revealed that there were different versions of the document, and that none of the participants had a printed copy of the most recent one. Furthermore it was revealed that the final version was on Thomas' home computer, which they did not have access to from campus.

> "There are some pages missing … (This isn't the last version you sent?) No it is not. (The one you sent a couple of days ago?) The document we sent to Sebastian [the teacher], the one we called version 4. It was the version Lisa had re-written. Unfortunately I don't have a printed version, because my printer isn't working. But Lisa has combined our original versions, it is about 6-7 pages long." (Thomas and Emma, in the evaluation meeting in January 2002)

The missing document caused a problem, because it is a central part of the meeting with the teacher. Due to the email coordination, not all had read the final version, and they had no printed version on campus. What happened in January was, that due to the breakdown in the communication-process producing the document, the group re-negotiated their procedural protocols from November turning them into practical protocols. But what was the difference between the negotiation session in November and the re-negotiation session in January? Comparing the two sessions some clear differences appear. One difference is the role I played in the sessions. In the first session I had a dominated role, when implicit presenting pre-scripted protocols for the group to negotiate. These protocols where inscribed in the examples of reification e.g. the project contract

and conceptual structures at BSCW. These reifications were needed in the session, because the group did not have any experience in using groupware, and to negotiate future work through groupware, they needed an idea of the opportunities, problems and challenges that lie within groupware technology. In the second session I had a completely different role, much more withdrawn. I only questioned the group about their actions in the period, assisting them to articulate their work. Beside the differences in my role, there was an important difference in the focus of the two sessions. Focus in the first session was for the group to formulate pre-scripted protocols and define them as procedural protocols for future work and capture the essence in the reifications (project contract, plan and conceptual structure at BSCW). In the second session the goal were to articulate their situated actions from January to November. They described their experienced work, which at the same time would be a description of the group's practical protocol. Through the discussion, the tacit in their collaboration were exposed, which made it possible for the group to reflect explicitly on their work. The articulation-process increased the common understanding of the collaboration, aligning the misunderstandings and thereby conceived a re-negotiated protocol grounded in practical actions. The result was a revised procedural protocol for future work, but this time the protocol had emerged from practice and not speculations.

After having re-negotiated the protocol five initiatives was decided to accommodate the difficulties experienced in the period. The initiatives were: A new introduction of the BSCW technology, a written introduction to the technical functionalities in BSCW was produced, the direct notification was activated so the participants got email whenever written and revising events occurred, development of three scenarios describing the usage of BSCW for different situations and establishment of a so-called weekly-logbook.

How these initiatives and the re-negotiation of protocols had influenced the integration of BSCW was investigated in March 2002. Based on observations of the virtual collaboration in the period from January to March, a completely different picture of the group collaboration emerged. The group had managed to beneficially integrate BSCW in their collaboration. This was reviled by the massive actions in the BSCW system – especially in the weekly-logbook. It was clear that the group had a mutual understanding of the project, process and document. In January they used almost all the time finding out which documents with what content existed; this was a minor issue in March. When articulating their work in March something interesting emerged. A phone meeting planned in January had been cancelled. Instead they had used the BSCW to coordinate their activities. They needed a phone meeting between Christmas and New Year to coordinate, but the need was reduced between January and March. The BSCW was no longer 'a stranger out there' it had become 'a friend'.

4. Conclusion

IT-systems have inscripted categories (protocols) embedded (Suchman, 1994). Efficient use of groupware technology requires adjusting the collaboration to the inscripted protocols in the groupware. Awareness of this aspect necessitates the importance of choosing a technology that supports the collaboration process, so the protocols enable instead of constrain the collaboration (Grudin et al., 1995). In my study the inscripted protocols in BSCW stipulates that the group needed to have an explicit planning of the project that could be inscripted in the possible conceptual structures of folders and documents. Knowledge of the inscripted protocols, and how these can support a collaborative learning process based on Problem Oriented Project Work, was presented to the group at the session in November, by the presented reifications such as the example of project contract, plan and structures at BSCW. The negotiation process involved the interaction of two constituent processes, the process of adjusting the group to the inscripted protocol of BSCW, and the process of adjusting the BSCW to support the collaboration process. This was done in the creation of procedural protocols for future collaboration, based on the group's earlier experience performing Problem Oriented Project Work and the suggested reifications.

Negotiating the procedural protocols gave the group a clear image of the project and how BSCW could support their needs for distance collaboration. But the image was blurred due to the 'dead period', which resulted in the group forgetting both the technical functions and the procedural protocols. The group did not succeed in integrating the groupware and the protocols as reifications for practice, because they did not have any practice. The group had not been establish as a community of practice, but why? If a protocol is to be a reification for collaboration in a community of practice, the reification has to have a 'meaning' in the community. Meaning evolves from practice through participation in practice (Wenger, 1998: p. 52) and can be viewed as implicit structure located in practical actions (Suchman, 1983). Reducing the complexity of articulation work by adjusting both the collaboration process to the embedded protocols in the groupware technology, and the protocols embedded to the collaboration process, one needs to make the underlying structures located in the practical actions explicit. To do so there has to be a period of practice. This is why the negotiation process of procedural protocols, when establishing a group, is not enough to integrate the protocol, because at that stage there are no practical actions.

So how do we successfully implement groupware in distributed project groups? The venture with the four groups within the two Master Education programs exposed many different essential factors for success, but one of the main observations was; protocols integrated in a community of practice have to be *practical* protocols connected with a meaning to be reifications for

collaboration. This is why *re*-negotiating protocols is essential, because it is by this process that the procedural protocol evolves to a practical protocol. In the re-negotiation process the explicitness of protocols are grounded in practical actions.

If one succeeds in integrating groupware in distributed groups, using groupware can increase the possibility to establish the group as a community of practice, and being established as a community of practice, the group will be able to discuss and reflect on essential topics of the study-project and thereby having better opportunities for collaborative learning instead of wasting energy on articulation work.

References

Avison, David; Francis Lau, Michael Myers and Peter Axel Nielsen: Action Research, in Communication of the ACM, January 1999, Vol. 42, No. 1

Bentley, R. T., T. Horstmann, and J. Trevor: The World Wide Web as enabling technology for CSCW: The case of BSCW, Computer Supported Cooperative Work: The Journal of Computer-Supported Cooperative Work, vol. 6, no. 2-3, Kluwer Academic Publishers, 1997, pp. 111-134

Dirckinck-Holmfeld, Lone and Elsebeth K. Sorensen: Distributed Computer Supported Collaborative Learning through shared Practice and Social Participation, In Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference, C. Hoadly & J. Roschelle (Eds.) Dec. 12-15, Stanford University, Palo Alto, California. Mahwah, NJ: Lawrence Erlbaum Associates.

Dirckinck-Holmfelt, Lone and Bo Fibiger (Eds.): Learning in Virtual Environments, Samfundslitteratur, 2002a.

Dirckinck-Holmfelt, Lone; Håkon Tolsby and Tom Nyvang: E-læring systemer i arbejdsrelateret projektpædagogik, read in Illeris, Knud (red.) Udspil om læring i arbejdslivet, [E-learning in working project pedagogy] Learning lab Denmark, Roskilde Universitetsforlag, 2002b.

George, Sébastian and Pascal Leroux: Project-Based Learning as a Basis for a CSCL Environment: An Example in Educational Robotics, Euro-CSCL 2001, Maastricht, 22 - 24 March 2001.

Grudin, Jonathan and Grinter, Rebecca E.: Ethnography and Design, Computer Supported Cooperative Work (CSCW), vol. 3, no. 1, 1995, pp. 55-59

Grudin, Jonathan: Groupware and social dynamics: Eight challenges for developers, Communication of the ACM, Vol. 37, No. 1, 1994, pp. 92-105.

International Conference on Project Work in University Studies 14-17 September 1997, Conference Papers, Volume 1-3, Roskilde University, Denmark 1972-1997.

Jean Lave and Etienne Wenger: Situated Learning - Legitimate peripheral participation, Cambridge University Press, Cambridge, 1991 - reprint 1999.

Kensing, F., J. Simonsen, and K. Bødker (1998): "MUST - a Method for Participatory Design", Human-Computer Interaction, Vol. 13, No. 2, Lawrence Erlbaum Associates, Inc., pp. 167-198.

Mathiassen, Lars: Collaborative Practice Research, in Scandinavian Journal of Information Systems – Vol. 14, 2002; pp. 57-76.

Mathiassen, Lars: Reflective Systems Development, in Scandinavian Journal of Information Systems - Vol. 10, No. 1&2, 1998; pp. 67-134.

Orlikowski, Wanda J.: Learning from NOTES: Organizational Issues in Groupware Implementation, in J. Turner and R. Kraut (eds.): CSCW '92. Proceedings of the Conference on Computer-Supported Cooperative Work, Toronto, Canada, 31. October - 4. November 1992, ACM Press, New York, 1992, pp. 362-369.

Pors, Jens and Jesper Simonsen: Emergent Use-Patterns: Studying the Integration of Groupware in a Networked Organization, In proceedings of the IRIS 25 Working conference, the 25th conference of Information System Research In Scandinavia, 10-13. August 2002.

Prinz, Wolfgang: NESSIE: An Awareness Environment for Cooperative Settings, GMD-FIT, Germany, Proceedings of the Sixth European conference on Computer supported cooperative work, 1999, Copenhagen, Denmark, Kluwer Academic Publishers Norwell, MA, USA , 1999.

Salling Olesen, Henning and Jens Højgaard Jensen (Eds.): Project Studies – a late modern university reform? Roskilde University Press, 1999.

Schmidt, Kjeld and Bannon, Liam: Taking CSCW Seriously - Supporting Articulation Work, Computer Supported Cooperative Work (CSCW). An International Journal, vol. 1, no. 1-2, 1992, pp. 7-40.

Schmidt, Kjeld and Simone, Carla: Coordination mechanisms: Towards a conceptual foundation of CSCW system design, Computer Supported Cooperative Work. The Journal of Collaborative Computing, vol. 5, no. 2-3, 1996, pp. 155-200.

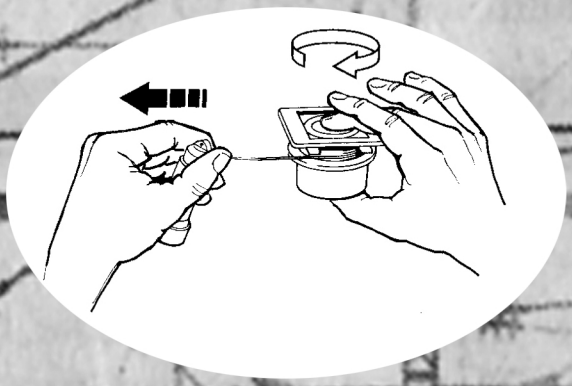
Suchman, Lucy A.: Office Procedure as Practical Action: Models of Work and System Design, ACM Transactions on Office Information Systems, Vol. 1, 1983, pp. 320-328.

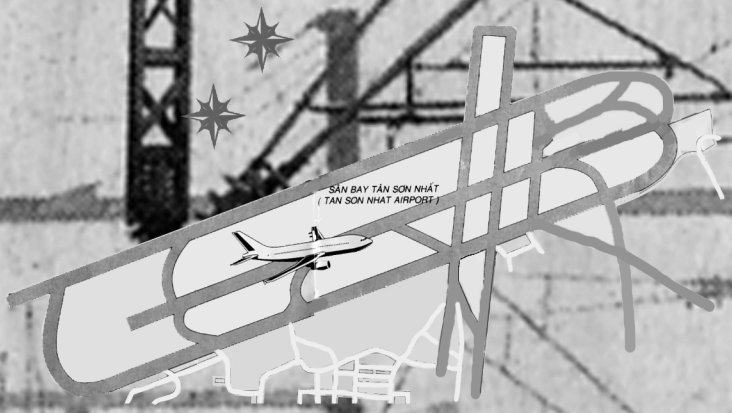
Suchman, Lucy: Do Categories Have Politics? The language/action perspective reconsidered, Computer Supported Cooperative Work (CSCW) 2: pp 177-190, 1994.

Suchman, Lucy: Plans and situated actions – the problem of human machine communication, Cambridge University Press, 1987

Svensson, Lars: The social practice of Distance Education, In proceedings of the IRIS 25 Working conference, the 25th conference of Information System Research In Scandinavia, 10-13. August 2002.

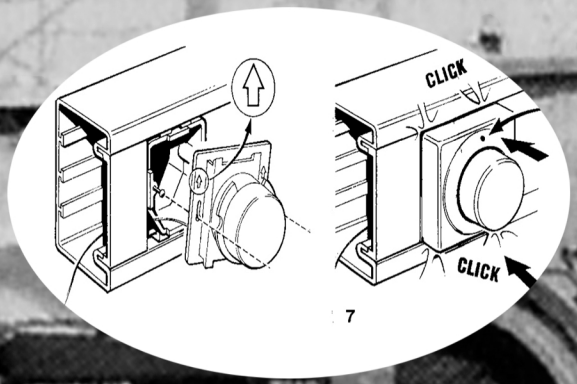
Wenger, Etienne: Communities of practice - learning, meaning, and identity, Cambridge University Press, 1998.





Groupware Integration in Virtual Learning Teams

A Qualitative analysis based on the TAM-model



Bjørn, P., and Scupola, A. "Groupware Integration in Virtual Learning Teams: A Qualitative Analysis based on the TAM-model," IT Innovation for Adaptability and Competitiveness, IFIP 8.6, Kluwer Academic Publisher, Leixlip, Ireland, 2004, pp. 289-312.

Groupware Integration in Virtual Learning Teams

A Qualitative Analysis based on the TAM-model

Pernille Bjørn and Ada Scupola
Roskilde University
pbr@ruc.dk, ada@ruc.dk

Abstract: In this paper we apply Davis' Technology Acceptance Model (TAM) in a qualitative fashion to analyze and interpret the chronological sequence of events leading to the acceptance of the Groupware technology, BSCW, in a virtual learning team. The research question investigated is: What are the factors influencing the integration process of Groupware technology in virtual learning teams in part-time adult education? The data were gathered through an in-depth qualitative action research study of one virtual learning team doing problem-oriented project work within a master education program. We find that one important factor influencing the integration process of Groupware is: How the technology provides support for social perspective awareness. In the case investigated the technology BSCW supported social awareness, which influenced both the ease-of-use and the perceived-usefulness of the Groupware technology, thus being an important condition that influenced the positive outcome of the integration process.

1. Introduction

Problem-oriented learning and university teaching based on a pedagogy whereby students collaborate in teams are a central part of newer educational research (Olesen and Jensen, 1999). At the same time there is a demand that it should be possible to take an education anywhere at any time. Close collaboration in distance setting *could* be a contradiction in terms, however new technology such as Groupware gives us the opportunity to do both.

Geographical distributed project teams need technology support for collaborative activities. We define a virtual team as a team comprising geographically distributed participants who mainly mediate their collaborative activities through technology. The team collaboration can be supported by e-mail correspondence, phone meetings or by using more advanced Groupware technologies such as the BSCW (Basic Support for Cooperative Work). The foundation of these kinds of technologies is advanced file-management systems based on web-technologies (Bentley et al., 1997). We however need new innovations in this field to insure success with Groupware technologies.

Current research on Groupware states that appropriate support for the integration, implementation and continued use of the technology is crucial for success (Karsten, 1999; Orlikowski, 1992; Grudin, 1994 and Majchrzah et al., 2000). Drawing on these findings we conducted an action research project, where we intervened to facilitate a virtual learning team in integrating Groupware. Our action research approach was to support the integration by assisting the team to develop and implement coordination mechanisms (Schmidt and Simone, 1996). Here we describe how the virtual learning team went from using e-mail and phone to mediate their collaboration by integrating Groupware to support the distributed practice.

When analyzing the data we needed a model to examine why the integration succeed. We used Davis' Technology Acceptance Model (Davis, 1989) – the TAM-model – as a 'lens' or framework to describe and analyze the different factors that influenced the integration process at different periods of time. We chose to use the TAM-model for two main reasons. First the TAM-model is the most well-known, rigorously validated empirically and widely accepted model for examining technology acceptance (Legris et al., 2003; Adams et al., 1992; Davis, 1989; Davis et al., 1989), and secondly because we found that the model constructs Ease-of-use, Perceived-usefulness, Intentional-use and Actual-use provided a framework, which was useful when analyzing the integration process.

Groupware support for Problem Oriented Project work in distributed part-time education has been investigated in a range of studies (e.g. Dirckinck-Holmfelt and Sorensen, 1999; Cheesman and Heilesen, 1999; Bjørn, 2003). However none of these studies has used the TAM-model to investigate the Groupware integration process. This paper does so by reflecting and analyzing the integration of Groupware technology in a virtual learning team by using the TAM-model in a qualitative and interpretative way. The overall research question investigated is: What are the factors influencing the integration process of Groupware technology in virtual learning teams in part-time adult education?

We found that besides the importance of coordination mechanisms another aspect of Groupware technology influenced the integration in a positive way: social perspective awareness. We define social perspective awareness as

background information on belief and knowledge of team members, similar to the information one can gather when working around in the physical office. Groupware technology affected the social setting in the virtual team by providing support for an unarticulated need in the team for social perspective awareness. So besides supporting the need for coordination and document handling, which we expected, the Groupware technology also supported the team's need for perspective awareness. This factor influenced the integration of this technology in a positive way. We use the TAM-model to illustrate this point while showing that social perspective awareness influences both the construct Ease-of-use and the construct Perceived-usefulness in the model.

The paper is structured as follows. In the next section, the TAM model and its application in a variety of contexts are presented. Then, the concept of social perspective awareness and its relevance to virtual teams is discussed. Following this, the research setting, research method and data analysis is presented. In the empirical part of the paper we analyze the integration of Groupware technology over four key checkpoints, followed by a discussion of the research results. Finally, the conclusions, limitations and implications of the study for further research using the TAM model in integration of Groupware in virtual learning teams are discussed.

2. The Conceptual Base

2.1 Technology Acceptance Model (TAM)

Davis (1989) synthesized the findings of a range of diverse research streams to propose the Technology Acceptance Model (TAM), which identifies a number of constructs relevant to technology acceptance (First publish in Davis' dissertation in 1986). These constructs fall into two broad categories, *ease of use (EoU)* and *perceived usefulness (PU)*. Davis suggests a chain of causality between these categories: greater EoU leads to higher PU, which in turn leads to more usage of technology (see Fig. 1).

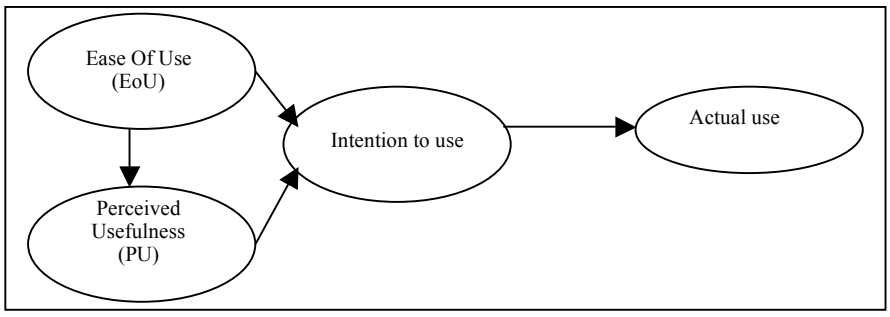


FIG. 1: DAVIS' TECHNOLOGY ACCEPTANCE MODEL (TAM), (DAVIS, 1989)

In the original TAM-model two more constructs were present in addition to those in fig. 1: *External variables* and *Attitude*. The external variables influenced both EoU and PU, while Attitude was influenced by both EoU and PU affecting the construct Intentional-use. We have chosen not to include the External-variables and Attitude in our model, drawing on the research of Legris et al. (2003) and Gefen et al. (2003). In fact, Legris et al. (2003) found that in most cases researchers have mainly considered EoU and PU and their effects on Intentional-use.

The TAM-model has been used in a range of studies. Kwon and Chidambaram (2000) use and test the TAM model to examine patterns of cellular phone adoption and usage in an urban setting. The results of the study confirm that users' perceptions and especially perceived EoU, are significantly associated with the motivation to use cellular phones. Lederer et al. (2000) applies TAM in relation to work-related tasks in the context of the World Wide Web. They find full support for the TAM model and demonstrate that ease of understanding and ease of finding predict EoU, and that information quality predicts usefulness for revisited sites. Yager (1999) uses the TAM constructs to address the perceptions of currently available and yet-to-be-released IT support mechanisms among virtual and face-to-face (non-virtual) teams. The study shows that virtual team members reported greater EoU and PU of the IT support mechanisms than non-virtual team members together with more Intention-to-use. Pavlou (2001) extends the TAM model to incorporate the constructs of risk and trust in consumer intention to adopt electronic commerce. The TAM model has also been extended with variables such as control, intrinsic motivation and emotion (Venkatesh, 2000), and has been used in the marketing field to explain online consumer behavior (e.g. Koufaris, 2002). Social influence has been found important in technology acceptance. Venkatesh and Davis (2000) develop and test a modified version of the original TAM, which explains PU and usage intentions in terms of social influence (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, and result demonstrability). This study was however not done in concern to virtual teams or Groupware technology.

Originally the TAM-model was developed to study the integration and acceptance of an IT-system in an individual setting, and the different constructs of the model were measured at a given point in time by using quantitative data collected mainly through surveys. Three main points differentiate earlier use of TAM from the use in this paper. First our goal is not to measure the TAM's constructs at a given point in time, but instead we want to describe how the different constructs of the TAM-model *change* during the integration and acceptance process. Secondly we use the TAM-model in a *qualitative study*, whereas it is normally used in a quantitative fashion. Others have also used the TAM-model in a qualitative approach e.g. Neville and Fitzgerald (2002). Finally,

while the TAM-model is typically concerned with an individual's acceptance of technology, we use it to investigate *a group's* acceptance of technology.

2.2 Virtual Teams and Social Awareness

Research on the integration of technology in virtual teams is important, because virtual teams in general have more malleable structures due to the typically 'not-yet-organized' and more informal organization (Majchrzak et al. 2000). In this way we can learn from virtual teams when interested in change management. Also research on virtual team is important to understand and support the practice of global organizations. Some research has taken up the challenge of investigating virtual teams by focusing on managerial aspects such as the role of the project manager (e.g. Kayworth and Leidner, 2002; Paré and Dubé, 1999; Piccoli and Ives, 2000), while other research has taken an empirical approach to exploring the process of virtual teams (e.g. Maznevski and Chudoba, 2000). Most of the research has however been conducted with emphasis on special aspect of virtual teams such as culture or trust (e.g. Jarvenpaa et al., 1998; Massey et al., 2001; Alexander, 2002). No research has however addressed the importance of social perspective awareness in virtual teams.

Social and people-centered issues such as social awareness have been found important when researching group collaboration (Steinfield et al., 1999; Prinz, 1999, Tollman et al., 1996; Schmidt, 2002). Awareness as a concept has been categorized in different ways. Prinz (1999) identifies two types of awareness: social awareness and task-oriented awareness. In our study the type of awareness relevant to the integration of Groupware can be categorized as social awareness according to Prinz (1999: p. 2) definition: namely, to provide information similar to 'information received when walking along the office floor'. Others have also located the importance of social awareness saying that 'Awareness involves knowing who is "around", what activities are occurring, who is talking with whom; it provides a view of one another in the daily work environments (Dourish and Bly, 1992)".

Steinfield et al. (1999) proposes a number of awareness categories, including activity awareness, availability awareness, process awareness, environmental awareness, and perspective awareness. A full discussion of each of these categories is beyond the scope of this paper. However, the one most relevant to our study is that of *perspective awareness* which is defined as 'giving group members information helpful for making sense of others' actions, such as background on team members belief and knowledge' (Steinfield et al., 1999: p. 84). There is a difference between knowing who is around and background knowledge necessary to interpret others' actions. In our empirical data, the importance and need was on the background knowledge: perspective awareness.

For the purpose of this study, we complement therefore Prinz definition of social awareness with aspects of perspective awareness in giving group members

information helpful for making sense of each others' actions so that the information received is similar to the one gathered when walking along the office floor'. Finally, the setting investigated in our study is an asynchronous setting, meaning that the team members do not work synchronously or at the same time, while being apart from each other. The need for 'knowing if people are available in a synchronous perspective' is thus not an issue. Therefore, our concept of social awareness differs, from Tollmar et al. (1996) and Dourish and Bly (1992), which both focuses on a synchronous context. The awareness concept used in this paper can be defined as asynchronous social perspective awareness – here just referred to as social awareness.

3. The Research Context

3.1 Research Settings

The empirical investigation was conducted within a part-time Master program (the Master of Adult Education at Roskilde University in Denmark), where a virtual learning team was closely followed. The focus of the investigation was to facilitate and in this way locate important factors for success when integrating the Groupware technology BSCW in the virtual team.

The master of adult education is a three-year part-time university education for people active on the labour marked. To apply and being accepted the students need a bachelor degree and at least two years of job experience. The average participant is a woman between 40 and 50 years old working with health or education in the public sector. Because it is a part-time education each semester is stretched over a whole year from September to June, and each year the program requires the students to attend five weekend-long seminars on campus in September, November, January, March and April. Over 50% of the program is based on project work in groups of two to four participants with an academic supervisor.

The team in focus consisted of three students in their mid-thirties: Emma, Thomas and Lisa. They all had families and were in full-time employment, so study-time was on weekends and evenings. The three team-members lived far apart, leaving little opportunity to physically meet, apart from the five seminars on campus. Due to different working hours the team primarily collaborated asynchronously. On this basis, we classify the group as a virtual team according to Steinfield et al. (1999) definition: 'any group characterized by having members in different locations' and use the terms virtual learning team and group interchangeably.

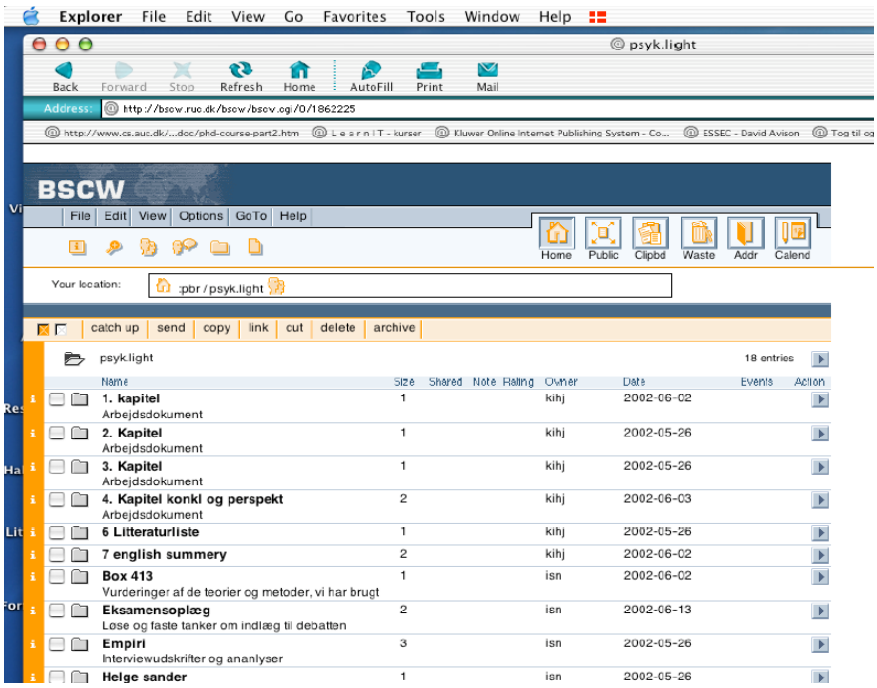
It could be argued that there is a difference between groups in educational and working contexts. However, following the Schmidt and Simone' (1996: p.

158) definition of cooperative work as 'constituted by the interdependencies of multiple actors who interact through changing the state of a common field of work', we believe the setting of the study represented a true and realistic work context. The multiple actors were Emma, Thomas and Lisa, the common field of work was their project, and the state was changed through discussion, reading, writing, revising documents – which in the end led to the final project report they turned in to the exam.

Our research focused on the coordination activities surrounding the production of an outline of a project report that the group was required to submit to the supervisor by a particular deadline. The research was conducted during the group's last year at the university. All group members had experience with project work in virtual teams mediated by e-mail and phone, but no experience in using Groupware to support their collaboration.

3.2 Technology

The Groupware system used in the investigation was Basic Support for Cooperative Work (BSCW, further details at bscw.gmd.de), one of the most well known CSCW (Computer-Supported Cooperative Work) systems in the academic world (Bentley et al., 1997).



The BSCW system is a web-based CSCW system, which supports file-management, asynchronous and synchronous dialogs, management of URLs, and calendar functions. The BSCW system also supports different awareness functions such as monitoring which documents, folders and notes are new, read,

revised or moved. It is also possible to get automatically e-mail notifications, when different events occur within the system. The BSCW broad functionality and versatility, which allow users to adjust the conceptual structures as needed makes it a strong tool, when there is a requirement to collaborate and coordinate different tasks within a distributed group.

3.3 Research Method

Research on Groupware integration and use based on 'experimental settings' with the sole purpose of evaluating Groupware has produced confusing and inconsistent results, because it is not possible to simulate real-life collaboration (Davison et al., 1998). Davison et al. (1998) proposes, instead, using action research to fully capture the complexity of Groupware use and collaboration. Using the action research approach in the Information Systems (IS) community is well known (e.g. Mathiassen 1998, 2002; Avison, Lau, Myers & Nielsen 1999; Vidgen and Braa, 1997; Braa and Vidgen, 2000; Donnellan, 2003). The IS action research approach combines theory and practice through change and reflection in a problematic real-life situation.

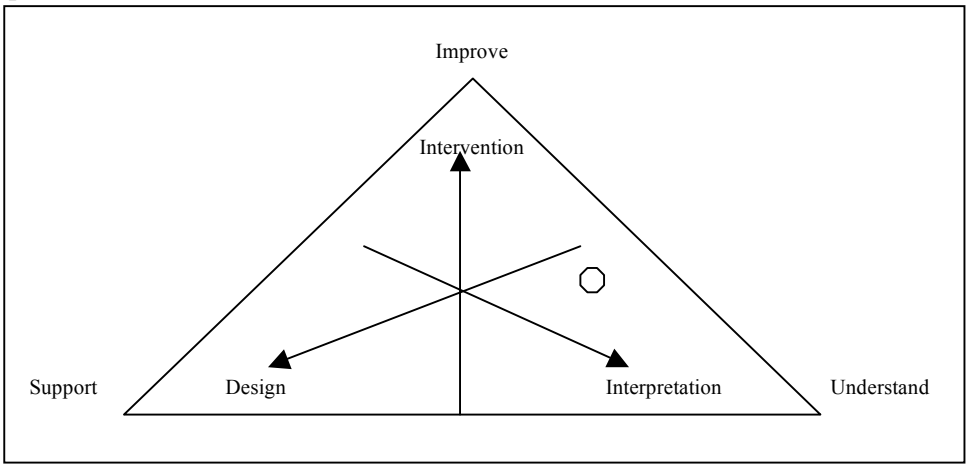


FIG. 2: A FRAMEWORK FOR ACTION RESEARCH (ADAPTED FROM MATHIASSEN, 1998)

The triangle in Fig. 2 represents the unity of the three goals: to understand, to support and to improve. The arrows inside the triangle represent the distinct research activities through which the different goals are supported. Having the activities inside the triangle illustrates that each activity can benefit from the other activities. "First, our understanding is based on interpretations of practice. Second, to support practice we simplify and generalize these interpretations and engage in design of normative propositions or artifacts, e.g. guidelines, standards, methods, techniques, and tools. Third, we change and improve practices through different forms of social and technical intervention." (Mathiassen, 1998: p. 20). In this way different studies are placed in different locations of the triangle.

The study presented here was lead by the research question: What are the factors influencing the integration process of Groupware technology in virtual learning teams in part-time adult education? In pursuing this question we wanted to *understand* practice (the social practice and collaboration within virtual learning team) with the aim of *supporting* the practice (support of coordination and social aspect by Groupware) and then *intervene* with the practice (facilitate the integration of Groupware to support the group's needs). As predicted by the research question our emphasis is on the understanding of the practice in the virtual team (what are the factors...) in combination with a motivation for facilitating and improving the integration process. In this way we position ourselves in the triangle as closer to improve and understand than to support (see circle in fig. 2).

When doing action research it is crucial to be explicit about the role of the researcher. The role of the researcher in this study was to act as an outside facilitator and process-supervisor in the integration of Groupware in the virtual learning team. It was made explicit to the students that the integration of Groupware should support their collaboration, and if they did not find the Groupware useful they should state this. This approach made the students to be critical towards the technology. As a result, they clearly stated throughout the investigation if and when they were unhappy with the technology and what they would have liked to change. The researcher had no direct connection to the Master of Adult Education program, and was not one of the teachers within the Master education.

3.4 Research Activities

The research took place over the period September 2001 to June 2002. In September the research project was presented to all the students attending the first on-campus seminar in the third year, and the students were asked if they were interested in participating. It was made clear to the students that the researcher not only wanted to make the technology available to the students, but also wanted to facilitate the use being a process-supervisor. The work of the researcher was then supporting the team in both the technical functions and in translating the teams work patterns into guidelines for adjusting the conceptual structures in BSCW. One team volunteered to participate to the research project.

During the whole research period, four intervention points in the process were analyzed: November 2001, January, March and April 2002. In November 2001 a workshop of six hours was held. The workshop activities were recorded for later analysis by using wall-graphs (Simonsen and Kensing, 1997) and tape-recording, in addition to a personal logbook written by the researcher just after the session. In January 2003 the researcher's intervention took the form of a focus group interview (Kvale, 1996). The interview lasted about 2 hours, was tape-

recorded for later analysis combined with wall-graphs and rich-pictures (Checkland and Scholes, 1990).

The third researcher's intervention was another evaluation session held in March 2002. The researcher was not present due to external reasons. The team was, therefore, given a list of questions to discuss. The questions could be divided into two types. One type related to the evolution of the project itself and another aiming at finding out the role of BSCW in the collaboration. Examples of questions are: Which kind of document do you have at this time? How far are these? And are there documents not placed in BSCW? Try to describe what you have been doing in the past period and how BSCW or other kinds of technology (like phone and e-mail) have worked? The team recorded the conversation, and these data were later analyzed by the researchers. The researcher asked the team some clarifying questions through the BSCW system after listening to the tapes.

The last intervention in April was organized as one-hour focus group interview. The session was recorded on tape for later analysis. In between the different intervention sessions the researcher had observed and recorded the group's activities within BSCW and intervened if necessary or asked by the students. This recording was done in the personal logbook held by the researcher.

3.5 Data Analysis

Each physical intervention with the team was tape-recorded and transcribed within 24 hours in a sequential order to ensure reliability of the data (Perakyla, 1997). Wall-graphs or rich-pictures were made during the sessions, containing rich-pictures and notes of the sessions. After each encounter two resumes of the session were made. One was done by the researcher and one was done by the team. The collected data were analyzed intuitively by the authors according to the theme of Groupware integration. The parts of the interview text relevant to this theme were then contextualized to the framework of the TAM-model and social awareness (Creswell, 1998; Walcott, 1994). The resumes and conclusions were presented to and discussed with the team in a following intervention session to ensure validity (Creswell, 1998).

4. Analysis of the Integration Process of the BSCW Groupware System

In this section we use the TAM-model to analyze and describe the evolution of the integration process of BSCW in the virtual learning team over the four points in time described above – November, December, January and March. The analysis illustrates how BSCW was adopted and accepted by the virtual learning

team, and how BSCW contributed to reduce coordination efforts, achieve a mutual understanding of each other and support collaboration, thus indirectly supporting also social perspective awareness among the members of the team.

4.1 November Setting

Due to the geographic distance among Emma, Thomas and Lisa, the first workshop between the researcher and the team was conducted on a Friday evening between 6:00pm and midnight the day before a Master seminar on campus. The purpose of the workshop was for the researcher to support the team in the negotiation of both the content and the goal of the project, and to find out how the team could use the BSCW to support their collaboration.

The team negotiated the project and developed a first common understanding for the use of BSCW to support collaboration. The understanding was based on the team's earlier experience with project work, combined with examples of how to use BSCW efficiently to support the task at hand. This was then used to design the conceptual structures of BSCW e.g. which folders should be created, how they should be named, and more importantly, how the participants should use the different folders. The result of the November activity was a project contract mainly describing the overall plan for the project, and a designed BSCW workspace. The researcher also held a hands-on introduction to BSCW technical functionalities. When asked to reflect on how the distributed collaboration was perceived after this November workshop, a group member expressed it as follows:

> "I think we all had a feeling of being far more on track than the year before. It was a relief to have an overview of the project and process even though it might have been an illusion. (...) the hard thing about this part-time education is that you sometime lose feeling with the project and then something like this (BSCW) is extremely good to have."
> (Group member in January 2002)

Thus, the November introductory session on how the group could use the BSCW system to coordinate the work did induce a feeling that the BSCW system would be useful in supporting collaboration. In TAM's terms, the perceived usefulness (PU) was positive (depicted as + in Fig. 3). The group had gone through the different functions and constructed the folders agreed upon, however the question of how easy it was to use did not arise as an issue. Thus, the group's view on the EoU construct was 'missing' or neutral at this point in time (depicted as 0 in Fig. 3). Still the high PU made the Intention-to-use high, and the expectation of Actual-use was high. However, we did not know at that time whether the group would *actually use* the Groupware in the future (depicted as ? in Fig. 3).

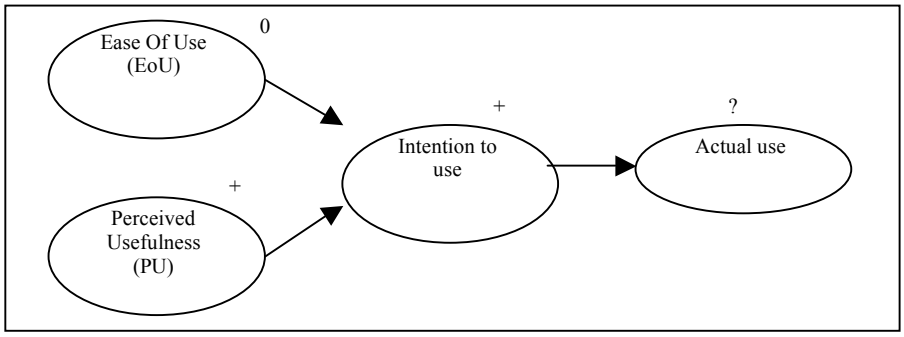


FIG. 3: NOVEMBER SETTING; BSCW USE IN TAM.

4.2 December Setting

The period from November to December was characterized by very low or almost no interaction within the group. Due to the members' daily work and family routine, the group did not have any kind of collaboration in this period. The members did logon to BSCW to 'see' if anything was happening and there were one or two small discussion-notes added but none were answered. Then between Christmas and New Year the group held a telephone-conference to "start up the communication again", as they put it. The main issue for the telephone meeting was to discuss and coordinate the production of an outline of the project to be sent to their supervisor before meeting him in January. In the telephone discussion about how to proceed to coordinate the document they decided *not* to use BSCW, but e-mail and telephone instead. When asked in January why they had decided not to use BSCW, a group member explained:

> "The thing with the BSCW is that when the working process is not continuous (...) then nothing happens (...) so it becomes like a stranger out there" *(Group member in January)*

In a part-time education program, where the participants use their free time to study, the process will never be continuous, and this makes it difficult to achieve sustained use of the Groupware technology. Analyzing the situation in December using the TAM model, the main issue emerging was the EoU (Fig. 4).

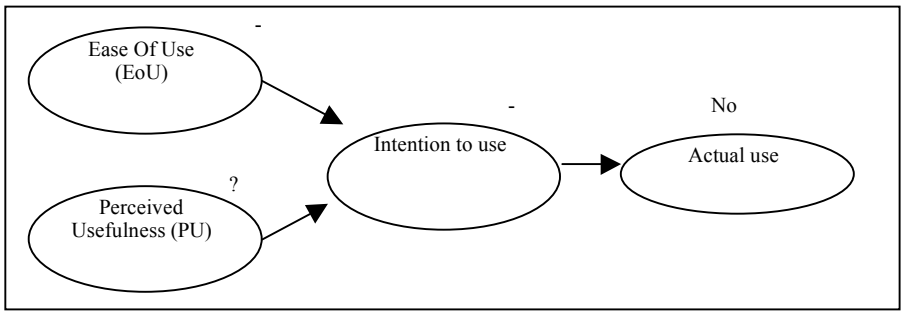


FIG. 4: DECEMBER SETTING: BSCW IN TAM.

The high expectations and Intention-to-use BSCW present in November decreased in December because the focus in this period shifted from learning how to use the technology to creating the content and coordinating the project outline to be delivered to the supervisor. The perception that BSCW would be useful in the coordination process began to be questioned (depicted by ? in Fig. 4). The group started to question *whether* BSCW actually could help them reduce the complexity of coordination, and as the EoU factor started to be problematic (depicted by - in Fig. 4), the Intention-to-use was also reduced. The result was that the group did not actually use the groupware technology between November and December, but instead chose to rely on the more familiar e-mail and telephone. When we model the use of e-mail and telephone technology using the TAM model, the scenario in Fig. 5 emerges.

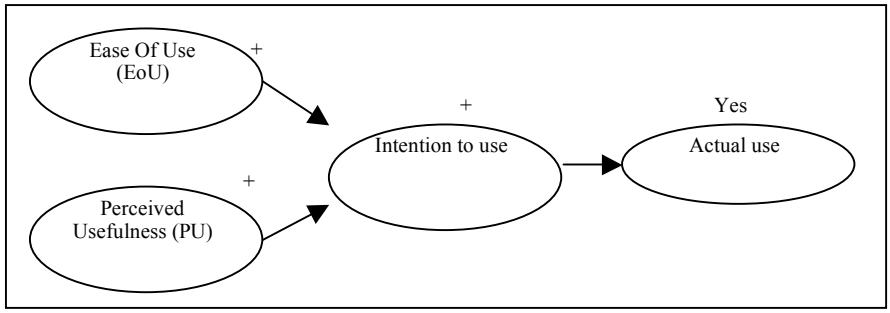


FIG. 5 DECEMBER SETTING: E-MAIL/TELEPHONE IN TAM

The EoU concerning e-mail and telephone was positive. They were both familiar technologies and used previously by the group for coordination purposes. At the same time the expectations that these familiar technologies would support coordination were high due to earlier experience. So both the PU and Intention-to-use were high, leading to the Actual-use of e-mail and telephone to coordinate the production of the project outline. Thus, the Actual-use of these technologies was achieved.

4.3 January Setting

In January a new workshop was held to evaluate the use of the Groupware system in the period from November to January. Here the group was encouraged to articulate the *actual* collaboration process as experienced from November to January. Knowing they had used e-mail and telephone to coordinate the outline, the main question was whether these "more traditional" technologies were successful in *coordinating* the document production. If they were, then the inevitable question would arise as to the need for the Groupware system. However, it transpired that the use of e-mail and telephone to support the project coordination had failed. The group did not actually realize this before the January meeting with their supervisor to whom they had already sent the document by e-mail two days before. They *thought* they had a common

understanding of the content and the process by which the document had been produced, but it was not the case. The following discussion went on in the workshop:

> Thomas: I think there is something missing here on the first few pages [pointing at a printed version of the document].
>
> Emma: Is this not the last version you sent?
>
> Thomas: No it is not.
>
> Emma: The one you sent a couple of days ago?
>
> Thomas: The one we mailed to Adam [the supervisor], the one we called version 4, the one Lisa had written on – unfortunately I don't have a printed version because my printer isn't working, but Lisa had put mine and hers together; it is about 6-7 pages long...(...) (Group discussion, January)

This discussion continued and they got more and more frustrated about the situation. They did not have a printed last version, and at the end they decided to contact the supervisor to check if he had gotten the right version. They also started discussing the e-mail coordination process, and soon realized that they did not have a common understanding of the process underpinning the situation:

> Emma: No I just had a thought, if I did get that e-mail I would have made a printed copy and taken it with me.
>
> Thomas: Well, have you then got it or what? Sometimes I have trouble with my e-mail (...)" (Group discussion in January)

By examining the situation using the TAM model, it becomes clear that the group had been incorrect in their December expectation regarding the perceived usefulness of using e-mail and telephone for coordinating the project outline and submission. The group now realized that the e-mail and telephone technology had not been adequate.

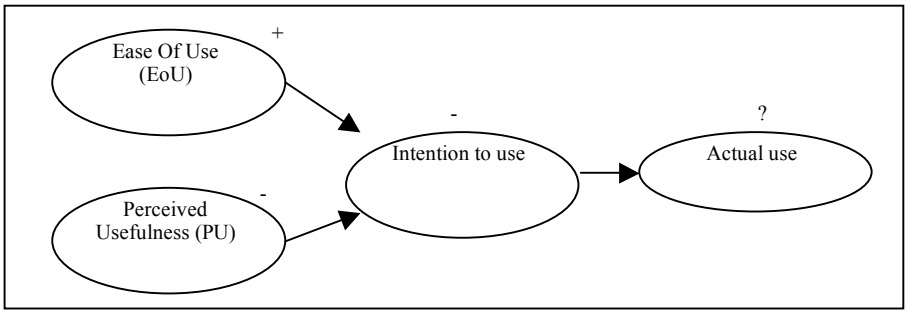


FIG. 6: JANUARY SETTING: E-MAIL/TELEPHONE IN TAM

As shown in Fig. 6, in January the PU of e-mail and telephone has been altered from positive to negative. The EoU was not changed, but the low PU affected the Intentional-use of e-mail for this kind of task. The low Intention-to-use made the Actual-use less likely. This experience affected, in turn, the use of BSCW. The PU of BSCW was restored also due to the need for 'something else.' Also, at the end of the workshop in January, a number of specific actions were taken by the researcher to help improve the EoU of the BSCW system. These actions were: 1) a

new hands-on introductory session, 2) a written description of the functionalities of the BSCW system, 3) writing up three scenarios on how to use the BSCW for coordination, 4) turning on the BSCW direct notification function which would alert group members of relevant events occurring in the system, 5) setting up a discussion forum called weekly logbook, where group members could write comments about the project, together with personal information and other issues they wished to mention.

All these actions were meant to help the group overcome the troubles they had experienced using BSCW (low EoU). The PU for the BSCW system was high due to the coordination difficulties experienced with e-mail and telephone earlier. The EoU was also high as a consequence of the new training on the BSCW technical aspects. However, the main explanation for the positive increase in EoU was the January introductory hands-on session. One of the group members expressed the EoU this way:

> "Now we need to get past these [feelings towards BSCW] and say; ok it is not that difficult and instead realize that this [BSCW] actually makes it easier to get access to each other. I think that what we need is to commit to the system." (Group member in January)

The expectation for using the BSCW for future coordination was high at the end of the January workshop. However, the group had not actually used BSCW yet.

4.4 March Setting

The situation for the group had changed in two ways in March (Fig. 7). Firstly, they had managed to integrate the BSCW in their collaboration. This was clear by the large number of actions in the system, e.g. revising the structure of folders, uploading lots of documents and leaving notes in the weekly logbook. Secondly, the group collaboration had changed; they had developed a common understanding of how the project was taking shape, and also of the process of working on the project. The overall purpose of introducing BSCW was to reduce the effort required for coordination.

The group had managed to coordinate different documents while still keeping track of changes and versions. However, it emerged during the March workshop that the most interesting part of using BSCW was the weekly logbook. The weekly logbook had been originally established to encourage regular use of BSCW in the group to increase the EoU. However reflecting back on the situation in the March meeting, the group realized that they had expressed a need for 'something' not only related to the coordination of documents already in January.

> "(...) in the period [November to January] I needed to know how you were doing and so... or up to this seminar, how will we get the things we need to do done... I would have liked that kind of communication." (Group member in January)

The need being expressed here was awareness. In co-located teams the daily small interaction around the coffee-machine or water-cooler helps members to get a sense of each other. Lack of such information in virtual teams can affect group morale due to the possibility of misunderstandings and misinterpretations. When other group members are out-of-sight, this may be misinterpreted as inactive and unproductive. The group expressed a need for awareness related to the task they were doing, but also something more – the need for social awareness. In March a positive side effect of the integration of BSCW emerged. The use of BSCW and more specifically, the use of the weekly logbook had supported the need for social perspective awareness. The Groupware technology had affected the social setting of the virtual team.

> Lisa: I think this weekly logbook has been very good, because I have had a good sense of where you all have been – especially you Thomas, who have written all about your illness.
>
> Emma: It makes it much more captivating to go in and read stuff like this too.
>
> Thomas: Yes (...) because it gives you a good feeling of what is going on. (...) The constant response. It is especially good in these kinds of distance projects.
>
> Lisa: Sometime you get hung up with work and lose contact with the project...
>
> Emma: (...) you know you have it all in BSCW (...) it gives you a sense, psychologically, that there is a project forming." (Group discussion in March)

The use of the weekly logbook had given the group a sense of awareness both in the task-oriented and social-oriented sense. The logbook content provided extra information e.g. about interviews that had been conducted and about members' health and family situation. The group members pointed out how useful the first was for example in later analysis of the transcriptions. The weekly logbook had been also a useful way to have 'casual social encounters' in an asynchronous way, simultaneously hosting coordination activities such as planning and task location. One example was the cancellation between January and March of a telephone meeting, which had been planned during the workshop in January in favor of BSCW use. When asked why, they explained that it was too expensive. The cost of a telephone meeting had not been an issue between Christmas and New Year because they needed it for coordination, but after BSCW integration in their work, the perceived need for the telephone was reduced.

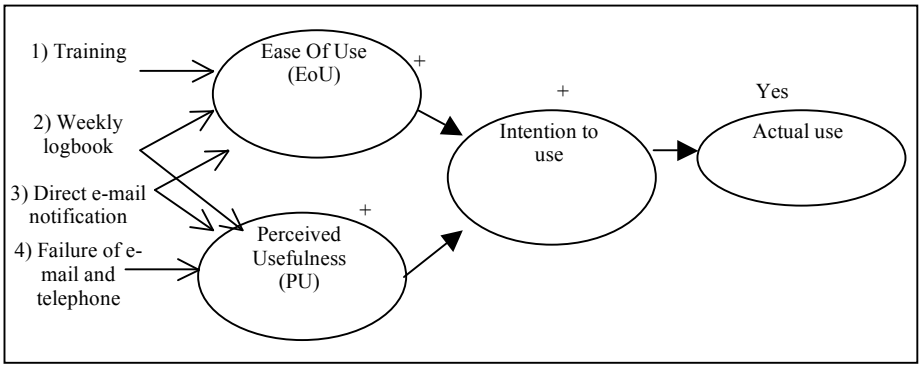


FIG. 7: MARCH SETTING: BSCW IN TAM.

The weekly logbook in combination with the direct notification feature supported social awareness, both in an active and a passive manner (Steinfield et al., 1999). The passive manner was due to BSCW direct notification feature, turned on in the January workshop. This meant that each time a member wrote, revised or moved objects within the system, an automatic e-mail was sent to all members informing them of the activity. Each member could therefore monitor when others had made a contribution in the weekly logbook. The active way was due to the fact that to actually read the content of the contributions, the members needed to logon to BSCW and actively click on the weekly logbook. As a result the weekly logbook had a huge impact on the EoU, because it caused the participants to use the system functionality regularly.

The weekly logbook facilitated spontaneous and informal interaction by being a free-form discussion forum, with no prescription as to usage or content. Still the participants needed to actively provide the awareness data (writing notes), which requires a deliberate and obtrusive strategy, as opposed to a situation where the data might be automatically generated. This aspect could have caused distraction and the related extra effort might cause resistance and non-acceptance of the technology. This was not the case. *If* the weekly logbook were perceived as a lot of extra work without relevance, the group would have perceived it as a distraction leading to decreased PU. It was very evident in March, instead, that the group had successfully integrated the BSCW technology to achieve the necessary collaboration.

5. Discussion

So, what does our analysis using the TAM-model tell us about the integration process of Groupware in virtual teams in the Master of Adult Education? To summarize, in November we learned that highly PU did have a big impact on the Intentional-use and that the EoU was not even an issue. The data suggest that in the case of Groupware technology, high PU can supercede the importance of EoU, resulting in high *Intentional*-use. It was however not our goal to test,

evaluate or change the TAM-model – and further elaboration in this direction would require more data.

However, we have learned in December that when it comes to the *Actual-use*, the EoU influence is vital. In fact, the conditions had changed in December due to little interaction and deadline pressure, which made EoU for BSCW more important than in November. This led to no Actual-use of BSCW, but to the use of the more familiar technologies instead: e-mail and telephone. Therefore we can conclude that the influence of both EoU and PU is present and important in the integration of Groupware technology in virtual learning teams.

During the January workshop the conditions for using BSCW to support the collaboration changed dramatically. It had become apparent to the group members that the December perceived usefulness of e-mail and telephone had not materialized. Instead, the new initiatives such as training, direct e-mail notification and weekly logbook had increased the EoU *and* PU of BSCW, even though the initial aim was only to increase EoU. The changed conditions of EoU and PU influenced the Intentional-use, and in March this led to Actual-use of BSCW. We had expected that the weekly logbook would increase only the EoU, instead we found out that the logbook also had increased the PU. Surprisingly the weekly logbook had supported a need for social interaction within the virtual learning team. Due to the large physical distance between the members, the group had a need to know about each other' intentions and actions, not only in relation to work but also in their social life. This need we have identified as social perspective awareness. The social awareness was supported by the weekly logbook within BSCW, and the use of the weekly logbook substantially contributed to BSCWs acceptance by the group. This in turn led to the integration of BSCW in the collaborative practice of the virtual team.

6. Conclusions, Limitations and Suggestions for Further Research

The overall research question in this study was: What are the factors influencing the integration process of Groupware technology in virtual learning teams in part-time adult education? On the basis of an in-depth action research study (Mathiassen, 1998; 2002) conducted in a Problem Oriented Project Pedagogy Master Program at Roskilde University, Denmark, we got rich data describing the integration process of BSCW in a virtual learning team consisting of three students. We used the TAM-model to describe and analyze the data collected in four key checkpoints and found it useful in the description of successes and failures during the integration process of Groupware.

We can conclude that the TAM model can be used in a qualitative way to analyze and interpret technology acceptance. Furthermore in the specific setting

of Groupware integration in virtual learning teams, we can conclude that both EoU and PU are important for the Intention-to-use and the Actual-use. We also found that social perspective awareness influenced the PU, which affected the Groupware integration in a positive way. Therefore we can conclude that one important factor influencing the integration process of Groupware technology in part-time adult education is: How the technology can provide support for social perspective awareness, which can in turn influence the PU of the technology.

The limitation of the study presented in this paper arises mainly in two aspects. Firstly the empirical work was collected with a virtual team consisting of students and thus it is somewhat questionable as to whether social awareness would have the same importance in virtual teams in business environments. However, even though it was not our goal to generalize our findings from an educational setting to a business setting, we expect social perspective awareness to be important within virtual teams in a business context as well, at least in relation to project coordination and document handling. We would propose that future research – qualitative as well as quantitative – should be done in business settings to test our results. The second limitation of the study lies in that, we on the one hand use the TAM-model in a total new setting (groupware, qualitative study, different goal) and on the other hand the study does provide some evidence to question the model's use in this setting (e.g. the causal relation between EoU and PU). Thus, we can conclude that the results of the study do not fully support the model, and this could be used to generate a new and revised TAM-model to be used in this setting. This is however beyond the goal of this paper. Here the main purpose was to use the TAM-model in a descriptive way when investigating the integration process, rather than trying to question its explanatory effect. To conclude we propose to use the TAM-model in qualitative studies in future research investigating Groupware integration in virtual learning teams. Also, we suggest that such investigation should focus on conditions influencing both EoU and PU in an integrated manner in the search for how to successfully integrate Groupware, and especially explore the role of social awareness in the integration of Groupware technology to support collaboration.

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References

Adams, D, Nelson, R. and Todd, P. (1992): Perceived usefulness, perceived ease of use and user acceptance of information technology: a replication, *MIS Quarterly*, (16, 2), July, 1992, pp. 227-247.

Alexander, P.M. (2002): Teamwork, Time, Trust and Information, in Proceedings of SAICSIT 2002. pp 65-74.

Avison, David; Francis Lau, Michael Myers and Peter Axel Nielsen: Action Research, in Communication of the ACM, January 1999, Vol. 42, No. 1

Bentley, R. T., T. Horstmann, and J. Trevor: The World Wide Web as enabling technology for CSCW: The case of BSCW, Computer Supported Cooperative Work: The Journal of Computer-Supported Cooperative Work, vol. 6, no. 2-3, Kluwer Academic Publishers, 1997, pp. 111-134

Bjørn, P. (2003): Re-Negotiating Protocols: A Way To Integrate GroupWare in Collaborative Learning Settings, Proceedings of European Conference in Information Systems (ECIS), Naples, 2003.

Bødker, K., Kensing, F. and Simonsen, J. (2003): Professional IT design – the foundation for sustainable IT usage, Forthcoming MIT Press.

Braa, K. and Vidgen, R. (2000): Research – From observation to intervention, Ch. 12 in Planet Internet. K. Braa, C. Sørensen, B. Dahlbom (eds.), Studentlitteratur, Lund, Sweden.

Carstensen, P. and Sørensen, C. (1996): From the social to the systematic: Mechanisms supporting coordination in design, Computer Supported Cooperative Work, The Journal of Collaborative Computing, vol. 5, no. 4, 1996, pp. 387-413.

Checkland, P. and Scholes, J. (1990): Soft Systems Methodology in Action, Chichester, West Sussex, UK, 1990.

Cheesman, Robin og Simon B. Heilesen: Supporting Problem-based Learning in Groups in a Net Enviroment, In Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference, C. Hoadly & J. Roschelle (Eds.) Dec. 12-15, Standford University, Palo Alto, California. Mahwah, NJ: Lawrence Erlbaum Associates.

Creswell, J.W. (1998), *Qualitative Inquiry and Research Design*, Sage Publications.

Davis, F. (1989): Perceived usefulness, perceived ease of use and user acceptance of information technology, *MIS Quarterly*, (13, 3), September, 1989, pp. 319-340.

Davis, F., Bagozzi, R. and Warshaw, P. (1989) User acceptance of computer technology: comparison of two theoretical models, *Management Science*, (35, 6), August 1989, pp. 982-1003.

Davison, R., Qureshi, S., Vreede, G-J. d., Vogel, D. and Jones, N.: Group Support Systems through the Lens of Action Research: Cases in Organizations, Journal of Global IT Management, 3, 4, 6-23, 2000.

Dirckinck-Holmfeld, Lone og Elsebeth K. Sorensen: Distributed Computer Supported Collaborative Learning through shared Practice and Social Participation, In Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference, C. Hoadly & J. Roschelle (Eds.) Dec. 12-15, Standford University, Palo Alto, California. Mahwah, NJ: Lawrence Erlbaum Associates.

Donnellan, B. (2003) Knowledge Management Systems Implementation to Support New Product Development, Unpublished Phd Dissertation, University of Limerick.

Dourish, Paul and Bly, Sara (1992): Portholes: Supporting Awareness in a Distributed Work Group, In P. Bauersfeld, J. Bennet and G. Lynch (eds.): CHI'92 Conference Proceedings: ACM Conference on human factors in computing systems, 3-7 May 1992, Montercy, California, New York: ACM press. pp. 541-577.

Gefen D., Karahanna, E. and D.W. Straub (2003): Trust and TAM in online shopping: An integrated model, MIS Quarterly 27, No. 1, pp 51-90.

Grinter, R. E. and Eldridge, M. A. (2001): y do tngrs luv 2 txt msg?, In Proceedings of the Seventh European Conference on Computer-Supported Cooperative Work, 16-20 September 2001, Bonn, Germany, pp. 219-238, Kluwer Academic Publishers, Netherlands, 2001

Grudin, J. (1994): Groupware and social dynamics: Eight challenges for developers, Communication of the ACM, Vol. 37, No. 1, 1994, pp. 92-105

Jarvenpaa, Sirkka L.; Knoll, Kathleen and Leidner, Dorothy E. (1998): Is Anybody Out There? Antecedents of Trust in Global Virtual Teams, Journal of Management Information Systems; Spring 1998; 14, 4; ABI/INFORM Global pg. 29

Karsten, H.: Collaboration and Collaborative Information Technologies: A Review of the Evidens, The DATA BASE for advances in Information Systems, Vol. 30, No. 2, 1999.

Kayworth T. R., and Leidner, D.E. (2002): Leadership Effectiveness in Global Virtual Teams, Journal of Management Information Systems, Winther 2001-2002, Vol. 18, No. 3, pp 7-40.

Koufaris, M. (2002): Applying the Technology Acceptance Model and Flow Theory to Online Consumer Behavior, Information Systems Research, Vol. 13, No. 2, pp. 205-223.

Kvale, S. (1996): InterViews: An introduction to qualitative research interviewing. Thousand Oaks, Ca.: Sage, 1996.

Kwon, H.S., Chidambaram, L. (2000): A Test of Technology Acceptance Model, The Case of Cellular Telephone Adoption, Proceedings of the 33rd Hawaii International Conference on System Sciences, IEEE Computer Society.

Lederer, A.L., Maupin, D.J., Sena, M.P., Zhuang, Y.(2000): The Technology Acceptance Model and the World Wide Web, Decision Support Systems, Vol. 29, No. 3, pp. 269-282.

Legris, P., Ingham, J. and Collerette P. (2003): Why do people use information technology? A critical review of the technology acceptance model, Information & Management 40 (2003), pp 191-204

Majchrazak, A., Rice, D.E., Malhotra, A., King, N.: Technology Adaptation: The case of a Computer-Supported Inter-organizational Virtual Team, MIS Quarterly, Vol. 24, No. 4, pp. 569-600, 2000.

Massey, A.P., Hung, Y.C., Montoya-Weiss, M., and Ramesh, V. (2001): When Culture and Style Aren't About Clothes: Perceptions of Task-Technology "Fit" in Global Virtual Teams, Proceedings of the 2001 – International ACM SIGGROUP Conference on Supporting Group Wokr – vol. 2001.

Mathiassen, Lars: Collaborative Practice Research, in Scandinavian Journal of Information Systems – Vol. 14, 2002; pp. 57-76.

Mathiassen, Lars: Reflective Systems Development, in Scandinavian Journal of Information Systems - Vol. 10, No. 1&2, 1998; pp. 67-134.

Maznevski, M.L. and Chudoba, K.M. (2000): Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness, Organization Science, Vol. 11, no. 5, September-October 2000, pp. 473-492.

Neville, K. and Fitzgerald, B. (2002): An Innovative Training Model for an Organization Embracing Technology, *Journal of IT Education*, Vol.1, No. 3.

Olesen, H.S. and Jensen, J.H. (1999): Project Studies – A late modern university reform?, Roskilde University Press, 1999.

Orlikowski, Wanda J.: Learning from NOTES: Organizational Issues in Groupware Implementation, in J. Turner and R. Kraut (eds.): CSCW '92. Proceedings of the Conference on Computer-Supported Cooperative Work, Toronto, Canada, 31. October - 4. November 1992, ACM Press, New York, 1992, pp. 362-369.

Paré, G. and Dubé, L. (1999): Virtual Teams: An exploratory study of key challenges and strategies. Proceedings of the 20th International conference on Information Systems, January 1999.

Pavlou, P.A. (2001) Consumer Intentions to Adopt Electronic Commerce-Incorporating Trust and Risk in the Technology Acceptance Model, Paper Presented at DIGIT Workshop, December, http://www.mis.temple.edu/digit, accessed the 4th February, 2003.

Perakyla, A. (1997), Reliability and Validity in Research Based on Transcripts, in *Qualitative Research,* Ed. Silverman D., Sage Publications, pp. 201-220.

Piccoli, G. and Ives, B. (2000): Virtual Teams: Managerial Behavior Control's impact on Team Effectiveness, International Conference on Information Systems. Proceedings of the 21 ICIS, Brisbane, Queensland, Australia, pp. 575-580.

Prinz, W. (1999): NESSIE: An Awareness Environment for Cooperative Settings, GMD-FIT, Germany, Proceedings of the Sixth European conference on Computer supported cooperative work, 1999, Copenhagen, Denmark, Kluwer Academic Publishers Norwell, MA, USA, 1999

Schmidt, K. (2002): The Problem with 'Awareness' – Introductory Remarks on 'Awareness in CSCW', Computer Supported Cooperative Work. *The Journal of Collaborative Computing*, vol. 11, 2002, pp. 285-298.

Schmidt, K. and Simone, C. (1996): Coordination mechanisms: Towards a conceptual foundation of CSCW system design, Computer Supported Cooperative Work. *The Journal of Collaborative Computing*, vol. 5, no. 2-3, 1996, pp. 155-200

Simonsen, J. and Kensing, F. (1997): Using Ethnography in Contextual design, Communication of the ACM, Volume 40, Issue 7, pp. 82-88.

Steinfield, C., Jang, C. and Pfaff, B. (1999): Supporting Virtual Team Collaboration: The TeamSCOPE System, Group 99, Phoenix Arizona USA, ACM 1999 - 1-58113-065-1/99/11

Tollmar, K., Sandor, O., and Schomer, A. (1996): Supporting social awareness @Work: Design and experience, in Proceedings of CSCW '96, Cambridge MA, November 1996, ACM Press, pp. 298-307

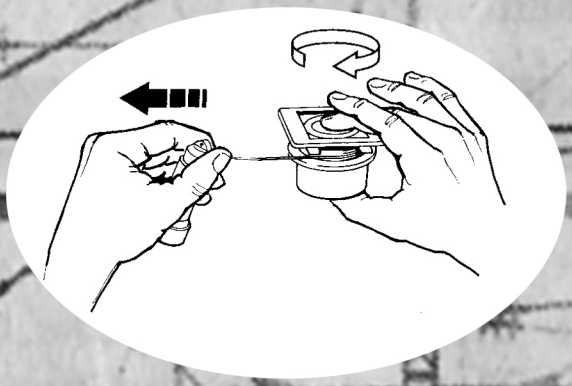
Venkatesh, V. (2000): Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion Into The Technology Acceptance Model, *Information Systems Research*, Vol. 11, Issue 4, p. 342-366.

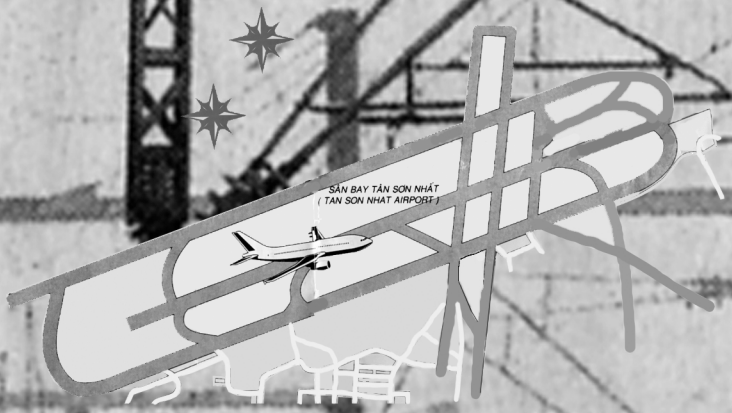
Venkatesh, V., Davis F. (2000): A Theoretical Extension of The Technology Acceptance Model: Four Longitudinal Field Studies, *Management Science*, Vol. 46, No. 2, pp. 186-205.

Vidgen, R. and Braa, K. (1997): Balancing Interpretation and Intervention in Information System Research: The Action Case Approach. In Lee, A.S., Liebenau, J., and DeGross, J.I. (Eds.) (1997): Information Systems and Qualitative Research, London: Chapman & Hall.

Walcott, H.F. (1994), *Transforming Qualitative Data: Description, Analysis and Interpretation,* Thousand Oaks, Sage.

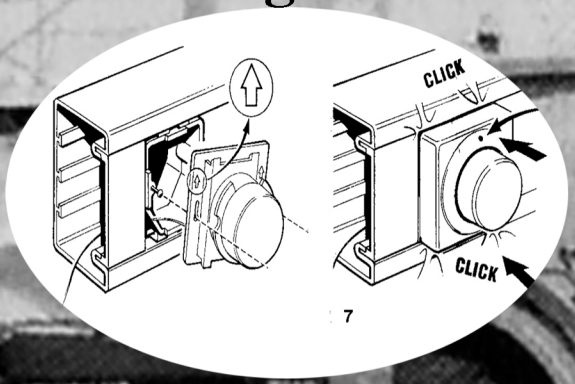
Yager, S.E. (1999): Using Information Technology in a Virtual Work World: Characteristics of Collaborative Workers, SIGCPR '99, New Orleans, LA, USA. Copyright ACM.





Expanding Technological Frames Towards Mediated Collaboration

Groupware Adoption in Virtual Learning Teams



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Expanding Technological Frames Towards Mediated Collaboration

Groupware Adoption in Virtual Learning Teams

Pernille Bjørn
Roskilde University, Denmark
pbr@ruc.dk

Ada Scupola
Roskilde University, Denmark
ada@ruc.dk

Brian Fitzgerald
University of Limerick, Ireland
bf@ul.ie

Abstract: This paper provides an in-depth analysis of the technological and social factors that led to the successful adoption of groupware by a virtual team in a educational setting. Drawing on a theoretical framework based on the concept of technological frames, we conducted an action research study to analyse the chronological sequence of events in groupware adoption. We argue that groupware adoption can be conceptualised as a three-step process of expanding and aligning individual technological frames towards groupware. The first step comprises activities that bring knowledge of new technological opportunities to the participants. The second step involves facilitating the participants to articulate and evaluate their work practices and their use of technology. The third and final step deals with the participants' commitment to, and practical enactment of, groupware technology. The alignment of individual technological frames requires the articulation and re-evaluation of experience with collaborative practice and with the use of technology. One of the key findings is that this activity cannot take place at the outset of groupware adoption.

1. Introduction

When adults return to universities for vocational education, they often find that the other students are based in different physical locations. This complicates collaborative learning. Groupware technology can, however, promote collaboration in such situations and is especially relevant for education programmes that involve project work by geographically dispersed groups (Dirckinck-Holmfelt and Sorensen, 1999; Cheesman and Heilesen, 1999). Current research on teamwork in geographically distributed situations, referred to as virtual teams, have investigated important aspects such as trust, mutual knowledge, culture, media-stickiness, and time (Cramton, 2001; Maznevski and Chudoba, 2000; Huysman et al, 2003; Jarvenpaa, Knoll, and Leidner, 1998; Massey et al, 2001). In addition, researchers generally agree that technology plays an important role for the success of virtual teams (eg. O'Connor et al, 1993; Hollingshead et al, 1993). In particular, research on the adoption of groupware technology shows that appropriate guidance on the adoption processes is crucial to achieve continuing use of groupware (Karsten, 1999; Orlikowski, 1992; Grudin, 1994). Some research (eg. Majchrazak et al, 2000) has addressed the actual adoption process of the technology by virtual teams, but few projects have been undertaken in this area to date.

The purpose of this paper is to complement this research by presenting the results of an action research project that guided the adoption of groupware by a virtual team of adult students in a part-time vocational education programme. It draws on Orlikowski and Gash's (1994) concept of the technological frame. We investigate changes in the technological frames of key actors during two cycles of the groupware adoption process. Technological frames comprise peoples' interpretations of a particular technology related to its nature, strategies and use. Because the functionality embedded in specific applications influences technological frames, it is important to investigate technological factors. In addition, frames are affected by the engagement of people in social settings. It is therefore important that we also investigate the social factors that influence technological frames. Thus, our research question is: What technological and social factors influence the changes in virtual team members' technological frames towards adopting groupware?

To answer this question, we analyse a series of events that aligned practice and technology in a groupware adoption process. Specifically, we analyse how students change, expand and align their shared technological frames. By proposing that groupware adoption can be conceptualised as the expansion and alignment of technological frames, we argue that groupware adoption is a three-step process. The first step provides knowledge of new technological opportunities to the participants. The second step involves guidance so that they can articulate and re-evaluate their concrete work practices and technology use.

The third step addresses the participants' commitment to groupware and their practical usage of a system. We also identify technological and social factors that influence successful groupware adoption.

This paper is structured as follows. Following this introduction, section 2 presents related research on groupware adoption. The theoretical framework of technological frames is then presented in section 3, followed in section 4 by descriptions of the empirical case study and the groupware technology. Section 5 introduces the action research approach, including descriptions of the data sources and how the data was analysed. Section 6 provides an empirical analysis, related to the theoretical framework of technological frames. This is followed in section 7 by a discussion of the technological and social factors that influenced the expansion of technological frames in the case study. Section 8 examines the implications for research and practice, concluding with a proposal for a three-step model of technological frame expansion.

2. Related Work: Groupware Adoption

To understand the adoption of complex technologies such as groupware we need to understand the realities of introducing technology at group level in specific organisational settings (Gallivan, 2001). Groupware adoption is here viewed as a set of ongoing processes that align practice and technology so that they complement each other (Majchrazak et al, 2000). Majchrazak et al (2000) argue that virtual teams may initially experience misalignment among pre-existing group practices and technology. In their study, the team first tried to resolve this misalignment by modifying the group practices while leaving the technology unchanged. However, the team experienced a series of events that caused them to re-evaluate this approach. They made further modifications to both the group practices and the technology structures. In the end these took on forms that were different from the pre-existing and the initial ones (Majchrazak et al, 2000). Groupware demands more effort and commitment from the people adopting the system than single-user systems (Grudin, 1994). However, we still lack an in-depth understanding of which kinds of activities and factors actually foster the essential commitment of team members. Research on the organisational issues related to groupware adoption is therefore required to improve the adoption processes. Moreover, it has been found that successful groupware adoption depends on how well the technology is embedded in the local context, including local work practices. Adjustments to the technology thus play a key role in groupware adoption (Karsten, 1999).

Users' capabilities to engage in successful groupware adoption are found to depend upon whether the users have a common ground and are ready to appropriate collaborative technologies (Olson and Olson, 2000). This suggests that successful adoption depends on the users and their abilities to meet new

challenges. Additionally, research in large organisations has found that the ability of users to communicate and to transform technology across different social worlds drives groupware adoption (Mark and Poltrock, 2003). We do not yet know the factors that support the readiness of users for collaborative technologies. Nor do we know the factors that support users in the transformation of technology across social worlds. However, it has been suggested that users' capabilities to adopt groupware increase when they are given a clear understanding at the beginning of the adoption process of how the technological features are used in mature installations. Making sure that problems experienced early on are dealt with quickly prevents premature rejection (Grudin, 1994). The initial stage of adoption is especially important, as actions taken immediately after the initial introduction and installation have been found to determine the path of technology use in the long run, while unproductive behavioural patterns concerning technology have been found difficult to change (Tyre and Orlikowski, 1994; Huysman et al. 2003).

In summary, researchers generally agree that groupware adoption processes are influenced by both technological and social factors. Nevertheless we still need to identify these factors. In this paper we extend and supplement the current research by investigating and identifying technological and social factors that support groupware use. Thus we seek to improve the basic conditions for collaboration among geographically dispersed participants.

3 Theoretical Framework: Technological Frames

To understand users' capabilities and perspectives with respect to technology we apply the concept of the technological frame. People's frames of reference, or mental models about their work and technology, influence groupware adoption greatly (Orlikowski, 1992). A mental model comprises the individual frame of reference, as in how participants view their work, the organisation and the technology. Orlikowski (1992) finds that groupware adoption is most likely to fail in the absence of mental models that appreciate its collaborative nature. Orlikowski further suggests that prospective users must have an appropriate understanding of the technology and their technological frames should reflect a perception of groupware as a collective rather than a personal tool (Orlikowski, 1992, p. 386). All actions of individuals, including groupware adoption, are socially oriented and take place within a predefined social context (Lyytinen and Ngwenyama, 1992). The social context of a team in, for example, education is a conglomeration of pieces that people bring from various social contexts in which they exist simultaneously, such as family and work contexts. How people perceive technology depends upon the particular social context in which the technology should be applied. The social context provides a repository of rules and resources that enable participants to make sense of each other's actions,

including the use of technology. These allow them to interpret collective activities while adjusting their own work accordingly (Ngwenyama and Klein, 1994). The members of a social group have individual interpretations, but they also possess a set of common core beliefs. Shared frames of reference in relation to technology within a specific social group comprise similar assumptions, knowledge and expectations on the role and nature of the technology. This includes specific conditions and consequences in a particular shared social context. Technological frames comprise the individuals' perceptions of technology. Shared technological frames emerge from an alignment process that results in a congruence of the individual technological frames on key elements and categories (Orlikowski and Gash, 1994). Congruence means that structure and content are related, but not identical. Groupware adoption involves an alignment of the individuals' technology frames to create congruence, while expanding the shared frame to include new technological opportunities. Congruence is in this way similar to the concept of ecology, as suggested by Star and Ruhleder (1996) with reference to the delicate balance (or lack of balance) between language and practice. Groupware adoption requires a balance between the way that participants perceive and articulate their technology-mediated collaborative practice and their practical implementation of collaboration and technology use.

The adoption of groupware is a process that aligns technology with work practice and results in a new or transformed practice (Berg, 1998). Transforming practice should be guided by in-depth understandings of actual situated practices, rather than on plans describing practices because situated practices are influenced by but not equal to plans (Suchman, 1983: Suchman, 1987). Further, Robinson (1991) gives evidence that the provision of new computer-supported opportunities and capabilities is likely to be appreciated by the users. Prior to adoption, however, it is difficult, if not impossible, to identify the new capabilities that groupware will provide. Technology transforms practice in unanticipated ways, sometimes resulting in unintended social effects (Berg, 1998). When a group appropriates a complex technology, the extent to which it is used can be much wider than it was designed to support (DeSanctis and Pool, 1994; Kiesler, 1986). The criteria for successful groupware adoption is thus that both technology and practice transform each other so that participants not only have the possibility of sharing and archiving documents in a common repository, but also that participants actively construct shared meanings of the shared objects and folder-structures through negotiations to be able to interpret the shared information items. Groupware should become a common information space (Hertzum, 1999).

Orlikowski and Gash (1994) suggest three domains that characterise the technological frames of participants: the nature of technology, technology strategies and technology-in-use. The nature of technology domain comprises

peoples' understanding of the capabilities and functions of the technology. Technology strategies comprise peoples' understanding of the motivation behind the decision to adopt it. Finally technology-in-use comprises peoples' understanding of how to use the technology on a day-to-day basis and the consequences associated with such use (Orlikowski and Gash, 1994, p. 183).

Since frames of reference are individually held, they form schemes constructed upon the individuals' existence in various social contexts such as education, family and work. This means that factors outside the social context of education influence the expansion of individually held technological frames. In this paper, however, we focus on factors that influence the expansion of technological frames in relation to collaborative work in education. While we acknowledge the influence of factors from other social contexts on the adoption of groupware, we are emphasising factors that are directly located within the social context of education. We do not claim to have identified the complete set of factors that influence technological frame expansion, but we argue that we have identified a number of important factors that influence the expansion of technological frames in the social context of education.

In this paper we propose a conceptualisation of groupware adoption as the expansion and alignment of individual technological frames to include groupware. This concept provides for all three of the domains suggested by Orlikowski and Gash (1994). Expanding and aligning participants' shared knowledge of new technological opportunities includes gaining an understanding of the functionality of groupware. This takes the nature of technology domain into consideration. The functionality should be connected to the usefulness and motivation for adopting groupware in the specific setting. This takes account of the technology strategies domain. Furthermore, the participants should develop an understanding of the consequences of groupware use, combined with an ability to articulate unanticipated consequences. This gives attention to the technology-in-use domain. We can thus examine the technological frames of key actors related to the three domains. The sets of actors in the empirical study presented by this paper are teachers, students and the action researcher. We include the action researcher as a key actor, because this individual's technological frames influenced the groupware adoption process and the technological frame expansion of other participants.

The table below shows the theoretical framework that is used to analyse the empirical observations in this paper. It charts the three sets of actors in the groupware adoption process (teachers, students and the action researcher) against the technological frames related to the three domains (nature of technology, technological strategies and technology-in-use). We use this model to represent different stages of technological frame expansion during the case study.

	Teachers	Students	Action researcher
Nature of technology	What functionality and capabilities are embedded in the technology?	What functionality and capabilities are embedded in the technology?	What functionality and capabilities are embedded in the technology?
Technology strategies	What are the reasons and motivation for using groupware?	What are the reasons and motivation for using groupware?	What are the reasons and motivation for using groupware?
Technology-in-use	How should groupware be used in practice and by whom?	How should groupware be used in practice and by whom?	How should groupware be used in practice and by whom?

TABLE 1: TECHNOLOGICAL FRAMES OF KEY ACTORS

4. The Empirical Research

4.1 Case Study Setting

The empirical investigation was conducted in a part-time master's degree programme (the Master of Adult Education at Roskilde University in Denmark), where groupware adoption by a virtual learning team was closely studied. The master program is a three-year, part-time university education for people who are active in the labour market. Students need to hold a bachelor's degree and to have at least two years of job experience to be accepted. Because it is a part-time programme, each semester is stretched over a whole year from September to June. Students are required to attend five weekend seminars on campus in September, November, January, March and April. Over 50% of the programme is based on problem-oriented project work (Dirckinck-Holmfeld, 2002; Olsen and Pedersen, 2005). Students are given a research question to investigate. They locate relevant literature, conduct empirical work and finally they co-author a project report.

The master's degree programme has a long tradition in vocational teaching for adults, but has no tradition in technology use for teaching or for collaboration among the students. In 2001, however, the teachers decided that they would like to employ technology in the new millennium, especially to support collaboration among the students in the intervals between the campus seminars. The teachers had no particular ideas which kind of technology to use, by whom or for what purpose.

The project team investigated here consisted of three students in their mid-thirties: Emma, Thomas and Lisa. All were in full-time employment and their study times were restricted to weekends and evenings. The three lived far apart and had few opportunities to meet face-to-face, apart from the five campus

seminars. Because the team members had different working hours, most of their collaboration was asynchronous. Initially all three members of this group had email and phone experience, but no knowledge about groupware. This research was conducted during their final year in the master's programme.

The following table summarises the technological frames of the key actors at the initial stage of the action research project.

	Teachers	Students	Action researcher
Nature of technology	Had not really considered the nature of the technology.	Had experience of group work supported by email and phone, but no knowledge of groupware technology.	Groupware that supports collaboration in project groups in education needs functions such as coordination, shared archive, version control and negotiations.
Technology strategies	Other master's degree programmes have successfully employed technology. Technology could support students in collaboration between campus seminars.	Experienced communication and coordination difficulties in earlier projects. Groupware might resolve some of these issues.	Geographically distributed groups have difficulties collaborating. Groupware can provide opportunities for collaboration, reducing time for coordination, while increasing time for learning and negotiation.
Technology-in-use	Not really an issue. Teachers see themselves providing the technology. Then it is up to the students to employ it for their own benefit.	No idea.	The group should be assisted to negotiate common working procedures for groupware, including how, why and when to use it in specific situations related to their project.

TABLE 2: INITIAL TECHNOLOGICAL FRAMES OF KEY ACTORS

4.2 Groupware Technology

The groupware application used in this investigation was Basic Support for Cooperative Work (BSCW, further details at bscw.gmd.de), one of the most well known CSCW (Computer-Supported Cooperative Work) systems in the academic world (Bentley et al, 1997).

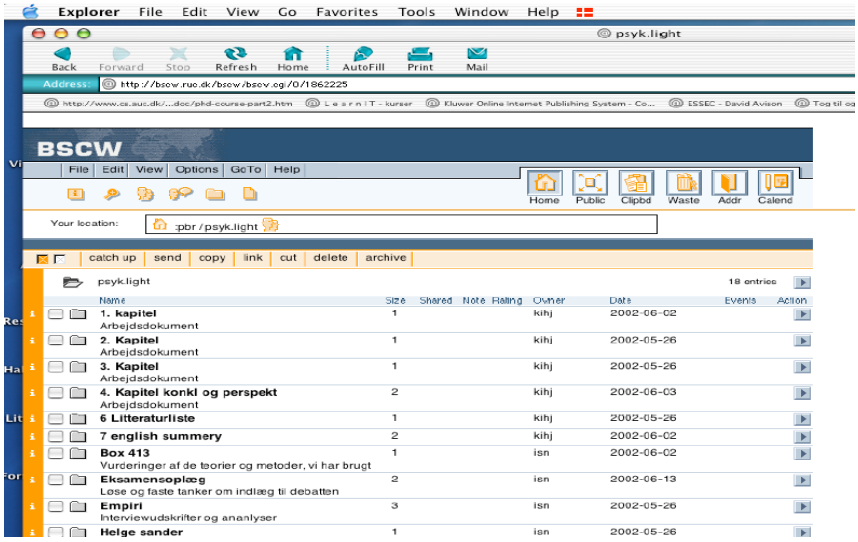


Figure 1: Screen shot of the folder structure at BSCW

The BSCW system is a web-based CSCW system, which supports file management, asynchronous and synchronous dialogues, the management of URLs and calendar functions. The BSCW system also supports different awareness functions, such as monitoring which documents, folders and notes are new, read, revised or moved. Automatic email notifications can be generated when specified events occur within the system. The BSCW's broad functionality and versatility allow users to adjust the conceptual structures, making it a strong tool for collaboration and coordination.

The group in this investigation accessed BSCW through stationary computers. These were located either in their homes, where they accessed the system over dial-up connections, or on campus, where broadband connections were provided.

5. The Action Research Approach

Research on the adoption and use of groupware in 'experimental settings' has produced confusing and inconsistent results, because it is impossible to simulate real-life collaboration (Davison et al, 1998). Instead, Davison et al. (1998) propose using action research to fully capture the complexity of groupware use and collaboration. With this approach it becomes possible for the researcher to become actively engaged in the practical adoption process. The researcher can intervene and positively influence the process, providing theoretical reflections that are grounded in planned activities. This increases of chances of identifying relevant new issues for groupware adoption.

The use of action research is well established in the information systems community (eg. Mathiassen 1998, 2002; Avison, Lau, Myers & Nielsen 1999; Vidgen and Braa, 1997; Braa and Vidgen, 2000; Donnellan, 2003), where it combines theory and practice through change and reflection in a problematic real-life situation. Action research involves iterative cycles of activities: identifying problems, planning interventions, executing the actions, observing the outcome and reflecting upon the result, while collecting data about the situation and actions (Davison, 2001). Different action researchers describe different cyclical processes, but the fundamental elements and issues are similar (eg. Susman and Evered, 1978; Davison et al, 2004; Checkland and Holwell, 1998: Baskerville and Wood-Harper, 1996). The action cycles in this study follow the approach presented by Davison (2001): problem diagnosis, action planning, action execution, observation and reflection.

The action research project presented in this paper involves an in-depth investigation of how the groupware application BSCW was adopted by a geographically dispersed project group. As previously explained, this team was participating in a part-time master's degree education that required project work. The teachers were initially concerned about their experiences with students who were less active than others (and sometimes inactive), especially in the gaps between the campus seminars. This caused projects to begin late, thus increasing the difficulties of teacher supervision. The teachers saw the introduction of technology as a possible way to increase student activity between seminars, providing more time for critical reflection and learning. There were two action cycles in the study. One spanned the period from September to January and the other from January to April. The table below presents all of the data sources for the two action cycles of the empirical study.

Data sources related to steps in the action cycles
Initial activities to establish contact and create a contract agreement, September 2001
1. Presentation of research interest to the teacher group
2. Document analysis of a project proposal for applying groupware to the master's programme, as made by the teachers to the institutional board
3. Interview with the key author behind the project proposal
4. Presentation of research interest to the students at a weekend seminar in September. One group volunteered to participate
5. Document analysis of the book: A different way to university: 'Report concerning the master's programme in educational studies at Open University' [En anden vej til universitetet: En undersøgelse af den treårige universitetsuddannelse i Voksenpædagogik under Åben Universitet] (Christensen 2000)
6. Document analysis of: Master's in Adult Education (Master i Voksenpædagogik), Roskilde University, Department of Educational Research

First action cycle: Problem diagnosis activities with the teacher group, September 2001 1. Diagnosis of problems using mapping techniques 2. Articulation of the pedagogical practice using Dead Sea Scrolls 3. Investigation of how IT might help resolving problems 4. Presentations on the possibilities to support group work through IT 5. Summary of workshop given by a teacher 6. Diary notes made by the researcher before and after the workshop
First action cycle: Workshop with the teachers' group, November 2001 1. Observation of their discussion concerning a new description of the master's programme 2. Document analysis of the official rules and content of the master's programme 3. Facilitation of discussion on IT use in the master's programme
First action cycle: Planning intervention activities, November 2001 1. Document analysis of the group's initial project proposal 2. Diary notes concerning the research purpose in general, the purpose of the first intervention activity, and specific planning activities 3. Technical preparations, including passwords etc. for BSCW
First action cycle: Intervention activity, November 2001 1. Presentation of the purpose of the activity for the group 2. Questions for the group to discuss, creating common ground while planning and coordinating the project, eg.: 'What are your expectations for this group work?', including decisions concerning time, collocated and mediated collaboration; 'What are the concrete collaborative activities of the project?', including decisions concerning meetings, working papers, readings, empirical work, analyses, how often to log on BSCW and what it mean to log on; 'Which kind of deliverables will there be, and when should they be finished?' and 'How should structures created within BSCW support your work?' 3. Presentation of an example of a project contract, a project plan and different examples of folder structures. 4. Document analysis of summary made by the group, including its plan, project contract and folder structure 5. Hands-on introduction to BSCW 6. Tape recordings, drawings, pictures and maps were used to capture the rich activities 7. Diary notes made immediately after the session, including evaluation of different interventions
First action cycle: Observation activities, December 2001-January 2002 1. Observations of the use of BSCW 2. Diary notes

First action cycle: Evaluation, **Second action cycle**: Diagnosis and planning activities, January 2002 1. Diary notes made before the session 2. Questions for the group comparing the decisions negotiated in November to actual experience between November and January 3. Facilitation of articulation of specific work practices 4. Tape recording of the session 5. Diary notes made immediately after the session 6. New planning for the project 7. New hands-on introduction 8. Revising folder structure 9. Technical explanation document about the functionality of BSCW
Second action cycle: Observation activities, January-March 2002 1. Observation of the use of BSCW 2. Status session in March 2002 in which the group received questions to articulate and in which they evaluated their collaborative practice from January to March 3. Tape recording of activity 4. Diary notes made immediately afterwards and as follow up questions using BSCW
Second action cycle: Reflective session with the group on the groupware adaptation process as a whole, April 2002 1. Observation of the use of BSCW 2. Diary notes made before and immediately after the session 3. Questions for the group 4. Tape recording of the activity
Second action cycle: Document analysis, May 2002 1. The group's description of the project period, including their engagement with the action research project officially handed in to the master's programme 2. The project report made by the group
Second action cycle: History interaction logs of the actions performed in BSCW 1. Calculation of the interaction logs comprising the number of actions made within each folder and sub-folders of BSCW, divided by month

TABLE 3: DATA SOURCES OF THE EMPIRICAL CASE

Theory plays an important role in action research. Even though some action research projects begin by being theory-free, explicit theorising is necessary if a grounded theory does not emerge during the diagnostic stage (Davison et al. 2004). During the actual performance of the action research project presented in this paper, the theoretical perspective was informed by earlier research on groupware adoption by researchers such as Grudin (1994), Karsten (1999) and Orlikowski (1992). In the course of the analysis of the empirical observations, the research interest remained on groupware adoption. The theoretical perspective, however, changed and became informed by the theory of technological frames (Orlikowski and Gash 1994). This influenced how the data was re-examined and

analysed. The theoretical standpoint informed the empirical observations and drew attention to specific aspects of groupware adoption. The action research approach during the data collection process brought in high quality material, including views of the practical situation from different perspectives (documents, workshops, interviews and observations) at different points in time. This data provided opportunities for additional analysis.

The empirical observations presented in this paper were analysed by applying the theoretical perspective of technological frames as a lens for identifying the technical and social factors that influence the expansion of frames. The analysis comprised re-examinations of all the audio transcripts, field notes, pictures, drawings and observations collected during the action research process, focusing on all aspects that impacted on groupware adoption related to the nature of the groupware, the strategies for adoption and the technology-in-use on a day-to-day basis. The focus of the analysis was to identify the empirical observations that showed how the actors changed, modified, aligned and expanded their technological frames concerning groupware.

The action research approach applied in this paper began by creating a researcher-client agreement. It involved two cyclical processes of action, based upon the principles of change through action and learning through reflection. It was guided and informed by complementing theories at the data collection and analysis stages alike. The approach described in this paper thus meets the criteria for action research presented by Davison et al. (2004).

6. Analysing the Groupware Adoption Process

This analysis is divided in two main sections, one for each action cycle of the research project. Sub-sections for each action cycle focus on its different activities: problem diagnosis, action planning, intervention, observation and reflection. Finally each main section ends by presenting the technological frames of key actors in the particular action cycle.

6.1 The First Action Cycle - September to January

The initial phase of the first action cycle, from September to November, involved the following activities: establishing contact with the organisation (the master's degree programme); producing a researcher-client agreement (Davison et al, 2004); understanding the problems experienced by the teachers concerning students' inactivity between campus seminars (problem diagnosis); planning the intervention to include finding a student group that was willing to participate (action planning); conducting an introductory workshop with the group (intervention); and producing final observations on the use of groupware and the evaluation of the actions (reflection).

6.1.1 Problem Diagnosis

The master's degree programme has existed since 1990. In the summer of 2001 the teachers proposed a pilot project to apply IT to the education. In a proposal submitted to the institutional board they argued that 'applying net-based teaching supplementing other teaching activities would be obvious since the students live far away from campus and each other and the geographic distance is a barrier for the project work in groups' (translation from the Danish proposal). Activities to diagnose the problems in the first action cycle took the form of interviews with the key author of the proposal and two workshops involving the whole teaching group for the programme. At the workshops we facilitated the teachers to articulate the problems they had experienced, using mapping techniques (Lanzara and Mathiassen, 1985).

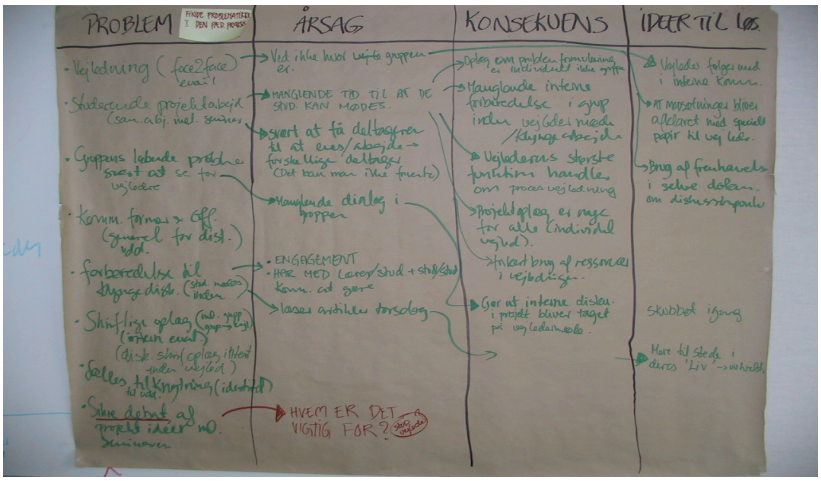


Figure 2: Diagnostic mapping of problems experienced by the teachers and articulated at the second workshop

The primary problem they identified was that students were less active between the on-campus seminars, causing project-related work to begin in April or even in May, when it originally was intended to begin in November. Groups that started their projects too late created a problem for the teachers, because they made project supervision more difficult. The teachers wanted to change this situation and believed that an IT conferencing system might contribute to the solution. Their knowledge about this kind of technology and its use was limited. They selected a conference system called Magenta[1] on the principle that it was 'simple and that both students and teacher did not have to invest time and effort in learning how to use it'. After examining the functionality of Magenta, we questioned this choice of IT system. Even though it fully lived up to their requirement for 'very low functionality', their choice did not reflect any thinking on the kinds of student activity that the system should support. They had given

[1] Magenta is a message board. You can write a text message and read others' text message. There is no possibility to build up folder structures, attach documents, delete or move messages.

even less consideration to how the system should resolve the problem of students' inactivity between on-campus seminars.

The teachers agreed with the researcher on these matters, but by that time they were unable to change the decision to use Magenta as the main supporting technology. Instead the teachers decided that, if one group would voluntarily participate in the adoption of another system which would support the group's project work in a better way, we could facilitate that group in their adoption process. BSCW was chosen as the supporting technology because it was already available from the IT department of the university, while being well suited to facilitate group work.

6.1.2 Action Planning

At the first on-campus seminar in September the action research project was presented to the students and one group volunteered to participate. The researcher offered to introduce and facilitate the use of groupware, including building a shared ground and providing ongoing suggestions for improvements to their collaborative process. In return the students should commit to participate in four workshops/reflective conversations. The students were free to reject the system at any time. The group members were asked to write an email about their individual experiences with IT, which was used to plan the first intervention in November.

6.1.3 Intervention

In November a six-hour workshop was conducted on a Friday evening between 6:00 pm and midnight on the day before an on-campus seminar. The aim was to introduce BSCW to the group by providing hands-on training and demonstrating the functions for coordinating, communicating and exchanging documents. The group was also facilitated to negotiate their common ground (Olson and Olson, 2000) on the content and the goal of the project. The workshop activities were recorded using wall-graphs (Simonsen and Kensing, 1997) and tape recording. In addition, an entry was made in the researcher's personal logbook just after the session.

This introductory activity resulted in a contract among the students, covering preparations for the project work, a project plan, and a designed BSCW workspace comprising a folder structure based on the project plan. One student remarked that after this introductory workshop they all felt more on track with the project, than the year before.

> 'I think we all had a feeling of being far more on track than the year before. It was a relief to have an overview of the project and process even though it might have been an illusion. (...) The hard thing about this part-time education is that you sometimes lose your feeling for the project and then something like this [BSCW and plan] is extremely good to have.' (Group member in January 2002)

The introductory workshop in November thus induced a feeling that BSCW would extend their capabilities for remote collaboration. At this workshop students were informed about new technological opportunities and how to relate the BSCW functionality to their actual practice. This new knowledge of technological opportunities expanded the students' technological frames in relation to technology strategies. None of the members had heard about groupware technology before, and remarked that email 'had worked OK' in former projects, even though they had experienced difficulties in keeping track of various versions of specific documents. After the workshop the students perceived that the primary motivation for using groupware was to reduce the effort of coordination.

By creating sub-folders in BSCW based on the negotiation of the project content and plan, the group was facilitated to embed their future work practices into the structures of the groupware system. This process supported the alignment of the participants' understanding of how to deploy the system, thus facilitating the development of congruence among their individual technological frames in relation to daily use of groupware. Whereas their earlier technological frames related to the nature of technology in project work centred on email, now they included knowledge of groupware. Additionally, the group members' frames towards groupware were to some extent in balance, since all the participants had taken part in negotiating the folder structures.

6.1.4 Observation

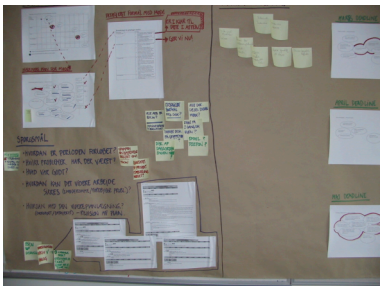
Within the first action cycle, the period from November to December was characterised by very low, or almost no, interaction within the group. Due to the members' daily work and family routines, the group did not engage in any kind of collaboration in this period. The members did log onto BSCW to 'see' if anything has happened. Two small discussion notes were added, but none were answered. Then between Christmas and New Year the group held a telephone meeting to 'get the communication started again'. The main purpose for this telephone meeting was to discuss and coordinate the production of a synopsis, which they should send to their supervisor before meeting him in January. Using the telephone they also discussed how to coordinate and exchange different versions of the synopsis and they decided *not* to use BSCW, but email instead. When asked in January why they took this decision a group member explained:

> 'The thing with the BSCW is that when the working process is not continuous (...) then nothing happens (...) so it becomes like a stranger out there' (Group member in January)

Participants in part-time vocational education use their free time to study. Therefore the process will never be continuous and this makes it difficult to achieve sustained use of groupware technology. The motivation to use BSCW decreased in December because the focus in this period shifted from learning

how to use the technology to creating the content of the synopsis. Thus, the barrier of learning and enacting the functionality of groupware in practice was problematic. The result was that the group chose to rely on the more familiar email technology.

6.1.5 Reflection



In January a two-hour reflective session with the group was conducted using wall-graphs and rich-pictures (Checkland and Scholes, 1990), and the activity was tape-recorded. The aim of this session was to evaluate the use of the groupware system in the period from November to January, and the researcher encouraged the group to articulate the *actual* collaboration process as experienced from November to January. Knowing they had used email for coordinating the synopsis, the main question was whether this 'more traditional' technology was successful. If it were, then the inevitable question would arise as to the need for the groupware system. However, it transpired that the use of email for coordination had failed. The group did not actually realise this before the reflective session. They had emailed the synopsis to their supervisor two days before the reflective session and they all thought they shared a common understanding of both the content and the process by which the document had been produced. However, this was not the case. The following discussion took place at the reflective session:

> Thomas: I think there is something missing here on the first few pages [pointing at a printed version of the document].
>
> Emma: Is this not the last version you sent?
>
> Thomas: No it is not.
>
> Emma: The one you sent a couple of days ago?
>
> Thomas: The one we mailed to Adam [the supervisor], the one we called version 4, the one Lisa had written on – unfortunately I don't have a printed version because my printer isn't working, but Lisa had put mine and hers together; it is about 6-7 pages long...(...) (Group discussion, January)

This discussion continued and they became increasingly frustrated about the situation. They lacked a printed final version and in the end they decided to contact the supervisor to check if he had the right version. In addition they began discussing the email coordination process, and soon realised that they lacked a shared understanding of the underlying process. The group thus found itself in a new problematic situation that influenced a change in its members' perspectives on email. This, in turn, affected their perception of groupware.

6.1.6 Technological Frames after the First Action Cycle

The technological frames of the teachers group after the first action cycle were influenced by the activities planned and guided by the action researcher – especially with regard to their perspective on the nature of groupware as in the functionality and capabilities provided by the technology. Where they initially perceived that they needed 'low functionality', reducing time for learning the technology, they acknowledged at the end of the first action cycle that the technology also should support particular collaborative activities in order to be useful. The teachers' perspectives on the strategies for groupware became more explicitly articulated – preventing late project starts and thus improving the conditions for supervision. The day-to-day use of the groupware system to support group work was still perceived by the teachers as an issue for the students themselves.

The technological frames of the student group related to the nature of the technology changed by the end of the first action cycle. Initially the group had no knowledge about groupware but, influenced by the intervention activities, it had now been introduced to functionality that should be relevant for future collaboration. The students' primarily motivation for using the system was to decrease their effort in coordination. At this time the students still did not have any experience of technology-in-use but, guided by the researcher, they had negotiated how groupware would support their activities. These negotiations were not based on experience, but on assumptions about their future collaboration.

The technological frames of the action researcher were not changed during the first action cycle, particularly because the role of the researcher in this action cycle was to influence the technological frames of the student group and the teachers. So far none of the researchers' initial assumptions of groupware support of problem-oriented project work in geographically dispersed groups were challenged by the technological frames of these two sets of actors. The following table summarises the technological frames after the first action cycle.

	Teachers	Students	Action researcher
Nature of technology	Technology must support particular collaborative activities between the students to be useful.	Support of coordination, shared archive and planning.	Groupware supportive of collaboration in project groups in education needs to have functions such as coordination, shared archive, version control and negotiations.

Technology strategies	The motivation behind groupware is to make the project begin earlier, thus making the supervision process easier.	Decreasing effort of coordination.	Geographically distributed groups have difficulties collaborating. Groupware can provide opportunities for collaboration, reducing time for coordination, while increasing time for learning and negotiation.
Technology-in-use	The use of groupware technology in the project groups is up to the students themselves.	Negotiated use of technology related to their subject matter, but no practical experiences with day-to-day use.	The group should be assisted to negotiate common working procedures for groupware, including how, why and when to use it in specific situations related to their project.

TABLE 4: TECHNOLOGICAL FRAME OF KEY ACTORS AFTER THE FIRST ACTION CYCLE

6.2 The Second Action Cycle – January to April

The second action cycle began where the first one ended at the reflective session in January and ran to the end of the action research project in April. The second action cycle comprised problem diagnosis of the situation in January, planning of new actions to resolve the problems experienced by the group related to us of BSCW, intervention activities, observations of the effects of the new actions, and finally reflections on the new intervention activities in relation to groupware adoption.

6.2.1 Problem Diagnosis

When the group members and the researcher together reflected upon the group's collaboration between November and January it became clear that the problems experienced by the students were related both to email and groupware. The main problem with email was found to be the difficulty of keeping track of the various versions of the documents they exchanged. This had also been a problem in previous projects. The reason for not using groupware was mainly the lack of motivation to make an effort to learn the groupware functionality during the process of constructing the synopsis. Because they had not undertaken shared collaborative activities immediately after the initial introduction to BSCW, the students had not become familiar with the functionality of BSCW while it was still fresh in their memories. The students had not adopted these functions on a regular basis immediately after their introduction to groupware before new situations emerged and put them under time pressure. Pattern behaviour of technology is highly influenced by the initial stage of use, since initial behaviours typically determine the use of technology over time lasting the entire project (Tyre and Orlikowski, 1994; Huysman et al, 2003).

6.2.2 Action Planning

The researcher and the group planned new actions aiming at solving the problems that had been identified in groupware adoption. These activities were intended both to facilitate the students in learning the functionality of BSCW ensuring immediate and regular use while changing the technology-behaviour patterns within the group. The activities included concrete actions by the researcher and new commitments from the students. As one group member said:

> 'Now we need to get past these [feelings towards BSCW] and say; OK it is not that difficult and instead realise that this [BSCW] actually makes it easier to get access to each other. I think that what we need is to commit to the system.' (Group member in January)

6.2.3 Intervention

The first activity to support the group's BSCW adoption was a new hands-on introduction to the system's functions. This was structured around questions from individual group members on how to perform specific tasks. During this process the members realised that they actually remembered the functionality of the system quite well. In this way the individual technological frames towards groupware were not established in the second cycles, but were instead expanded as the group learned more about the nature of the system.

Secondly the researcher produced a document that described the functionality of the system, and a second document that described three scenarios for using the BSCW for coordination. In addition, a direct notification feature in the BSCW was turned on in order to alert the group members to relevant events occurring in the system. Finally, the researcher set up a discussion forum called the weekly logbook, where group members could write notes about the project, together with personal information and other issues they wished to mention. The main purpose of the logbook was to encourage regular use. The students were therefore advised to write an entry in the logbook each week.

6.2.4 Observation

Besides observing the actions in BSCW, a status session was also conducted in March. The aim of this session was to gather information about how the group perceived its collaboration and use of groupware at that point in time. The researcher was not present at this session, but had provided the group with a list of questions to discuss. The group recorded their conversations and this data were later transcribed and analysed. The questions the group discussed were divided into two types. One related to the evolution of the project itself and another aimed at understanding the role of BSCW. Examples of questions are: Which kind of documents do you have at this time? Are there documents not placed in BSCW? Describe what you have been doing in the past period and how BSCW or other kinds of technology (like phone and email) have been used?

Between January and March the situation for the group had changed in two important ways. Firstly, they had managed to adopt BSCW into their collaborative practice and secondly, the group had developed a shared understanding of how the project was taking shape by using the actions within BSCW to interpret each other's individual activities. This was evident by the large numbers of actions within the system, eg. revisions of folders, uploads and downloads of documents and weekly notes in the logbook.

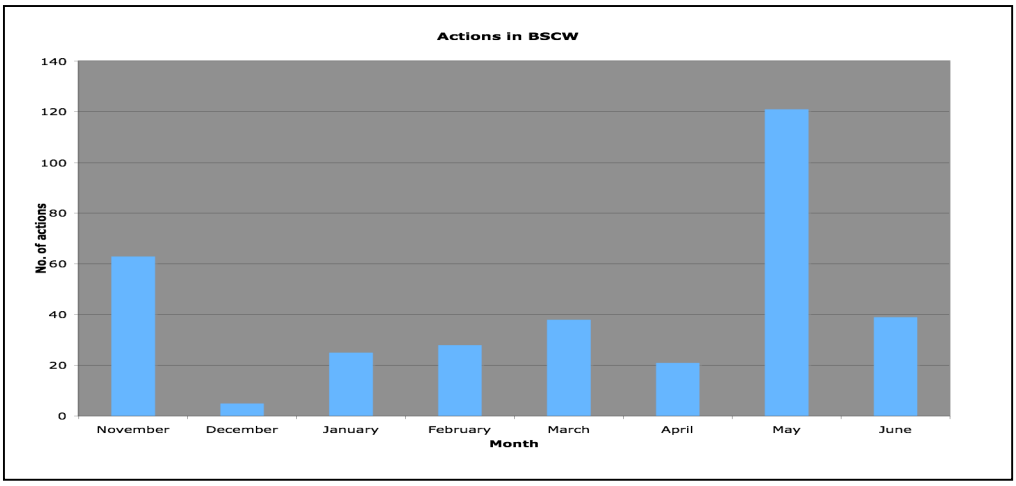


FIGURE 3: NUMBER OF ACTIONS MADE WITHIN BSCW ILLUSTRATED BY MONTH

The actions depicted in Figure 3 comprise creations, revisions and deletions of folders, documents, URLs and notes made within BSCW during the whole period from November to June. They do not include reading or downloading. The actions in November include those made during the hands-on introduction (37 actions). Out of the remaining 25 actions in that month, 20 actions were made by the researcher concerning technical guidelines, such as how to perform specific tasks like uploading documents or using the version control. In November, the participants made only 5 actions after the first hands-on introduction. In Figure 3 we see the major difference between the numbers of actions made before and after the intervention in January.

The group had managed to reduce the effort required for coordination by using the groupware system during the second action cycle. While in January almost all the time at the campus seminar was spent discussing the status of the project, this was a minor issue in March. Surprisingly, a wider use of the system was also detected. In fact, the weekly logbook, originally established to encourage regular use of BSCW, had brought additional visibility to the social dimension of the collaborative situation by providing a social context for interpretation of each other' actions. This is shown, for example, by the following extracts:

> "Lisa: I think this weekly logbook has been very good, because I have had a good sense of where you all have been – especially you Thomas, who have written all about your illness.

Emma: It makes it much more captivating to go in and read stuff like this too.

Thomas: Yes (...) because it gives you a good feeling of what is going on. (...) The constant response. It is especially good in these kinds of distance projects.

Lisa: Sometimes you get hung up with work and lose contact with the project...

Emma: (...) you know you have it all in BSCW (...) it gives you a sense, psychologically, that there is a project forming.' " (Group discussion in March)

The weekly logbook had bridged the geographic distance between the group members, ensuring that the geographic distance did not lead to social distance. Social and people-centred issues have been found important when researching group collaboration (Steinfield et al, 1999; Prinz, 1999, Tollmar et al, 1996; Schmidt, 2002). Small daily interactions around the coffee machine or water cooler help members of collocated teams to get a sense of each other. The lack of such information in geographically distributed teams can affect group morale due to possible misunderstandings and misinterpretations (Cramton, 2001). The group had found that their use of groupware provided a new capability for their collaboration by mediating information similar to 'information received when walking along the office floor' (Prinz, 1999, p.2).

6.2.5 Reflection

The last activity conducted with the group was a reflection session held in April five weeks before the group turned in the final version of the project report. The reflective session was organised as a one-hour conversation, which was tape recorded and later transcribed. We found that the collaborative practice of the group had been transformed by groupware. One example was that a telephone meeting originally planned between January and March had been cancelled because the group preferred using BSCW instead. When asked why they cancelled the telephone meeting, the group explained that it was too expensive. The cost of a telephone meeting had not been an issue between Christmas and New Year because they needed it for coordination, but after BSCW was adopted into their practice, the need for the telephone was reduced. Also the email direct notification feature transformed the practice. This feature supported visibility and awareness of the actions conducted within the BSCW system, since each time a member wrote, revised or moved objects within the system, an automatic email was sent to all members to inform them. Each member could therefore monitor when others had made a contribution. When the participants made their weekly entries to the logbook, their actions generated email notifications. This made a huge contribution to the successful adoption, because it caused the group to use the system functionality regularly. The weekly logbook also facilitated spontaneous and informal interaction, serving as an informal discussion forum with no prescribed usage or content. Spontaneous interaction has also in previous research been found to support collaboration in virtual teams (Hinds and Mortensen, 2005).

At the reflective session the group members characterised their experience of the project work as 'much more calm' than in earlier projects and they had a strong feeling of confidence that they would 'finish on time with a good result'. Additionally they stated that the researcher's interventions had influenced the process in a positive way. As one group member said:

> '[Without the researcher intervention adopting groupware] we would not have come this far, especially in our heads. Maybe in respect to the written documents, but the feeling of coherence around the project would not have existed. This is the first time I feel, we are in control.' (Group member in April)

Aligning work practices and technology requires articulation of the practice. Asking questions related to the collaborative processes initially as well as during their project helped the students to articulate their work practices. In this way two goals were achieved. First it supported the group by developing a common ground (Olson and Olson, 2000) for its project and second it helped build actual work practices based on technology use instead of speculation about the potential use of groupware (Suchman, 1983). The students perceived both goals as important for success in the project work process and in groupware adoption. The nature of BSCW was also vital for adoption. Besides providing a shared repository for the documents, BSCW additionally created a feeling of a 'backbone' of the project embedded in the folder structures. BSCW had become a common information space, because group members through negotiations had constructed shared meanings related to the shared information items and their locations within the groupware system (Hertzum, 1999).

The group was of the opinion that they would not have adopted BSCW without the researcher's interventions. First, none of the participants were even aware of the existence of groupware technologies, so the intervention provided them with knowledge of the new technological opportunity. Furthermore, one group member explained that his anxiety towards technology would have caused an immediately rejection, if he had not known that someone who cared about their project and their use of groupware was available to answer his questions. Additionally, two of the group members told they had been 'bragging' about their use of the system, showing it to friends, family and colleagues when asked about their project. They were proud of the system, which also affected their view of technology in their daily jobs. One group member was planning to adopt groupware for collaboration with colleagues in her day job. Another group member explained that she had advocated that colleagues in her workplace should remember to store common documents at the 'X-folder'.

6.2.6 Technological Frames after the Second Action Cycle

The technological frames of the teachers had not changed much in the second action cycle, primarily because there were no special activities arranged for the teachers in this period. The teacher who supervised the group that adopted BSCW, however, asked regularly how the members' use of groupware was

going. Since the group was enthusiastic about the system and also wrote about its experiences in the official evaluation of the project, the teachers came to believe that the master's degree programme should extend the use of technology.

The technological frames of the students changed dramatically in the second action cycle. Concerning the nature of groupware technology, the students had expanded their view to include functions beyond coordination and shared archive. The additional capabilities that BSCW provided to support the students' collaboration were visual representation of the project (as embedded in the conceptual folder structures within the system) and the possibility to mediate social relations. The expansion of technological frames related to the nature of groupware also expanded the category of strategies for adopting groupware. Now the students were not only motivated to adopt groupware for coordination and shared archive, but also because the system would provide new capabilities that improved their collaboration – supporting the exchange of informal social information and providing a visual representation of the project. After the second cycle, moreover, the students' understanding of the day-to-day use of BSCW was changed from being solely at a theoretical level to comprise concrete experiences with groupware in particular contextual collaborative situations.

Just as the action researcher had greatly influenced the technological frames of the students in the second cycle, the students' perspectives on groupware also influenced the technological frames of the action researcher. As regards the nature of the technology, the technological frames of the action researcher after the second cycle included not only shared archive and coordination, but also visual representation of the project and the mediation of social relations. This further expanded the technology strategies, since the motivation for adopting groupware now included more possibilities: developing social coherence among geographically dispersed actors by providing a platform for exchanging social information and giving them a visual representation of the project. Lastly, the action researcher's understanding of technology-in-use was based upon negotiation and re-negotiation among participants, developing a common understanding of workflows and the use of technology in particular situations.

	Teachers	Students	Action researcher
Nature of technology	Technology must support particular collaborative activities between the students to be useful.	Groupware functions include support for coordination, shared archive, visible representation of the project and mediation of social relations	Groupware functions include support for coordination, shared archive, visible representation of the project and mediation of social relations
Technology strategies	The motivation behind groupware is to make the project begin earlier, thus making the supervision process easier.	The motivation behind groupware adoption is to reduce coordination effort, having more effective collocated meetings, exchanging social information while being a visual representation of a project taken form.	The motivation to adopt groupware includes the reduction of coordination efforts, increasing time for reflection and learning, as well as support for developing social coherence among geographically distributed actors by providing a platform for exchanging social information and giving them a visual representation of the project
Technology -in-use	The use of groupware technology in the project groups is up to the students themselves.	Concrete experiences with use of groupware in particular collaborative situations of the group work.	Implementation of groupware on day-to-day basis is based upon a negotiated and re-negotiated understanding of workflows and collaborative activities developed through the participants' experiences of regular use and negotiation in reflective episodes.

TABLE 5: TECHNOLOGICAL FRAMES OF KEY-ACTORS GROUPS IN THE END OF THE SECOND ACTION CYCLE

7. Discussion

The identified factors that influence the expansion and alignment of participants' technological frames towards groupware are both technological and social. The technological factors comprise the nature of the technology in relation to the new capabilities that it offers. The unanticipated capabilities that groupware provided in this study were the visual representation of the project embedded in the emerging structures of BSCW and the opportunity for mediating social relations. Both of these factors supported the group in the transformation of BSCW to become a common information space (Hertzum, 1999). The participants perceived both of these new capabilities as positive influences for groupware adoption. BSCW had provided a shared workspace where social actions were propagated and 'objects-of-work' were operated upon (Ngwenyama and Lyytinen, 1997). This was perceived as a new capability, useful for supporting collaboration. The use of BSCW transformed the group practice by creating a representation of the project that induced the feeling that the project was taking

form. The project was right 'there' in all the folders and documents located in the group's common repository related to a shared meaning. Moreover the use of the weekly logbook provided the group with a sense of both task-oriented and social-oriented awareness related to their mutual work (Prinz, 1999). The logbook provided the 'group members with information helpful for making sense of others' actions necessary to interpret others' actions (Steinfield et al, 1999: p. 84). The logbook contained extra socially significant information such as information about group members' health and family situations. Exchanging social information supported a feeling of coherence within the geographically dispersed group. The weekly logbook also facilitated asynchronous casual social encounters through the simultaneous hosting of coordination activities and social interactions. Spontaneous communication has previously been associated with a stronger shared identity and shared context in virtual teams (Hinds and Mortensen, 2005). This finding is also supported by our data. Groupware adoption thus transformed the collaborative practice of the group, resulting in unanticipated social effects and a much wider appropriation of BSCW than initially intended (Berg, 1998; DeSanctis and Pool, 1994). We also found evidence that the new capabilities of groupware were greatly appreciated by the participants, affecting groupware adoption positively (Robinson, 1991).

There were three main social factors influencing the expansion of technological frames. First the introductory session afforded knowledge about the new technological opportunities by introducing the groupware functions. Here the functionality related to the future practice of the group. Second the initial negotiation of goal, aim and plan for the project supported the group in developing a common ground (Olson and Olson, 2000). The initial introductory session presented a new window of opportunities (Tyre and Orlikowski, 1994) by including negotiations of the goal, aim and plans for the project and by basing the first folder structures upon the insights from these negotiations. In this way the introduction to the technology was related directly to the project, supporting the group's understanding of how groupware could be useful to mediate their distributed activities. This served as a link between groupware and practice. The third social factor that influenced groupware adoption was the reflective episode two months after the initial introduction. When the group attempted to collaborate using the system after this time lapse, their willingness to learn the new technology seems to have decreased. They rejected the groupware system and used familiar technologies instead. This observation suggests that collaborative activities conducted immediately after the introduction session strongly influence the subsequent patterns of technology use. This is also supported by earlier findings that it is difficult to change patterns of technology use and that participants often get stuck in unproductive work patterns (Huysman et al. 2003; Tyre and Orlikowski, 1994). The reflective session provided the group with the opportunity to articulate their work practice

experiences while re-evaluating both the collaborative practice and their use of technology.

Our empirical observations provide strong evidence that groupware adoption would have failed without the reflective session in January. That session was a disruptive event because the group realised that their use of email to coordinate the project documents had not produced the expected results. Disruptive event is previously been found to guide the alignment of technology in virtual teams (Majchrzak et al, 2000). The reflective session provided a new window of opportunity. This new window was exploited immediately by the new actions planned and executed by both the group and the researcher. Disruptive events often provide participants with the ability to evaluate their work practices critically, thus increasing their willingness to revise, modify and adjust work practices, including their use of technology (Tyre and Orlikowski, 1994). In addition, the work practices immediately after the reflective session were characterised by activities performed within the groupware system, especially in the newly created weekly logbook, which were in stark contrast to the inaction that followed the initial introduction session.

Socially related factors (eg. the reflective session) and technology related factors (eg. the weekly logbook forum) both supported the expansion and alignment of the participants' technological frames, leading to the adoption of groupware. Without these factors it is most likely that the group would have been unable to adopt groupware to mediate distributed yet interrelated activities.

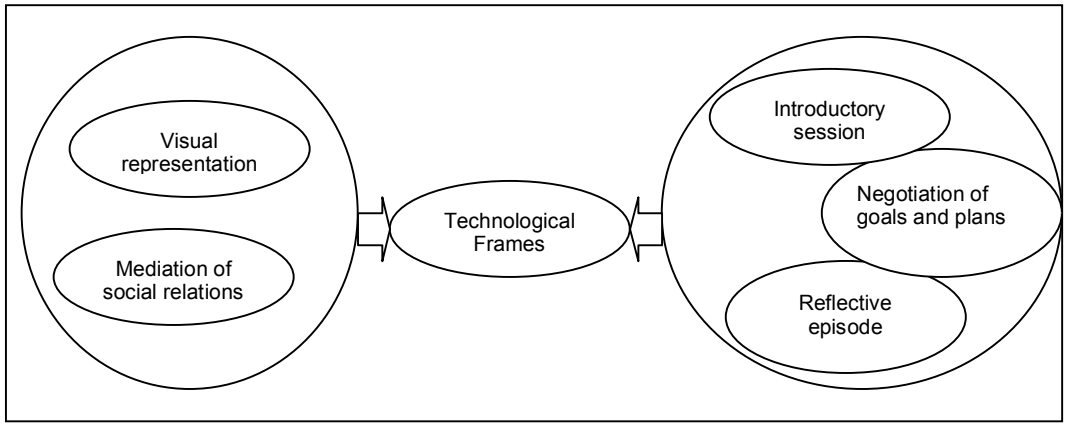


Figure 4: Technological and social factors expanding participants' technological frames

8. Implications

By conceptualising groupware adoption as the alignment and expansion of participants' technological frames we must focus on the participants' particular interpretations of the technology and on its role in settings that include nature, strategies and use of technology (Orlikowski and Gash, 1994). The process of

expanding technological frames must be understood as a continuum with varying degrees of technology adoption. Initially, in our group, the participants' technological frames were aligned and comprised the use of email and phone. The assumptions, expectations and knowledge about the technological opportunities for mediating group collaboration did not include groupware. Then, after the first intervention, the technological frames of the participants were expanded in terms of new knowledge about technological opportunities, including the nature and strategies of groupware. Nonetheless, the groupware was not fully adopted. The expansion was only in terms of knowledge concerning new opportunities, even though the groupware functionality had been introduced in a context of future collaborative actions. It was assumed that groupware could support their collaboration and they expected it to do so, but it failed. Participants had seen the artefact as having potential to support their collaboration (Mogensen and Trigg, 1992).

The participants' interpretations of groupware technology were modified in the reflective session in the first action cycle, moving towards the next level of technological frames expansion. The reflective session provided a new window of opportunity for changing the unproductive patterns of collaboration (Tyre and Orlikowski, 1994). Here the technological frames towards groupware not only contained knowledge about new opportunities, but also included articulation of the non-use of groupware and concrete experience of activities mediated by email. In this way the non-use of groupware was related to previous practical collaborative experiences, instead of to proposals for future activities. The technological frames were thus expanded from mere speculative knowledge about new opportunities to a degree of in-depth articulation of actual collaborative work practices and use of technology. The technological frames were no longer just related to plans for collaboration, instead they were related to situated actions in collaborative practice (Suchman, 1987). Then, in the problem diagnosis stage of the second action cycle, the in-depth articulation of experienced practice was related to the possible future use of groupware. Here the articulation of concrete work experiences and use of technology facilitated the alignment of the technological frames of the participants. The participants recognised the potential of the artefact (Mogensen and Trigg, 1992). The difference between participants seeing groupware at the initial stage compared to the recognition at the reflective session is participants' recognition was embedded in practical experiences while the initial 'seeing' was based on assumptions of the potential of groupware.

The third level of technological frame expansion concerned the practical enactment of groupware. Here groupware is appropriated and used to mediate the interrelated activities of the group. This step requires commitment from the participants and alignment of the individual technological frames on key categories. Here the technological frames of the participants are expanded from

the degree of knowledge about the technology through the articulation of concrete work practices and technology use towards practical enactment of groupware. It is only during this third level of expansion of technological frames that the use of groupware becomes embedded into the social practices. At this stage the participants experience a balance between how they articulate their practices and their use of technology so they can own the artefact (Star and Ruhleder, 1996; Mogensen and Trigg, 1992). These observations suggest that groupware adoption can be conceptualised as an expansion and alignment of technological frames at three levels: knowledge of new technological opportunities, articulations of concrete work practices and technology use, and the practical enactment of groupware.

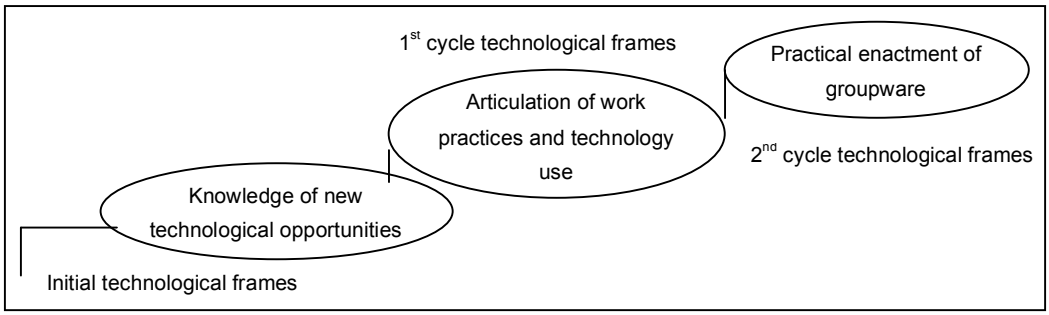


FIGURE 5: EXPANDING TECHNOLOGICAL FRAMES AT THREE STEPS

The figure above illustrates the three levels of technological frame expansion, representing three steps towards groupware adoption. Initially in this research project we tried to take the first two steps at the same time, attempting to establish a close tie between the introduction to groupware and the actual practices of the group. Our empirical observations illustrate, however, that this initial connection between practice and technology was based on speculation about future work and not on concrete experiences. This suggests that it is difficult, if not even impossible to introduce groupware and to establish a new practice with only limited experience of group work practices. Until the breakdown of email coordination the group did not have a group work practice and the breakdown resulted from the failure of a previous technology to support the first concrete group task in a proper way. The experience of breakdown provided the group with an understanding of how group work practice is something more than just email correspondence. This triggered the group's understanding of potential future work practice and the need for groupware, such as BSCW, to support it. Finally our empirical observations suggest that the third step of groupware adoption (practical enactment) should be taken immediately after the second step, since delays are damaging for the adoption process.

One could argue that if the collaborative process immediately after the initial introduction had not been an interruptive period, but instead consisted of interrelated activities, the groupware adoption process would have looked

different. However, we would argue with reference to Majchrazak et al (2000) that, in order to solve misalignment between technology and practices, it is essential to foster re-evaluation to help achieve groupware adoption. Thus we argue that, even with a large number of activities immediately following the initial introduction, there would still be a need for reflective sessions to provide an opportunity to re-evaluate the collaborative practice and technology use. The links between groupware use and practice call for articulation and reflection that are grounded in actual experiences.

Our findings in this paper suggest that adopting groupware in geographical distributed project work should be perceived as the alignment and expansion of technological frames related to the nature of technology (the functionality that is required), technology strategies (the motivation for adopting groupware) and technology-in-use (how should groupware be used in practice). Practitioners might use the three-step model of expanding technological frames to plan the process of groupware adoption. The model suggests that the first step would be to introduce the new technological opportunities for the participants at all three domains of technological frames: nature, strategies and use. During this introductory stage time for negotiations of the subject matter, collaborative process and technology use is essential. Moreover, evaluation activities including re-negotiations of the collaboration process and the use of groupware are important. Finally, practitioners should choose groupware technology appropriate for the particular collaborative process to ensure that the functionalities are appreciated by the participants thus expanding group members' capabilities for collaboration.

Like other studies, ours has potential limitations. One obvious limitation is that we only examined a single self-selected group of three participants. One could question whether they were representative of groupware adopters or if they were too interested in, and eager to learn about, the technology. Their attitudes may have influenced the success of the adoption process. We believe, however, that the group members were critically reflective towards technology. They had the opportunity at all times to withdraw from the project with no consequences for their education. In fact, they rejected the adoption of BSCW between November and January. In addition, one of the group members stated explicitly that he was easily intimidated by technology. We would argue that the perspective of technology in the group we investigated was representative of adults attending master's degree vocational education. Another potential limitation of our study is its focus on social and technological factors that are closely related to the social context of education. This excludes other considerations, such as political and economic factors, that might also influence the expansion of technological frames. We acknowledge the existence of the other factors and that our focus in this study excluded factors from social contexts outside education. Our three-step model of groupware adoption should

therefore be viewed as a proposed conceptualisation and not as a final statement. New research, including the consideration of factors from related social contexts, is required to complete the conceptualisation of technological frame expansion. Additional research is required to refine and test the conceptualisation. These new studies might expand our understanding of, and definitions for, the different factors that lead to successful groupware adoption, so we can improve the conditions for collaboration in geographical distributed groups.

References

Avison, D., Francis Lau, F., Myers, M., and Nielsen, P.A. 'Action Research', *Communication of the ACM*, (42:1), 1999, pp. 94-97

Baskerville, R. and Wood-Harper, A. T. 'A Critical Perspective on Action Research as a Method for Information System Research', *Journal of Information Technology*, (11), 1996, pp. 235-246

Bentley, R. T., T. Horstmann, and J. Trevor, 'The World Wide Web as Enabling Technology for CSCW: The case of BSCW', *Computer Supported Cooperative Work: The Journal of Computer-Supported Cooperative Work*, (6:2-3), 1997, pp. 111-134

Berg, M. 'The Politics of Technology: On Bringing Theory into Technological Design', *Science, Technology, & Human Values*, (23:4), autumn, 1998, pp. 456-490.

Bjørn, P. 'Re-Negotiating Protocols: A Way To Integrate Groupware in Collaborative Learning Settings', in *Proceedings of European Conference in Information Systems* (ECIS), Naples, 2003.

Blomberg, J., Giacomi, J., Mosher, A., and Swenton-Hall, P. 'Ethnographic Field Methods and their Relation to Design,' in: *Participatory Design: Principles and Practices*, D. Schuler and A. Namioka (eds.), Lawrence Erlbaum Associates Publisher, London, UK, 1993, pp. 123-155.

Bowker, G. C., and Star, S. L. *Sorting Things Out: Classification and Its Consequences*, The MIT Press, Cambridge, 2002.

Bødker, K., Kensing, F. and Simonsen, J., *Participatory IT Design: Designing for Business and Workplace Realities*, The MIT Press, Cambridge, Massachusetts, 2003

Braa, K. and Vidgen, R., 'Research – From observation to intervention', Ch. 12 in *Planet Internet*, K. Braa, C. Sørensen, B. Dahlbom (eds.), Lund, Sweden, 2000.

Carstensen, P. and Sørensen, C., 'From the Social to the Systematic: Mechanisms Supporting Coordination in Design', *Computer Supported Cooperative Work, The Journal of Collaborative Computing*, (5:4) 1996, pp. 387-413.

Checkland, P., & Holwell, S. 'Action Research: Its Nature and Validity', *Systemic Practice and Action Research*, (11:1), 1998, pp. 9-21.

Checkland, P. and Scholes, J. *Soft Systems Methodology in Action*, Chichester, West Sussex, UK, 1990.

Cheesman, R. and Heilesen, S. 'Supporting Problem-based Learning in Groups in a Net Environment', In *Proceedings of the Computer Support for Collaborative Learning* (CSCL), C. Hoadly & J. Roschelle (Eds.) Dec. 12-15, Stanford University, Palo Alto, California. Mahwah, NJ: Lawrence Erlbaum Associates, 1999.

Cramton, C. D. 'The Mutual Knowledge Problem and its Consequences for Dispersed Collaboration', *Organization Science*, (12:3), 2001, pp. 346-371

Christensen, L. *En Anden Vej til Universitetet: En Undersøgelse af den Treårige Universitetsuddannelse i Voksenpædagogik under Åbent Universitet [A Different Way to University: Report Concerning the Master Programme in Educational Studies at Open University]*, Roskilde Universitetscenter, Roskilde, 2000.

Davison, R. 'GSS and Action Research in the Hong Kong Police', *Information Technology & People*, (14:1), 2001, pp. 60-77.

Davison, R. M., Martinsons, M. G., and Kock, N. 'Principles of Canonical Action Research,' *Information Systems Journal*, (14), 2004, pp 65-86.

Davison, R., Qureshi, S., Vreede, G-J. D., Vogel, D. and Jones, N., 'Group Support Systems through the Lens of Action Research: Cases in Organizations', *Journal of Global IT Management*, (3:4), 6-23, 2000.

DeSanctis, G., and Poole, M. S. 'Capturing the Complexity in Advanced Technology Use: Adaptive Structuration Theory,' *Organization Science*, (5:2), May 1994, pp. 121-147.

Dirckinck-Holmfeld, L. 'Designing Virtual Learning Environments Based on Problem Oriented Project Pedagogy,' in: *Learning in Virtual Environments*, L. Dirckinck-Holmfeld and B. Fibiger (eds.), Samfundslitteratur, Frederiksberg, 2002, pp. 31-54.

Dirckinck-Holmfeld, L. and Sorensen, E. K., 'Distributed Computer Supported Collaborative Learning through shared Practice and Social Participation', In *Proceedings of the Computer Support for Collaborative Learning* (CSCL), C. Hoadly & J. Roschelle (Eds.) Dec. 12-15, Stanford University, Palo Alto, California. Mahwah, NJ: Lawrence Erlbaum Associates. 1999

Gallivan, M. 'Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework,' *The DATA BASE for Advances in Information Systems*, (32:3), 2001, pp. 51-85.

Grudin, J. (1994): 'Groupware and Social Dynamics: Eight Challenges for Developers', *Communication of the ACM*, (37:1), pp. 92-105

Hertzum, M. "Six Roles of Documents in Professionals' Work," Sixth European Conference on Computer Supported Cooperative Work, Kluwer Academic Publisher, Copenhagen, Denmark, 1999, pp. 41-60.

Hinds, P., & Mortensen, M. 'Understanding Conflict in Geographical Distributed Teams: The Moderating Effects of Shared Identity, Shared Context, and Spontaneous Communication', *Organization Science*, (16:3), 2005, pp. 290-307.

Hollingshead, A., McGrath, J., and O'Connor, K. 'Group Task Performance and Communication Technology: A Longitudinal Study of Computer-Mediated versus Face-to-face Work Groups', *Small Group Research*, (24:3), 1993, pp. 307-333

Huysman, M., Steinfield, C., Jang, C-Y., David, K., Veld, M. H. I. T., Poot, J., et al. 'Virtual Teams and Appropriation of Communication Technology: Exploring the Concept of Media Stickiness', *Computer Supported Cooperative Work (CSCW): An International Journal*, (12) 2003, pp. 411-436.

Jarvenpaa, S. L., Knoll, K., and Leidner, D. E. 'Is Anybody out there? Antecedents of Trust in Global Virtual Teams,' *Journal of Management Information Systems*, (14:4), spring, 1998, pp 29-64.

Karsten, H. 'Collaboration and Collaborative Information Technologies: A Review of the Evidence,' *The DATA BASE for Advances in Information Systems*, (30:2), 1999, pp 44-65.

Kiesler, S. 'Thinking Ahead: The hidden messages in computer networks,' *Harvard Business Review*, (1), January-February, 1986, pp 46-60.

Kvale, S. *Interviews: An Introduction to Qualitative Research Interviewing*. Thousand Oaks, Ca.: Sage, 1996.

Lanzara, G., and Mathiassen, L. 'Mapping Situations within a Systems Development Project', *Information and Management*, (8:1), 1985, pp 3-20.

Majchrazak, A., Rice, D.E., Malhotra, A., King, N.: Technology Adaptation: The case of a Computer-Supported Inter-organizational Virtual Team, *MIS Quarterly*, (24:4), 2000, pp. 569-600.

Mark, G., and Poltrock, S. 'Shaping Technology Across Social Worlds: Groupware Adoption in a Distributed Organization,' *Proceedings of the International ACM SIGGROUP Conference on Supporting Group Work*, 2003, pp. 284-293.

Massey, A.P., Hung, Y.C., Montoya-Weiss, M., and Ramesh, V. 'When Culture and Style Aren't About Clothes: Perceptions of Task-Technology 'Fit' in Global Virtual Teams', *Proceedings of the International ACM SIGGROUP Conference on Supporting Group Work,* 2001.

Mathiassen, L. 'Reflective Systems Development', *Scandinavian Journal of Information Systems*, (10:1&2), 1998, pp. 67-134.

Mathiassen, L. 'Collaborative Practice Research', *Scandinavian Journal of Information Systems*, (14), 2002, pp. 57-76.

Maznevski, M.L. and Chudoba, K.M., 'Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness', *Organization Science*, (11:5), September-October 2000, pp. 473-492.

Mogensen, P., and Trigg, R. 'Using Artefacts as Triggers for Participatory Analysis,' Participatory Design Conference (PDC), 1992.

Ngwenyama, O. K., and Klein, H. K. 'An Exploration of the Expertise of Knowledge Workers: Towards a Definition of the Universe of Discourse for Knowledge Acquisition,' *Information Systems Journal*, (4), 1994, pp 129-140

Ngwenyama, O. K., and Lyytinen, K. J. 'Groupware Environments as Action Constitutive Resources: A Social Action Framework for Analyzing Groupware Technologies', *Computer Supported Cooperative Work (CSCW): An International Journal*, (6), 1997, pp. 71-93.

O´Connor, K., Gruenfeld, D., & McGrath, J. 'The Experience and Effects of Conflict in Continuing Work Groups'. *Small Group Research*, (24:3), 1993, pp. 362-382

Olsen, P. B., and Pedersen, K. Problem-Oriented Project Work - a workbook, Roskilde University Press, Frederiksberg, Denmark, 2005.

Olson, G. M., and Olson, J. S. 'Distance Matters,' *Human-Computer Interaction*, (15), 2000, pp 139-178.

Orlikowski, W. 'Learning from NOTES: Organizational Issues in Groupware Implementation', in J. Turner and R. Kraut (eds.): CSCW '92. Proceedings of the Conference on Computer-Supported Cooperative Work, Toronto, Canada, 31. October - 4. November 1992, ACM Press, New York, 1992, pp. 362-369.

Orlikowski, W. J. 'CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development,' *MIS Quarterly*, (17:3), September, 1993, pp 309-340.

Orlikowski, W., and Baroudi, J. 'Studying Information Technology in Organizations: Research Approaches and Assumptions,' *Information Systems Research*, (2:1), 1991, pp 1-28.

Orlikowski, W. J., and Gash, D. C. 'Technological frames: making sense of information technology in organizations,' *ACM Transactions on Information Systems*, (12:2), April 1994, pp 174-207.

Prinz, W. 'NESSIE: An Awareness Environment for Cooperative Settings', GMD-FIT, Germany, *Proceedings of the Sixth European conference on Computer supported cooperative work*, 1999, Copenhagen, Denmark, Kluwer Academic Publishers Norwell, MA, USA, 1999

Rapoport, R. N. 'Three Dilemmas in Action Research,' *Human Relations*, (23:6), 1970, pp 499-513.

Robinson, M. 'Double-level Language and Co-operative Working,' *AI & Society*, (5), 1991, pp 34-60.

Schmidt, K. and Simone, C. 'Coordination Mechanisms: Towards a Conceptual Foundation of CSCW System Design', *Computer Supported Cooperative Work (CSCW), The Journal of Collaborative Computing*, vol. 5, no. 2-3, 1996, pp. 155-200

Simonsen, J. and Kensing, F. 'Using Ethnography in Contextual Design', *Communication of the ACM*, (40:7), 1997, pp. 82-88.

Star, S. L., and Ruhleder, K. 'Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces,' *Information Systems Journal*, (7:1), March, 1996, pp 111-134.

Steinfield, C., Jang, C. and Pfaff, B. 'Supporting Virtual Team Collaboration: The TeamSCOPE System', *Group 99, Phoenix Arizona USA, ACM* 1999.

Suchman, L. "Office Procedure as Practical Action: Models of Work and System Design," ACM Transactions on Office Information Systems, (1), 1983, pp 320-328.

Suchman, L. Plans and Situated Actions. The Problem of Human Machine Communication, (1 ed.), Cambridge University Press, Cambridge, 1987.

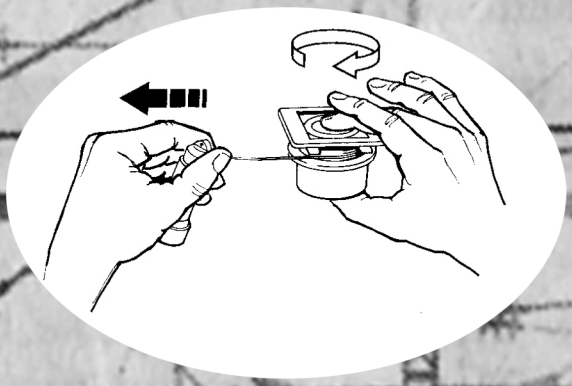
Susman, G. I., and Evered, R. D. 'An Assessment of the Scientific Merits of Action Research,' *Administrative Science Quarterly*, (23:4), December 1987, pp 582-603.

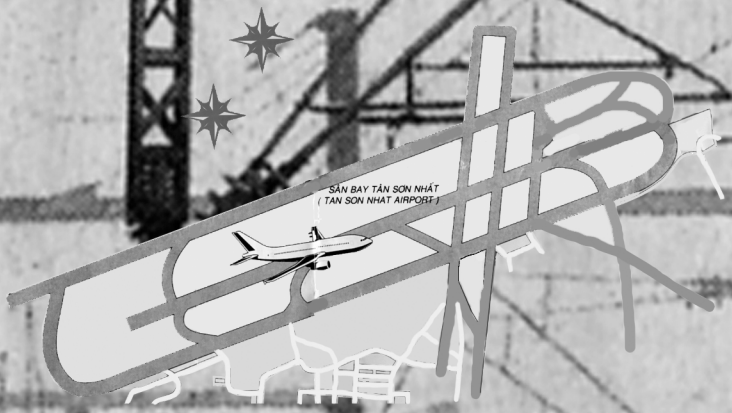
Tollmar, K., Sandor, O., and Schomer, A. 'Supporting Social Awareness @Work: Design and Experience', *in Proceedings of CSCW '96*, Cambridge MA, November 1996, ACM Press, pp. 298-307

Tyre, M., & Orlikowski, W. 'Windows of Opportunities: Temporal Patterns of Technological Adaptation in Organizations', *Organization Science*, (5:1), 1994, pp. 98-118.

Vidgen, R. and Braa, K. 'Balancing Interpretation and Intervention in Information System Research: The Action Case Approach'. In Lee, A.S., Liebenau, J., and DeGross, J.I. (Eds.) (1997): *Information Systems and Qualitative Research*, London: Chapman & Hall.

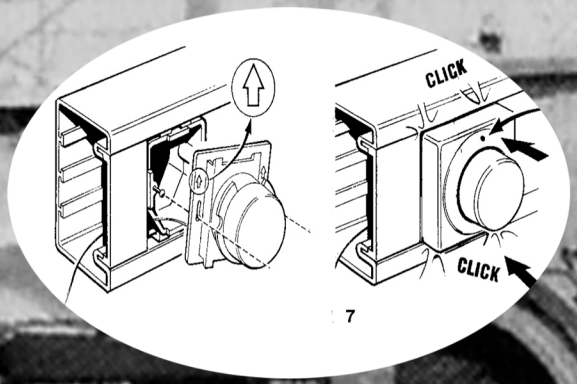
Yager, S.E. 'Using Information Technology in a Virtual Work World: Characteristics of Collaborative Workers', *SIGCPR '99*, New Orleans, LA, USA. ACM, 1999.

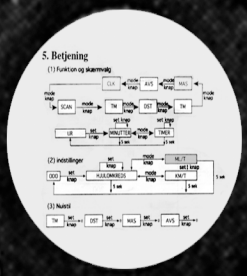




Joint Enterprise and the Role of the Intermediator

Challenges Managing Groupware in Global Virtual Teams





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Joint Enterprise and the Role of the Intermediator

Challenges Managing Groupware in Global Virtual Teams

Pernille Bjørn and Jesper Simonsen
Roskilde University
pbr@ruc.dk, simonsen@ruc.dk

Abstract: Managing groupware technologies in global virtual teams is viewed as a process of integrating technology and collaboration. This involves a continual negotiation of the team's goals, processes, and technology. We investigate organizational factors constraining this integration process, by analyzing the failure of integrating groupware into two global virtual teams within industry. We present an empirically driven interpretive case study conducted in a large distributed global organization. Based on the empirical observations, we reveal two organizational factors challenging the integration process: The importance of joint enterprise and the role of the intermediator.

1. Introduction

In order to achieve synergy and represent the best expertise available in various kinds of projects, there is an increasing need for collaborative work between dispersive participants within global organizations. Information and communication technologies in general, and groupware technology in particular, offers support for such virtual teamwork. In this paper we focus on groupware technology providing a shared repository available any time and any place. Groupware supporting collaborative work in global virtual teams are characterized as open-ended and configurable technologies [21]: They mediate interactions among multiple distributed actors, who not only are users but also

manage the system's structure as well as it's content. Organizational models for implementing such technologies in general, and within global virtual teams in particular, have only recently started to take form. Different approaches have been exploring the issue of integrating groupware in virtual teams [1, 2, 16, 23], and it is a well known fact that success with integrating groupware in virtual teams is highly dependent on the introduction process [6, 8, 10]. There exist a need to investigate which issues should be addressed when facilitating the introduction and integration of groupware. We address and analyze the failure of integrating groupware in virtual teams by asking the research question: Which organizational factors challenge the integration process of groupware in virtual teams?

We have conducted an interpretive case study of two global virtual teams within a transportation organization of around 100.000 employees located at sites in Europe, Canada, United States, and Asia. Both teams were formed by top management to develop common processes for doing software development within the organization around the globe. Our analysis elicits two organizational factors constraining the integration process: When participants are unable to negotiate their joint enterprise; and when nobody takes on the role as the intermediator facilitating the integration process. We argue that the introduction of groupware should address these factors, which in turn will support an integration process and aim at establishing a successful virtual collaboration.

The following part of the paper is divided into five sections: Theoretical background presenting resent contributions within the field and introducing core concepts; research method; case study, examining and analyzing the empirical data from the two virtual teams; and finally, a conclusion summarizing our findings.

2. Theoretical Background

Recent research has focused on what constitutes success in a groupware integration process. Jarvenpaa et al. [9] examine virtual teams and find that reciprocal trust has an important impact on team success. Kayworthland and Leidner [11] focus on virtual leadership of global virtual teams, identifying several aspects of successful leadership. Maznevski and Chudoba [18] carried out a longitudinal empirical study of three global virtual teams. They find that teams whose interaction incidents are in a temporal rhythm function more efficiently than teams who do not develop such rhythms. None of these researchers have specifically addressed the question of technology support. Turning to technology-focused studies, we find research focusing on customizing these open-ended systems [e.g. 7, 24, 25], though not specifically addressing the issue of integrating groupware within global virtual teams. Only a few studies [e.g. 16, 23] combine interests in both virtual teams, technology, and addressing the issue

of integrating groupware and collaborative work. However, researchers studying either organizational aspects of global virtual teams, technology, or the integration process, generally agree that when it comes to starting up a virtual team, technology is required to mediate and support the collaboration. A good technological introduction and integration process are important in fostering success [6, 10].

Overall, we view the integration process of groupware within teams as a negotiation/re-negotiation process [1]. A team needs to negotiate their project at its inception and continually re-negotiate their common project throughout the process until the project ends and the final report is completed.

In order to describe more specifically what a team needs to negotiate, we are inspired by literature concerning project management. Lindkvist and Söderlund [15] have addressed the question of "what is going on during project work". They examine the planning and scheduling aspects and identify a significant aspect of project work: The goal. The importance of goals has been investigated by Ferrán-Urdaneta [5], who states that goals have to be clear, measurable, and accomplishable, and general management objectives are not the same as project goals. While there is general agreement that goals are important for project and teamwork, Ferrán-Urdaneta [5] argues for the need for clear and measurable goals, while others state that goals are never clear and measurable but are often unclear and shifting [4, 15]. This does not imply that goals are less important, but rather that they play a different role within the project. For Lindkvist, Söderlund and Engwall [4, 15], goals allow participants to create a division of labor and to continually suggest adjustments and compromises. These important aspects of collaborative project work can be summarized by Wenger's [26] concept of joint enterprise.

A goal is more than a goal, it is a joint enterprise [26]. The joint enterprise comprises the ongoing negotiation of meaning as defined by the participants (the goal) in the very process of pursuing the goal (the team's collaboration process). The joint enterprise is not only intentional but becomes an embedded part of the collaboration by creating relationships of mutual accountability among the participants [26, p. 78]. Joint enterprise contains both the team's goal and the team's negotiated process of how to collaboratively reach that goal.

Olson and Olson [19] describe joint enterprise as the importance of developing a common ground for collaboration. They add that in order to support the collaboration by means of technology this requires collaboration readiness as well as collaborative technology readiness. Groupware systems that include a shared repository are characteristic in the sense that the repository seldom contains a large amount (if any at all) information when the team starts it's project. The information is typically in form of all documents produced by the team and this information evolves as the project evolves. The system's structure in terms of access rights, folder structure, notification functions, support for

custom document types (templates), document version control, etc. is a task left for the team to instantiate, configure, and continually maintain [3]. Research within knowledge management systems characterize this as the establishment of three major roles: The producer, the consumer, and the intermediator [17]. The role of the intermediator is defined as managing the system's structure as well as facilitating the users who produce and consume the information recorded in the repository [17, p. 61].

In light of these considerations, we can summarize that the integration process of groupware in global virtual teams includes the team's goals, collaboration, and technology. The team needs to continually negotiate what the project is about: Joint enterprise. This includes negotiating how to collaborate and also how to support the collaboration by means of groupware support. Finally, integrating groupware includes the role of the intermediator managing the structure of the system as well as facilitating the shared use of the system.

3. Research Method

Our background is based on earlier studies of groupware conducted in a large distributed financial organization. These studies demonstrated that integrating groupware in distributed project settings is significantly more problematic in comparison to other settings, such as organizational units like departments, special interest groups, or teams handling recurrent tasks [3]. The difference in complexity is mainly due to the temporary constellations related to the context of projects. Projects are characterized as a temporary context where different actors meet for a limited time period. We analyzed a range of critical conditions that influence integration of groupware [22], providing us with an initial idea of the conditions related to distributed and collaborative projects. On this basis, we conducted the study presented in this paper.

The empirical data stems from studying two global virtual teams. The teams were observed during the course of their projects in 2002 and 2003 and interviews were conducted after the projects had ended in 2003.

In order to get familiar with the company one of the authors was furnished with an office for several weeks. During this time various reflective conversations were held with the team managers and a senior management team. Thirteen sessions were observed where internal consultants reviewed the software work processes as part of both projects. Focusing particularly on the two teams and their collaboration process, we conducted a two-hour focus-group-interview involving both project managers. This was followed up by an individual reflective conversation with each of the project managers lasting two hours each. We also conducted two single-interviews and one group-interview with participants from the project teams. Analyses of important documents and of the structure and content of one of the teams' Lotus NotesTM database was also part

of the study. At the end of the study, we presented the findings at a senior management meeting, where the project managers reviewed our findings.

4. Case Study

The citations below are all taken from interviews with various participants from the two teams in the following referred to team 1 and team 2.

4.1 Joint Enterprise: The Story of Team 1

Team 1 was formed by top management, with the objective to define, develop, and deploy 'one set of processes' for doing software development. The team consisted of 10 participants located in Germany, Denmark, Thailand, Finland, and at two different sites in Sweden. The different participants were chosen to represent expertise from all sites involved. They had a Lotus Notes database set up to support their collaboration, but they never succeeded in integrating this groupware technology into their team work. This is the tale of Team 1, focusing on their ability to integrate groupware into their collaboration.

Team 1 began their project at a workshop where the project manager had planned sessions for all participants to get to know each other and to start developing their joint enterprise. He introduced a knight symbol for the team to identify themselves by inspired by the tale of King Arthur of Camelot [12].

> "And then I wanted them to have some kind of symbol, and I had the idea of calling us knights. We are the knights fighting for one common set of processes. I gave them playmobil [knight] figures to put on their desks."

Besides the knight symbol, the project manager also suggested rules for how email communication should be distributed. He arranged weekly phone meetings for all participants, he asked each participant to make a weekly report describing their activities during the week, and he gave them access to their shared Lotus Notes groupware system. In this way the project manager persistently tried to facilitate the team to initiate collaboration. In spite of the manager's good intentions, the participants did not succeed in articulating their work and collaboration at the workshop. A participant describes what he viewed as an unproductive workshop, emphazising difficulties in discussing and deciding on common goals for the collaboration within the virtual team.

> "It [the workshop] was managed in a democratic way. [The project manager] had a goal that we should make a vision. But you cannot do that, ten people meeting for the first time, and trying to decide what this team should even be working on. [...] So we should state a vision, but nothing has developed since that. [...] It is easier when a manager enters and states that we have to work in this direction."

It is easier to address direct orders from management than it is to negotiate a shared understanding of a goal, a process, and a collaboration. The manager's

"democratic way" increased complexity. However the reason for establishing an international team for this kind of a task is to use experts from all sites to develop *the* common set of processes that they all should comply with. The necessary engagement, involvement, motivation, and commitment might indeed be dependant on pursuing such a democratic management approach.

The difficulties emerging at the workshop were symptoms of the main issue and challenge within Team 1: A lack of common understanding of their joint enterprise. The participants had not obtained a clear idea of the common goals and objectives. The team's participants mostly continued doing their work as they did before entering the project. For example, one member thought that to maintain a site-local database with no relation to process-definition was the same as contributing to the project. It also became clear that different interpretations of the goal existed not only within the team but also within top management. This in turn effected Team 1 and resulted in members working in quite different directions: Some focusing on safety critical software; some developing common coding standards; and others developing processes for vital software. The participants also had different backgrounds for joining the team. Some were selected because they were the only software process experts available at a site and others had a specific interest in code-standards, configuration management, or in software version control. Most participants were busy working in other teams parallel to participating in Team 1. For some this reduced their contribution to only participating in the weekly phone meeting. The result was unsuccessful phone meetings.

> "We have a phone conference at least once a week. [...] It seems it don't really work. Even if they are just discussing technical things. There is no discussion."

The project manager explained that difficulties with communication meant that much of his time was spent traveling, trying to get the team to collaborate. He was eager to encourage participants to phone each other to discuss various topics, but none of the members contacted other members. When asked why they didn't contact each other, the participants said they didn't know what they should discuss with each other, so there was no reason for calling. Because the team did not collaborate, they did not succeed in using the groupware technology nor any other kind of technology to support the collaboration: There was no collaboration.

The project manager and the team did not fully succeed in achieving the goals of the kick-off workshop. They did not manage to negotiate the joint enterprise, the process, or the groupware technology. None of the initiatives supporting communication worked as planned by the project manager. When the difficulties concerning communication in Team 1 were later discussed between the project manager of Team 1 and the project manager of Team 2, the Team 2 project manager was also puzzled by the situation. He stated that it seemed that the project manager of Team 1 had done all the right things but was still

experiencing problems. The project manager of Team 1 suggested the main problem within the team as follows:

> " It's quite important for the group members to ask am I working on the right thing? But we didn't have the time to define it – so we didn't have this one [the alignment tool]"

The knight figure, or the "alignment tool" (a workshop technique including an elaborated question statement about the project), was supposed to create a common ground for the project participants, not only in form of an identity but in the form of concrete guidelines for working.

Different factors appeared to contribute to the failure of the negotiation process at the kick-off workshop. Participants' varying motivations, different cultures, language differences, etc. all appeared to play some part, but a primary factor was that the team was unable to specify what it actually means to develop 'one set of processes'. They were unable to transfer top management objectives into their own goals, tasks, and deliverables. The indefinite nature of 'what' they were supposed to collaborate about constrained the participants in discussing the team's work process and technology use. It was impossible for the team to discuss how to collaborate.

We learned from Team 1, that participants are unable to discuss how they want to collaborate if they do not share an understanding of what they are supposed to collaborate about. The latter is a much more fundamental question, which was not presented to Team 1 in the kick-off workshop. There can be different interpretations of general objectives such as the statement "developing one set of processes", but as a foundation for a single interpretation, the team needs to have a common understanding of what this statement means. As a result, the team did not manage to reach a common ground: They failed to establish a joint enterprise.

Concluding the tale of Team 1, we suggest that an organizational factor that constrains the negotiation of how the team should collaborate (including how groupware should be used to support the virtual teamwork) is when the team is not able to negotiate is the joint enterprise for the project.

4.2 The Intermediator Role: The Story of Team 2

Team 2 consisted of five participants located in Canada, United States, United Kingdom, and in two different sites in Sweden. It's objective was to define and pilot "a software configuration management process" to be used throughout the global organization. Team-members were chosen on the basis of their expertise in configuration management. Some also were quite experienced in refining and operationalizing mandates and goals from top management.

The collaboration process in Team 2 was planned around four regular one-week, co-located workshops held respectively in Canada, Sweden, United Kingdom, and Untied States. Despite experiencing various personal difficulties,

the team managed to engage in successful collaboration and complete their objective. Team 2 was however unable to integrate groupware in their team work. Even though they all had access to a Lotus Notes groupware system, they ended up mediating their collaboration entirely by phone and email.

The team's initial co-located workshop was held in Canada and focused on negotiating the joint enterprise including the process ahead. The participants negotiated a common interpretation of management's overall objective "to develop and define a common high-level software configuration management process". Team 2 translated this general objective into a project definition, which comprises a list of concrete activities for the team to perform.

> "The Steering committee said: We want a common high-level process and we want a tool. And we said we are going to take that and make a few objectives. Because we have to put a scope around that. Sure we'll define a process, and we give you a deployment strategy. [...] So we had to bound it a bit. And we came up with objectives and we all agreed to them."

It is evident that being fewer people (five as compared to ten in Team 1) had a positive effect on negotiating the goal, but more crucial is that Team 2 succeed in translating general objectives from top management into workable project goals: The joint enterprise. Having decided on what to collaborate about, Team 2 started negotiating how to collaborate.

> "(...) The objective we build together and we build the mandate. And we build team-roles, we used some [...] tools. Here is what we think we will do; here is the project, we find this process, we tried it out, we decided on the tools, and then we looked at potential customers, we did team ground rules."

Even though Team 2 explicitly negotiated how to collaborate at the initial workshop ("we did team ground rules"), they continuously negotiated how to collaborate throughout the whole project period. They negotiated explicitly by reflecting on difficulties in the collaboration activities and by trying to address these difficulties by proposing new rules and norms for their practice. They also negotiated implicitly by participants acting in certain ways, like constraining or enabling other participants ability to act. The negotiation of how to collaborate was thus an ongoing continual process, which primarily took place during the regularly co-located workshops.

While Team 2 managed initially to negotiate the joint enterprise, the question of how their groupware system should support the collaboration was an issue they did not manage to seriously reflect on. Their Lotus Notes system was never really used during the project.

After the initial workshop, the team used email to support the coordination of deliverables and to review comments arising between workshops The team did not attempt though to integrate groupware into this collaboration process. By reflecting on the use of email, it became clear that email resulted in difficulties concerning document location, e.g. where the most recent version of the project mandate was located.

> "I will go looking in my emails because I saved them all. And I would have to search them for the project mandate, and I would find them all, and then I would look date wise, and then I would look content wise, and then I would give you one. Is it the right one, is it the current one? I don't know. And if you call [the project manager] you can't trust what he gives you – he just lost his complete email database. We have to send him everything."

Participants expressed a need for having all documents available at one shared repository. None of the participants (including the project manager) had an overview of the project documents. This was a situation that created extra work for all participants. When attempting to locate a specific document, members would look into their local email database, sort the emails by date, and then maybe retrieve the right document. When reflecting on this experience, they recognized a need for reducing this complexity in their collaboration. At the initial workshop, one participant considered suggesting using the Lotus Notes system to the team. She was however insecure of her role in the team and did not have the authority needed for pushing this idea further.

> "There was some discussion that we should have a common Lotus Notes database. [...] We have one, but nobody put the project schedule in it. [...] That's really embarrassing [not using the Lotus Notes system]. I would have expected it. I raised the question, so I feel that maybe I should have pushed harder to get this working. But I didn't feel the rest of the team was up to it. (...) if you are supposed to be an SCM-expert [Software Configuration Management-expert] why do everything backwards, why do everything the wrong way. That is why I think it is embarrassing. Don't tell anybody about this – it would spoil our reputation."

Even though Team 2 did manage to negotiate their joint enterprise, they did not negotiate how to support their collaboration with groupware: Team 2 "was not up to it". The team had access from the very start of the project to the groupware system, and using it was mentioned at their first workshop. However, as everyone was busy establishing the project and developing a joint enterprise, nobody took any further action concerning the matter of using groupware. Later in the collaboration process, the lack of a shared repository became an issue when the team members experienced problems managing the growing number of (different versions of) project documents. At this point in time the team acknowledged a collective group need for groupware support not like earlier, where just one participant anticipated such a need but was unable to "push harder to get this working".

> "We did ask for the database, but there was no kind of instructions of this is the way to use it, this is how you create [...] there is no support from whoever's going to support the database that would help you get a good database template."

This situation can be explained by the lack of an intermediator in Team 2. Even though they succeed in negotiating joint enterprise, nobody from Team 2 took the role of the intermediator, and nobody outside the team went in and facilitated the intermediator role. The result was that Team 2 was unsuccessful in integrating groupware to support their distributed collaboration.

In concluding the tale of Team 2, it appears that apart from managing to negotiate the joint enterprise successfully, teams are also required to negotiate groupware support in order to integrate groupware in their collaboration. Managing the process of negotiating how to use groupware and to instantiate, configure, and maintain the system's structure requires a facilitator taking on this intermediator role. We suggest that an organizational factor constraining the negotiation of how groupware should support the collaboration within virtual teams is when nobody takes the role as the intermediator facilitating this integration process. The intermediator role might be established in various ways. Some participants may already be aware of the need for this role from earlier experiences. One participant in Team 2 saw this need, but she did not have the authority to bring this issue on the agenda. The intermediator role might also be taken by a facilitator from outside of the team. Team 2 did in fact (without success) ask for such support.

5. Conclusion

We investigated organizational factors constraining the integration process of groupware in global virtual teams, a process of continual negotiation of joint enterprise, collaboration, and the use of groupware. The investigation was an empirically driven interpretive case study, acted out in real-world environments consisting of two global virtual teams within a large, global, and distributed industry.

We agree with earlier research, that it is not sufficient to simply apply groupware by making it accessible to the participants [see e.g. 8, 10, 20]. In both cases presented, groupware was accessible, yet neither team managed to integrate it into their collaboration. It appears, with respect to virtual teams conducting projects, that a successful groupware integration process is highly dependent on conditions formed in the projects' introductory stages.

Drawing on our empirical data, we suggest two propositions about integrating groupware in virtual teams:

(1) Managing the integration of groupware in virtual teams is a process dependent on the negotiation of the joint enterprise for the project. This includes how to collaborate and how to use groupware to support collaboration. The lack of a joint enterprise seriously constrains collaboration as well as constrains introducing collaborative support by means of groupware technology.

(2) Managing the integration of groupware includes a process of structuring the groupware system and it's repository as well as facilitating how to use the system. This process is seriously constrained if no one fulfils the role of the intermediator.

Our first proposition states the importance of negotiating the joint enterprise within project work in virtual teams. We found that Team 1 was unable to negotiate how to collaborate (even though the project manager eagerly tried to

facilitate this process), because the participants disagreed in what their joint enterprise was. It is important to notice that embedded in negotiating the joint enterprise is the issue of how to collaborate. In practice, you cannot distinguish between negotiating what the team should aim at (goal) and how to reach this aim (through a process of collaboration).

You might have a negotiation of joint enterprise without addressing how to use technology support, as we experienced with Team 2. This will also reduce the possibility for successful integration. Our second proposition states the importance of someone filling the intermediator role and thus facilitating the negotiation of how to support collaboration by means of using groupware. Without the intermediator, whether they be a member of the team or a consulting facilitator, the chance for successful integration decreases, even if the team has acknowledged a need for using a shared repository.

We conclude that these two organizational factors challenge the process of managing groupware integration in global virtual teams. First we found that uncertainty on the part of the participants of the joint enterprise for the project constrains the negotiation of how to both collaborate and use groupware to support this collaboration. Lastly we found that without someone taking on the intermediator role, the integration process of groupware into the virtual teamwork is constrained.

We hope our work may inspire future research in the form of descriptive studies of how virtual teams manage the issue of supporting collaboration with groupware, as well as prescriptive studies aiming at developing normative guidelines with regards to obtaining prerequisites for integrating groupware.

References

[1] Bjørn, P., "Re-negotiating Protocols: a way to Integrate Groupware in Collaborative Learning settings", in *Proceedings of ECIS'03*, Naples, Italy, 2003.

[2] Bjørn, P. and Scopula, A., "Groupware Integration in Virtual Learning Teams – a qualitative analysis based on the TAM-model", in *Proceedings of IFIP 8.6,* Leixlip, Ireland, Kluwer Academic Publisher, pp. 289-312, 2004.

[3] Bødker, K., J.K. Pors, and J. Simonsen, "Implementation of Web-based Information Systems in Distributed Organizations – a Change Management Approach", *Scandinavian Journal of Information Systems*, Vol. 16, pp. 85–116, 2004.

[4] Engwal, M., "The futile dream of the perfect goal", In Shalin-Andersson, Kerstin and Söderholm, Anders (eds.), *Beyond project management – New perspectives on the temporary permanent dilemma*, Copenhagen Business School Press pp. 261-277, 2002.

[5] Ferrán-Urdaneta, C., "Teams or Communities? Organizational Structures for Knowledge Management", *SIGCPR'99*, New Orleans LA, ACM, pp. 128-134, 1999.

[6] Gallivan, M., "Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework", *The DATA BASE for Advances in Information Systems*, Vol. 32, No. 3, pp. 51-85, 2001.

[7] Ginsburg, M. and Duliba, K., "Enterprise-Level Groupware Choices: Evaluating Lotus Notes and Intranet-based Solutions", *Computer Supported Cooperative Work: The Journal of Collaborative Computing*, vol. 6, pp. 201-225, Kluwer Academic Publisher, 1997.

[8] Grudin, J., "Groupware and social dynamics: Eight challenges for developers", *Communication of the ACM*, Vol. 37, No. 1, pp. 92-105, 1994.

[9] Jarvenpaa, S.L., Kathleen, K, and Leidner, D.E., "Is Anybody Out There? Antecedents of Trust in Global Virtual Teams", *Journal of Management Information Systems*; Spring 1998; Vol. 14, No. 4; ABI/INFORM Global pg. 29, 1998.

[10] Karsten, H. "Collaboration and Collaborative Information Technologies: A Review of the Evidens", *The DATA BASE for advances in Information Systems,* Vol. 30, No. 2, pp. 44-65, 1999.

[11] Kayworthland, T.R. and Leidner, D.E., "Leadership Effectiveness in Global Virtual Teams", *Journal of Management Information Systems,* Winther 2001/2002; Vol. 18, No. 3; ABI/INFORM Global, pp. 7-40, 2002.

[12] Kostner, J., *Virtual Leadership – Secrets from the round table for the multi-site manager*, Warner Books, 1994.

[15] Lindkvist, L. and Söderlund, J., "What goes on in projects? On goal-directed learning processes", In Shalin-Andersson, K. and Söderholm, A. (eds.): *Beyond project management – New perspectives on the temporary permanent dilemma*, Copenhagen Business School Press pp. 278-291, 2002.

[16] Majchrazak, A., Rice, D.E., Malhotra, A., King, N, "Technology Adaptation: The case of a Computer-Supported Inter-organizational Virtual Team", *MIS Quarterly*, Vol. 24, No. 4, pp. 569-600, 2000.

[17] Markus, M.L., "Toward a Theory of Knowledge Reuse: Types of Knowledge Reuse Sit¬ua¬tions and Factors in Reuse Success", *Journal of Management Information Systems,* Vol. 18, No. 1, pp. 57-93, 2001.

[18] Maznevski, M.L., Chudoba, K.M., "Bridging Space over Time: Global Virtual Team Dynamics and Effectiveness", *Organization Science*, Vol. 11, No. 5, September-October, pp. 473-492, 2000.

[19] Olson, G.M. and Olson, J.S., "Distance Matters", Human-Computer Interaction, Vol. 15, pp. 139-178, 2000.

[20] Orlikowski, W.J., Learning from Notes: "Organizational Issues in Groupware Implementation", *Information Society* Vol. 9, No. 3, pp 237-250, 1993.

[21] Orlikowski, W. and Hofman J.D.,"An improvisational model for change management: The case of Groupware technologies". *Sloan Management Review*, Vol. 38, No. 2, pp. 11-22, 1999.

[22] Simonsen J. and J.K. Pors, "Conditions for Change Related to Groupware in a Distributed Organization – a Case Study", in *Proceedings ECIS'03*, Naples, Italy, 2003.

[23] Vreede, G.J., Davison, R.M. and Briggs R.O., "How a silver bullet may lose its shine", *Communication of the ACM*, August 2003, Vol. 46, No. 8, pp. 96-102, 2003.

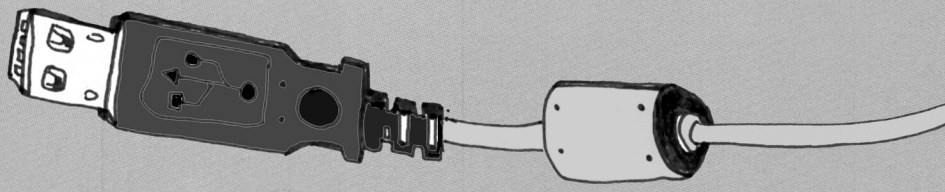
[24] Wang, W. and Haake, J.M., "Tailoring Groupware: The Cooperative Hypermedia Approach", *Computer Supported Cooperative Work: The Journal of Collaborative Computing*, Vol. 9, pp. 123-146, Kluwer Academic Publishers, 2000.

[25] Wasserschaff, M. and Richard, B., "Supporting Cooperation through Customisation": The Tviews Approach, *Computer Supported Cooperative Work: The Journal of Collaborative Computing*, Vol. 6, pp. 305-325, Kluwer Academic Publishers, 1997.

[26] Wenger, E., *Communities of practice - learning, meaning, and identity*, Cambridge University Press, 1998.

Virtual Team Collaboration

Building Shared Meaning, Resolving Breakdowns and Creating Translucence



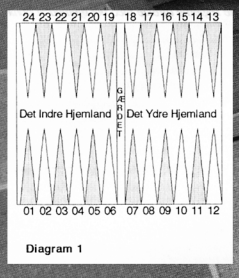


Diagram 1

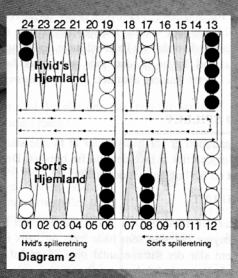


Diagram 2

Bjørn, P., and Ngwenyama, O. "Virtual Team Collaboration: Building Shared Meaning, Resolving Breakdowns and Creating Translucence," Information Systems Journal, under second review.

Virtual Team Collaboration

Building Shared Meaning, Resolving Breakdowns and Creating Translucence

Pernille Bjørn
Roskilde University, Denmark
pbr@ruc.dk

Ojelanki Ngwenyama
Ryerson University, Canada
ojelanki@ryerson.ca

Abstract: Managing international teams with geographically distributed participants is a complex task. The risk of communication breakdowns increases due to cultural and organizational differences grounded in the geographical distribution of the participants. Such breakdowns indicate a lack of shared meaning and general misunderstandings between participants. In this paper, we address the complexity of building shared meaning. The authors investigate the communication breakdowns that occurred in two globally distributed virtual teams. Providing an analytical distinction of building shared meaning at three levels, the authors examine communication breakdowns that can be attributed to differences in lifeworld structures, institutional structures, and work process structures within the team. The authors argue that translucence is essential for building shared meanings. We find that all communication breakdowns are manifested and experienced by the participants at the work process level; however, resolving breakdowns may require critical reflection at other levels. Where previous research argues that face-to-face interaction is an important variable for virtual team performance, our empirical observations reveal that communication breakdowns related to a lack of shared meaning at the lifeworld level often becomes more salient when the participants are co-located than when geographically distributed.

1. Introduction

Globally distributed organizations often bring together people of different cultures and languages across heterogeneous locations for collaboration on specific projects. These are typically referred to as virtual teams. Virtual teams are groups of geographically and/or organizationally distributed participants who collaborate towards a shared goal using a combination of telecommunications and information technologies (IT) to accomplish a task (Kirkman et al., 2004; Lipnack & Stamps, 2000; Majchrzak et al., 2000; Townsend et al., 1998). Some researchers reserve the concept of 'virtual team' for situations in which the team members never meet physically (e.g., Jarvenpaa et al., 1998), while others use it to refer to situations in which team members *rarely* meet face-to-face and, as such, use information technology as the primary medium of interaction (Chudoba et al., 2005). Still others view virtual collaboration as a continuum between face-to-face encounters and pure IT mediated interaction (Maznevski & Chudoba, 2000). More recently, concepts such as "hybrid teams" or "far-flung teams" have been proposed to define teams with geographical distributed participants performing highly interdependent tasks that meet face-to-face only occasionally (Bell & Kozlowski, 2002; Fiol & O´Connor, 2005; Griffith et al., 2003; Malhotra & Majchrzak, 2004). In this paper we investigate the practices of international virtual teams organized within a hybrid work arrangement characterized as a geographically distributed collaboration that is mediated by technology and is interrupted by regular face-to-face encounters in co-located settings.

Virtual teams must place the ongoing challenge of managing the collaboration at the very centre of teamwork. Managing collaboration means managing the coordination and communication between the participants and aligning the distributed work activities toward a common goal. Geographically distributed team members face a difficult challenge when negotiating their collaboration. To be able to engage in fruitful negotiations and to avoid or quickly recover from breakdowns in communication, the team members need to develop a 'shared meaning context' and common language for making sense of each other's actions. In co-located collaborations, participants have access to each other through daily encounters such as meetings or coffee breaks. It is in these encounters that, over time, they develop the 'shared meaning context' they use to interpret and make sense of each other's actions in the collaborative work setting. However, geographically distributed participants do not have frequent access to each other and, consequently, face a significantly more difficult task when developing a shared context of meaning (we will discuss this in more detail later). While they do have access to a common repository of e-mails, memos, documents, reports, or artefacts of the collaborative process, they can ascribe local interpretations that are quite different from the intended meanings at their

point of entry. Since they are geographically distributed, access to each other is mediated via the traces of actions located in the technology such as email and/or information repositories. The lack of regular physical encounters for social or work related activities inhibits the development of a shared meaning context, which results in difficulties in communication and negotiation and a higher risk of breakdowns in collaboration. But what is a shared meaning context? Just how does a virtual team develop it?

In this paper we introduce the concepts shared meaning context and translucence, and demonstrate their usefulness for analyzing and theorizing about geographically distributed collaboration within teams. Briefly, translucence can be defined as the triangulation of visibility, awareness, and accountability. Likewise, we define the shared meaning context as the background knowledge that guides actors to organize and shape their interpretations of events. We will discuss these in more detail in the next section. Our primary interest is to explicate how these concepts are important for understanding the social context and practice of collaboration, and the design of effective collaborative work practices and technologies for collaboration. We focus our investigation on the case studies of two international teams engaged in a hybrid work arrangement and we explore three specific research questions: (1) What is a shared meaning context, how is it developed and how do people use it for sense making and action? (2) What is translucence, why is it important and how can it be achieved in a teamwork situation with geographical distributed participants? and (3) How can the development and maintenance of translucence and meaning contexts be supported in geographically distributed teams? In section 2 we formally define and discuss the concepts of shared meaning and translucence related to the organizational context. In section 3 we present the organizational context of the case study including two sub-sections presenting the two teams investigated. In section 4 we present our research approach and our data sources. We then present our theoretical analysis of the empirical observations. Specifically, in section 5, we focus on how translucence is created at the three levels; in section 6, we reflect on the limitations and possibilities of technology mediation of translucence. Finally, we offer conclusions in section 7.

2. The Organizational Context of Collaboration

It has been pointed out elsewhere that all actions of participants within an organization are socially oriented and take place within a predefined organizational context (also called the social context) (Lyytinen & Ngwenyama, 1992; Ngwenyama, 1998; Ngwenyama & Lee, 1997). For the sake of analytical clarity, we will delineate three conceptual structures of the organizational context: (1) the lifeworld; (2) institutional structures; and (3) work practice. The *lifeworld* is the intersubjective reality that is built on the interpretations of all

personal work experiences as well as the collective experiences of the members of an organization (Ngwenyama & Klein, 1994). Habermas defines the concept of as being formed by the life experiences and beliefs that guide peoples' attitudes, behaviours and actions in their interaction (Myers & Young, 1997). It consists of the unarticulated and taken-for-granted background of assumptions, knowledge, culture, beliefs, and values. It forms the frame of reference that provides individuals with implicit guidelines for organizing and shaping their interpretations of events and situations, thus giving these meaning (Orlikowski & Gash, 1994; Pentland, 1995). The lifeworld schemes serve as filters of the collective reality like a veil through which people observe and interpret the actions of others (Ngwenyama & Klein 1994, p. 133). Fractures in lifeworld schemes surface only during breakdowns of understanding or when seemingly contradictory organizational actions are closely investigated (Schein, 1992). *Institutional structures* comprise explicit, articulated and visible organizational structures, such as policies, norms, symbolic artefacts, ritual activity and patterned behaviour (Gioia, 1986; Lundberg, 1989). Organizations continually reshape themselves through continuous negotiations of meaning and understanding by constructing, consolidating and developing norms and evolving language (Klein & Truex, 1996).

Work practice comprises the profession-specific norms, work practices, and languages. In organizations, various groups of people develop different vocabularies (i.e., lexicons) and everyday speech usage (i.e., parole), based on their professional background and the nature and organization of their work functions. For example, some professions describe and organize the work, while others perform the work (Holmqvist, 1989). Groups develop different lexicons and parole for their traditional workplace experiences that may be different from those developed by other groups. When groups from different locations work together these differences in language use can lead to miscommunication. Developing a common work-language is a process in which various uses of language are in constant contact, influencing each other and creating new language forms and meanings.

Individuals tend to look upon their national language as the default value for interaction (Holmqvist, 1989). For international teams, the situation is more complex since participants do not share a national language, nor do they constantly exchange lexical differences or adopt new vocabularies from one another. Thus, the possibility for creating new language forms and building shared meaning is very limited. Expanding this discussion, we turn to the influential notion of double-level language which consists of formal and cultural levels of discourse (Robinson, 1991). Collaborating people need a formal language, as in the text documents produced in a collaborative act. However, all documents also include language at the cultural level, which supports the local understanding and interpretation of the text. Participants engaging in teamwork

have personal a priori notions of what teamwork is about, what the objectives are, and how the collaboration process should be executed. This a priori knowledge can be labelled as pre-interpreted scripts of the symbolic knowledge, patterns of meaning about the organization and relationships among people at work. When placed in a team, a participant's frame of reference, or a priori knowledge, may be challenged by the other team members' interpretations of work, relationships, expectations, etc. In virtual teams, participants do not have access to the cultural level of language of the other participants because they lack regular person-to-person interface where these frames of reference are established. This increases the risk of communication breakdowns.

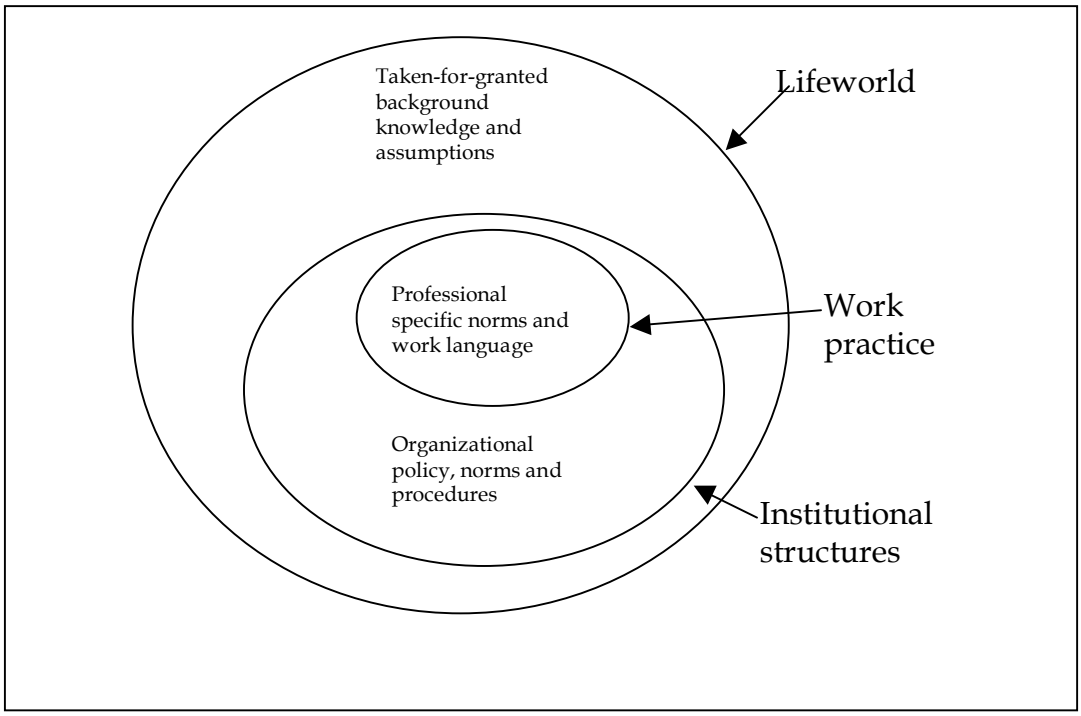


FIGURE 1: THREE ANALYTICAL LEVELS OF THE ORGANIZATIONAL CONTEXT

For all organizational actors, the lifeworld and institutional structures of the organization define the possibilities and potential for action and provide a meaning context that they draw upon to interpret each other's actions. In everyday action situations (work practices), the organization's policies, norms, and resources serve to enable, constrain, and sometimes prescribe what is proper or improper, and to lend meaning to an individual's actions. The institutional structures also define authority, and status of the individuals within the organization. As actors mediate action situations, they draw upon these stocks of knowledge, as well as material and nonmaterial resources of the organization (Lyytinen & Ngwenyama, 1992; Ngwenyama & Lee, 1997). While executing their work activities, actors rely upon the fact that they share aspects of the organizational context on key elements and categories. Thus, the organizational context has numerous practical consequences for teamwork.

2.1 Breakdowns and Translucence in Virtual Teams

The efficacy of teamwork is dependent on how well participants are socialized into the organizational context and their ability to make sense of and respond to each others' actions (Suchman, 1987). The activities of teams is no different, as Ngwenyama and Lyytinen (1997) state, "groupwork is a web of coordinated social actions, performed by the participants to achieve a joint outcome". A foundational feature of teamwork is communicative action. Many studies note that communicative action is an emergent and time-consuming process of establishing a mutual understanding that is crucial to the success of virtual teams (Bjørn & Simonsen, 2005; Cramton 2001; Malhotra & Majchrzak, 2004; Olson & Olson, 2000). Failure to establish and maintain shared meaning has been found to have serious consequences for collaboration (e.g., failure of information exchange or the interpretation of silence) (Cramton, 2001). Also, sharing knowledge is a fundamental feature of collaboration, which is closely related to the process of building shared meaning, since it is in 'the process of consensus building that knowledge is shared and visa versa' (Malhotra & Majchrzak, 2004). A new virtual team which brings together people from different subgroups of the wider organization can be viewed as a new emerging organization in which shared understanding, work routines and commitment to common goals must be negotiated (Mark & Poltrock, 2003). However, in a new virtual team, the processes of becoming one organizational unit is usually fragile and prone to failures and breakdowns because the participants come from and are socialized into various lifeworlds, institutional structures, and work practices. Further, communicative activity, which is critical to the development of the new organizational context, is also dependent upon a common language, media, and a shared understanding of the organizational context (Ngwenyama & Lyytinen, 1997). As Orlikowski and Gash point out, congruence, the alignment of individual frames of references, is necessary for establishing and maintaining a virtual team. Congruence refers to related, but not identical, structure and content. Incongruence implies important differences in expectations, assumptions, or knowledge about key aspects of the situation (Orlikowski & Gash, 1994). Congruence requires the development of shared lifeworld experiences upon which sense making, negotiating of collaboration and shared objectives, and activities can be based.

New virtual teams may breakdown (Hinds & Mortensen, 2005) due to a lack of common understanding and translucence in the collaborative practice. A breakdown is a disruption that occurs in the work process when previously successful work practices fail, or changes in the work situation (new workgroup, new technology, policy, etc.) nullify specific work practices or routines of organizational actors and there are no ready-at-hand recovery strategies (Ngwenyama, 1997). Flores et al. (1988) offer another similar definition: 'a breakdown is any interruption in the smooth unexamined flow of action'. They

include events that participants might assess as negative or positive new opportunities. Breakdowns affect the work situation on all three levels. On the lifeworld level, breakdowns challenge the taken-for-granted constitutive knowledge of actors and force actors to re-assess their mental models of the work situation and their work routines. On the work process level, breakdowns call into question the efficacy of teamwork practices and routines and force their re-assessment and redesign. And at the institutional level, they may force changes in policy, procedures and technologies. Breakdowns can occur at any level, but are usually clearly visible at the work processes level either as the breakdown itself or as the consequence of a breakdown at another level. At the work practice level, breakdowns can occur due to misinterpretation of a situation or the failure of a work routine closely connected to the professional context. Recovery from work-practice breakdowns requires that the actors engage in critical reflection to make sense of the situation and adjust her work practice. However, when this fails, an actor might elicit assistance from a colleague to understand and resolve the situation. On the institutional level, breakdowns can emerge due to misunderstandings or misinterpretation of the explicit and visible structures of the team and its relation to the organization. To recover from such breakdowns, the participants must switch from routine activity and engage in a process of restoring the background conditions upon which their collaboration is dependent, often including reflections on all three levels (Ngwenyama & Lee, 1997). In such a situation, the actors would generally engage each other in a debate of the issues until they agree on a course of action to resolve the breakdown.

Level of shared meaning	Communication breakdown	Resolving breakdown
Lifeworld level	Challenging the taken-for-granted constitutive knowledge	Re-assessment of both their mental models and work routines
Institutional level	Challenging existing organizational policies, procedures, technologies and norms	Re-assessment of policies, procedures, technology and norms
Work practice	Questioning the efficacy of teamwork practices and routines	Re-assessment and re-design of teamwork practices

TABLE 1: TYPES OF COMMUNICATION BREAKDOWNS AT THE THREE LEVELS

Poor translucence can lead to communication breakdowns. Socially significant information about the work situation (e.g., when one collaborator's actions could interfere with another's actions) should be clear and visible. Translucence has been noted as important for collaborative technologies, and it has been proposed that systems need to make users aware of appropriate information in a low-effort, even subconscious way that does not interfere with the user's primary task (Ebling et al., 2002). Socially translucent systems allow participants in groups to observe the actions of others, support their collective activity, and consist of three

characteristics: visibility, awareness, and accountability (Erickson & Kellogg, 2000). This enables participants to react according to their co-collaborators' actions. Awareness and accountability are closely connected and it is hard to distinguish between them in a face-to-face situation, they are however, less distinguishable in a mediated context. We agree with Health et al. (2002) that awareness is not a state of mind, a stable frame of reference, but rather it is a feature of practical action accomplished through ongoing collaborative activities. Awareness, as a part of translucence, brings out the social rules of behaviour. When social information becomes visible, people become aware of others' actions and presence; thus, they will adjust their actions accordingly. Moreover, translucence of others' actions means that one's own actions are likely to be visible too. As such, actors will act with the knowledge that their own actions may be judged by team mates. Hence, translucence and visibility foster accountability[1].

Translucence is important on all three levels of an organization. Breakdowns can also occur when actors fail to observe the norms or fail to comprehend the actions of others (Ngwenyama & Lee, 1997). We believe a common language for negotiating collaboration is important for interaction in virtual teamwork; however, we believe that it should be a language that emerges from practice through negotiation and re-negotiation of collaborations (Bjørn, 2003).

It is important to note that parts of communication are invisible in formal representation, as in final documents, visual presentations, or reports. These may be missing information about the interpretation of the objects at the cultural level. Understanding the relationship between visible and invisible communication and cooperation within a concrete collaborative practice, it is important to determine what counts as values in the setting, since values provide us with a deeper understanding of the cooperation under investigation (Star & Strauss, 1999). Descriptions of work involving perspectives and interests, and especially articulation work at a cultural level have a tendency to disappear from formal descriptions and representations. The further removed (both mentally and geographically) people are from the work of others, the more simplified their views of the work (Suchman, 1995). Important parts of collaborative practice become invisible at a distance. Since the distance and boundaries increase in virtual collaborative practice, visibility of the collaborative practice becomes vital. We do not propose that the ultimate goal for distributed collaborative practice is visibility, as it is in video conferencing; moreover, we argue that constructing, analyzing or evaluating distributed collaborative practice should take into account invisible or tacit knowledge at the cultural level.

[1] Accountability refers to knowing that ones' actions will be perceived by others and this impacts how one acts in a specific situation since the actor will be held accountable for her actions in future collaborative practice (Erickson & Kellogg, 2000).

3. The Organizational Context of the Case Study

This research is empirically grounded and based on a case study conducted in a global transportation company with 100,000 employees located in Europe, Canada, the US, and Asia. The organization develops and builds a variety of transport vehicles as well as programming transport-related electronic devices (e.g., doors and train signalling systems). As a result of mergers, the global transportation company develops software at different geographical locations including Scandinavia and Asia. The company's vision is to be a global organization using one set of processes for developing software. In 2002 they began initiatives for developing common software processes related to the software-process-improvement project based upon the Capability Maturity Model (CMM). The two teams investigated in this paper were parts of this initiative.

3.1 Team 1

Team 1 consisted of ten participants located in Denmark, Germany, Thailand, Finland and Sweden. The project manager was located in Germany. The participants were chosen by their local manager to provide expertise on how software was developed at their local site and the main objective of the project was to develop *one* set of common software development processes. This task was overwhelming and difficult, since neither top management nor the team members shared a common understanding of what the project was about, which kind of activities should be conducted and how the collaboration should be executed. Team 1 met initially in April 2002 at a three-day co-located kick-off workshop to negotiate these issues, but they never reached an agreement. In November they had an additional co-located three-day workshop in which they were trained in CMM by an internal consultant from Canada. After the kick-off workshop, most of the participants within Team 1 continued to work on their former project and only three people were fully released to participate in Team 1. These three people (one Dane and two Swedish employees) formed a sub-project with the aim of developing a shared coding standard. The project manager was very aware of the complexity of collaboration across geographical distance, thus at the initial workshop he presented rules for communication e.g. when to use email or telephone, and set up a Lotus Notes Database to be used as a common repository. Also fixed dates and time for telephone meetings were planned and executed, while each team member was supposed to fill in a weekly

flash report containing a description of their individual work. Finally, the project manager tried to create coherence between the team members by providing a symbolic artefact for their project: they were the knights who went around the world to develop common software processes. At the initial workshop, each member received a toy figure of a knight as a symbol of the virtual teams. Team members placed these figurines on their computer monitors. Nevertheless, Team 1 did not succeed in formulating the common software processes, nor did they adapt the Lotus Notes. After only a year, top management disbanded Team 1 and terminated the project[2].

3.2 Team 2

Team 2 consisted of five participants located in United States of America, Canada, United Kingdom, and at two different locations in Sweden. The project objective was to develop a high-level software configuration management (SCM) process grounded in existing software practices, and pilot the SCM-process at three sites in the organization. This assignment was narrower than Team 1's assignment, thus it was easier for the participants in Team 2 the conduct initial negotiations of the objective, which activities to conduct and how to execute the collaboration between the geographical distributed member. The team members were all experienced and highly educated people. They had high salaries based on bonus systems and were very motivated and ambitious. They were chosen on the basis of their expertise in software configuration management and were individually selected by the project manager. They put in extra effort and made compromises along the way. The team met regularly at two- to five-day co-located workshops at the different sites (Toronto, Canada; Stockholm, Sweden; Cleveland, UK; and Oregon, USA). Between the co-located workshops, the team executed three releases on the SCM-process for which the various sites could comment on the work completed thus far. Before the two final workshops, the team conducted three pilots (in Bangkok, Halmstad and Halifax) of the SCM-process assisting the local software development site to integrate the SCM-process into their software development processes. To support the virtual collaboration, the team mostly used e-mail and telephone, but they had also set up a Lotus Notes database, which was never used. Having access to the participants' reflective perspectives on their collaboration process, we find that what from the outside (top management) seemed like a best-case scenario on virtual teamwork, was really a distance collaboration process with many communication breakdowns.

[2] It is ironic that the symbol of choice of this team was the Templar knights of the crusades who failed due to their inability to 'share meaning' (or ideology) across distances.

3.3 Organizational Context of Team 1 and Team 2

In order to facilitate a comprehensive understand the organizational context impinging upon the teams we are investigating, we present a conceptual map in Figure 2. The global transportation company (labelled distributed organizational context in Figure 2) comprises an organizational context which can be analytically delineated into lifeworld, institutional structures and work practices. The ***lifeworld*** consist of taken-for-granted background knowledge and assumptions related to the company's culture. Since the company is a highly global organization, the lifeworld of the distributed organizational context is highly related to the 'local' lifeworlds comprising the basic assumptions constituted within the local geographical sites such as the taken-for-granted knowledge about human interaction in Thailand or in Canada (labelled 'local organizational contexts' in Figure 2). The lifeworlds of the geographical sites are naturally diverse by nature, since they all are grounded and situated in different national cultures that influence the kind of taken-for-granted knowledge that is required in order to act and interpret the actions of others. Still, similarities exist between the lifeworlds of the local organizational contexts (the geographical sites). These similarities comprise the lifeworld of the distributed organizational context: the global company.

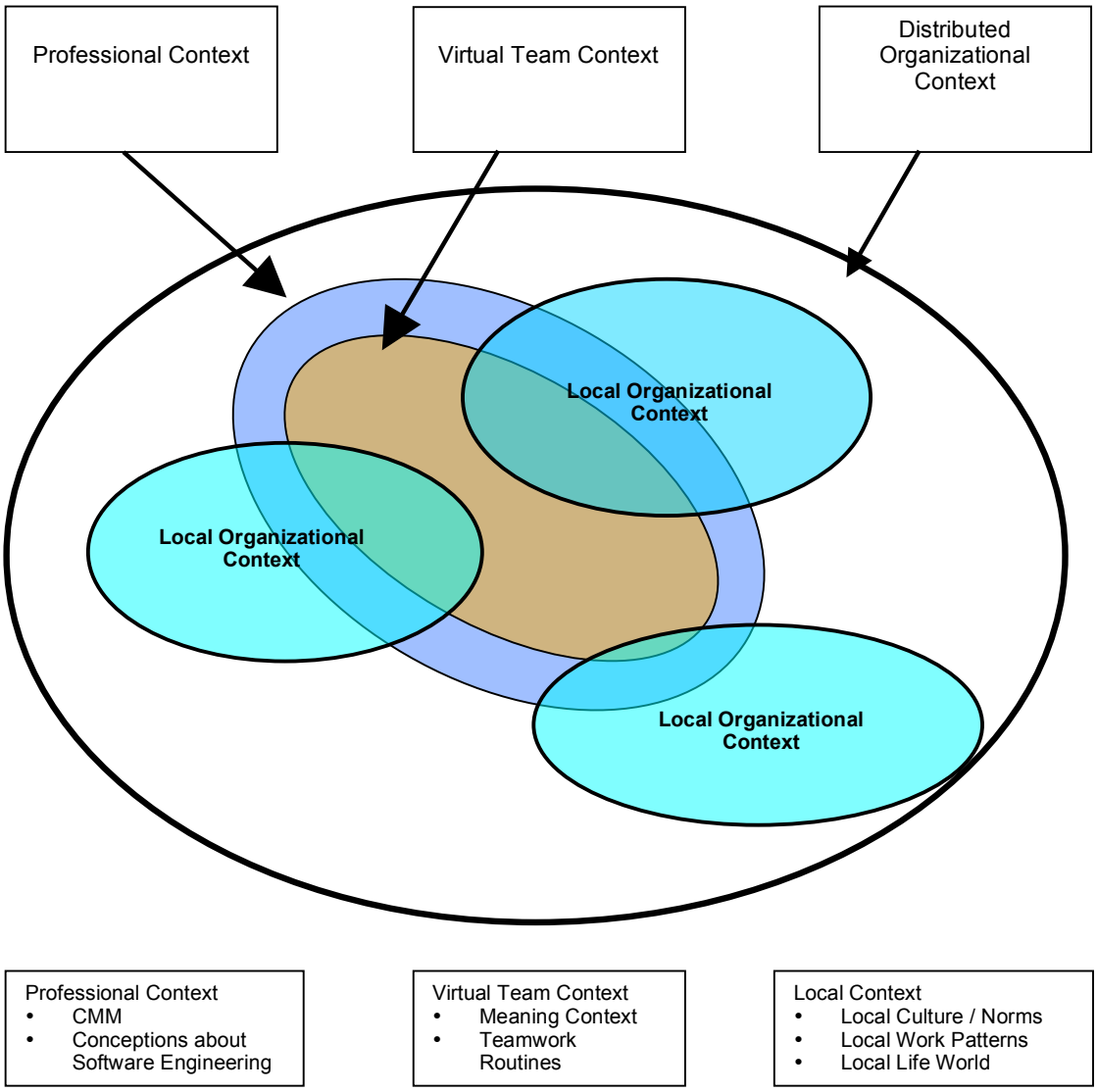


FIGURE 1: SHARED MEANING CONTEXT OF VIRTUAL TEAMS IS A CONGLOMERATION OF PIECES.

The ***institutional structures*** of the distributed organizational context comprise the explicit and visible articulated roles and norms formulated by the global transportation company (e.g., 'the vision of one global company using one set of common software processes') are typically communicated by internal magazines, memos and newsletters. The institutional structures articulated by the distributed organizational context influence the institutional structures within the local organizational contexts. However, the local sites also translate the institutional structures from the global company to fit the local organizational contexts of the geographical sites, while constructing additional institutional

structures such as local travel policies, local stories and rituals supportive of the local organizational contexts.

Work practices as constituted by the profession-specific norms and language used by employees all around the globe also differ between the local organizational contexts. The language used at one geographical site is developed by the constant contact between sub-languages on the basis of peoples' professional backgrounds. However, people from the same professional background have an occupational vocabulary for interaction (labelled 'the professional context' in Figure 2).

The model in Figure 2 shows how the organizational context of the virtual team is a conglomeration of aspects of lifeworlds, institutional structures, and work practices that participants bring from their local organizational contexts. Developing shared meaning within the social context of virtual teams thus comprises negotiation processes, where the local organizational contexts serve as the foundation for building shared meaning. In Team 1 the participants needed to develop shared meaning across six local organizational contexts situated in Denmark, Germany, Finland, Thailand and two locations in Sweden. In Team 2 the participants needed to develop shared meaning across four local organizational contexts situated in Canada, United Kingdom, United States and Sweden. In neither team had the participants collaborated together previously, however they shared the professional context of software development processes.

4. The Research Approach

Our approach to researching communication breakdowns in virtual teams is grounded the interpretive case study methodology (Eisenhardt, 1989; Klein & Myers, 1999; Walsham, 1995). In conducting this research, we adopt a social constructivist stance of knowledge creation. Our aim is to develop generalizable theoretical concepts and patterns grounded in empirical data that will explain a social phenomenon: virtual team collaboration. The interpretive case study method is appropriate because it focuses on the complexity of human sense making in emerging situations and attempts to understand the phenomenon through the meanings that participants assign to actions and situations (Klein & Myers, 1999). Our perspective on virtual collaboration is that it is an emerging process in which the geographically distributed participants try to make sense of their collective practice. We want to understand the context of virtual team collaboration and the processes whereby the technology influences and is influenced by the context. Trying to answer 'why' and 'how' questions concerning virtual team collaboration, we investigate human actions by examining the dispersed participants' interpretations of distributed collaboration (Walsham, 1995).

Types of data	Team 1	Team 2
A) Participation in Top management meeting *November 2002*	X	X
B) Observed one CMM assessment where CMM-consultants from Canada interviewed 15 software engineering employees about their work at the Danish site *November 2002*	X	
C) Individual interview with the Danish team member from Team 1 including diagnostic mapping of problems, *November 2002*	X	
D) Conducting one two-hour group interview with the project manager of Team 1 and the project manager of Team 2, *November 2002*	X	X
E) Interview/reflective conversation with project manager of Team 2, *November 2002*		X
F) Analysis of the content of Team 1's Lotus Notes database, *November 2002*	X	
G) Informal observation at the local German site in *December 2002*	X	
H) Individual interview with the German team member from Team 1 including diagnostic mapping of problems, *December 2002*	X	
I) Interview/reflective conversation with project manager of Team 1 in Germany including diagnostic mapping of problems, *December 2002.*	X	
J) Print-out of an email correspondences between two participants from Team 1, labelled 'Email-waste-of-time' by the Danish participant from Team 1, *December 2002*	X	
K) Participation in Top Management meeting *January 2003*	X	X
L) Interview/reflective conversation with the project manager of Team 2, *January 2003*		X
M) Observations at the local Danish site within the organization having informal conversation with employees and observing the organization *January 2003*	X	X
N) Informal observations at the local Swedish site January 2003		X
O) Conducting one three-hour group interviews with two participants (US and Swedish team member) from Team 2 in Sweden including diagnostic mapping of problems, *January 2003.*		X
P) Document analysis of Company official information material 1. Internal magazine 2. Our key corporate values 3. Common Systems & Processes: Getting it right 4. Slides: Software within research and products 5. About the organizational structure	X	X
Q) Document analysis of material related to the two teams 1. Capability Maturity Model – description 2. Slides: A proposal for a simplified software engineering process & tools group – SEPTG 3. One example of a weekly Flash report from Team 1 4. Slides: Software processes, methods and tools in two versions 5. Slides: Software Processes, methods and tools – communication rules 6. Slides: External Communication interfaces 7. Slides: Software engineering process group (SEPG) in two versions 8. Project Mandate for Team 2 9. Schedule for the CMM assessment in Copenhagen 10. Lessons learned from the CMM assessments in Stockhold, Helsinki, Copenhagen and Braunschweig	X	X
R) Field and dairy notes reflecting expressions and experiences. These were made all the way through the process *November 2002 – March 2003*	X	X
S) Validation of findings in form of given a presentation Top Management and the two project managers of Team 1 and Team 2, *March 2003*	X	X

TABLE 2: DATA SOURCES

Table 2 shows the activities conducted in the organization comprising the empirical case as well as the data sources. We have indicated which activities are the primary source for gaining data material related to Team 1 and Team 2. The primary data sources for this paper are the interviews with participants and project managers of each team. Interviews are often the primary data source in

interpretive case studies, since it is only through this method that researchers can access the participants' interpretations regarding actions and events (Walsham, 1995). Unfortunately, it was not possible to observe the co-located workshops or to gain access to the complete email communication within the teams, thus we triangulated the empirical observations from early interviews (C; D; E) to later interviews (H; I; L; O) while combining the empirical observations with the data sources such as the slides from the workshops (Q), the printout of specific email-correspondences (J) and the content analysis of the Lotus Notes Database (F). This approach helped us to interpret how the collaborative practice within the teams was performed and how the collaboration during co-located workshops was executed and experienced. The secondary data (e.g., A; B; G; K; M; N; P) support our competence analysis of the material at hand and help to bring it into context. The secondary data sources provided us with the opportunity to construct an understanding of the 'part' (the primary interviews) in relation to the 'whole' organization by giving us an improved understanding of the context. In this way, the secondary data support the principle of the hermeneutic circle, which is essential for interpretive research (Klein & Myers, 1999). Also we validate our data by doing a presentation of our findings to the company including Top Management and the two project managers of the teams in the end of the data collection (S).

All primary interviews were transcribed and later analyzed. The analysis began during data collection in field notes and a diary kept by the first author (R). The first author, in addition to describing incidents, also recorded reflections, impressions, and feelings about the processes experienced. The main analysis activities began after the data were collected. The authors conducted within-case analyses, which involved a detailed case study write-up (Eisenhardt, 1989). The write-ups consisted of both the pure transcriptions of the interviews and also coherent descriptions of special events which combined material from all interviews and documents from the field. Coherent descriptions are important when trying to understand complex problems involving many actors and technology use, and are helpful for researchers trying to grasp and render intelligently the multiplicity of complex conceptual structures. Only by using approaches such as coherent descriptions can the researcher access subtle changes and differences in interpretations of the participants (Walsham, 1995).

Interview material was imported into HyperReasearch for coding and low-level categories were attached to the text explaining the content, which made it easy to search the material later. An important part of coding is memo writing, which provides an immediate illustration of the ideas that emerge from the coding (Glaser & Strauss, 1967). Tentative themes, concepts, and even some relations between them were constructed based on the within-case analysis. We then conducted cross-case analysis between the empirical observations from both

teams. Cross-case comparisons are useful when experienced tendencies are counterintuitive to the data in many divergent ways (Eisenhardt, 1989).

When shaping and focusing the analysis, the use of theory plays a crucial role in interpretive research (Eisenhardt, 1989; Klein & Myers, 1999; Walsham, 1995). According to Eisenhardt (1989), theory can be used in interpretive research in three ways: as an initial guide, as a part of an iterative process of data collection and analysis, and as a final product of research. Our use of theory falls between the first and the third category, since we use theory (e.g., analytic distinction of shared meaning context) in the analysis process, and a part of our final product of this paper is our reflection on the theoretical concepts of shared meaning context and translucence. In interpretive research, it is desirable to preserve a considerable degree of openness to the data and a willingness to modify initial assumptions and theories (Walsham, 1995). When the analysis of the empirical material began, we had not yet decided on the theme of shared meaning context and translucence, but the importance of the concepts came through the analysis process. In this way, we used theory as a 'sensitizing device' to view our area of interest in a certain way (Klein & Myers, 1999), relating the write-ups, memos, and low-level concepts indicated in the transcriptions of the interviews to the theoretical concepts thus creating a more abstract understanding of communication in virtual team collaboration.

The theoretical concepts of shared meaning context and translucence allowed for a structured strategy for re-examination of the material. All problems and their categories experienced in the communication were written in a table, with links to the raw data in HyperResearch, and with exemplary quotes illustrating the problem formulated by the participants in the interviews. We found that some of the problems expressed indicated the same fundamental issues. This process resulted in new groupings and categories of problems. Then all problems were labelled and categorized into social, technical, and distributed issues. Following this we selected the problems that were related to the main communication breakdowns in the virtual team collaboration. We define *main communication breakdowns* as breakdowns that affect and influence the further collaboration intensively. The main communication breakdowns were then categorized according to the three levels of shared meaning, and analyzed with respect to the concept of translucence. We used our definitions of lifeworld, institutional structures and work practices to identify at which level a specific breakdown was grounded. Additionally, the use of technology to support the collaborative practice with respect to creating shared meaning was analyzed. The table below shows all the main communication breakdowns categorized into levels of shared meaning, and the problems with technology mediation of shared meaning. The following analysis section in this paper will explore each communication breakdown, followed by a section on technology mediation.

Lifeworld level	• Existing cultural working habits crashes (Team 2) • Difficulty in developing a common language (Team 1)
Institutional level	• Project manager and participants feel left out of important decisions made by top management (Team 2). • Assignments and tasks appear and disappear without team members knowing why (Team 2). • Communication rules without clarifying objective did not work (Team 1). • Not working full-time and selection of people out of control (Team 1).
Work process level	• Norms, language, and work practices at professional level crashes (Team 2). • Unconstructive weekly phone meetings (Team 1).
Technology mediation	• No shared workspace (Team 1 and Team 2). • No possibility for innovation upon shared application (Team 2). • Difficult to enact richness in email communication (Team 1 and Team 2).

TABLE 3: COMMUNICATION BREAKDOWNS AND PROBLEMS WITH TECHNOLOGY MEDIATION

5. Creating Translucence in Virtual Teams

We argue that successful virtual collaboration requires the ongoing negotiation and development of shared meaning. Developing and maintaining shared meaning requires translucence in communication structures at different levels: lifeworld, institutional structures, and work practice. Without translucence, the risk of breakdowns increases. We will show that breakdowns occur due to a lack of translucence on different levels, and that the recovery process is often a critical reflection of each level. This serves to create translucence. Note that breakdowns or their consequences manifest at the work practice level, even though the breakdown may occur elsewhere. Sub-sections address each level of breakdown.

5.1 Translucence at Lifeworld level

The lifeworld level consists of assumptions, knowledge, culture and beliefs and is the taken-for-granted knowledge that organizational members use to act on and interpret the actions of others. All participants in a geographically distributed team have their own lifeworld that is grounded in earlier experiences in the organization's life, thus their expectation of how to collaborate with other organizational members is formed by their lifeworlds. Communication breakdowns at the lifeworld level are grounded in incongruence of the various local work practices. Creating translucence at the lifeworld level is an alignment process where participants negotiate their newly established virtual team context including negotiating the norms, values, and work processes of the collaboration.

5.1.1 Communication Breakdowns at the Lifeworld level

In our case, the differences in expectations and processes and the need for creating translucence emerged at the co-located workshops. Co-located workshops are known to be important to shaping virtual teamwork (Kirkman et

al., 2004; Maznevski & Chudoba, 2000). Living in different countries with different cultural norms and habits, Team 2 tried to establish the newly formed context by bringing gifts and greetings to the scene.

> "This other interesting thing that this team has that I've never seen before is this international gift thing. When I pack, here's Louis's pile, here's Michael's pile and by the way Sven wants to see pictures of the new kid… There's always stuff going or coming in. And Louis brings chocolate. Sven brings licorice. Michael usually shows up with fudge. We take baby gifts for Michael's baby. And the latest thing as of the huggy-huggy, kissy-kissy thing — Michael has always done that. Not in Zurich, he kissed me in Toronto though. OK, from Michael you get one kiss, from Louis you get two. It's like this bee sting we had to go work it out, because how does this work? I'm from the States, we shake hands!" (U.S. Team member, Team 2)

The cultural exchange had a positive impact on the development of shared meaning in the virtual team context. However, the collaboration within the co-located workshop was also associated with communication breakdowns caused by the differences at the lifeworld level, even though the participants experienced the conflicts at the work practice level. The various working habits grounded in various lifeworlds crashed at the co-located workshops. In the quote below, the project manager of Team 2 describes how the working habits of the participants caused by cultural habits crashed at the co-located workshops.

> "If you look at my team, there are things like, some members were working, and worked very hard, they worked weekends, they have families and they work 15 - 20 hour days. [Not a Dane or a British person] but to a lot of the Americans and the Canadians they will sacrifice weekends and leave their kids, and they will fly off to Australia and... So there is a very high expectation to that the rest of the people in the team will do the same.[...] [Working remotely] people can take work, they can have some work and then send it back. There is not deadline pressure. So, if the Canadians or the Americans wanna work weekends they can, and it doesn't affect me and you. But when you get to these meetings, where you show up, that's when you get the problems, because all of a sudden it's like, we are gonna start at 8 in the morning and work until 9 o'clock in the night, and we are gonna do that for five days. And if we don't finish, then maybe work Saturday, so the expectation is really very high.[...] specifically within this five member group, you only get the real problems when we meet in one room, because then you have the clash of the cultures. (Project manager of Team 2)

The participant's expectations and assumptions of how the work at the co-located workshop should be conducted were not aligned. There were different interpretations of what it meant to work hard, especially between the Swedes and the Briton on one side, and the Canadian and American on the other. There was incongruence between the various interpretations of what it means to be co-located, what was expected and what should be done before, under, and after. The participants' overview of the workshops was that they were on a downward spiral, meaning that collaboration and productivity at the workshops was

declining. At the first workshop in Toronto, all came and stayed through the entire process. In Stockholm everyone attended the first day which was used for organizing the workshop, but some left before the end. In Cleveland some came late, and in Oregon people came and went at different times so they did not have a full five-day workshop. The participants tried to change this unwanted pattern by using an external consultant to moderate the workshop in Oregon, but by then it was too late.

For Team 1 the main communication breakdown at the lifeworld level concerned the negotiation of the purpose and objective of the project. This breakdown was grounded from the first day onwards and they never managed in resolve this breakdown, which also was the main cause of the unsuccessful project resulting in Top Management closing down the team after a year. Through our investigation, we find that this communication breakdown is located at the lifeworld level. The project manager of Team 1 prepared a program for the first workshop in March so that the participants could meet and develop relationships and trust (Jarvenpaa et al., 1998) so that they could contact each other later when separated geographically. This included facilitating the participants to get to know each other by exchanging information and expectations. Reflecting on the situation at the kick-off workshop in November, the project manager contemplated that the foundation for doing these kinds of activities was not present then and was still not present eight months later.

> "The idea was to drive, and the group was called process, methods and tools, and no one had a clue of what we should do. (...) Seeing this today, the difficulties were that most of them never worked in this environment, they have no experience using English as the business language. The first time as such, and they didn't, and even today many of them don't know, the details of what to do. We started this educational thing, but I think it's far away from being finished. (...) The next day we continued until ten o'clock, and then we had this brainstorming session discussing many things. And it was a real brainstorming session; it was very, very difficult to get real benefit from it, because the people had to find in their own language what they were talking about. And if you don't have English as your mother language, then it's much more difficult than if you have."(Project manager of Team 1)

The basic taken-for-granted assumption of international teamwork is that the participants have access to a common language. In Team 1 some of the participants were not even fluent in English (the business language of the company), which further complicated the development of a common work language making it impossible for the team to initially negotiate the general objective from Top Management turning these into workable goals at the kick-off workshop.

5.1.2 Creating Translucence at the Lifeworld level

Breakdowns at the lifeworld level were experienced at the work practice level when the participants were physically together. It was the consequence of

incongruence in lifeworlds that resulted in the unproductive workshops, and neither Team 1 nor Team 2 ever managed to resolve these conflicts. Team 1 never produced the expected outcome and Team 2 never had fruitful co-located workshops. Creating translucence and developing shared meaning of the collaboration at the lifeworld level is a negotiation process of the most fundamental elements regarding how to engage in collaboration with each other. Differences at the lifeworld level are unarticulated and invisible as long as no breakdowns are experienced, which makes it difficult to negotiate collaboration at the lifeworld level. Thus, creating translucence is an ongoing negotiation process to align lifeworlds, build the new virtual team context and develop shared meaning structured by the experiences of breakdowns. Unresolved breakdowns at the lifeworld level and their consequences for work practices impact the collaboration negatively. Moreover, it is important that virtual teams engage in a positive communication circle from the start, since it is very difficult to change unwanted patterns in virtual teamwork (Huysman et al., 2003; Jarvenpaa & Leidner, 1999; Tyre & Orlikowski, 1994).

5.2 Translucence at Institutional level

The toughest issues in information system design are those concerned with modelling co-operations across heterogeneous worlds, of modelling articulation work and multiplicity (Bowker & Star, 2002). Members of virtual teams are, like everyone else, participating in various communities. However, the boundaries between the communities become more challenging when geographical distance is the demarcation line. Virtual team members are both participants in the virtual community and participants of the local community in which they are physically located. The institutional level consists of the explicit and visible organizational structures forming the virtual team context, thus the physical location of management and the project manager is a part of the institutional level affecting the negotiated shared meaning.

5.2.1 Communication Breakdowns at Institutional level

In Team 2, top management was located in Toronto, Canada and so was one of the team members. The project manager was located in Cleveland, UK. When top management wanted information about the virtual team, they usually went to the member in Toronto rather than the project manager in the UK because it was easier than calling Cleveland which involved a five-hour time difference.

> "And they all sit in Toronto, and it's a hell of a lot more convenient to wander down the hall or to call [the team member], than it is to call [the project manager] with this five hour difference." (US Team member in Team 2)

The different physical locations of the team members, top management, and the project manager of the virtual team resulted in communication breakdowns.

Communication between management and the team did not go through hierarchical structures mediated by the project manager. Instead, communication was often through the team member placed in Toronto and not the project manager in the UK. Hence, important decisions affecting the work were communicated through invisible structures. When people collaborate they become involved with extra activities such as dividing, allocating, coordinating, scheduling and interrelated activities and tasks between participants. This extra work is referred to as articulation work (Bowker & Star, 2002; Schmidt & Bannon, 1992). The articulation work within the team was closely connected to the definition of tasks and actions. Invisible communication between top management and the team due to the geographical location of management made team members (including the project manager) feel left out of important discussions. Participants saw assignments, tasks, and actions as appearing or disappearing behind the inaccessible negotiations of these processes.

> "(...) and it all kind of ended up in the project schedule all of a sudden. From one day to another. The original was that we were doing pilots in Bangkok and Halmstad (...). And what I can remember all of a sudden, Halifax showed up in the monthly power point of some document somewhere. " (Swedish Team member from Team 2)

The number of pilot projects changed unbeknownst to the team members. This gave an impression that the pilot project in Halifax had suddenly appeared. Strategic discussions resulting in activities disappearing were also invisible to the team members.

> "I don't know how this works exactly (...) It just disappears. Or gets re-negotiated, get shuffled or [project manager] and [team member in Toronto] had some discussion where to push it though another project. There is a strategy discussion going on there that the other three of us don't know about. We just see the action go away." (U.S. Team member from Team 2)

The articulation work required for collaborative planning of actions was constrained by the invisible and opaque structures at the institutional level. The invisible structures prevented team members from having access to how the collaboration process was transformed and re-negotiated, and felt they could *not* rely on former decisions since they could be changed without their involvement in any discussions. They felt they were ignored and overruled by decisions taken elsewhere. The communication breakdown experienced at the work practice level (e.g., tasks disappearing) was grounded in the conflict regarding organizational structures at the institutional level. In a organizational context, well-socialized actors have taken-for-granted knowledge and a set of pre-interpreted patterns of meaning about the organization which serves as a reference scheme and enables actors to act and interpret the actions of others (Ngwenyama & Lee, 1997). The interpretation of others' actions was complex in the virtual teams since the participants did not develop a shared practice, which

means they did not have a reference scheme that would enable them to interpret each other's actions. Opaque communication structures at the institutional level constrain the building of shared meaning. Lack of a reference scheme increases complexity in making sense of actions and doing articulation work; this would align the individual actions to the common interaction. The team members in the study experienced incongruence in frames of reference (Orlikowski & Gash, 1994), and articulation work became inaccessible. The team members functioned under this condition knowing that they could not influence important communication that was taking place. The actions of some team members were culturally influenced (i.e., based on work ethics and issues of convenience in this case) and were inaccessible and too complex for interpretation by global team members abroad.

The project manager of Team 1 tried to establish a shared meaning at the institutional level by providing the symbolic artefact of knights. This artefact had the purpose representing the institutional structures of the team by being present at all time locally (at the computer screens) reminding the geographical distributed participants that they were a part of a community so they would not feel isolated.

> "[I wanted] to have some kind of symbol and to create some kind of community. So I said, okay, we have this idea called, how a group are fighting for one set of common processes. And they get playmobile, small figures you can sample together, it was a small light, so that everyone can put them on their desk, and have something… You are isolated, so now you have something on your desk, which reminds you of where you belong to." (Project Manager of Team 1)

However the unresolved breakdown at the lifeworld level meant that the team members lack having a common language to negotiate and construct meaning related to the symbolic artefact, thus even though the got the symbolic artefacts were locally present on the top of the computer screens this did not prevent the participants from feeling isolated from the virtual team. Therefore, when local managers asked individual team members from Team 1 to participate in local projects, they accepted the situation leaving little or no time for their Team's collaborative work. This was also affected by the confusion related to the blurred objective for Team 1 and how the participants were selected. As the project manager of Team 1 explains:

> "The first step was to find the people, and then to say that we didn't find the right people.(...) The managers [selected the people]. So I didn't really have a chance to say yes or no. That was the first mistake (...) The first thing dedicated people, and the second thing, make sure they're not working for someone else. And if you have a distributed team and you are not on the site, you can't control it. You don't have the commitment of the manager being on the site, or someone that's working in the management that can ensure that the persons are working for you." (Project Manager in Team 1)

The project manager of Team 1 states that he had the 'wrong' people appointed to the team. 'The right people' he defines as participants who are 'really self-motivated, driver type of person[s], responsible and able to manage [their] work' and if the right person experiences problems he or she will write an email or call someone. However it is not enough just having the right people. One must also ensure that the participants actually are working within the virtual team project and not on other project connected to their local sites. This is a basic challenge of virtual team work, since having people in different geographical locations related not only to the organizational context of the virtual teams but also to other contexts. Location can easily dominate the work flow causing the participants to work more on local projects. This was especially true for the German team member of Team 1, since he perceived maintaining a local German database as his contribution to Team 1, even though this database had no relation to the development of common software processes. It is striking that out of all Team 1 participants, the German member was the only one geographically co-located with project manager, who was also at the German site. The project manager, however, used most of his time travelling to other sites as he tried to get other team members to communicate.

5.2.2 Creating Translucence at Institutional level

Creating translucence at the institutional level is not a negotiation process, as it is at the two other levels. Here, the management made the decision regarding how the institutional structure of a virtual team should look. So where both the negotiation processes of lifeworld and work practice are handled by the virtual team members, negotiation on the institutional level is in the hands of management. When geographical aspects make it easier for management to use other, more informal ways to know about the work in the virtual team than the explicit and visible structures they themselves have provided, then these opaque, implicit, and invisible patterns have serious consequences for the work practice. Creating translucence at the institutional level is, in this way, a process of developing the appropriate institutional structure for the team, articulating the decision-making process, and then actually using it in practice. Moreover, the construction of symbolic artefacts representing the institutional structures of the virtual team context requires managerial support such as allocating resources for the virtual team. This would have prevented the local managers from using staff already committed to the virtual teams. Also, symbolic artefacts require negotiations that create shared meaning, thus unresolved breakdowns at the lifeworld level in respect to developing a shared language negatively influence the construction of symbolic artefacts at the institutional level.

5.3 Creating Translucence at Work Process Level

The work process level consists of profession-specific norms and work practices. All communication breakdowns manifest at the work practice level; however, not all breakdowns are grounded at this level, as we have illustrated above.

5.3.1 Communication Breakdowns at Work Process level

In Team 2, the breakdowns at the work practice level relate to the work assignment (developing one common SCM-process to be used in the whole global organization). Management chose experts from different sites so that together they could build a process reflecting the software development practice of the ten divisions around the globe. Four divisions were especially affected by the development of a common SCM-process, so each sent a representative to take part in the work. In all, around one thousand people located in these four divisions would be affected by the new SCM-process. However, prior to the project, there were already SCM-processes at the local sites, and bringing the four skilled people (excluding the project manager) together also meant that the existing practices challenged the participants to negotiate how to develop the common process. However, the negotiation process was not only about developing a common SCM-process – it was also a strategic discussion (Ngwenyama & Lyytinen, 1997) about what local SCM-process should be used as the foundation. The strategic discussion entailed convincing the others of how to begin developing the SCM-process using known local best practices. Participants focused on achieving an advantage over the others. The quote below illustrates the type of conflict that can result:

> "[The department] in Toronto has a process description already. ... so does Oregon. They are all over the place. They are multiple. But the two best ones are in Oregon and Toronto. [...] Locally these exist. Oregon already had one, Toronto already had one. We looked at all the divisions. Here is where the SCM-process already exits. Now we are gonna build one? Or we are gonna build one for [the organization]? Well why start from a blank sheet, if you have all these pieces already. The idea was: Take this survey - take the best from the process - and that became [the organization's] SCM. It makes sense based [on] inter-sustainable standards. Does ours look exactly the same - the one we build in Oregon? No, but the content are the same. Ok. All right then you get down to the documents the deliverable. The process description documents. If we use the table's content would I be ok? Sure. Do I have the same activities and deliverables? Sure. But do I fundamentally wanna start with Toronto's process description and turn it in to the organizations-process description? No." (U.S. Team member in Team 2)

Since only three participants in Team 1 were 100 percent dedicated to the project, these three formed a sub-group supposed to develop a common coding standard. They, however, had many disagreements about how to achieve this outcome. Investigating the current coding standards within the many geographical sites,

they find that each site has developed its own standard, thus software engineers refer to the local code standard within projects. The sub-group tried to find a common tool for validating the code to determine if a program was living up to the standard. However, having nine different coding standards, they had to define a common standard first and then decide upon the tool. They chose to begin by reviewing the code standard developed at the Swedish site by the Swedish member of Team 1. This was when the communication breakdowns related to the professional context emerged. These breakdowns were highly influenced by the unresolved breakdown at the lifeworld level concerning the main objective, purpose and aim of Team 1. The review was situated in a co-located setting in Sweden, where two of the sub-group members sat down with programmers from the local site to explain a code standard created primarily by one of the Swedish members. The last member of the sub-group had called in sick that day. After observing and talking to the programmers, the two members assessed the result. They were in great disagreement over what had happen.

> "We totally disagree about how the review had went. [A Swedish member] though that it went well and there only were small corrections to be made. I, on the other hand, was of the opinion that the programmers did not have a clue of the meaning behind the coding standard." (Danish team member in Team 1).

The Danish member thought that it was unrealistic to explain this code standard of around 200 rules to all the programmers within the company, and suggested instead that they implement an industrial code standard, since the chance of programmers already being familiar with an industrial standard was higher, thus making it easier for them to learn it and also because it would be easier to locate a generic tool for validating the code. However, the Swedish member disagreed and argued that he had been working with code standards at all of his positions within the company so he knew best. They could not agree and since choosing an industrial standard changed the project mandate for the sub-group. The decision was up to the top management in the end.

Bringing highly-skilled and motivated people together to agree on a common task is a challenge that is well known from software development practice (Ngwenyama & Lyytinen, 1997). Specialists often follow different goals and find themselves in conflict during teamwork; however, they still collaborate to produce the expected product, as did the virtual team. The conflict did not have anything to do with antagonism, but it was embedded in the task. Since the participants of Team 1 and Team 2 had prior experiences working with SCM-processes or coding standards, they had their own ideas, assumptions, and expectations of how the work should be done.

5.3.2 Creating Translucence at Work Process level

Creating translucence by building a shared meaning at the work practice level is a negotiation process between the participants where sub-languages make

contact with each other, new languages are formed, and meanings are developed (Holmqvist, 1989). Participants engage in and are challenged by each others' perspectives on how to do a task. Resolving the breakdown at the work practice level can include a critical reflection on the lifeworld level, if the breakdown is fundamentally grounded. However, the breakdowns illustrated here were related to the negotiation of the work process. Here, participants' knowledge, language, and norms concerning SCM-process and coding standards at the professional level were on the agenda. Thus, the participants had a common professional language to negotiate this aspect at the work process level, providing the possibility for articulating their differences by building shared meaning. The communication breakdown incident of Team 1 was easier to resolve than the breakdown experienced by Team 2. This was because, in the end, they could refer to top management to decide whether to use an industrial standard or to develop their own standard. However the participants of the sub-group of Team 1 did not find that top management was really interested in their work, which frustrated them. Team 2's communication breakdown was not resolved easily, since the negotiation process was not explicit, but ruled by the actions or non-actions concerning the assignment. There was clearly no translucence in the process, especially regarding the second release of the SCM-process. At that point, a team member changed the work of the whole group without consulting others and released the SCM-process description for comments from all sites. A team member describes the result as, 'release two was not team consensus, but team consensus edited'. The team was unable to create translucence around their work process in this incident, thus the development of shared meaning was constrained.

6. Technology Mediation of Translucence

The mediation of collaboration in the virtual teams was mainly done by email and phone, since neither of the teams managed to adapt the groupware system, Lotus Notes. Email as a technology can be viewed as an 'open-world' type of application in which the social context becomes important (Ngwenyama & Klein, 1994). Technology is the collection of resources and rules regarding the use of that technology. Email resources comprise the possibilities and opportunities provided in mediating the communication within the team, and the rules are negotiated agreements on how to engage in communication with each other (Ngwenyama & Lyytinen, 1997). The negotiation process can be viewed as subtle and slow, but no less significant to the organizational transformation process, grounded in the ongoing practices of actors, emerging out of their (tacit and not so tacit) experiments with everyday contingencies, breakdowns, expectation, opportunities and unintended consequences that they encounter (Orlikowski,

1996). The question is then, how can email support the creation of translucence in the virtual team's collective work?

6.1 Constrains of Emails in Creating Translucence

The basic requirements for groupware technology to support collaboration have been identified as management of task dependencies, coordination, negotiation and awareness by providing a common information space (Carstensen & Schmidt, 1999). A common information space refers to the possibility to create and share documents using a common repository, which requires participants to actively construct meanings from the shared objects to be able to interpret the shared information items and their locations (Hertzum, 1999). Thus, an important aspect of media support for collaborative action is the provision of a shared workspace, a kind of social 'sphere' where social actions are propagated and 'objects-of-work' are operated upon (Ngwenyama & Lyytinen, 1997). Objects-of-work can be various kinds of documents and the shared workspace should provide different tools for operating on the work-object, such as version control. Email, when used as a medium for collective work, does not support a public arena in which participants can collect their common items. Instead, the object of work is distributed on the laptops of the participants and exchanges in an unstructured way where it is up to the participants to develop their own structure locally. In the case of Team 2, participants expressed a need to have all documents available at one shared repository. None of the participants (including the project manager) had an overview of the project documents; hence, there was a lack of translucence. This was a situation that created extra work for all participants. When attempting to locate a specific document, members would search their local email database, sort the emails by date, and then possibly retrieve the right document.

> "I will go looking in my Lotus Notes emails because I save all of them. And I would have to say search for project mandate, and I would find all of them, and then I would look date wise and then I would look content-wise and then I would give you one. And then is it the right one? Is it the current one? I don't know. And if you call Paul, you can't trust what he gives you - he just lost his complete Lotus Notes database. We have to send him everything." (Team member)

Email provides a medium for creating and transmitting relatively unstructured messages and tools to organize and manage conversations among individuals and loosely organized groups (Ngwenyama & Lyytinen, 1997). We do not argue that email is not useful in virtual teams, but we argue that it is not enough since the virtual team needs a platform on which they can represent their collective work (by object of work as well as by actions), and that adaptation of common repositories requires negotiations constructing shared meaning related to the objects and structures within the technology. In the case of Team 1, team

members' use of the Lotus Notes database was not connected to a negotiated shared meaning concerning the repository. The Danish member explains that only he, the project manager and the Swedish member had uploaded documents to Lotus Notes.

> "[Besides me] the Swedish member uploads hundreds of documents. [I do not read these], because he uploads hundreds [of] documents." (Danish team member from Team 1)

Investigating the Lotus Notes database we found that in November, eight months after Team 1 had their kick-off workshop, the system did not contain hundreds of documents, only a few documents were uploaded. Also, few attempts were made to begin discussions (e.g., notes written by the project manager to begin an online discussion of the project objective; however, no negotiation process follows – only one small comment appears). They never managed to adapt the system to their collaborative practice.

Virtual team members need to be able to work on the object, share it, and use the representation within the common repository to interpret the actions of the others creating translucence, since they do not have access to each other by casual physical encounters. Adaptation of a common repository requires negotiations that develop shared meaning related to the use of the groupware. Without these negotiations, the groupware will not become an active part of the teamwork. This constrains the possibility for actors to monitor geographically distributed collaborative situations. Routine social interaction requires that actors can monitor the situations within which they operate and reflect upon their own actions and the actions of others (Ngwenyama & Lee, 1997). This is constrained when email mediates all communication within the team, since breakdowns occur more easily when actors cannot monitor the collaborative practice, thus they fail to comprehend the actions of others.

6.2 Visible Innovation upon Application Mediates Translucence

Innovations made upon the application of collaborative technologies reflecting an interpretation of the collaborative work in email are visible only to the participant who actually creates the innovation. We saw this in Team 2 during the creation of an awaiting-action folder. The organization has rules and norms that govern how to use email (e.g., that every email received should have a response within 24 hours in the receivers' time zone). These rules were resources for the use of email, however in the actual collaboration between participants, the use of email changed according to the actions and interpretation of others' actions. Even though there are official rules of response time for email, a particular US-member expressed that she did not receive responses to all her emails. Acting on her experience of the actions of others, she created an awaiting action folder in her email box.

> "I have an entire "Awaiting action" file folder of E-mails sent to [project manager], E-mails sent to [team member in Toronto] with no response that they even got the thing, let alone intended to do any thing about it." (US-team member from Team 2)

Here we can see the difficulties in interpreting the actions of others using email as a medium. She does not know if the recipient received the email or had any intentions of doing anything about the content of the email. She is left waiting, thus creating a folder, effectively putting her inquiries on hold. The folder is based on her interpretation of the actions of other team members. Researchers agree that one important part of technologically supported group work includes an alignment process of the technology and work practice (Majchrazak et al., 2000; Ngwenyama, 1998; Orlikowski & Hofman, 1997). This alignment of technology is a process in which work practice and technology-use merge, resulting in a new practice different from both the pre-exiting (before technology) and initial practice (introduction of technology). An adjustment to the technology includes an innovation of the application, for example changing folder structures, creating new folders, or deleting folders. However, when using an email application, the innovation is visible only locally. In our case study, the awaiting action folder is visible only in the US-member's email box. None of the other team members has access to the folder, thus they are not aware that questions have gone unanswered. Hence, email does not support innovation at the group level which is known to be an important feature of groupware (Ngwenyama, 1998). This is because many e-mail work routines can only be inscribed at the individual level and do not affect how the individual perceives the collaborative work. It is only through the human-processing of the actions of others (in this case, only visible in the email messages) that the shared practice can emerge.

6.3 Enacting Richness Creating Translucence

In the area of managerial communication involving electronic mail systems, the primary 'processing' of data into information is performed by humans and not by hardware or software. It is through the process of enactment that people, not electronic communication media, bring about the richness they experience in their communication (Weick, 1969 quoted in Ngwenyama & Lee, 1997). One example of the lack of richness within email communication was detected in the printout of the email-correspondence between two Team 1 members (see section 4, J). The email-correspondences were between three team members from Team 1 and was printed out and handed over to us by the Danish member as a example labelled 'Email-waste-of–time'. The printout contains 16 messages exchanged within two days by the three team members concerning the issue of "How to make a document available on the intranet web". The main problem was that even though they could upload documents to the intranet, these documents are

not visible for those others than author due to internal policies concerning uploading rights etc. In the end, they concluded that they could not solve the problem:

> "Tough luck. Technically, it works fine, but I've never tried to ask for it [how to upload a document for the intranet]. There isn't even a proper routine for international paying bills, so why should there be one for this [uploading documents for the intranet]. :-(Technically, there is no other way, expect Lotus Notes, so either a) keep asking or b) give up (and use Lotus Notes/Domino, like the other databases instead)" (Swedish team member in Team 1)

They did not solve the problem – more importantly, much of the content within the emails is related to the difficulty involved in interpreting the other participants' utterances. This is evidenced by sentences such as "Is there any substance in what you are saying, or is it just this intention with the system'".

The email process evolved between two team members of Team 2, reflecting a successful example of how to mediate shared meaning. Thus, translucence was created at the work practice level. While the teamwork began in March, it was not until November that the participants had implicitly negotiated rules for using email in situations where correspondence resembled synchronous chat.

> "[Team member in Sweden] and I have worked together so extensively, that if I'm on the phone, or if we're doing an E-mail conversation, and one of us has an appointment or a meeting or whatever, there's an E-mail that says, "got to go now, we'll finish later!". So that you don't keep E-mailing and expecting some reply, and there's no one there anymore. (...) And how long did it take us to get to that? Thanksgiving. November. It was highly amusing, but I'm sitting in Oregon yelling, "expected behavior, yay!" I know that nobody's there, so I'm not going to send anything. I'll just wait till later, that's much easier." (Team member)

The little sentence 'got to go now, we'll finish later' made a difference in the way the two participants collaborated via email. The sentence gave the content of the email social context and it gave the receiver the possibility to 'access' the physical situation of the provider, which impacted the shared context of the participants. It supported the receiver when interpreting the action of the provider, since without the sentence, the receiver would have continued to send emails and then it would have been difficult to interpret the following silence. However, 'human processing' or enacting richness requires a shared background, lifeworld, or scheme of reference on which participants can interpret the actions of others. The importance of the social context increases when using 'open-world' systems. Using open-world system increases the complexity of making sense of each others' actions, since the system itself does not provide resources for structuring the interactions. There is no clear workflow.

Given this episode of 'human processing' that developed expected email behaviour between participants, it can be argued that in the situated use of email, the participants had successfully created translucence in the very incident

mediating the social context. First, the US-team member knew that the Swedish team member was no longer by her computer because she explicitly stated she was leaving the computer, thus providing 'visibility'. Then, the US-member behaved accordingly to this knowledge as she became 'aware'. The Swedish-member wrote that she would be away from the computer because she knew she 'could be judged' according to her actions – she was being held 'accountable' for her actions. Here we see how visibility is only provided one way (from Sweden to the US), while awareness has two forms of creating accountability: the US member becomes aware of the Swedish member and the Swedish member is aware that the US member is creating accountability. Through human-processing, the participants created translucence when communicating by email in this specific situation, hence they reduced the complexity of sense-making of the other's actions. The reduction of complexity or ambiguity is the result of human nature rather than the nature of email.

7. Conclusion

Participants interpret the actions of others, making sense of the collaboration through their frame of reference formed by the lifeworld they inhabit. When situated at different locations in different countries and speaking different languages (not only national languages, but also organizational languages), participants in virtual teams simultaneously exist in various social contexts and lifeworlds. This setting makes it a complex task for the virtual team to develop and maintain a common language for interpretation of the collective actions, thus increasing the risk of breakdowns in communication. Also, in mediated collaboration, the actions are represented through the resources provided by the technology (such as email or groupware). Actions in virtual teams are accessible only through the content of emails, documents, reports or artefacts produced by the team members. Virtual team members lack face-to-face encounters such as meetings or coffee breaks. Understanding this constraint, we have proposed an analytical distinction between the three levels of shared meaning related to the organizational context of a virtual teams, and how these levels implicate the development of shared meaning. Our main empirical observations concerning implications are that conflicts and communication breakdowns caused by disjoint at the lifeworld level resulted in the participants' inability to negotiate the objective of the project in Team 1, and that this unresolved breakdown influenced both breakdowns at the institutional and work practice level. Hence, the team never managed to either collaborate or to produce the expected outcome.

Previous research argues that face-to-face meetings are vital for creating stronger social relationships (Chudoba et al., 2005; Maznevski & Chudoba, 2000), that activities focusing on social and personal information benefit the

collaboration (Zheng et al., 2002), and finally that the extend of face-to-face interaction positively influence the team performance, thus suggesting that virtual teams should be brought together for periodic co-located encounters (Kirkman et al., 2004). Nevertheless, our empirical observations indicate that the major discontinuities of lifeworld crashes emerge when team members were co-located, thus serving as a ground for communication breakdowns. This suggests that even though face-to-face interaction might positively influence the teamwork, face-to-face encounters might also lead to conflicts and miscommunications rooted in the discontinuities of lifeworlds. We argue that team members in virtual teams do not have access to interpretations of the interactions at the lifeworld level per se, thus resolving lifeworld conflicts requires dedicated negotiations that are vital for the participants to even engage in collaborative practice in the first place.

To have a successful virtual collaboration, there is a need to develop shared meaning related to the organizational context of the virtual team. The organizational context of a virtual team is a conglomeration of pieces related to the lifeworlds, institutional structures and work practices of the local organizational contexts, the distributed organizational context and the professional context. The shared meaning is the frame of reference for the taken-for-granted knowledge, which enables participants to act and to make sense of others' actions. Participants draw upon the shared meaning to interpret the actions of others, determining what is proper or improper in specific situations. Developing and maintaining shared meaning requires translucence in communication structures at three levels: lifeworld, institutional, and work practice. All breakdowns manifest at the work practice level and some can be resolved at this level depending on the participants' ability to critically reflect on their common actions. Creating translucence at the work practice level is a negotiation of the specific professional norms and work processes, which build shared meaning of the assignment in the professional context. However, complex breakdowns are grounded at the institutional or lifeworld level. Here, the process of creating translucence is more difficult. At the lifeworld level, translucence is created when participants negotiate the fundamental issues of their collaboration and create a common language and establish a new collaboration context (virtual team context) different from the existing local organizational contexts of the participants. Finally, creating translucence at the institutional level is a negotiation process, which includes participation of managers of the appropriate explicit structure and visible decision patterns surrounding the virtual team.

Supporting the development and maintenance of translucence and meaning context in virtual teams requires a shared workspace in which objects-of-work can be operated upon and participants can represent their collective actions, thus providing others the ability to interpret the mediated actions. Additionally,

technology should support collaborative innovation upon the groupware application and provide participants with the ability to construct and revise the conceptual structures of the common workspace. The technology should also support the enrichment of mediated actions that facilitate visibility, awareness, and accountability. Without translucence in the negotiations of shared meaning, the risk of breakdowns in communication increases. Thus, translucence is a vehicle to support shared meaning. We argue that there is a need for translucence in communication structures at all three levels of building shared meaning in a virtual team. This includes bringing visibility of actions to members and making them aware of the actions of others so they can interpret collective actions and adjust their own actions according to the collaboration process. This approach ensures that accountability for one's actions is understood.

Bibliography

Bell, B., and Kozlowski, S. "A Typology of Virtual Teams: Implications for Effective Leadership," *Group & Organization Management*, (27:1), March, 2002, pp 14-49.

Bjørn, P. "Re-Negotiating Protocols: A Way To Integrate GroupWare in Collaborative Learning Settings," ECIS 2003, New Paradigms in Organizations, Markets and Society, Proceedings of the 11th European Conference on Information System, Napoli, 19-21 June 2003, 2003.

Bjørn, P., and Simonsen, J. "Joint enterprise and the role of the intermediator: Challenges managing groupware in virtual teams," 5th International workshop on web based collaboration (W10-WBC'05), at the Sixteenth international workshop on database and expert systems application (DEXA'05), IEEE, Copenhagen, 2005, pp. 609-615.

Bowker, G. C., and Star, S. L. *Sorting Things Out: Classification and Its Consequences*, The MIT Press, Cambridge, 2002.

Carstensen, P., and Schmidt, K. "Computer support cooperative work: New challenges to system design," *CTI working paper*, (43), February, 1999.

Chudoba, K. M., Wynn, E., Lu, M., and Watson-Manheim, M. B. "How virtual are we? Measuring virtuality and understanding its impact in a global organization," *Information Systems Journal*, (15), 2005, pp 279-306.

Cramton, C. D. "The mutual knowledge problem and its consequences for dispersed collaboration," *Organization science*, (12:3), May-June, 2001, pp 346-371.

Ebling, M. R., John, B. E., and Satyanarayanan, M. "The importance of translucence in mobile computing systems," *ACM Transactions on Computer-Human Interaction*, (9:1), March, 2002, pp 42-67.

Eisenhardt, K. M. "Building theories from case study research," *The Academy of management review*, (14:4), 1989, pp 532-550.

Erickson, T., and Kellogg, W. A. "Social translucence: An approach to the designing systems that support social processes," *ACM Transactions on Computer-Human Interaction*, (7:1), March, 2000, pp 59-83.

Fiol, C. M., and O´Connor, E. J. "Identification in Face-to-Face, Hybrid, and Pure Virtual Teams: Untangling the Contradictions," *Organization science*, (16:1), January-February, 2005, pp 19-32.

Flores, F., Graves, M., Hartfield, B., and Winograd, T. "Computer systems and the design of organizational interaction," *ACM Transactions on Office Information Systems*, (6:2), April, 1988, pp 153-172.

Gioia, D. "Symbols, Scripts and Sensemaking: Creating Meaning in the Organizational Experience" in Sims, H. P., and Gioia, D. A. (Eds.) *The Thinking Organization*, San Francisco: Jossey-Bass, 1986.

Glaser, B. G., and Strauss, A. L. *The discovery of grounded theory: strategies for qualitative research*, Aldine De Gruyter, New York, 1967.

Griffith, T., Sawyer, J., and Neale, M. "Virtualness and Knowledge in Teams: Managing the Love Triangle of Organizations, Individuals, and Information Technology," *MIS Quarterly*, (27:2), 2003, pp 265-287.

Heath, C., Svensson, M. S., Hindmarsh, J., Luff, P., and Lehn, D. v. "Configuring awareness," *Computer Supported Cooperative Work (CSCW): An International Journal*, (11), 2002, pp 317-347.

Hertzum, M. "Six Roles of Documents in Professionals' Work," Sixth European Conference on Computer Supported Cooperative Work, Kluwer Academic Publisher, Copenhagen, Denmark, 1999, pp. 41-60.

Hinds, P., and Mortensen, M. "Understanding conflict in geographical distributed teams: The moderating effects of shared identity, shared context, and spontaneous communication," *Organization science*, (16:3), May-June, 2005, pp 290-307.

Holmqvist, B. "Work, Language and Perspective: An Empirical Investigation of the Interpretation of a Computer-Based Information System," *Scandinavian Journal of Information Systems*, (1), 1989, pp 72-96.

Huysman, M., Steinfield, C., Jang, C.-Y., David, K., Veld, M. H. I. T., Poot, J., and Mulder, I. "Virtual Teams and Appropriation of Communication Technology: Exploring the Concept of Media Stickiness," *Computer Supported Cooperative Work (CSCW): An International Journal*, (12), 2003, pp 411-436.

Jarvenpaa, S. L., Knoll, K., and Leidner, D. E. "Is Anybody out there? Antecedents of Trust in Global Virtual Teams," *Journal of Management Information Systems*, (14:4), Spring, 1998, pp 29-64.

Jarvenpaa, S. L., and Leidner, D. E. "Communication and trust in global virtual teams," *Organization science*, (10:6), Nov.-Dec., 1999, pp 791-815.

Kirkman, B., Rosen, B., Tesluk, P., and Gibson, C. "The Impact of Team Empowerment on Virtual Team Performance: The Moderating Role of Face-to-Face Interaction," *Academy of Management Journal*, (47:2), 2004, pp 175-192.

Klein, H., and Truex, D. "Discourse Analysis: An Approach to the Investigation of Organizational Emergince," in: *Signs of work: Semiosis and information processing in organisations*, B. Holmqvist, P. B. Andersen, H. Klein and R. Posner (eds.), Walter de Gruyter, Berlin, 1996.

Klein, H. K., and Myers, M. D. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems," *MIS Quarterly*, (23:1), March, 1999, pp 67-93.

Lipnack, J., and Stamps, J. *Virtual Teams: People working across boundaries with technology*, (2 ed.), John Wiley & sons, Inc., New York, 2000.

Lundberg, C. C. "Working with culture", *Journal of Organizational Change Management*, Vol.1, No.2, pp.38-47, 1989.

Lyytinen, K. J., and Ngwenyama, O. K. "What does computer support for cooperative work mean? A structurational analysis of computer supported cooperative work," *Accounting management and information technology*, (2:1), 1992, pp 19-37.

Majchrazak, A., Rice, R. E., Malhotra, A., King, N., and Ba, S. "Technology Adaption: The Case of a Computer-Supported Inter-Organizational Virtual Team," *MIS Quarterly*, (24:4), December, 2000, pp 569-600.

Majchrzak, A., Rice, R. E., Malhotra, A., King, N., and Ba, S. "Technology Adaptation: The Case of a Computer-Supported Inter-Organizational Virtual Team," *MIS Quarterly*, (24:4), December, 2000, pp 569-600.

Malhotra, A., and Majchrzak, A. "Enabling knowledge creation in far-flung teams: best practice for IT support and knowledge sharing," *Journal of Knowledge Management*, (8:4), 2004, pp 75-88.

Mark, G., and Poltrock, S. "Shaping technology across social worlds: Groupware adoption in a distributed organization," GROUP, ACM, Florida, 2003, pp. 284-293.

Maznevski, M. L., and Chudoba, K. M. "Bridging Space Over Time: Global Virtual Team Dynamics and Effectiveness," *Organization science*, (11:5), Sep.-Oct., 2000, pp 473-492.

Myers, M., and Young, L. "Hidden Agendas, Power and Managerial Assumptions in Information Systems Development: An Ethnographic Study," *Information Technology & People*, (10:3), 1997, pp 224-240.

Ngwenyama, O. K. "Groupware, social action and organizational emergence: on the process dynamics of computer mediated distributed work," *Accounting management and information technology*, (8), 1998, pp 127-146.

Ngwenyama, O. K., and Klein, H. K. "An exploration of the expertise of knowledge workers: towards a definition of the universe of discourse for knowledge acquisition," *Information Systems Journal*, (4), 1994, pp 129-140.

Ngwenyama, O. K., and Lee, A. S. "Communication richness in electronic mail: Critical social theory and the contextuality of meaning," *MIS Quarterly*, (21:2), June, 1997, pp 145-167.

Ngwenyama, O. K., and Lyytinen, K. J. "Groupware environments as action constitutive resources: a social action framework for analyzing groupware technologies," *Computer Supported Cooperative Work (CSCW): An International Journal*, (6), 1997, pp 71-93.

Olikowski, W. J. "Improvising Organizational Transformation Over Time: A Situated Change Perspective," *Information Systems Research*, (7:1), 1996, pp 63-92.

Olson, G. M., and Olson, J. S. "Distance matters," *Human-Computer Interaction*, (15), 2000, pp 139-178.

Orlikowski, W., and Hofman, D. "An Improvisational Model for Change Management: The Case of Groupware Technologies," *Sloan Management Review*, (38:2), Winter, 1997, pp 11-21.

Orlikowski, W. J., and Gash, D. C. "Technological frames: making sense of information technology in organizations," *ACM Transactions on Information Systems*, (12:2), April, 1994, pp 174-207.

Pentland, B. "Grammatical Models of Organizational Processes", *Organization Science*, Vol. 6, No. 5, pp. 541-556, 1995.

Robinson, M. "Double-level language and co-operative working," *AI & Society*, (5), 1991, pp 34-60.

Schein, E. H. *Organizational culture and leadership*, (2 ed.), Jossey-Bass, San Francisco, 1992.

Schmidt, K., and Bannon, L. " Taking CSCW Seriously: Supporting Articulation Work," *Computer Supported Cooperative Work (CSCW): An International Journal*, (1:no. 1-2), 1992, pp 7-40.

Star, S. L., and Strauss, A. "Layers of silence, arenas of voice: The ecology of visible and invisable work," *Computer Supported Cooperative Work (CSCW): An International Journal*, (8), 1999, pp 9-30.

Suchman, L. *Plans and situated actions. The problem of human machine communication*, (1 ed.), Cambridge university press, Cambridge, 1987.

Suchman, L. "Making work visible," *Communications of the ACM*, (38:9), September, 1995, pp 56-64.

Townsend, A. M., DeMarie, S. M., and Henrickson, A. R. "Virtual teams: Technology and the workspace of the future," *Academy of Management Executive*, (12:3), August, 1998, pp 17-29.

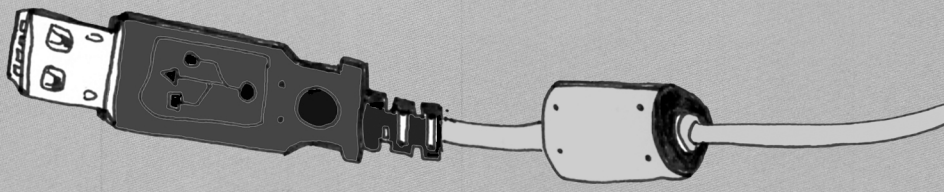
Tyre, M., and Orlikowski, W. "Windows of opportunities: Temporal patterns of technological adaptation in organizations," *Organization science*, (5:1), 1994, pp 98-118.

Walsham, G. "Interpretive case studies in IS research: nature and method," *European Journal of Information Systems*, (4), 1995, pp 74-81.

Zheng, J., Veinott, E., Bos, N., Olson, J., and Olson, C. "Trust without touch: Jumpstarting long-distance trust with initial social activities," Computer Human Interaction (CHI), ACM, Minneapolis, Minnesota, USA, 2002, pp. 141-146.

Project-Based Collaborative Learning

Negotiating Leadership and Commitment in Virtual Teams



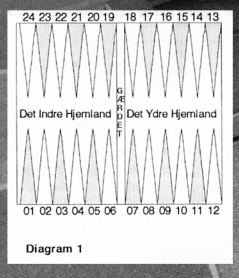


Diagram 1

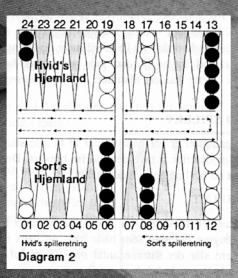


Diagram 2

Bjørn, P., and Hertzum, M. "Project-Based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams," 5th Conference on Human Computer Interaction in Southern Africa (CHI-SA), ACM SIGCHI, Cape Town, South Africa, 2006, pp. 6-15.

Project-Based Collaborative Learning

Negotiating Leadership and Commitment in Virtual Teams

Pernille Bjørn and Morten Hertzum
Roskilde University
pbr@ruc.dk, mhz@ruc.dk

Abstract: Identifying, formulating, and maintaining a shared focus in a project group is a difficult and complex negotiation process. We investigate this negotiation process in an educational setting with students collaborating in virtual project teams. We examine the asynchronous online negotiations of three project groups during one semester of project-based studies. The students are geographically dispersed and engaged in tightly coupled collaboration mediated by a text-only groupware system. The analysis leads to the identification of two issues that may jeopardize virtual negotiations: a risk of individualistic proactive behaviour that constrains consensus building and prevents progress and a risk of one student taking the lead while the other students assume subordinate roles and learn less. The study shows how the groupware system that mediated the students' negotiations about their project also entered into their handling of these two risks.

1. Introduction

Cooperative work is ubiquitous and increasingly involves people who are occasionally, periodically, or permanently cooperating at a distance [1, 4, 8, 13, 17, 18, 20]. This physical distribution has partly been made possible by standardization and division of labour and partly by the introduction of computer support in terms of information and communication technology (ICT). People's ways of working must, however, be adjusted to accommodate remote co-workers, and some types of cooperative tasks have proven detrimental to virtual cooperation – distance matters [5, 24]. This study investigates one such

task, namely the process of identifying and formulating a shared focus in projects where the interaction among participants is primarily by means of technology. Whereas several studies have investigated this process of negotiating a shared project focus for virtual teams in industry [e.g., 9, 22, 29], this study takes place in an educational setting of project-based collaborative learning.

A crucial element of project-based collaborative learning as discussed in this study is that the students define their own project – including the problem with which they will be working, the methods they will apply, and the literature they will draw upon in the process. The students work with real or at least realistic problems and are consequently confronted with ambiguous and chaotic situations, rather than simplified, decontextualized problems [33]. This makes the process of identifying and formulating the problem, or project focus, the students' main activity during the initial stage of a project [11]. Further, the students work in groups throughout the process and produce a project report for which they are jointly responsible. Thus, 'open skills' [6, 30] such as argumentation and negotiation are indispensable. Identifying and formulating a shared project focus is a complex activity, which is often slow and punctuated by mistakes and redirections even when performed by experienced professionals in co-located settings [25, 26]. When teams and thereby negotiations become virtual, complexity is further increased and Olson and Olson [24] provide the broadly scoped warning that firm common ground is essential for virtual cooperation to succeed. To sort out this complexity we need a detailed understanding of how virtual negotiations evolve in real-life settings such as project-based collaborative learning.

This paper concerns the process of negotiation in student groups that communicate by means of electronically mediated textual messages for extended periods of time. Like Lave and Wenger [16] we use negotiation in a broad sense, referring to actors' continued negotiation of situated meaning and shared focus. Our empirical data comprise the complete online written interaction of three virtual teams during one semester of project work on the two-year, part-time master education of *ICT and Learning* in Denmark. The education is for people who have full-time jobs and need to study in the evening and during weekends. This makes it difficult for students to meet, a difficulty further aggravated by considerable geographical dispersion among the students. Consequently, students predominantly study remotely via a Web-based groupware system: Virtual University (VU).

The next section covers previous work on virtual teams, followed by a description of our research method. Then, we analyse the students' virtual negotiations and the strategies they employ in reaching closure on the focus of their projects. This results in the identification of two risks to successful negotiations and an understanding of how VU contributes to and otherwise affects the students' handling of these risks.

2. Virtual Teams

Townsend et al. [31, p. 18] define virtual teams as "groups of geographically and/or organizationally dispersed co-workers that are assembled using a combination of telecommunications and information technologies to accomplish an organizational task". A distinctive feature of this definition is that virtual teams are, partly, defined by their reliance on certain technologies. This is rarely meant to imply that teams never meet face to face, and illustrates that the difference between virtual and co-located teams is one of degrees. Further, virtual teams are often composed of dispersed sub teams of co-located people [9, 10, 19].

A core result of previous studies of distributed collaboration is that articulation [27] is crucial to closing the gaps between collaborating actors. Recent studies find that major aspects of this articulation work concern trust, commitment, task complexity, and appropriation of technology. These four aspects all relate to the process of negotiating the focus and common ground of a project.

Trust. Virtual teams often include people who have not previously worked together and therefore have little or no basis for forming an initial perception of their remote colleagues' ability, benevolence, and integrity [12]. Thus, the physical distance between actors may develop into a psychological distance characterized by uncertainty and absence of trust. Jarvenpaa and Leidner [13] find that trust is facilitated by different types of behaviour at different stages of a project. Early on, the primary facilitators of trust are social communication, communication of enthusiasm, and individual initiative. Several studies propose initial face-to-face activities as an effective – or even necessary – means of creating social relationships, building trust, and thereby jumpstarting virtual collaboration [e.g., 12, 35]. Later in the lifecycle of a virtual team Jarvenpaa and Leidner [13] find that trust is mainly facilitated by predictable communication, substantial and timely responses, and a successful transition from social through procedural to task focus.

Commitment. There is a distinct difference between agreeing about what to do and agreeing about who will do it. Jarvenpaa et al. [12] find that in effective virtual teams members volunteer for explicit roles and engage in independent activities, whereas in ineffective teams members are reluctant to take on individual responsibilities. Commitment to future action is to a considerable extent negotiated indirectly, and this often leads to differences between the requester and the other team members in their perception of the salience of requests and, in turn, to differences in team members' perception of their individual commitments [7]. At the utterance level Searle's [28] taxonomy of illocutionary acts provides a means of analysing how commitment is negotiated. As email and other asynchronous messages typically contain multiple utterances,

turns in these forms of communication may involve negotiation of multiple intertwined commitments. The taxonomy of illocutionary acts helps identify requests and clarify whether they lead to commitments or go unnoticed. In a study with designated leaders in virtual teams of students, Kayworth and Leidner [14] report that the subordinate students experienced a lack of information from their leader to clarify their commitments and motivate them. At the same time the leaders felt powerless and experienced considerable difficulty asserting their authority. This testifies, we believe, not to a need for more clarity about commitments than in face-to-face interactions but to an increased need for communication in order to achieve clarity about commitments.

Task complexity. Maznevski and Chudoba [22] propose that in effective virtual teams more complex tasks and higher interdependence of sub tasks instigate richer and more frequent communications. Conversely, ineffective teams tend to either assign less importance to rich and frequent communication or fail to get the majority of team members involved in such communication. A specific aspect of complexity concerns the initial level of goal agreement. Whereas virtual teams have successfully handled tasks for which goal agreement has been achieved prior to virtual collaboration [e.g., 1], the prospects of virtual collaboration are much more uncertain when goal agreement is to be reached through virtual negotiation [24].

Appropriation of technology. In synchronous communication mutual understanding is typically assumed if the other party continues relevantly [2]. This implicit assessment of mutual understanding breaks down in asynchronous communication, such as the email-like messages exchanged in VU, because feedback cannot be obtained instantly and continuously but only after a distinct delay and normally at a more coarse-grained level. Media richness is, however, not simply a feature of the technologies [23]. Markus [21] finds that lean media, such as email, can be rich in situations where people know each other, but that people expect their relationships to degrade if they are confined to textual media for extended periods of time. Further, different technologies affect people's negotiation behaviour in different ways. Valley et al. [34] find that people are less trustworthy in telephone negotiations than face-to-face, and that written negotiations tend to result in less information being exchanged and more negotiations reaching an impasse.

In *project-based collaborative learning* [3, 11, 33] all of the above aspects of articulation are important. In addition, the process of reaching and preserving goal agreement is a major aspect of the collaboration and cannot be confined to an initial pre-virtual stage. The transition from an overall choice of topic, through a delimitation of a problem area, to the formulation of a specific problem is thus a pivotal element of problem-oriented learning. The educational setting implies that the formulation of a problem is not just a decision process for the group, but

a learning process for each individual student [3]. Starting from vague, individual notions about the focus of their project students must continually negotiate a shared agreement. This involves a balancing of individual interests and group consensus and it is a complex, time-consuming activity.

3. Research Method

The data analysed in this paper are the complete written online communications of three project groups during their second semester of a two-year master education in ICT and learning. The three groups that allowed us access to their communications consisted of a total of 12 students (7 female, 5 male), all with full-time jobs. Apart from two weekend seminars, the groups were virtual throughout the six-month project period and communication was mediated by VU, which was known to the students because they had used it during their first semester. VU provided the students with facilities for writing textual messages to their group and made these messages available as threaded discussions. Students could further create folders, so-called conferences, to help structure their negotiations. This study is based on an analysis of the 1833 messages exchanged in VU by the three groups of students. The messages were supplemented with observation at the two weekend seminars, an interview with each group, and four interviews with the groups' supervisor.

We analysed the structure and contents of the groups' communications in VU. The structural analysis involved calculations of the number and length of messages and quantitative differences in how individual students contributed to the negotiations. The contents analysis involved coding the messages according to two sets of categories. These categories were developed by exploring and annotating about a third of the messages, and inspired by the literature.

First, we coded the messages with respect to their main contents. We distinguish three categories of contents, which can be simultaneously present: (1) *Social*, which is messages about the students' interests, activities, and lives beyond their studies. (2) *Process*, which is messages about how the students plan and coordinate their collaboration. (3) *Subject matter*, which is messages about the topic, line of argumentation, results, and other elements that form the contents of the project report.

Second, we coded the messages with respect to Searle's [28] taxonomy of illocutionary acts. The purpose of this coding was to investigate how commitment was negotiated and, thereby, how the groups orchestrated the individual efforts that constituted their collective project. The taxonomy of illocutionary acts has five categories: (1) *Assertives*, which are utterances committing the sender, in varying degrees, to something being the case, to the truth of the expressed proposition. Example: 'There is something inconvenient in the way we go about our discussions'. (2) *Directives*, which are utterances in

which the sender attempts, to varying degrees, to get the receivers to do something, ranging from questions to commands. A directive can address a specific person, such as 'Nicolas, could you make the interview guide for tomorrow?', or be addressed to nobody in particular: 'We need to email the agenda to our supervisor'. (3) *Commissives*, which are utterances in which the sender commits, in varying degrees, to a future course of action. As a special subcategory we include utterances in which the commitment is expressed post hoc through the sender's provision of the outcome of a self-initiated course of action. Examples of the two types include 'I will do the review for tomorrow' and 'I have read this book and here is a summary'. (4) *Expressives*, which are utterances expressing the sender's psychological state about a state of affairs, including such acts as apologizing and praising. Example: 'SORRY ABOUT MY IMPATIENCE' (capitals in original). (5) *Declarations*, which are utterances that bring about a state or condition by virtue of the sender declaring the new state or condition. Example: a student becomes a candidate by virtue of the examiners at the final exam declaring that the student has passed.

A subset of 198 messages (11% of the data) was coded by both authors. Inter-coder agreement was assessed by Cohen's kappa. Landis and Koch's [15] interpretation of the strength of agreement is given in parentheses. Kappa yielded values of 0.82 ("almost perfect agreement") for the coding of main contents and 0.67 ("substantial agreement") for the coding of illocutionary acts. Consequently, the codings of contents and illocutionary acts were retained (while a third coding of the depth to which participants argued about each others' ideas was skipped due to insufficient inter-coder agreement). Disagreements among the coders were discussed and a consensus reached. Then, the first author coded the remaining messages.

4. Analysis

The analysis starts with a short description of the groups. Then, we identify overall patterns with respect to message content. On this basis, the remainder of the analysis looks into the negotiation process of each group in turn.

4.1 The Three Groups

Groups were formed at the weekend seminar in January. Here the 45 students taking part in the master education met face to face, discussed their interests with respect to the projects they would be doing until June, and engaged in a group-formation process.

Group 1 consisted of five motivated and self-reliant students. During and immediately after the weekend seminar they created 13 conferences in VU to structure their negotiations. The intensity of these negotiations is evident in the

explosive number of messages written by the five group members from the first week onward, see Figure 1. During the first month they wrote more messages than Groups 2 and 3 did during the entire semester. However, while Group 1 started out enthusiastically they dissolved into three subgroups after about a month. These three subgroups – Groups 1A, 1B, and 1C – all completed their projects with above average grades.

Group 2 consisted of three students. Once the group was formed they experienced few problems reaching agreement about the focus of their project, partly because Liza immediately emerged as the leader, and partly because they quickly got access to an empirical case and made it the pivotal element of their project. Group 2 received an above average grade for their project.

Group 3 consisted of four students. While they were enthusiastic about their project, their collaboration in VU was very limited during the first month, see Figure 1. After that they got more focussed and productive. Group 3 succeeded in negotiating a problem statement and made a project receiving an above average grade.

Table 1. Distribution of messages with respect to main contents. A message can be in multiple categories.

Group	Messages	Social		Process		Subject matter	
1	599	49	(8%)	485	(81%)	239	(40%)
1A	133	31	(23%)	118	(89%)	54	(41%)
1B	342	43	(13%)	318	(93%)	170	(50%)
1C	28	3	(11%)	25	(89%)	20	(71%)
2	501	31	(6%)	383	(76%)	180	(36%)
3	230	8	(3%)	176	(77%)	92	(40%)

4.2 Message Contents

The tripartition of message contents into social, process, and subject matter shows essentially the same pattern for Groups 1, 2, and 3, see Table 1. As much as 76-81% of the messages had process contents and about half as many, 36-40%, contained information about the subject matter of the projects. This suggests that VU played a considerable role in procedural and coordinative negotiations whereas detailed negotiation of the subject matter probably was divided between VU and the text processing system used for writing draft documents. Only 3-8% of the messages had social contents and few messages were exclusively social. Although we were unable to detect much social interaction in VU we did find traces of social activities in VU mediated by other technologies such as phone, email, and instant messaging. The subgroups of Group 1 had a higher percentage of messages with social contents. In Group 1A these messages occurred mainly during the first half of the project; in Group 1B mainly during the last half.

Jarvenpaa and Leidner [13] find that successful virtual collaboration is facilitated by an initial focus on social communication and a subsequent transition through a procedural focus to a focus on the subject matter. In contrast to Jarvenpaa and Leidner [13] we find that apart from the initial social communication at the first weekend seminar the relative prominence of social, process, and subject-matter contents was rather stable over time. Figure 2 illustrates this for Group 2.

4.3 Group 1: Insisting on Individual Views

Table 2 summarizes how the individual students contributed to the negotiations of their group. In Group 1 all five students were very active during the short period the group existed. The least active group member wrote more messages a week than any member of Groups 2 and 3. Although they exchanged an average of 120 messages a week, the students in Group 1 did not reach a mutually acceptable agreement about the focus of their project. To understand the apparent discrepancy between an active and enthusiastic group and their failure to complete their project we turn to Table 3, which shows the distribution of the messages onto illocutionary acts.

A total of 51% of the messages exchanged by Group 1 were commissives but they were very unevenly distributed between the two subcategories of commissives. Whereas commissives to future actions tend to occur in reply to directives from other group members, post-hoc commissives indicate proactive behaviour. For Group 1, 40% of the messages were post-hoc commissives through which the students volunteered the outcome of self-initiated activities, whereas only 11% of the messages were commissives toward future actions. Furthermore, all students in Group 1 displayed this pattern (post-hoc commissives were in the range 28-51%; commissives to future action were in the range 8-15%). For Groups 2 and 3 the two subcategories of commissives were

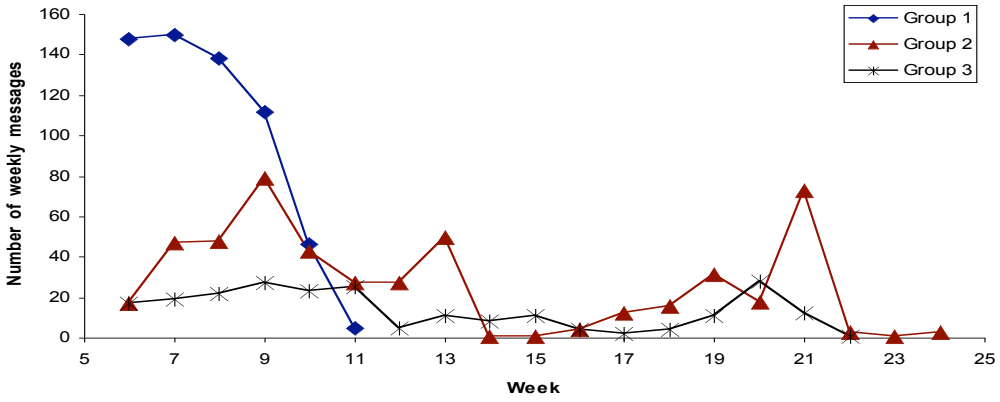


FIGURE 1: NUMBER OF MESSAGES PRODUCED BY THE GROUPS DURING EACH WEEK OF THE PROJECT PERIOD.

more evenly balanced and at least some group members displayed the opposite pattern; that is, they committed to future actions more often than they engaged in proactive behaviour.

Investigating this aspect further, the messages exchanged by Group 1 include numerous incidents where one of the students promotes his or her own interest without making an attempt to integrate this individual interest with the other students' views. The large number of such messages was, to some extent, recognized by the group and experienced as a problem, for example in relation to the explosive number of summaries. The below quotations illustrate how they articulated the problem:

> "Our positive problem [concerning self initiative and high engagement] can in the future become a negative one as we may loose our overview [...]" [Sascha, #13, 6th of February, 10:51, Group 1 conference]

> "Maybe it is a good idea that we decide which books/articles each of us will read and make summaries of. I will however make a lot of summaries myself, no matter whether others have made them too." [Thomas, #18, 6th of February, 13:33, Group 1 conference]

> "I have now provided comments on messages from Mary, Ellen, and Jane. It took a long time (read: inordinately long time) [...]. Also, Thomas has provided an annotated summary of the article, which I will start commenting on now... But there is something awkward in the way we conduct these discussions." [Sascha, #59, 10th of February, 16:53, Group 1 conference]

The quotations show that the students were highly committed, that each of them produced summaries of the same books and articles to verbalize their individual perspective, and that the resulting masses of material made the process confusing and complicated collaboration. The large number of post-hoc commissives reflects the students' individualistic attitude, implying that their summaries pointed in different directions rather than supported the group in converging toward a shared focus. Underneath the socially supportive tone of

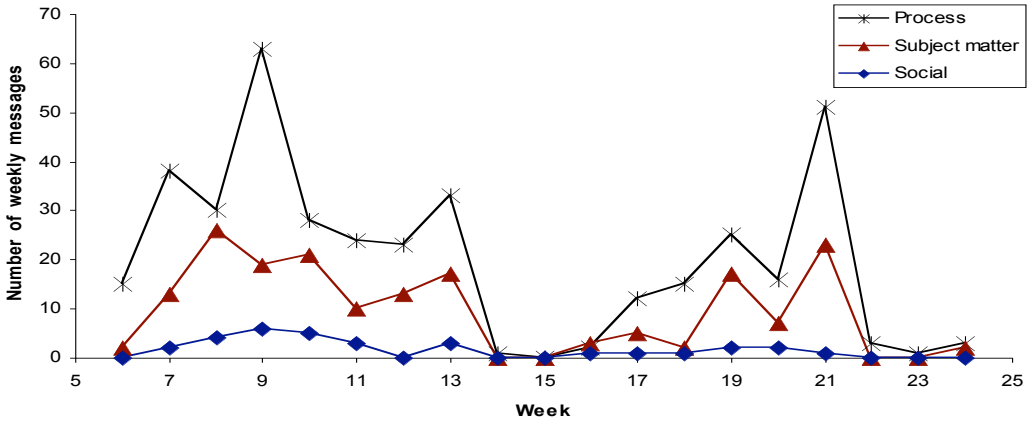


FIGURE 2. CONTENTS OF THE MESSAGES PRODUCED BY GROUP 2 DURING EACH WEEK OF THE PROJECT PERIOD. A MESSAGE CAN BE IN MULTIPLE CATEGORIES.

the messages a more manipulative practice emerged, in which the students in Group 1 used strategies such as simply ignoring other group members' ideas and repeating their own points:

> "Hi all, I have started to read all the good and inspiring messages posted here in this conference [...] and I would like to repeat my suggestion from #36 [...]" [Sascha, #39, 20th of February, 13:15, Problem statement conference]

> "Referring to the dialogues we have had on the problem statement so far, I want to make the below suggestion [...]. I have mostly adjusted my previous proposal [...]" [Thomas, #35, 20th of February, 00:02, Problem statement conference]

The students in Group 1 were not able to change their unconstructive ways of working toward a more collaborative process and after about a month Sascha decided to leave the group, creating Group 1C. Soon after Ellen and Jane also left and created Group 1A, leaving Mary and Thomas as Group 1B.

In Group 1 activities were mainly triggered by the students' pursuit of their individual interests, and group consensus remained a secondary issue to which none of the students felt genuinely committed. VU provided an explicit record of their previous messages and this made it easy to include or refer to old

Table 2: The students' negotiation behaviour (all names are pseudonyms). Self transitions are the number of times a message is followed by another message by the same person without in-between messages by other people, including the supervisor.

Group	Person	Messages	Words/message	Messages/week	Self transitions
1	Ellen	111	123.75	22.20	54 (49%)
	Mary	110	157.19	22.00	37 (34%)
	Jane	113	132.97	22.60	46 (41%)
	Sascha	159	120.96	31.80	56 (35%)
	Thomas	106	193.54	21.20	51 (48%)
	Total	599	143.24	119.80	244 (41%)
1A	Ellen	57	219.82	4.75	25 (44%)
	Jane	76	265.03	6.33	43 (57%)
	Total	133	245.65	11.08	68 (51%)
1B	Mary	152	179.70	12.67	84 (55%)
	Thomas	190	143.43	15.83	124 (65%)
	Total	342	159.55	28.50	208 (61%)
1C	Sascha	28	158.46	2.33	21 (75%)
	Total	28	158.46	2.33	21 (75%)
2	Liza	217	135.25	12.76	87 (40%)
	Peter	175	96.99	10.29	66 (38%)
	Nicolas	109	49.62	6.41	40 (37%)
	Total	501	103.26	29.47	193 (39%)
3	Emma	50	94.82	2.94	15 (30%)
	Michael	44	88.32	2.59	25 (57%)
	Juliette	83	168.55	4.88	31 (37%)
	John	53	309.81	3.12	17 (32%)
	Total	230	169.73	13.53	88 (38%)

statements in a new message. In advocating their ideas, the students mainly used the presence of previous messages to refer to their own former messages. Other students' messages were referred to if they provided supporting arguments but were otherwise largely ignored.

Asynchronous, text-based systems such as VU provide users with plenty of opportunity for carefully selecting and deselecting the messages to which they respond and refer. Thus, for a group to benefit from the availability of previous messages the group members must be open toward other group members' views and seek to establish common ground. Previous work on virtual teams has emphasized proactive behaviour and individual initiative as indicators of success [e.g., 12, 13]. However, Group 1 exemplifies that proactive behaviour may also be an indication of group members with strong individual views and a limited disposition to accept a compromise.

4.4 Group 2: Creating Subordinate Members

Contrary to Group 1 there was only one student in Group 2 who maintained a strong individual position and she quickly attained a leading role. Table 2 shows that Liza wrote more and longer messages than the other group members, reflecting her leading role. Conversely, the two other students in the group assumed subordinate roles and followed Liza's lead. On several occasions Nicolas was inactive for four or five days without warning and apparently with no need for ensuring that important decisions were not made in his absence. Peter was more vocal than Nicolas but did not challenge Liza's position.

It was settled early on that the group would make a case study. A major reason for this decision was that Liza knew about and could provide access to an empirical case. By introducing the case Liza got an advantage due to her prior knowledge of the case, and she single-handedly settled the key question about which stakeholder group to prioritize. The negotiation of the problem statement ended without explicit closure when Liza stated:

> "I think we will eventually come up with the right formulation [of the problem statement]. With respect to the contents I don't see any disagreements." [Liza, #22, 21st of February, 14:17, Problem statement conference]

Here Liza stated that they agreed although they did not yet have a clear formulation of the problem statement. In effect she said that she could not see any objection to her approach, but at the same time she acknowledged that it had not yet been properly formulated. This left the other group members in limbo and made Liza the only person who fully knew what they had agreed to do. While nobody challenged her at this point in the process, the proposed agreement might have collapsed later when Peter and Nicolas gradually learned the contents of their agreement. This was, however, not the case since both Peter and Nicolas accepted the situation. When Liza subsequently adjusted the formulation no objections were raised.

Liza was an active and engaged leader, but she could only attain her leading role because Peter and Nicolas adapted to the situation and assumed subordinate roles. The majority of Liza's commissives were post-hoc commissives as opposed to commissives to future action (29% versus 12%), indicating her proactive behaviour and supporting her leading role. Peter and especially Nicolas displayed the opposite pattern (17% versus 23% and 5% versus 14%, respectively), suggesting a hesitation to take proactive action. They tended to have Liza sanction ideas and suggestions before action was taken. In total, Group 2 had the lowest percentage of post-hoc commissives of all the groups, see Table 3.

Jarvenpaa et al. [12] find that possibilities for and readiness to engage in independent activities are crucial to successful virtual collaboration. When a strong student assumes leadership and the other group members accept subordinate roles there will be few individual initiatives and independent activities. Nicolas' reluctance to volunteer for tasks that were brought up in group discussions led to some situations in which Liza and Peter encouraged him to participate more actively by addressing directives specifically to Nicolas. Messages containing directives were frequent in all groups but directives addressed at specific persons were mostly found in Group 2.

A characteristic common to all the groups was that the number of directives clearly exceeded the number of commissives to future actions, see Table 3. Some directives probably went unnoticed because they were stated too vaguely or because other parts of the message captured the reader's attention. People are often reluctant to state directives clearly and this may hamper communication in VU where students needed to state their directives in writing and without instant feedback from other group members. Other directives were probably noticed but neglected because the reader had a different opinion about how to proceed or was otherwise unwilling to commit to the suggested action. People often prefer to avoid confrontation and in written virtual negotiations it is especially easy to simply not respond. Cramton [7] asserts that it is psychologically hard to state directives explicitly and comparatively easy to avoid them in virtual negotiations. The possibility of avoiding directives without confrontation makes

Table 3. Distribution of messages with respect to illocutionary acts. A message can be in several of the five categories from Searle's (1979) taxonomy, but in at most one of the two subcategories of commissives.

Group	Assertives	Directives	Commissives future action	Commissives post hoc	Expressives	Declarations
1	440 (73%)	273 (46%)	67 (11%)	241 (40%)	50 (8%)	0 (0%)
1A	111 (83%)	42 (32%)	26 (20%)	63 (47%)	12 (9%)	0 (0%)
1B	244 (71%)	140 (41%)	91 (27%)	138 (40%)	33 (10%)	0 (0%)
1C	16 (57%)	16 (57%)	4 (14%)	17 (61%)	6 (21%)	0 (0%)
2	302 (60%)	217 (43%)	82 (16%)	97 (19%)	46 (9%)	0 (0%)
3	136 (59%)	77 (33%)	43 (19%)	70 (30%)	25 (11%)	0 (0%)

it easier for the students in Group 1 to insist on their individual views in spite of periodic calls for compromises and easier for Nicolas to remain reluctant to commit himself in spite of periodic directives addressed specifically at him.

In previous work, lack of information and an ensuing reduced ability to act competently have been identified as the major deficiencies of subordinate roles [14]. In Group 2 the major deficiency of the subordinate roles was the reduced engagement and participation on the part of the subordinate students. The subordinate students displayed less initiative and were to a considerable extent dependent on input and instructions from their leader. Students that do not perceive themselves as equal partners have been found to learn less from project work [3]. Also, Group 2 largely bypassed the complex process of negotiating a shared agreement about the focus of their project and, thus, did not develop their open skills and abilities to identify and reach closure on compromises among their individual views. That is, the division of the group into a leader and several subordinate students ran counter to the educational learning objectives. Additionally, common ground was fragile in this group because Liza was the only person who fully understood and was able to articulate how the project hung together.

4.5 Group 3: Building Consensus

In Group 3 the low level of activity, especially during the first month of the project, was common to all students. The most active student in this group wrote fewer messages a week than any member of Groups 1 and 2 (see Table 2). The negotiation strategy in Group 3 was very different from both Group 1 and Group 2 in that Group 3 began by conducting teambuilding activities, which have previously been found to affect virtual collaboration positively [35]. The emphasis on teambuilding meant that the group did not really start negotiating the problem statement until a month into the project period. Their interaction in VU was fairly constant throughout the project period with a small peek in week 20 (see Figure 1). Either Group 3 communicated less than the other groups or they made more frequent use of other media beside VU. In negotiating their problem statement the group employed a consensus building strategy and made an effort to be open toward each other even when they disagreed. A key incident concerned the use of the concept 'intercultural', which was advocated by John. This discussion went on for several weeks but eventually Emma emerged in a mediating role:

> "I would also like to move the process forward. However, I believe we still have small differences and uncertainties about where we want to go with the project. I believe we need to discuss and decide on these matters. Off the top of my head I see a difference between my interest and John's suggestion. Our primary task is to find a common course so we can all become "almost happy" and get on with it." [Emma, #34, 5th of March, 11:38, Problem statement conference]

Emma introduced the notion of striving for being 'almost happy' with the problem statement, a consensus-seeking approach. Her mediating role is also reflected in the distribution of illocutionary acts. As the only person in Group 3 Emma made fewer post-hoc commissives than commissives to future action (12% versus 28%).

Group 3 were slow starters and had not accomplished much after the first month. This was a cause for concern among the students and explicitly raised by their supervisor. However, during the remainder of their project the group seemed to benefit from the time they had spent on teambuilding activities during the first month. They kept listening to each other after the teambuilding activities and also when the time pressure increased. The openness involved designated efforts toward reaching a consensus (e.g., Emma's notion of 'almost happy') and a willingness to "kill one's darlings" though it is hard (e.g., in spite of his affection for 'intercultural' John agreed to let go of this concept). In contrast to Groups 1 and 2, Group 3 embraced the challenge of collaboratively identifying, formulating, and reaching closure on a problem statement reflecting their joint interests.

5. Appropriating of Technology

While technologies such as VU certainly have an impact on group processes, these technologies are open-ended and in no way determine how groups collaborate. Through their enactment and appropriation of technologies people create ways of working and continuously experience and react on the opportunities provided by technologies as well as the constraints they impose. We have identified three main areas where VU impacted the ways in which the groups accomplished their virtual negotiations.

First, VU provided a permanent record of the groups' previous messages and thereby made it possible to refer to and revisit prior messages. For the students in Group 1 this became a vehicle for basing their arguments on their own previous messages. Individual interests kept reappearing through references to previous messages, and one can speculate whether consensus building in this group would have benefited from the forgetfulness inherent in the ephemeral nature of oral communication. Certainly, the persistence of messages in combination with the students' individualistic proactive behaviour had a negative effect on the outcome of the virtual negotiations in Group 1. Conversely, for the students in Group 3 the persistence of the messages provided additional opportunities for taking other group members' views into account when new messages were written. Group 3 used the easy access to previous messages as a vehicle for reflection and, partly for this reason, managed to maintain an open dialog.

Second, the asynchronous nature of the groups' negotiations brought about multiple parallel discussions. When group members sat down in the evening to

work on their project they would normally read and respond to new messages in each discussion in turn, creating a batch of messages. If other group members were online at the same time quasi-synchronous exchanges could occur, otherwise the batches resulted in consecutive messages in VU authored by the same person. For Groups 1, 2, and 3 such consecutive messages (termed self transitions in Table 2) comprised 38-41% of the messages written by the groups. The average time that elapsed from posting a message to receiving a reply was 0.97-1.11 days, which is a typical rhythm for email-like communication [32]. The batch way of responding to messages, typical of asynchronous communication, has caused group members to read messages out of the sequence in which they were written and thereby increased the difficulty of interpreting both the contents of messages and their silence on issues raised in previous messages. Cramton [7] find that one of the biggest challenges group members face in asynchronous virtual negotiations is interpreting the various meanings of the periods of silence between messages.

Third, technologies like VU make it necessary to state directives rather explicitly and, conversely, make them easier to avoid by simply not responding. This may jeopardize virtual negotiations because people often find it difficult, or impolite, to state directives clearly and often are somewhat unwilling to commit themselves. As for other aspects of VU, the implications of this aspect differed across the groups. In Group 1 the possibility of avoiding directives without direct confrontation made it easier to insist on individual views. In Group 2, Liza's leading role was not reflected in a proportional number of clearly stated directives, and it was difficult to ascertain whether absence of commitments from the subordinate students was due to disagreements, unwillingness, or not having noticed the directives.

6. Conclusion

We have investigated how negotiation of a shared project focus is accomplished in a text-only groupware system by three groups of dispersed students. Negotiation of a shared project focus is a complex task that involves rich and frequent communication. It has been suggested that unless goal agreement has been achieved prior to virtual collaboration, the prospects of virtual collaboration will be uncertain. In the educational setting studied in this paper negotiation of the problem statement is a key element of the entire process, not an activity that can be confined to the initial stage of the project. Consequently, goal agreement must be achieved through virtual negotiations.

We have identified two issues that may jeopardize virtual negotiations in an educational context:

- A risk of individualistic proactive behaviour that constrains consensus building and prevents progress. To support students in countering this risk,

technology must contribute to decreasing the psychological distance between students. Facilities for team- and consensus building may hold promise.

- A risk of one student taking the lead while the other students assume subordinate roles and learn less. In countering this risk, students need alternative means of stating directives and making commitments as well as more elaborate techniques for interpreting other students' silences.

Learning exists beyond educational settings, thus our findings may also be relevant in other settings. Though one of the three studied groups split up after about a month, all the students completed their projects with good results. This across-the-board success was, however, brought about through very different processes of virtual negotiation. The differences concerned the students' abilities to articulate their ideas and interests in writing, their self confidence and negotiation strategies, their enthusiasm and the time they had available for the project, their familiarity with collaborative problem-based project work, and their readiness to explore and embrace groupware technologies. Technologies for supporting collaborative learning must accommodate such differences, both within and between groups.

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References

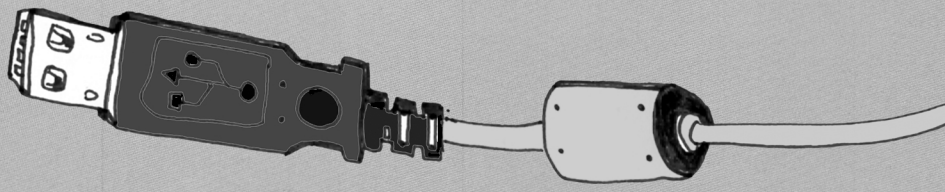
1. Arkesteijn, H., de Rooij, J., van Eekhout, M., van Genuchten, M., and Bemelmans, T. Virtual meetings with hundreds of managers. *Group Decision and Negotiation* 13, 3 (2004), 211-221.
2. Baker, M., Hansen, T., Joiner, R., and Traum, D. The role of grounding in collaborative learning tasks, in P. Dillenbourg (ed.): *Collaborative Learning: Cognitive and Computational Approaches*, Elsevier, Amsterdam, 1999, 31-63.
3. Borgnakke, K. Group work and learning processes: viewed practically and analytically, in J. H. Jensen and H. S. Olesen (eds.): *Project Studies – A Late Modern University Reform?* Roskilde University Press, Roskilde, 1999, 78-92.
4. Bradner, E., Kellogg, W. A., and Erickson, T. The adoption and use of 'Babble': a field study of chat in the workplace, in S. Bødker, M. Kyng, and K. Schmidt (eds.): *Proceedings of the Sixth European Conference on Computer-Supported Cooperative Work*, Kluwer, Dordrecht, 1999, 139-158.
5. Bradner, E., and Mark, G. Why distance matters: effects on cooperation, persuasion and deception, in *Proceedings of the CSCW Conference on Computer Supported Cooperative Work*, ACM Press, New York, 2002, 226-235.
6. Cohen, E. G. Restructuring the classroom: conditions for productive small groups. *Review of Educational Research* 64, 1 (1994), 1-35.

7. Cramton, C. D. The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science* 12, 3 (2001), 346-371.
8. Fitzpatrick, G., Kaplan, S., and Mansfield, T. Physical spaces, virtual places and social worlds: a study of work in the virtual, in *Proceedings of the CSCW Conference on Computer Supported Cooperative Work*, ACM Press, New York, 1996, 334-343.
9. Herbsleb, J. D., and Mockus, A. An empirical study of speed and communication in globally-distributed software development. *IEEE Transactions on Software Engineering* 29, 6 (2003), 1-14.
10. Huysman, M., Steinfeld, C., Jang, C.-Y., David, K., Veld, M. H. I., Poot, J., and Mulder, I. Virtual teams and the appropriation of communication technology: exploring the concept of media stickiness. *Computer Supported Cooperative Work* 12, 4 (2003), 411-436.
11. Illeris, K. Project work in university studies: background and current issues, in J. H. Jensen and H. S. Olesen (eds.): *Project Studies – A Late Modern University Reform?* Roskilde University Press, Roskilde, 1999, 25-32.
12. Jarvenpaa, S. L., Knoll, K., and Leidner, D. E. Is anybody out there? antecedents of trust in global virtual teams. *Journal of Management Information Systems* 14, 4 (1998), 29-64.
13. Jarvenpaa, S. L., and Leidner, D. E. Communication and trust in global virtual teams. *Organization Science* 10, 6 (1999), 791-815.
14. Kayworth, T. R., and Leidner, D. E. Leadership effectiveness in global virtual teams. *Journal of Management Information Systems* 18, 3 (2002), 7-40.
15. Landis, J. R., and Koch, G. G. The measurement of observer agreement for categorical data. *Biometrics* 33, 1 (1970), 159-174.
16. Lave, J., and Wenger, E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge, 1991.
17. Lipnack, J., and Stamps, J. *Virtual Teams: Reaching Across Space, Time, and Organizations with Technology*. Wiley, New York, 1997.
18. Majchrzak, A., Rice, R. E., Malhotra, A., and King, N. Technology adaptation: the case of a computer-supported inter-organizational virtual team. *MIS Quarterly* 24, 4 (2000), 569-600.
19. Mark, G., Abrams, S., and Nassif, N. Group-to-group distance collaboration: examining the "space between", in K. Kuutti, E. H. Karsten, G. Fitzpatrick, P. Dourish, and K. Schmidt (eds.): *Proceedings of the Eighth European Conference on Computer-Supported Cooperative Work*, Kluwer, Dorcrecht, 2003, 99-118.
20. Mark, G., Grudin, J., and Poltrock, S. E. Meeting at the desktop: an empirical study of virtually collocated teams, in S. Bødker, M. Kyng, and K. Schmidt (eds.): *Proceedings of the Sixth European Conference on Computer-Supported Cooperative Wor*k, Kluwer, Dordrecht, 1999, 159-178.
21. Markus, M. L. Electronic mail as the medium of managerial choice. *Organization Science* 5, 4 (1994), 502-527.
22. Maznevski, M. L., and Chudoba, K. M. Bridging space over time: global virtual team dynamics and effectiveness. *Organization Science* 11, 5 (2000), 473-492.
23. Ngwenyama, O. K., and Lee, A. S. Communication richness in electronic mail: critical social theory and the contextuality of meaning. *MIS Quarterly* 21, 2 (1997), 145-167.
24. Olson, G. M., and Olson, J. S. Distance matters. *Human-Computer Interaction* 15, 2&3 (2000), 139-178.

25. Olson, G. M., Olson, J. S., Carter, M. R., and Storrøsten, M. Small group design meetings: an analysis of collaboration. *Human-Computer Interaction* 7, 4 (1992), 347-374.
26. Potts, C., and Catledge, L. Collaborative conceptual design: a large software project case study. *Computer Supported Cooperative Work* 5, 4 (1996), 415-445.
27. Schmidt, K., and Bannon, L. Taking CSCW seriously: supporting articulation work. *Computer Supported Cooperative Work* 1, 1&2 (1992), 7-40.
28. Searle, J. R. A taxonomy of illocutionary acts, in J. R. Searle: *Expression and Meaning: Studies in the Theory of Speech Acts*, Cambridge University Press, Cambridge, 1979, 1-29.
29. Stahl, G., and Herrmann, T. Intertwining perspectives and negotiation, in *Proceedings of the GROUP'99 Conference*, ACM Press, New York, 1999, 316-325.
30. Strijbos, J. W., Martens, R. L., and Jochems, W. M. G. Designing for interaction: six steps to designing computer-supported group-based learning. *Computers & Education* 42, 4 (2004), 403-424.
31. Townsend, A. M., DeMarie, S. M., and Hendrickson, A. R. Virtual teams: technology and the workplace of the future. *Academy of Management Executive* 12, 3 (1998), 17-29.
32. Tyler, J. R., and Tang, J. C. When can I expect an email response? a study of rhythms in email usage, in K. Kuutti, E. H. Karsten, G. Fitzpatrick, P. Dourish, and K. Schmidt (eds.): *Proceedings of the Eighth European Conference on Computer-Supported Cooperative Work*, Kluwer, Dorcrecht, 2003, 239-258.
33. Ulriksen, L. In the crossfire of tradition and modernisation, in J. H. Jensen and H. S. Olesen (eds.): *Project Studies – A Late Modern University Reform?* Roskilde University Press, Roskilde, 1999, 136-150.
34. Valley, K. L., Moag, J., and Bazerman, M. H. "A matter of trust": effects of communication on the efficiency and distribution of outcomes. *Journal of Economic Behavior & Organization* 34, 2 (1998), 211-238.
35. Zheng, J., Veinott, E., Bos, N., Olson, J. S., and Olson, G. M. Trust without touch: jumpstarting long-distance trust with initial social activities, in *Proceedings of the CHI Conference on Human Factors in Computing Systems*, ACM Press, New York, 2002, 141-146.

Medieret Vejledning af Problemorienteret Projektarbejde

Udfordringer for Vejledning i Problemformuleringsfasen



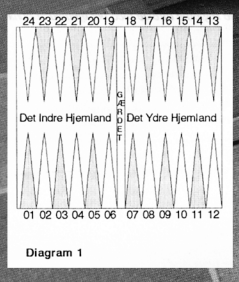


Diagram 1

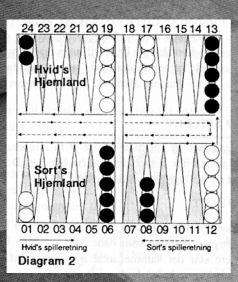


Diagram 2

Bjørn, P. "Medieret Vejledning af Problemorienteret Projektarbejde: Udfordringer for Vejledning i Problemformuleringsfasen," Tidsskrift for Universiteternes efter- og videreuddannelse, UNEV, (9), 2006

Medieret Vejledning af Problemorienteret Projektarbejde

Udfordringer for Vejledning i Problemformuleringsfasen

Pernille Bjørn
Roskilde University
pbr@ruc.dk

Abstract: Denne artikel ser nærmere på de ændrede betingelser og nye udfordringer, en vejleder af problemorienteret projektarbejde står over for i forbindelse med IKT-medieret vejledning af projektgrupper med geografisk adskilte deltagere. Artiklen anvender empiri om en vejleders situation i forhold til vejledning i problemformuleringsfasen af tre projektgrupper på masteruddannelsen i IKT & Læring, indsamlet i foråret 2002. Målet er at udforske særlige udfordringer og betingelser ved medieret vejledning for at forstå, hvilke betingelser, der danner grundlag for medieret vejledning samt at forstå, hvordan vejlederen oplever medieret vejledning. I artiklen bliver en vejleders fortolkninger og meningsdannelser over egne handlinger analyseret og tre eksempler på særlige udfordringer oplevet af vejlederen i forbindelse med skriftlig asynkron vejledning af tre konkrete projektgrupper bliver præsenteret. Artiklen identificerer den største udfordring for både produkt- og procesvejledning som det at konstruere, kommunikere og fortolke kontekstuel information signifikant for selve vejledningssituationen, en udfordring der kom til udtryk på forskellige måder i de tre grupper.

1. Udfordringer ved Vejledning i Problemformuleringsfasen

Uddannelsessituationer med geografisk adskilte deltagere eksisterer særligt inden for efter- og videreuddannelsesområdet, eksempelvis på universiteternes masteruddannelser. Samtidig fordrer pædagogiske principper såsom deltagerstyring, gruppearbejde og problemorientering et tæt samarbejde mellem studerende, såvel som mellem gruppen og vejlederen. Tæt samarbejde bliver besværliggjort, når deltagerne har begrænsede muligheder for at mødes face-to-face. Således har samarbejde og kollaborativ læring anderledes betingelser, hvis deltagerne bor langt fra hinanden og er afhængige af hyppig brug af IKT til at mediere deres samarbejde.

Denne artikel fokuserer på de udfordringer, vejlederen af problemorienteret projektarbejde står overfor, når der skal gives vejledning i problemformuleringsfasen, og det *ikke* er praktisk muligt for gruppen at mødes fysisk med vejlederen. Det særligt interessante ved problemformuleringsfasen er, at deltagerne befinder sig i en vital forhandlingssituation, hvor den endelige beslutning har stor betydning for resten af gruppens arbejde. Problemformuleringen styrer valg af både teori og empiri og danner således omdrejningspunktet for projektet. Forhandling om og valg af problemformulering er en af de vigtigste processer i gruppens arbejde – et kardinalpunkt i projektforløbet (Borgnakke, 1999). Derudover er forhandling af problemformuleringen en samarbejdsopgave, hvor deltagerne har forskelligrettede motiver, idet de studerende på den ene side skal samarbejde og kombinere deres individuelle bidrag til et samlet hele, og på den anden side sikre sig, at deres egne interesser bliver varetaget. Dette betyder, at de studerende ud over at være samarbejdspartnere også konkurrerer (O´Connor *et al.*, 1993). Forskning i forskellen mellem geografisk adskilte grupper og geografisk samlede grupper har peget på, at der er særlig risiko for konflikter i geografiske adskilte grupper (Griffith *et al.*, 2003), samt at det er væsentligt, at konflikter bliver opdaget tidligt i forløbet, da geografiske adskilte grupper er mere skrøbelige af natur (Hinds & Mortensen, 2005). Hensigten med denne artikel er at se nærmere på de ændrede betingelser og nye udfordringer, en vejleder af problemorienteret projektarbejde står over for i forbindelse med IKT-medieret vejledning af projektgrupper i problemformuleringsfasen. En forhandlingssituation der er kendetegnet ved, at deltagere med forskelligrettede motiver skal opnå enighed på trods af de begrænsninger, teknologien sætter.

2. Det Empiriske Grundlag

Artiklen anvender empiri om en vejleders situation i forhold til vejledning i problemformuleringsfasen af tre projektgrupper på masteruddannelsen i IKT & Læring, indsamlet i foråret 2002. Masteruddannelsen i IKT & Læring (MIL) er en toårig deltidsuddannelse (60 ECTS points) for voksne med mindst to års erhvervserfaring, under IT-Højskolen i Vest-danmark udbudt som et samarbejde mellem Aalborg Universitet (AAU), Århus Universitet (ÅU), Roskilde Universitetscenter (RUC), Handelshøjskolen i København (CBS) og Dansk Pædagogisk Universitet (DPU). Uddannelsen er en kombination af IKT-medieret og tilstedeværelsesundervisning, hvor de studerende deltager i kurser i efteråret og arbejder med projektarbejde i foråret. Projektarbejdet er organiseret som problemorienteret projektarbejde i grupper (f.eks. Dirckinck-Holmfeld, 2002a, 2002b; Illeris, 1999; Nielsen, 2002; Ulriksen, 1997). Projektarbejdet i foråret begynder med en gruppedannelsesproces under et tilstedeværelsesseminar på DPU i januar og ender med en gruppeeksamen på AAU i juni måned. For en nærmere beskrivelse af uddannelsen se www.hum.aau.dk/mil.

Den IKT-medierede undervisning foregår via konferencesystemet Virtual University (Virtual-U), som er et asynkront tekstbaseret IKT-system, hvor deltagerne kan skrive og svare på skriftlige indlæg i et antal underkonferencer. Som en del af projektarbejdet oprettes en særlig undermappe til hver gruppe, hvori gruppen selv har mulighed for at oprette yderligere underkonferencer til at diskutere særlige problematikker (f.eks. problemformulering eller litteratur). Alle grupper opretter sædvanligvis også en undermappe til vejledning, hvori al korrespondance mellem vejlederen og gruppen er placeret. Gruppen og vejlederen aftaler, hvor ofte vejlederen logger på Virtual-U (typisk én til to gange om ugen) og svarer på gruppens indlæg. Derudover kan gruppen sende en e-mail til vejlederen, hvis hurtigt svar er nødvendigt. Gruppemedlemmerne bestemmer selv, om vejlederen skal have adgang til deres andre undermapper. Når man logger på Virtual-U, er det synligt i hvilke undermapper, der befinder sig nye og ulæste indlæg. Det er også muligt at vedhæfte dokumenter til enkelte indlæg. Derudover er Virtual-U et meget simpelt system, der ikke direkte understøtter eksempelvis koordinering og ressourcehåndtering. Til tider er det svært at bevare overblikket i systemet. I forbindelse med vejledning medvirker den asynkrone natur indlejret i Virtual-U til at gøre det vanskeligt at skabe rum for uformelle læringssituationer. Endelig kan skriftligheden i Virtual-U skabe en yderligere formalisering af vejledningen, der ellers ikke er påtænkt (Dirckinck-Holmfeld *et al.*, 2002).

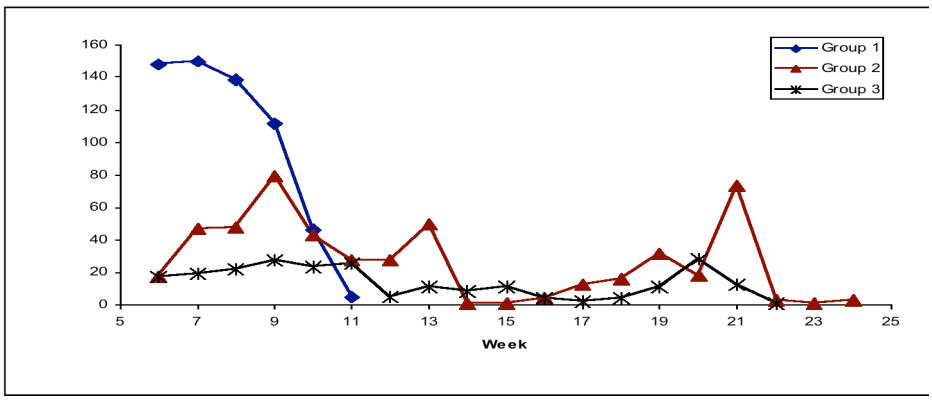
Årgangen, der startede på MIL-uddannelsen i september 2001, bestod af 45 studerende. De skulle danne et antal grupper på 3-5 medlemmer under tilstedeværelsesseminaret i januar på DPU. 12 af disse studerende (7 kvinder og 5

mænd) dannede tilsammen tre projektgrupper, og det er vejledningen af disse tre grupper, der er i fokus i denne artikel.

Gruppe 1 består af Ellen, Mary, Jane, Sascha og Thomas. Alle fem er meget aktive og engagerede studerende. Fire af dem er bosiddende forskellige steder i Danmark, og en er bosiddende i Norge. Gruppen opretter tidligt 13 underkonferencer, og gruppens medlemmer skriver hver gennemsnitlig 24 indlæg pr. uge i Virtual-U i løbet af den første måned (se tabel 1). Gruppen oplever mange problemer med at blive enige om problemformuleringen med det resultat, at gruppen splittedes i tre efter en måned: Gruppe 1A, 1B og 1C. Alle tre undergrupper afleverer et projekt og består deres eksamen med en karakter i den øverste tredjedel af karakterskalaen.

Gruppe 2 består af Liza, Peter og Nicolas. De har få problemer med at nå til enighed om problemformuleringen. Dels fordi de tidligt får adgang til en empirisk case, og dels fordi en af deltagerne tager rollen som leder i gruppen. To af gruppens medlemmer er bosiddende i Danmark, og den sidste er bosiddende i Norge. Gruppens brug af Virtual-U følger en rytme, der består af løbende interaktion afbrudt af mere intensive perioder med høj aktivitet, typisk i forbindelse med afslutningen af et delprodukt såsom afholdelse af interview, midtvejsevaluering og skrivning af den endelige rapport. Efter de intensive perioder følger gerne en kortere periode med mindre aktivitet (se figur 1). Gruppens medlemmer skriver hver i gennemsnit 9,8 indlæg pr. uge over hele forløbet (se tabel 1). Gruppe 2 består deres eksamen med en karakter i den øverste tredjedel af karakterskalaen.

Gruppe 3 består af Emma, Michael, Juliette og John. De fire danske studerende er ikke synderligt aktive i forhold til forhandling af problemformulering i den første måned, skønt de er meget engagerede i hinanden og projektet. Gruppe 3 er i det hele taget ikke særlig aktive i Virtual-U sammenlignet med de to andre grupper (se figur 1). Gruppen starter ud med at lave teambuilding-aktiviteter, hvilket viser sig at have positiv indflydelse på deres senere konsensusprægede forhandlingsstrategi i forhold til problemformuleringen. Gruppens medlemmer skriver i gennemsnit hver 3,4 indlæg pr. uge over hele forløbet (se tabel 1). Gruppe 3 består eksamen med en karakter i den øverste tredjedel af karakterskalaen.



FIGUR 1: ANTAL AF INDLÆG PRODUCERET AF GRUPPERNE I HVER UGE AF PROJEKT FORLØBET.

Gruppe	Person	Indlæg	Ord/indlæg	Indlæg/uge
1	Ellen	111	123.75	22.20
	Mary	110	157.19	22.00
	Jane	113	132.97	22.60
	Sascha	159	120.96	31.80
	Thomas	106	193.54	21.20
	Total	599	143.24	119.80
1A	Ellen	57	219.82	4.75
	Jane	76	265.03	6.33
	Total	133	245.65	11.08
1B	Mary	152	179.70	12.67
	Thomas	190	143.43	15.83
	Total	342	159.55	28.50
1C	Sascha	28	158.46	2.33
	Total	28	158.46	2.33
2	Liza	217	135.25	12.76
	Peter	175	96.99	10.29
	Nicolas	109	49.62	6.41
	Total	501	103.26	29.47
3	Emma	50	94.82	2.94
	Michael	44	88.32	2.59
	Juliette	83	168.55	4.88
	John	53	309.81	3.12
	Total	230	169.73	13.53

Tabel 1: Aktivitetsniveau i de tre grupper fordelt på personer. Navnene er pseudonymer

Ovenstående tabel er en oversigt over alle gruppemedlemmers aktivitet, inklusive Gruppe 1's undergrupper fordelt over forløbet. Det bemærkelsesværdige er, at deltagerne i Gruppe 1 har et lagt højere aktivitetsniveau end Gruppe 2 og 3. De producerer rent faktisk flere indlæg i den måned gruppen eksisterer, end de to andre grupper gør over hele perioden. Aktivitetsniveauet falder i undergrupperne for Gruppe 1, særligt Gruppe 1C, der kun består af et medlem. Gruppe 1C's kommunikation består især af vejlederrelateret korrespondance. En anden interessant observation er, at alle deltagerne i Gruppe 1 har et højt aktivitetsniveau, hvor aktivitetsniveauet i f.eks. Gruppe 2 er forskelligt internt blandt gruppemedlemmerne, hvor Liza producerer flere og længere indlæg end f.eks. Nicolas. Aktivitetsniveauet er også forskelligt internt i Gruppe 3, hvor Juliette producerer flest indlæg, og de tre andre medlemmer producerer stort set lige mange indlæg.

3. Metode

Forskningsmetoden bag denne artikel er et kvalitativt fortolkende case-studie (Eisenhardt, 1989; Klein & Myers, 1999; Walsham, 1995). Fortolkende case-studier fokuser særligt på kompleksiteten i, hvordan mennesker danner betydning i

erfarede situationer og søger at forstå et fænomen gennem de meningsdannelser, de undersøgte personer lægger i handlinger og situationer (Klein & Myers, 1999). Målet med undersøgelsen her er at udforske særlige udfordringer og betingelser ved medieret vejledning i problemformuleringsfasen gennem en analyse af vejledernes fortolkninger og meningsdannelser over egne handlinger. Jeg søger at forstå, hvilke betingelser der danner grundlag for medieret vejledning samt at forstå, hvordan vejlederen oplever medieret vejledning.

Tabel 2 indeholder en oversigt over de aktiviteter, der blev foretaget i forbindelse med dataindsamlingen for at opnå en dybdegående forståelse af vejledernes rolle i forbindelse med gruppernes forhandling af problemformuleringen.

Aktiviteter
4 Interview/reflekterende samtaler med vejlederen af de tre grupper
Observation af tilstedeværelsesseminaret på DPU i januar 2002
Observation af tilstedeværelsesseminaret på RUC i maj 2002
Observation af gruppernes aktivitet i Virtual-U
Interview med Gruppe 1
Interview med Gruppe 2
Interview med Gruppe 3
Adgang til den komplette samling af alle gruppers indlæg i Virtual-U (1833 indlæg)

Tabel 2: Aktiviteter i forbindelse med dataindsamlingen

Selvom alle aktiviteterne udgør det empiriske grundlag for denne artikel, vil jeg særligt fremhæve samtalerne med vejlederen og de tre observationer af gruppernes medierede forhandling, da disse har bidraget særligt til en forståelse af vejlederens situation. Den nærmere analyse og kodning af alle gruppernes indlæg i Virtual-U og interviewene med grupperne har mere bidraget til en forståelse af de forskellige strategier for forhandling, som grupperne benytter i Virtual-U (Bjørn & Hertzum, 2006).

4. Projektvejledning

Vejledning i forbindelse med problemorienteret projektarbejde er tidligere blevet fremstillet forskelligt i form af generelle overvejelser (Berthelsen *et al.*, 1993, p. 53-58), som retningsliner for gruppers brug af deres vejleder (Olsen & Pedersen, 1997, 2005), som overvejelser af bestemte typer af vejledning f.eks. praktiske diskursanalyser (Mathiesen, 1999, p. 14), eller som produkt- eller procesvejledning (Kaae, 1999; Tofteskov, 1996). Lærerens rolle i forbindelse med IKT-støttet undervisning bliver typisk beskrevet i form af moderatorrollen (Witfelt, 2001) eller facilitatorrollen (Agertoft *et al.*, 2003). At være moderator kræver kompetencer af organisatorisk, social og intellektuel art. Organisatoriske aktiviteter handler om at oprette, strukturere og modificere indlæg fra studerende. Sociale relaterede aktiviteter handler om at befordre et venligt miljø for gensidig udveksling og læring, og sidst handler intellektuelle aktiviteter om

at rette diskussionerne i retning af vigtige pointer for læringsmålet (Paulsen, 1998). Samtidig er en væsentlig udfordring i forbindelse med IKT-støttet kollaborative læringsforløb at få dialogen i gang, hvilket kan være svært til trods for de bedste konstruktivistiske og kollaborative intentioner (Sorensen, 2000). Derudover er det blevet fremhævet, at den ændrede rolle for underviseren i net-baseret undervisning udmønter sig ved, at underviseren skal være mere synlig, tydelig og hele tiden på forkant med organiseringen af både kommunikationen og det pædagogiske indhold (Agertoft *et al.*, 2003). Teknologien har også betydning for vejledningssituationen, og brugen af nye kommunikationsmedier forøger kompleksiteten, idet rammerne for kommunikationen er anderledes og til tider ukendte for både de studerende og underviseren (Mathiasen, 2004).

Underviserens rolle bliver i tidligere studier af online-kursusundervisning karakteriseret som forskellig fra foredragsholderens, idet underviserens rolle i online-undervisning handler om at opbygge strukturer for online-diskussioner, overvåge og opfordre til deltagelse, uddele roller til deltagerne (f.eks. koordinator og moderator), moderere og facilitere gruppeprocesser, koordinere og organisere interaktionen, samt at etablere normer for medieret interaktion (Harasim *et al.*, 1998). Alle disse aktiviteter ved IT-støttet kollaborativ læring er bestemt essentielle for succes også i problemorienteret projektarbejde. Forskellen er, at ansvaret for aktiviteter, såsom opbygning af strukturer og etablering af normer, befinder sig hos projektgruppen og ikke hos vejlederen. Det er gruppemedlemmernes eget ansvar at få etableret sig socialt og fagligt samt at opbygge strukturer, der understøtter det projekt, de selv definerer. Vejlederens rolle i denne sammenhæng er at give gode råd og erfaringer videre til gruppen, så gruppen selv opnår kompetencer til at foretage aktiviteterne. Men selve arbejdet med formen (mediet) for projektarbejdet er en mindre del af vejlederaktiviteten, hvis væsentligste opgave er at udøve proces- og produktvejledning i forhold til gruppens faglige projekt, akkurat som hvis gruppen havde været en face-to-face projektgruppe. I den eksisterende litteratur om online undervisning af kollaborative læringsforløb har denne side af vejlederens rolle fået begrænset opmærksomhed, hvilket betyder, at der er et behov for at undersøge de udfordringer og muligheder, den medierede praksis sætter for udøvelsen af produkt- og procesvejledning.

Produktvejledning fokuser hovedsageligt på det produkt, de studerende laver. Vejlederens rolle er at vise vejen, så de studerende når så langt som muligt, samt at påpege fejl og mangler, som de studerende så kan imødegå (Tofteskov, 1996). I produktvejledning handler det om at anvise introducerende litteratur og relevante fagtidsskrifter, forklare faglige problemstillinger og begreber, samt give respons på mundtlige og skriftlige oplæg (Kaae, 1999). *Procesvejledning* fokuser særligt på processen. Perspektivet er, at de studerende lærer 'noget' gennem deres erfarede projektproces. Samtidig er selve arbejdet med skriveprocessen vurderet som en vigtig del af erkendelsesprocessen. Vejlederens rolle er at stille

spørgsmål til refleksion. Samtidig er diskussion af problemformulering og metode særlig relevante for denne type af vejledning (Tofteskov, 1996). I procesvejledning handler det om at få gruppearbejdet i gang, få afgrænset problemfeltet, identificere og definere problemstillinger, indgå som konfliktløser, samt støtte gruppeprocessen (Kaae, 1999).

I denne artikel giver jeg en dybdegående analyse af en vejleders betingelser og udfordringer for at udøve proces- og produktvejledning medieret af teknologi. Jeg bidrager ydermere til de forholdsvist få dybdegående empiriske studier, der eksisterer af vejledningspraksis (Simonsen, 1997) og gruppesamarbejdspraksis (Keldorff, 1999) ved at basere min artikel på kvalitative analyser af konkrete empiriske erfaringer.

5. Gruppe 1: Vejledning i en Faglig Konfliktsituation

Gruppe 1 starter sit projekt ud med stort engagement og aktivitet. Alle gruppens medlemmer læser mange tekster, laver referater og kommenterer hinandens indlæg. Deres kommunikation er tydeligt præget af motivation og glæde over projektet. Ser man nærmere på gruppens problemformuleringskonference, finder man 93 indholdsmættede indlæg. Der er mange forskellige bud på problemformuleringer, der ofte tager udgangspunkt i de forskellige tekster, gruppemedlemmerne har læst. Gruppen søger også ny litteratur til inspiration, hvilket fordrer nye diskussioner, men samtidig har den ulempe, at gruppens medlemmer ikke nødvendigvis læser den samme litteratur. De er dog gode til at udveksle tekster med hinanden, men det fremgår klart, at de tekster, de enkelte medlemmer har læst først, er styrende for deres læsning af nye andre tekster. Gruppen befinder sig i en forhandlingssituation karakteriseret ved forskelligrettede motiver. På den ene side skal de samarbejde for at nå til en fælles enighed om problemformuleringen, og på den anden side insisterer alle medlemmerne på at få deres egne interesser (karakteriseret ved de tekster, de er glade for) indarbejdet i problemformuleringen. Kompleksiteten stiger med tiden, og nye bud på problemformuleringer er meget influerede af den litteratur, de læser. I en kort udveksling bliver der nævnt ikke mindre end 17 forskellige tekster skrevet af blandt andre Luhman, Bateson, Vygotski og Habermas.

På et tidspunkt forslår et gruppemedlem en problemformulering, der indeholder begreber fra både Habermas og Luhman i selve formuleringen: *"Hvordan kan idealet om argumentets tvangsløse tvang (eller den herredømmefri dialog) tilgodeses i en CSCL-læreproces, hvor kommunikation mellem selvreferentielle systemer med forskellige symbolske medier grundlæggende er usandsynlige?"*. Her begynder gruppen selv at tvivle på deres evner og søger vejledning for at komme videre. Indlægget i vejlederkonferencen giver dog ikke udtryk for de frustrationer, der er begyndt at opstå i gruppen. Gruppemedlemmerne citerer heller ikke nogen af deres forskellige eksempler på problemformuleringer. I stedet giver indlægget

indtryk af, at de er godt i gang og læser meget, men godt kunne tænke sig at få indspark i forhold til medie-brugen af Virtual-U i forbindelse med forhandling af problemformuleringen. Vejlederen foreslår gruppen at arbejde videre med en skabelon, hvor gruppen fastholder elementer, de er enige om for derved at holde sig til at diskutere uenigheder. Dette tiltag forsøger gruppen at føre ud i livet ved at arbejde med en sætning indeholdende parenteser (..) de steder i sætningen, hvor begreber skal forhandles på plads.

Gruppen afholder også ugentlige synkrone chat-møder, og efter en måned beslutter de sig endelig for en formulering. Alle virker enige og er glade for, at der *er* taget en beslutning, men så bryder gruppen sammen. Sascha kontakter vejlederen via telefon og meddeler, at hun grundet arbejdspres ønsker at melde sig ud af gruppen. Hun oplever, at det kræver megen tid at deltage i projektgruppen. Tid som hun ikke har, da arbejdsopgaverne på hendes job er vokset. Vejlederen taler med Sascha i telefonen og opfordrer hende til at blive i gruppen alligevel. Vejlederen foreslår, at Sascha kan lave en aftale med de andre gruppemedlemmer om, at hun arbejder med nedsat aktivitet i en periode. Sascha ønsker dog i stedet at skrive et projekt alene. Dagen efter bliver vejlederen kontaktet, igen pr. telefon, af Ellen og Mary. De overvejer også at gå ud af gruppen, da de mener, at gruppen har for forskellige interesser til at kunne samarbejde. Vejlederen opfordrer Ellen og Mary til at tage det op i gruppen og tilbyder at hjælpe gruppen ud af deres problemer evt. via deltagelse i et chat-møde eller et telefonmøde. Det er ikke muligt at samle hele gruppen til et tilstedeværelsesmøde, da deltagerne bor langt fra hinanden.

Det særlig interessante her er, at deltagerne skifter medie da det brænder på i gruppen. De vælger at kontakte vejlederen via telefon frem for e-mail eller i vejledningskonferencen. Skal man karakterisere de forskellige mediers muligheder for kommunikation i denne situation, er vejledningskonferencen et offentligt sted (alle deltagere har adgang) samtidig med at svarfrekvensen er lav (da mediet er asynkront). Svarfrekvensen er en betegnelse for det tidsrum fra et indlæg er skrevet til der kommer et svar. Modtagergruppen for en e-mail kan bedre kontrolleres, hvilket betyder at e-mail er mere privat (da afsenderen selv kan tilføje eller slette modtagerne af den enkelte mail). Samtidig har e-mail den samme lave svarfrekvens som konferencesystemet (asynkront medie). Telefonen derimod er karakteriseret som et synkront medie med høj svarfrekvens og en kontrolleret modtagergruppe. Derudover stiller telefonmediet mindre krav til formaliseringen af kommunikationen. Endvidere giver telefonmediet mulighed for brug af flere udtryksmuligheder, end der eksisterer i skriftsproget. Telefonmediet bliver af Ellen og Mary betragtet som det bedste valg i konfliktsituationen.

Ellen og Mary har besluttet sig for at forlade gruppen, da de kontakter vejlederen, og de meddeler resten af gruppen beslutningen via e-mail. Herefter opstår en heftig e-mail udveksling internt i gruppen, hvor det blandet andet

fremgår, at de tilbageblevne gruppemedlemmer Mary og Thomas gerne vil være med til at finde et kompromis. Mary og Thomas foreslår, at vejlederen bliver inddraget og overraskes, da de finder ud af, at Ellen og Jane allerede har været i kontakt med vejlederen. Dette leder til mistillid i gruppen, hvorefter vejlederen træder ind som konfliktmægler og skriver en lang e-mail om, hvem der har kontaktet hvem og med hvilke informationer. Vejlederen afslutter e-mailen med endnu en opfordring til forsoning og gentager, at han gerne vil deltage som konfliktløser. Han giver klart udtryk for, at et face-to-face møde ville være at foretrække. Problemet er, at det ikke praktisk kan lade sig gøre på grund af den geografiske adskillelse af deltagerne. Vejlederen skriver blandt andet:

> "Hvis I havde været en [fysisk]-gruppe, ville jeg have indkaldt Jer til et fælles møde hvor problemfeltet grundigt kunne diskuteres igennem og jeg ville forsøge at medvirke til en løsning, subsidiært til at "skilsmissen" blev af en rimelig art.(...) Jeg må gentage jeg har været overrasket, forbløffet og nedtrykt over situationen - og jeg har været uvidende om at I ingen steder var kommet den sidste måned, da I ikke har præsenteret problemerne i Vejledningskonferencen. Konkluderende på denne ulykkelige situation: I er velkomne til igen at kontakte mig, til at arrangere en chat/Instant Messaging hvor jeg inviteres eller arrangere et telefonmøde, hvor vi alle drøfter situationen."

Bruddet er tydeligvis en stor overraskelse for vejlederen, og gruppen har på intet tidspunkt hentydet til deres frustrationer i vejlederkonferencen. På baggrund af indlæggene i vejledningskonferencen, vurderer vejlederen tidligt, at gruppen er selvstyrende og selv vil sige til, hvis de har brug for vejledning. Samtidig danner vejlederen sig et indtryk af gruppen på baggrund af deres megen aktivitet i Virtual-U. F.eks. oplever vejlederen, at underkonferencer med betegnelser som litteratur, problemformulering og metode voksede med stor hast. Aktivitetsniveauet bliver tolket som, at gruppen består af gode, engagerede og målrettede studerende. Vejlederen baserer således sit indtryk af gruppen på det høje aktivitetsniveau, gruppens indlæg i vejlederkonferencen, samt det fysiske vejledermøde de havde på tilstedeværelsesseminaret i januar. Men som det fremgår, gav disse aktiviteter ikke et nuanceret billede af gruppens egentlige situation.

5.1 Reduceret Mulighed for Indblik i Gruppens Samarbejdsproces

Vejlederen oplever, hvordan medieret vejledning er en anderledes kompleks størrelse end fysisk vejledning. De asynkrone fora i Virtual-U egner sig ikke til diskussion af gruppedynamiske konflikter udsprunget af faglig uenighed. Denne problematik er både relevant i forhold til procesvejledning og produktvejledning. Gruppens problem er for det første af procesrettet art; *hvordan* skal de opnå enighed? Samtidig handler den underliggende faglige diskussion om det produkt, de arbejder med eller rettere, hvilken type produkt de *vil* arbejde med. I situationen har vejlederen intet indblik i gruppens problemer, da de er skjulte og

ikke præsenteret offentligt i vejlederkonferencen. En løsning kunne være, at vejlederen fulgte med i alle gruppens indlæg, men det ville betyde, at vejlederen ville få en rolle som gruppemedlem og ikke længere vejleder. Samtidig kan man ikke forlange, at vejlederen følger med i alle indlæg i samtlige underkonferencer, fordi særligt Gruppe 1 producerer en stor mængde indlæg (i gennemsnit 120 indlæg pr. uge, se tabel 1). Det ville tage uforholdsmæssig lang tid at læse alt, og man kan diskutere, om det ville være den rigtige brug af vejlederens ressourcer. Derfor bidrager de arkiverede indlæg ikke til transparens i forhold til vejledning.

Havde gruppen været en face-to-face gruppe, ville vejlederen på deres møder have bedre muligheder for at danne sig et indtryk af gruppens arbejde. Her kan vejlederen gå mere kvalificeret ind som konfliktløser og hjælpe gruppen til at opnå enighed. Naturligvis har grupper mulighed at 'skjule' deres konflikter på et fysisk møde, og en vejleder kan vælge ikke at gå ind i konfliktsituationer under fysiske vejledermøder, selvom disse er synlige. Men forskellen er, at vejlederen har valget mellem at indgå eller ignorere konflikterne frem for ikke at kende til dem. Derudover giver fysisk vejledning også vejlederen mulighed for at 'besvare' spørgsmål, som gruppen ikke selv er i stand til at formulere. Gruppe 1's projektrelaterede spørgsmål skrevet i vejlederkonferencen, er formuleret som konkrete spørgsmål fordret af det skriftlige medie. F.eks. spørgsmålet om, hvordan de på en hensigtsmæssig måde kan diskutere problemformuleringen. De får et konkret svar – men de får ikke udstillet deres problem, som det udfolder sig. Et problem der i høj grad har med teoretisering af problemformuleringen at gøre. Teoretisering af problemformulering sker, når deltagerne i stedet for at stille et konkret erfaret relevant spørgsmål søger at indarbejde teoretikerne i selve problemet. At have succes med en teoretisk problemstilling kræver en på forhånd omfattende viden om teorien, hvilket typisk ikke er tilfældet i studentergrupper, der jo netop skal til at tilegne sig teorien gennem projektet (Keldorff, 1999). En alternativ tilgang er at formulere problemet som en konkret undren, og så bruge teoretikerne som metode til at besvare problemet. Her er udgangspunktet mere tilgængeligt.

6. Gruppe 2: Synkron Vejledning i et Asynkront Medie

Afklaringsprocessen af problemformuleringen i Gruppe 2 er mindre kompleks end i Gruppe 1. For det første sker der tidligt en rollefordelingen i gruppen, fordi Liza tager rollen som leder og på den måde bliver det styrende element i gruppen. Liza er den mest aktive og uddeleger til en vis grad opgaver til Nicolas og Peter. Nicolas' aktivitet er særlig lille, og til tider er han direkte fraværende – selv ved forhandling af vigtige beslutninger såsom problemformuleringen. Dette kommer f.eks. til udtryk i de personrettede indlæg til Nicolas med opfordringer

til at påtage sig bestemte typer af opgaver, såsom at skrive en interviewguide. Derudover får Gruppe 2 tidligt i forløbet adgang til en empirisk case, der hjælper til at afgrænse deres problemformulering betydeligt.

Det særlige ved Gruppe 2's måde at benytte Virtual-U er, at de ikke bruger det som et decideret asynkront medie. I stedet aftaler gruppen at logge på systemet samtidig og fører synkrone møder ved at springe mellem de asynkrone underkonferencer. Denne brug af Virtual-U fører til en forøget kompleksitet, når udefrakommende (f.eks. vejlederen) logger ind i deres konferencer for at danne sig et overblik. Indlæg indlejret i en underkonference bygger direkte videre på indlæg indlejret i andre underkonferencer, samtidig med at overskrifterne for indlæggene ikke altid er dækkende for det egentlige indhold. Et eksempel er, at der langt nede i en længere tråd-diskussion under overskriften "Gennemskrivning af problemformulering" befinder sig en række indlæg, hvor gruppemedlemmerne diskuterer, hvilken type smørrebrød de skal spise, næste gang de skal mødes face-to-face. Resultatet af Gruppe 2's brug af det asynkrone medie til synkron dialog er, at det er uoverskueligt for vejlederen at følge med i deres interne fora. Det betyder, at vejlederen er nødt til at basere sit indblik i gruppens arbejde på indlæg skrevet i vejlederkonferencen, selvom deres aktivitetsniveau (antallet af indlæg) er langt under Gruppe 1's aktivitetsniveau (se tabel 1).

I den første uge af marts udarbejder Gruppe 2 et oplæg til vejledning. Den efterfølgende vejledning afholdes som et virtuelt synkront vejledningsmøde ved at bruge det asynkrone Virtual-U. Selve oplægget til mødet beskriver tydeligt, hvor gruppen er, og hvad den arbejder med. Oplægget er et udpluk af gruppemedlemmerne egne indlæg fra deres problemformuleringsdiskussion. Oplægget opsummerer meget godt, hvad gruppen vil og har karakter af en fælles gruppebeslutning. Det interessante i denne sammenhæng er ikke selve oplægget, men det efterfølgende synkrone vejledermøde afholdt i det asynkrone medie, samt de begrænsninger som mediet sætter. Hele vejledningsmødet består af i alt 21 indlæg, hvor de 11 indlæg er skrevet af vejlederen, de 9 indlæg er skrevet af Liza, og det sidste indlæg er skrevet af Peter. Nicolas er slet ikke synlig i vejledermødet, men der er god grund til at tro, at han er tilstede. Gruppen indikerer i hvert fald ikke, at han *ikke* er tilstede. Denne usikkerhed om, hvem der er tilstede under mødet, ville aldrig opstå, hvis mødet havde været fysisk.

Opstarten af vejledermødet foregår asynkront og før det endelige vejledermøde. De første 6 indlæg danner således rammerne for vejledermødet. Herunder aftaler om det præcise tidspunkt, hvor det skriftlige oplæg til vejledermødet befinder sig, samt en lille udveksling om problematikkerne ved at bruge det asynkrone medium til en synkron proces. De næste 15 indlæg er fra selve vejledermødet, som fandt sted mellem kl. 11:00 og 11:36, hvor det virker som om, at vejlederen er den sidste, der logger af. De sidste tre indlæg fra

vejlederen står i hvert fald ukommenteret tilbage. Gruppens sidste indlæg kl. 11:30 slutter da også af med, at de siger tak for denne gang, og skriver:

> "Ellers tolker vi det som om vi er på rette vej. Vi går videre til vores næste møde.[...]. Derfor logger vi af nu - men læser dit svar bagefter. Tak for denne gang."

6.1 Reduceret Fornemmelse af Nærvær under Synkron Vejledning

Selvom gruppen selv indkalder til det synkrone vejledermøde, giver de under det meget korte vejledermøde udtryk for, at de ikke har tid til at læse alle indlæggene, men i stedet vil vende tilbage og læse dem senere. I vejlederperspektiv virker situationen meget utilfredsstillende grundet den manglende fornemmelse af nærvær fra gruppens medlemmer. Som vejlederen også udtrykker det under et senere interview:

> "Gruppe 2 chat fungerede på en underlig måde - en tung måde - man skulle jo for hvert indlæg uploaded det og sige ja til dokumentet. For så at logge ind på konferencen igen og følge den videre diskussion. Her skulle man hele vejen tilbage til et andet skærmbillede. I Virtual-U kan man ikke have to adskilte skærme og både se, hvad der bliver skrevet, samtidig med at man selv skriver. Men de sagde, at de var trygge ved brugen af systemet."

Ud af de i alt 15 indlæg skrevet under selve vejledermødet, relaterede de tre sig til, om alle deltagere er logget på Virtual-U. 30 minutters synkron vejledning i et asynkront forum opfattes ikke som optimalt set i vejlederperspektiv. Der er ingen ping-pong dialog, og dybdegående dialog mellem gruppen og vejlederen udebliver. Samtidig kommer Liza til at dominere mødet gennem sin tilstedeværelse (aktivitet) og de andre gruppemedlemmers manglende tilstedeværelse (manglende aktivitet). Det er den aktive deltagelse i dialogen, der skaber nærvær i medieret kommunikation (Thommesen, 2005). På fysiske møder er manglende deltagelse mere tydelig, og vejlederen har mulighed for at forsøge at få inddraget inaktive medlemmer i dialogen. Man kunne også forestille sig, at Peter og Nicolas gennem deres kropssprog ville være mere aktive deltagende i en fysisk dialog og ikke, som i det virtuelle, totalt fraværende.

Nogle af problemerne kunne naturligvis være undgået, hvis teknologien rent faktisk understøttede synkron dialog, såsom indikation af hvem der er tilstede og hurtigere svarfrekvenser. Men i dette tilfælde valgte gruppen et kendt mediet, som de fandt understøttede deres behov. Vi kan dog konkludere, at mediet ikke understøtter vejlederens behov.

7. Gruppe 3: Svært Gennemskueligt Oplæg til Vejledning

Gruppe 3 aktivitet i Virtual-U er meget lav. Det kan have to forskellige forklaringer. Enten er gruppen en mindre aktiv gruppe, eller også benytter de sig

flittigt af andre medier i dens samarbejde. Fordi gruppemedlemmerne i deres indlæg i Virtual-U henviser til tidligere diskussioner, som ikke befinder sig i Virtual-U, er der stor sandsynlighed for, at gruppen benytter sig af andre medier i kombination med Virtual-U. I forhold til vejledning er gruppens spørgsmål i vejledningskonferencen meget få, og først i begyndelsen af marts sender de deres første oplæg til vejledning.

Gruppe 3's oplæg er ikke et forsøg på en gruppebeslutning af problemformuleringen, men i stedet en opsamling af en række udsagn fra gruppens medlemmer i forhold til deres interesser. Det gode ved dette oplæg er, at gruppemedlemmerne forsøger at fremstille deres indbyrdes enig- og uenigheder i forbindelse med problemformuleringen. Problemet med oplægget er, at det er meget svært for vejlederen at forstå, forholde sig til og vejlede gruppen, da dokumentet er uden egentlige konklusioner og spørgsmål. Eksempelvis står der:

> "Søndag aften konkluderer John på baggrund af ovenstående dialog følgende 'pinde' til afklaring sammen med vejleder...
>
> - er der almindelig enighed om at anvende begrebet 'newcommer' som Emma foreslår?
>
> - at Juliette definerer begrebet betingelser: som bevidst/ubevidste processer, individuelle (kognitive)/gruppe (psykodynamiske, kulturelle) samt organisatoriske (samfundsmæssige, kulturelle) perspektiver
>
> - at Michael og John vedr. betingelser endvidere diskuterer de teknologiske aspekter.
>
> - at Emma operer med begrebet kompetencer i stedet for betingelser (kan dog godt acceptere ordet betingelser)
>
> - at Juliette støtter formuleringen, hvis interkulturel bare kan blive til kulturel jvf. hvilke interkulturelle/kulturelle og sociale betingelser skal være tilstede for at en ..."

Hele oplægget er struktureret på denne måde, hvilket gør det meget svært for vejlederen at give kvalificeret input til deres proces, særligt fordi mange af deres 'pinde' handler om aspekter ved deres problemformulering, som de selv skal afklare og blive enige om. F.eks. om de skal benytte begrebet kompetencer eller betingelser. I et efterfølgende interview om oplægget fra Gruppe 3 udtaler vejlederen:

> "Det her indlæg fra Gruppe 3 det er ikke til at forholde sig til.. Jeg prøvede og troede jeg kunne gøre det på et par timer, men der skal så bruges mange timer, rigtig mange. Jeg ved ikke hvad deres konklusion er. Og hvad er konteksten og sådan. Jeg følte, at det var helt ukvalificeret, det jeg spillede ind, men jeg tænkte at jeg skulle gøre noget."

Som en del interviewet med vejlederen om Gruppe 3's oplæg reflekterer vejlederen over, hvad gruppen egentlig vil, samt hvilke strategier for vejledning, der vil være mest hensigtsmæssig i situationen. Han beslutter sig for at hjælpe gruppemedlemmerne til at samle sig om en problemformulering ved at komme med litteraturforslag, der kan guide dem videre. Så selvom det lader til, at gruppens største uenighed handler om begreberne interkulturel eller kulturel,

hvilket gør det naturligt for vejlederen at stille nærmere spørgsmål om netop disse begreberne, vælger vejlederen en anden strategi.

> "Det man så kunne sige, var; prøv at finde frem til de to tekster i kompendiet, og prøv at se om det ikke er det, I ligesom fisker efter... Ja. I stedet for at begynde at spørge alt for meget, hvad er det for et kulturbegreb, så får man dem også fuldstændigt ud af den. Og så bliver de ligeså usikre, som jeg følte, da jeg sad og læste, og så har de endnu mindre selvtillid egentligt.."

Under interviewet vurderer og tolker vejlederen på gruppens styrker og svagheder. Han finder, at gruppens 'tilstand' kræver en bestemt type af vejledning. Nemlig, at gruppemedlemmerne ikke må miste deres selvtillid. Derfor ønsker han ikke at øge deres forvirring ved at stille spørgsmål til teoretiske begrundelser for deres brug af begreber. I stedet kommer vejlederen med nogle bud på relevant litteratur. Rent faktisk kender vejlederen ikke særlig meget til gruppens faglige styrker og svagheder og har kun mulighed for at vurdere gruppemedlemmerne ud fra deres virtuelle arbejde. Forsigtigheden fra vejlederens side bunder også i, at Gruppe 1 lige er blevet opløst. Vejlederen er derfor ekstra opmærksom på, hvordan grupperne har det. Havde det været et fysisk vejledermøde med gruppen, ville vejlederen højst sandsynligt ikke være så bange for at spørge kritisk ind til begreberne, både fordi det er mere uformelt i en samtale end på skrift, og fordi vejlederen her har mulighed for at se gruppens reaktion på spørgsmål og reagere herefter. Denne mulighed har vejlederen ikke i en medierede vejledningssituation. Under interviewet reflekterer vejlederen over, hvad Gruppe 3 vil med projektet. Han kommer frem til, at gruppen rent faktisk ikke er interesseret i kulturbegrebet som sådanne men i stedet er interesseret i normer, som det blev præsenteret på nogle af kurserne i efteråret. Vejlederens refleksion handler om at skabe et billede af gruppen – en kontekst for gruppen, der ikke fremgår af gruppens oplæg til vejledermødet. Det efterfølgende problem er så, om det billede vejlederen skaber rent faktisk stemmer overens med gruppens forståelse.

7.1 Reduceret Mulighed for Konstruktion af Konteksten bag et Skriftligt Oplæg

Gruppe 3's vejledning er et eksempel på den reducerede mulighed for adgang til kontekstuel information signifikant for valget af vejledningsstrategier. Den følelse og fornemmelse af en gruppe som opstår under fysiske vejledermøder er svær at skabe i den medierede vejledning. For at kunne vurdere, hvilken type vejledning en gruppe har behov for, er gruppens sociale situation væsentlig. Er konteksten ikke ekspliciteret af gruppen, er det op til vejlederen selv at forsøge at konstruere den kontekstuelle information. Den kontekstuelle information bliver i face-to-face vejledning modificeret via gruppens reaktioner på vejlederens udtalelser i form af kropssprog, udsagn og handlinger. På denne måde har vejlederen mulighed for at ændre strategier i selve situationen. Uden adgang til

gruppens umiddelbare reaktioner kræver konstruktionen af kontekstuel information, at vejlederen søger at 'gennemleve' gruppens diskussioner bag et givent skriftligt oplæg for derigennem at opnå en forståelse. Denne forståelse kan være mere eller mindre sammenfaldende med gruppens egen forståelse af konteksten. Samtidig er det også en kompliceret opgave for vejlederen i et skriftligt vejlederindlæg at give udtryk for den kontekst, vejlederen selv har analyseret sig frem til og som indlægget er baseret på. Vejlederen skal ydermere også præsentere og synliggøre den kontekstuelle information bag et vejlederindlæg, som er signifikant for gruppens fortolkninger og forståelse af vejlederens tilbagemelding på deres oplæg. I face-to-face vejledning har både vejlederen og gruppen således øgede muligheder for at udrede misforståelser, mens der i en medierede asynkron vejledningssituation er forøget kompleksitet for at konstruere, kommunikere og fortolke kontekstuel information.

8. Diskussion: Begrænsede Praktiske Muligheder

Forskere har tidligere givet udtryk for, at en af de store fordele ved brugen af teknologi i vejledningen er, at vejlederen har mulighed for at følge de studerendes interne diskussioner i systemet (blandet andre Cheesman, 2000). Jeg argumenter for, at vejlederens praktiske muligheder for at følge med i projektgruppens underkonferencer er begrænsede af to hovedgrunde. For det første skriver meget aktive projektgrupper, såsom Gruppe 1, så mange indlæg, at det ikke ville være optimal udnyttelse af vejlederens ressourcer at skulle læse alle indlæggene. For det andet opbygger grupper deres egne strukturer i systemet. Strukturer de selv tillægger mening, men som ikke nødvendigvis giver mening for udenforstående, såsom det var tilfældet med Gruppe 2.

Jeg vil ikke afvise, at mediet giver vejlederen en anderledes mulighed for at følge med i gruppens interne dialoger, en ny mulighed der ikke er tilstede uden mediet. Jeg vil heller ikke afvise, at et sådan indblik i de interne dialoger ikke forhøjer muligheden for en langt mere detaljeret viden om gruppen, som kan bruges konstruktivt i forbindelse med vejledning. Det, jeg problematiserer, er vejlederens praktiske mulighed for at kunne følge med på sidelinien. Skal vejlederen følge med på sidelinien kræver det, at denne kan lokalisere væsentlige indlæg, hvis ikke samtlige indlæg skal læses. Jeg vil argumentere for, at vejlederens rolle *ikke* handler om at læse samtlige indlæg, men i stedet om at udøve produkt- og procesvejledning. Udfordringen er således at danne sig et indtryk af gruppens samarbejdsproces, faglige konflikter og projekt uden at skulle læse samtlige indlæg og alligevel give kvalificeret vejledning. Det betyder, at vejlederen skal danne sig sine indtryk på baggrund af de udspil, gruppen kommer med i f.eks. vejlederkonferencen.

Den største udfordring ved medieret vejledning er vejlederens begrænsede mulighed for konstruere og opretholde signifikant kontekstuel information på

baggrund af gruppers udspil. For at udøve god vejledning er det essentielt, at vejlederen har kendskab til, hvad gruppen arbejder med, hvilke problemstillinger de reflekterer over, samt hvilke faglige og processuelle udfordringer, de kæmper med. Skal man anvise introducerende litteratur, forklare problemstillinger og begreber samt give respons på oplæg, er det nødvendigt med kontekstinformation vedrørende gruppemedlemmernes arbejde og deres interesser. Kontekstinformation er speciel vigtigt i forbindelse med problemformuleringsfasen, da vejledning i forbindelse med afgrænsning af problemfelt, identifikation og definition af problemer kræver, at vejlederen har kendskab til gruppens situation og projekt.

Muligheden for at danne sig et indtryk af gruppens arbejde bliver hæmmet af teknologimediering, hvilket betyder, at man som udøver af medieret vejledning skal opfordre og støtte gruppens medlemmer i at sætte deres projekt til skue. Som vejleder bør man gøre det klart for de studerende, at det er bedre at fremstille ufærdige og konfliktbundende dokumenter, frem for at vente med at inddrage vejlederen, til konflikterne er løst. Skriftlige oplæg behøver ikke være fuldt færdige, før de sendes til vejlederen. Dette er særligt vigtigt i situationer, hvor deltagerne er usikre på, hvor de er på vej hen. Det betyder, at vejlederen skal søge at opnå indsigt i gruppemedlemmerne og deres projekt for at få mulighed for at hjælpe gruppen til at identificere uenigheder og agere som konfliktløser. Samtidig bør udøvere af medieret vejledning være opmærksomme på, at projektgruppers største problemer typisk er dem, de ikke selv kan formulere. Derfor kan vejlederen opfordre grupperne til at skrive 'rundt om' deres uafklarede aspekter, og så er det vejlederens opgave at forsøge at lokalisere problemet.

Der er behov for udvikling af bedre redskaber (teknologiske såvel som organisatoriske) til at mediere forskellige perspektiver i en forhandlingssituation og præsentere gruppeprocesser for udenforstående. Et bud på et organisatorisk redskab, som blev benyttet af vejlederen i Gruppe 2 og 3, efter at Gruppe 1 blev opløst, er at opfordre grupperne til hver uge at skrive et kort indlæg (10 linier) i vejlederkonferencen, der besvare følgende spørgsmål:

1. Hvordan har I det i gruppen?
2. Hvordan skrider processen frem, hvad har I lavet i den sidste uge?
3. Hvad er jeres største udfordring lige nu?
4. Hvad er jeres problemformulering i denne uge?
5. I hvilken retning bevæger projektet sig?

Disse og lignende spørgsmål fordrer grupperne til at reflektere over deres proces, samt forbedrede vejlederens muligheder for at konstruere kontekstinformation i forhold til grupperne løbende. Grupperne behøver ikke at svare på alle spørgsmålene hver uge, og længere inde i forløbet kan de holde helt op. På dette tidspunkt vil grupperne typisk begynde at sende længere skriftlige udkast til vejlederen, som således bliver opdateret ad denne vej.

Ydermere viser dette studie også, at synkron vejledning bør foregå via medier, der understøtter synkron aktivitet. Dette inkluderer blandt andet, at teknologien skal give mulighed synliggørelse af tilstedeværelse og engagement på andre måder end gennem antallet af indlæg. Dette empiriske studie peger også på, at vejledere af problemorienteret projektarbejde har behov for synkron mediering af vejledning, hvilket også understøttes af andre studier, der påpeger vigtigheden af synkron medieret mundtlig dialog i undervisningssituationer, hvor der let kan opstå tvetydigheder (Thommesen, 2005).

9. Konklusion: Teknologien Transformerer Praksis

I denne artikel har jeg set nærmere på de ændrede betingelser, teknologi-medieret vejledning af problemorienteret projektarbejde i geografisk adskilte grupper eksisterer under. Jeg har præsenteret tre eksempler på særlige udfordringer, som det blev oplevet af vejlederen i forbindelse med skriftlig asynkron vejledning af tre konkrete projektgrupper på masteruddannelsen i IKT & Læring. Disse udfordringer er væsentlige at forske i og videreudvikle løsningsforslag til inden for feltet computer supported collaborative learning (CSCL). Den største udfordring for både produkt- og procesvejledning er at konstruere, kommunikere og fortolke kontekstuel information signifikant for selve vejledningssituationen, en udfordring der kom til udtryk på forskellige måder i de tre grupper.

Jeg mener ikke, at medieret vejledning er umulig, men påpeger, hvordan betingelserne for vejledning ændrer sig, når den er medieret af teknologi. Vejledning kan godt fungere medieret. Man skal blot være særlig opmærksom på de faldgruber og situationer, hvor den har vanskelige vilkår. At indføre IKT i problemorienteret projektarbejde medfører ikke, at eksisterende vejlederroller ikke længere har nogen betydning. Samtidig er vejlederrollerne heller ikke uændrede. Teknologien transformerer vejledningspraksisen, så der opstår en ny situation med anderledes muligheder og betingelser. En af de nye betingelser er mulighed for vejledning af geografisk adskilte grupper. En anden betingelse er den reducerede muligheden for at konstruere, kommunikere og fortolke kontekstuel information. Problemer man sandsynligvis ville være opmærksom på tidligt i forløbet i forbindelse med face-to-face vejledning, kan være usynlige for vejlederen i teknologi medieret vejledning, før det er for sent.

Litteratur

Agertoft, Annelise, Inge Bjørnshave, Jørgen Lerche Nielsen & Lis Nilausen: Netbaseret Kollaborativ Læring - En Guide til Undervisere, Værløse, Billesø & Baltzer, 2003.

Berthelsen, Jens, Knud Illeris & Sten Clod Poulsen. Grundbog i Projektarbejde - Teori og Praktisk Vejledning, København. Unge Pædagoger. 1993.

Bjørn, Pernille & Morten Hertzum."Project-based Collaborative Learning: Negotiating Leadership and Commitment in Virtual Teams". In: *Proceedings of the 5th Conference on Computer Human Interaction in Southern Africa (CHI-SA)*. Eds. Darelle van Greunen. Cape Town. ACM SIGCHI, 2006. 6-15.

Borgnakke, Karen. "Group Work and Learning Processes: Viewed Practically and Analytically". Project Studies - A Late Modern University Reform? Eds. Henning Salling Olesen & Jens Højgaard Jensen. Roskilde: Roskilde University Press, 1999. 78-92.

Cheesman, Robin. "Internetbaseret Undervisning i Kommunikation + noget mere". At Undervise med IKT. Eds. Simon Heilesen. Frederiksberg: Samfundslitteratur, 2000. 257-276

Dirckinck-Holmfeld, Lone. "Virtuelle Læringsmiljøer på et Projektpædagogisk Grundlag". At Undervise med IKT. Eds. Simon Heilesen. Frederiksberg: Samfundslitteratur, 2000. 217-234.

Dirckinck-Holmfeld, Lone. "CSCL - Computer Supported Collaborative Learning: Projektpædagogisk Læringsformer i Virtuelle Omgivelser". Uddannelse, Læring og IT: 26 forskere og praktikere gør status på området. København: Undervisningsministeriets forlag. 2002a. 53-64

Dirckinck-Holmfeld, Lone. "Designing Virtual Learning Environments based on Problem Oriented Project Pedagogy". Learning in Virtual Environments. Eds. Lone Dirckinck-Holmfeld & Bo Fibiger. Frederiksberg: Samfundslitteratur. 2002b. 31-54.

Dirckinck-Holmfeld, Lone, Håkon Tolsby & Tom Nyvang. "E-læring Systemer i Arbejdsrelateret Projektpædagogik". Udspil om læring i arbejdslivet. Eds. Knud Illeris. Frederiksberg: Learning Lab Denmark, Roskilde Universitetsforlag. 2002. 123-154

Eisenhardt, Kathleen M. "Building Theories from Case Study Research". The Academy of Management Review 14.4(1989): 532-550.

Griffith, Terry L., Elizabeth A. Mannix & Margaret A. Neale. "Conflict and Virtual Teams". Virtual Teams That Work: Creating Conditions for Virtual Team Effectiveness. Eds. Christina B. Gibson & Susan G. Cohen. San Francisco: Jossey-Bass A Wiley Imprint. 2003. 335-351.

Haramis, Linda, et. al. Learning Networks: A Field Guide to Teaching and Learning Online, Cambridge, Massachusetts, The MIT Press. 1998.

Hinds, Pamela & Mark Mortensen. "Understanding Conflict in Geographical Distributed Teams: The Moderating Effects of Shared Identity, Shared Context, and Spontaneous Communication". Organization Science 16.3(2005): 290-307.

Illeris, Knud. "Project Work in University Studies: Background and Current Issues". Project Studies - a Late Modern University Reform? Eds. Henning Salling Olesen & Jens Højgaard Jensen. Roskilde: Roskilde University Press. 1999. 25-32

Kaae, Arno. "Vejlederrollen ved Projektarbejde". Om Voksenundervisning - Grundlag for Pædagogiske og Didaktiske Refleksioner. Eds. Carsten Nejst Jensen. Værløse. Billesø & Baltzer. 1999. 383-403.

Keldorff, Søren. Tæt på en Gruppe - En Projektgruppes Besvær og Succes, Gistrup. Edupax. 1999.

Klein, Heinz K. & Michael D. Myers. "A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems". MIS Quarterly, 23.1(1999): 67-93.

Mathiasen, Helle. "Lærer- og Elevroller i Projektorganiseret og Netstøttet Undervisning - Kompleksitetsøgning og Reduktionsmuligheder". Tidsskrift for Universiteternes Efter- og Videreuddannelse, 1.4(2004).

Mathiesen, Anders. Projektarbejde i Praksis - Om Uddannelsesproblemer i 90érnes Danmark - en Studiebog, København. Unge Pædagoger. 1999.

Nielsen, Jørgen Lerche. "The Implementation of Information and Communication Technology in Project Organized Pedagogy". Learning in Virtual Environments. Eds. Lone Dirckinck-Holmfeld & Bo Fibiger. Frederiksberg: Samfundslitteratur. 2002. 55-79.

Olsen, Paul Bitsch & Kaare Pedersen. Problemorienteret Projektarbejde – en værktøjsbog. Frederiksberg. Roskilde Universitets Forlag. 1997.

Olsen, Paul Bitsch & Kaare Pedersen. Problem-Oriented Project Work - a Workbook. Frederiksberg, Denmark, Roskilde University Press. 2005.

O´Connor, Kathleen, Deborah Gruenfeld & Joseph McGrath. "The Experience and Effects of Conflict in Continuing Work Groups". Small Group Research, 24.3(1993): 362-382.

Paulsen, Morten Flate. Teaching Techniques for Computer-Mediated Communication, Ph.D.-Thesis, Adult Education: The Pennsylvania State University. 1998.

Simonsen, Birgitte. Lærer på RUC - Himmel og Helvede, Roskilde, Erhvervs- og Voksenuddannelsesgruppen, Roskilde Universitetscenter. 1997.

Sorensen, Elsebeth (2000). "Interaktion og Læring i Virtuelle Rum". At Undervise med IKT. Eds. Simon Heilesen. Frederiksberg: Samfundslitteratur. 2000. 235-256

Thommesen, Jacob. "Internet-Telefoni i Fjernundervisning". Tidsskrift for Universiteternes Efter- og Videreuddannelse. 2.5(2005)

Tofteskov, Jens. Projektvejledning - og Organisering af Projektarbejde. Frederiksberg Samfundslitteratur. 1996

Ulriksen, Lars. Projektpædagogik - Hvorfor det? Erhvervs- og Voksenuddannelsesgruppen. Roskilde. Roskilde Universitetscenter. 1997.

Walsham, Geoffrey. "Interpretive Case Studies in IS Research: Nature and Method". European Journal of Information Systems, 4(1995):74-81.

Witfelt, Claus. "Mellem Moderatorer, Mediatorer og andet Godtfolk". Dansk Pædagogisk Tidsskrift, 4(2001):22-32.

Datalogiske Skrifter, 1985 – 2006

1. Henning Christiansen, 1985: Syntax, semantics, and implementation strategies for programming languages with powerful abstraction.
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29. David S.Stodolsky, 1991: Consensus Journals: Invitational journals based upon peer consensus.
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35. Jesper Simonsen, 1992: Computer Supported Cooperative Work.
36. Keld Helsgaun, 1992: CBack: et simpelt værktøj til baksporsprogrammering i C.
37. Faglig Udviklingsplan for Institut for geografi, samfundsanalyse og datalogi. Forskningsprofil 1993-98, Datalogiafdelingen.
38. Henning Christiansen, 1992: A complete resolution method for logical meta-programming languages.
39. David S. Stodolsky, 1992: Computernetværk-baseret demokrati: Videnskabelig kommunikation som grundlag for den demokratiske beslutningsproces.
40. H.B.Hansen, 1993: Konkret Matematik.
41. H.B.Hansen, 1993: Objektorienteret Programmering
42. Keld Bødker og Lars Bogetoft Pedersen, 1993: Systemudvikling i organisationer, systemudvikling som organisation.

43. Troels Andreasen, 1993: Semantic Information derived from Integrity Constraints.
44. Institut for geografi, samfundsanalyse og datalogi. Årsberetning for 1992. Datalogiafdelingen.
45. Institut for geografi, samfundsanalyse og datalogi. Årsberetning for 1993. Datalogiafdelingen.
46. Keld Bødker & Finn Kensing, 1994: Design in an Organizational Context - an Experiment.
47. Troels Andreasen og Oliver Pivert, 1994: Fuzzy Relational Query Weakening.
48. Niels Jørgensen, 1994: Finding Fixpoints in Finite Function Spaces Using Neededness Analysis and Chaotic Iteration.
49. Finn Kensing, Keld Bødker and Jesper Simonsen, 1994: An emerging approach to systems design - experience from the MUST-program.
50. Troels Andreasen, 1994: Dynamic Conditions.
51. Henning Christiansen, 1994: Efficient and complete demo predicates for definite clause languages.
52. Jesper Simonsen, 1994: Designing Systems in an Organizational Context: An Explorative Study of Theoretical, Methodological, and Organizational Issues from Action Research in Three Design Projects.
53. Inge-Lise Salomon, 1994: Effektmåling af uddannelsesforløb, Kursusevaluering - et pilotprojekt.
54. Inge-Lise Salomon, 1995: En undersøgelse af fælleskurset i gymnasiets edb-undervisning, Piger & Drenge - Sproglige & Matematiske.
55. Jesper Simonsen, Finn Kensing, 1995: Take Users Seriously, but Take a Deeper Look: Organizational and Technical Effects from Designing with an Ethnographically inspired Approach.
56. Finn Kensing & Andreas Munk-Madsen, 1995: Participatory Design: Structure in the Toolbox.
57. Finn Kensing & Terry Winograd, 1995: The Language/Action Approach to Design of Computer-Support for Cooperative Work: A Preliminary Study in Work Mapping.
58. Henrik Legind Larsen, Troels Andreasen, 1995: Flexible Query-Answering Systems.
59. Institut for datalogi, kommunikation og uddannelsesforskning, 1995. Årsberetning 1994. Datalogiafdelingen.
60. Henrik Legind Larsen, Ronald R. Yager, 1996: Query Fuzzification for Internet Information Retrieval.
61. Peter H. Carstensen, 1996: Computer Supported Coordination.

62. Henning Christiansen, Henrik Legind Larsen, Troels Andreasen, 1996: Flexible Query-Answering Systems.
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