

PREPRINT:

Pors, J.K. and J. Simonsen (2003): "Coordinating Work with Groupware: The Challenge of Integrating Protocol and Artefact", in M. Korpela, R. Montealegre, and A. Poulymenakou (Eds.): *Organizational Information Systems in the Context of Globalization* [IFIP TC8 & TC9/WG8.2 & WG9.4: Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization, 15.-17. June 2003, Athens, Greece], Kluwer Academic Publishers, pp. 53-68

Coordinating Work with Groupware *The Challenge of Integrating Protocol and Artefact*

Jens Kaaber Pors and Jesper Simonsen

Computer Science, Roskilde University, Denmark

Abstract: One important goal of employing groupware is to make possible complex collaboration between geographically distributed groups. This requires a dual transformation of both technology and work practice. The challenge is to reduce the complexity of the coordination work by successfully integrating the protocol stipulating the collaboration and the artefact, in form of the groupware application, mediating the collaboration. This paper analyses a generic groupware application that was deployed in a large financial organisation in order to support working groups distributed throughout four countries. Using the CSCW framework of coordination mechanisms, we have elicited six general factors influencing the integration of the groupware application in two situations.

Key words: Groupware, Distributed Work, Collaboration, Coordination, Coordination Mechanism, Protocol, Artefact, Integration.

1 INTRODUCTION

For a number of years it has been acknowledged that introducing groupware in an organisation is indeed a difficult matter that requires attention to the implementation of the technology as well as to a range of organisational and social factors (Bullen and Bennet 1990; Orlikowski 1993; Grudin 1994). In order for a groupware application to be successfully adopted, the introduction and the implementation of the application have to comprise a number of organisational and social factors (Grudin 1994): It has to address a real need from the group members; they should have a clear understanding of a mature use of the application and the positive impacts on their daily work; training and facilitation might be necessary, as well as perhaps even preparations to prevent premature rejection. The IS community in general and the Computer Supported Cooperative Work (CSCW) research community in particular have addressed this issue. This has led to an acknowledgement of ethnographically-informed systems design approaches (Plowman et al., 1995; Harper, 2000), while others have discussed employing groupware by means of tailoring (Mørch & Mehandjiev, 2000; Weigang & Haake, 2000). Studies of the consequences of introducing new technologies in organisations emphasise the importance of the practical use situation and the mutual agreements on how to use a groupware application, and this often entails changes in work organisation and practice (Orlikowski 1993; 2000, Mark 2002). The CSCW community is now becoming aware that focusing on supporting existing work practices (as in ethnographically-informed design) or focusing on flexible and transparent technologies (by means of tailoring or customising software) both represent too narrow of a perspective (Bowker et al., 1997).

Our starting point corresponds with Berg (1999). We aim for a “reconsideration of the notions of ‘supporting’ work and ‘transparent’ technologies” (p. 373). We strive for “an empirically grounded grasp of the functioning of information technologies in work practices” (ibid. p. 374), where we “want to work towards an account that emphasizes the *active mediating* roles of these artifacts. That is to say: an account that, in pointing to the activities of information technologies in [...] practices equally highlights the transformations of the work-activities that are mediated through them” (ibid. p. 376). The challenge is to grasp the intricate relation between this duality of changes when trying to understand how technological artefacts are employed in work practices. We refer to this transformation of both technology and work practice in general as the *integration* of groupware and work practice. When focusing on coordinating work with groupware, we use the CSCW framework related to coordination mechanisms conceptualised as protocol(s) of coordination embedded in a computational artefact (Schmidt & Bannon 1992; Carstensen 1996; Schmidt & Simone 1996). Thus the general question we follow in this paper is “when employing groupware in order to coordinate work, what conditions influence the integration of groupware and work practice?” or – to be more specific – “*what are the factors that actively influence the integration of protocol and artefact?*”

This paper presents an empirically based contribution to the above stated question by investigating how coordination of collaboration in geographically distributed groups is achieved with a generic groupware application. We have analysed the deployment and use of the web-based groupware application Lotus QuickPlace™ (in the following referred to as QP) in a large financial distributed organisation (in the following referred to as “Beta”), that had just emerged as a result of a major merger. In Beta more than 100 different QPs comprising in total about 3000 active users and more than 20 Gb of documents have emerged in less than 2 years. In this paper, we report on two differing cases with respect to the character of work and degree of integration. Both cases represent situations where coordinating work with groupware was attempted. The aim was to enhance collaboration in a distributed development project and in a distributed organisational section in charge of a recurrent task. To provide an answer to our research question, we have elicited six overall factors that have influenced the integration of QP in both cases.

In the following, we first provide a brief description of the conceptual framework of coordination mechanisms, the research method applied, and the overall starting point for deploying QP in Beta. Then, we give a more detailed account of each of the two cases: A project evaluating the possibility of creating a single customer security architecture across four different countries, and the translation section in charge of producing corporate financial reports. From these two accounts, we derive the factors that have influenced the integration of protocol and artefact in each situation, and the differences between the two situations are discussed in the light of these factors. In the concluding section we outline the implications of our research approach with regards to groupware employment and to integration of groupware with work practices.

2 COORDINATION MECHANISMS AS PROTOCOL AND ARTEFACT

The CSCW framework related to coordination mechanisms is especially relevant for our research aim since it explicitly captures the duality of changes related to the integration of groupware and work practice. The framework depicted in figure 1 is derived from Schmidt & Bannon (1992), Carstensen (1996), and Schmidt & Simone, (1996): Collaboration is analytical distinguished as comprising ‘real’ work (e.g. what the individual actor is doing) and the coordination of work (i.e. the articulated coordination involved in distributed activities needed in order for many actors to perform a cooperate effort). Coordination of work is sometimes referred to as articulation work (Schmidt & Bannon 1992; Star & Strauss 1999).

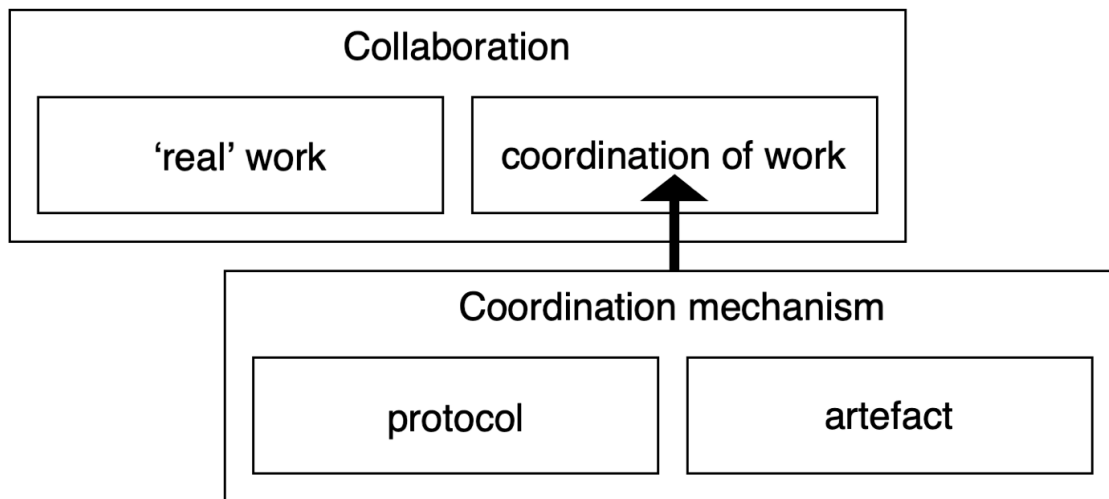


Figure 1. The conceptual framework of 'coordination mechanism'

A collaborative work task is distinguished from other kinds of work by presupposing mutual dependencies between multiple actors. In the instances where the use of groupware mediates mutual dependencies of collaborative work, a coordination mechanism is established. This duality is captured by the definition of a coordination mechanism as “a construct consisting of a coordinative protocol (an integrated set of procedures and conventions stipulating the articulation of interdependent distributed activities) on the one hand and on the other hand an artefact (a permanent symbolic construct) in which the protocol is objectified” (Schmidt & Simone 1996, pp. 165f). The protocol stipulates how the collaboration is carried out and the artefact is the material component that mediates the protocol. In our case the agreements on how to collaborate constitute the protocol while the groupware is the artefact of the coordination mechanisms. Introducing a groupware application thus involves developing a new protocol as well as taking the use of the artefact into account. At the same time the artefact (a generic groupware application) has to be tailored in order to objectify, reflect and support this specific protocol thus together forming an integrated coordination mechanism.

The motivation for employing groupware while aiming at establishing coordination mechanisms is to make complex collaboration possible. Conditions that enforce complex collaboration exist when geographically distributed actors must collaborate in order to accomplish a work task. A coordination mechanism supports the reduction of the complexity of coordination for each actor, thus “affording an increase in complexity of the work practice without a simultaneous increase in complexity in individual interactions“ (Berg 1999, p. 391). With a successful coordination mechanism in place, the members of a distributed working group are able to cope with such complex conditions for coordination.

We thus define the criteria for establishing such a computational coordination mechanism as the combination of three objectives: Attribution to meet a need (for a complex and problematic collaboration), integration of the coordination mechanism with work practice (integration of protocol and artefact), and the resulting reduction of complexity involved in the coordination (hereby supporting the collaboration).

Our aim is to close in on an understanding of the duality of changes involved when generic groupware applications are to be integrated in work practices. Our means to meet this aim is to derive the factors influencing the integration of protocol and artefact in order to reduce the complexity of collaboration by leading to stable and integrated coordination mechanisms.

3 RESEARCH METHOD

The study is part of the DIWA research program (www.diwa.dk) investigating the design and use of web-based applications supporting geographically distributed work practices. The research has been conducted with a grounded and interpretative approach (Golden-Biddle & Locke 1997) drawing on experiences from several initiatives in Beta during 2000-2002:

- An initial investigation of needs and strategies for intranet applications (6 interviews);
- An analysis of strategies and practices for Beta's organisational change support and special interest groups (6 interviews);
- An analysis of specific use of QP in newly established organisational units, projects, and teams handling recurrent tasks (7 interviews);
- Analyses of three development projects (based on interviews and observations);
- Document analysis of 90 requests for a QP from managers to IT operations stating the intended aim of using QP;
- A survey reporting from 53 QPs;
- An analysis based on a log of all http transactions to and from the QP server during a 10 month period.

The interviews lasted between 1 and 2 hours, structured by an interview guide, which was sent to the informant in advance. Interviews were tape-recorded, and later transcribed ad verbatim. All our analyses of this multi-faceted material were reported and discussed with management and other informants from Beta and constitute the basis of the research presented in this paper. The two cases presented here have been chosen from this material to illustrate situations, where groupware is employed with the explicit aim of facilitating the coordination work of a geographically distributed group. The analyses of the two situations show how the different circumstances for achieving the integration of QP actively contribute to this process as described by the identified factors.

4 INTRODUCING GROUPWARE IN BETA

Beta is a large international financial corporation and as a result of a recent merger it comprises several financial companies based in four countries. The organisations of the former companies have been merged into corporate sections and a number of corporate projects have been initiated. This created an instant need for a platform independent tool to support inter-organisational communication, since Beta at the beginning had no secure mail infrastructure, no local area network to exchanges files on, and no corporate intranet. The groupware application: Lotus QuickPlace™ release 2 (www.lotus.com/quickplace) was chosen by the communications department of Beta as the standard application to support communication within geographically distributed corporate projects and sections of Beta.

Setting up the central QP server requires virtually no integration with the existing IT infrastructure and offers secure Web-based workspaces accessible through web browsers. In addition, IT operations had good experiences with Lotus products. QP is a generic system (Bansler & Havn 1994), which means that it needs to be tailored to the specific need of the group of users. The standard configuration of a QP offers some basic facilities for discussion, calendar, user administration, index, search tool, and a tutorial. The person(s) with manager rights of a newly installed QP must start by designing an initial structure setting up a home page and creating and naming folders and rooms accessible in the QP and invite other users, granting each of them access rights as either manager, author or reader. Thus a QP is understood as a single instance of the generic application, and acts as a separate groupware tool for a specified group. Similar browser-based groupware applications are e.g. eRoom (www.eroom.com), Projectplace (www.projectplace.com), and BSCW (bscw.gmd.de), the latter especially familiar within academia (Bentley et al. 1997).

Apart from a customised logo appearing on every page of the application, QP has been deployed in the generic standard configuration leaving it up to the projects and organisational sections to decide how to integrate the groupware in their work practices. A specific QP is initiated on the server by request from the manager of a distributed group to IT operations. The manager is fully in charge of how to utilise QP. Users initially learn to use QP from the build-in tutorial and Beta offers no further formal training in using, tailoring, or integrating QP.

4.1 Employing Groupware for a Recurrent Task

The production of the financial reports of Beta involves translation of an English master into the four languages of the different countries. The completed financial reports are to be released simultaneously to the stock exchanges and the press. The translation of the English master is initiated about one week before the release deadline. At this time the master is not in its final state and corrections occur several times up to the deadline. This requires new versions of the English master to be distributed during the translation process. These changes have to be coordinated very tightly within the group of translators. During the preparation and translation of the final documents, the information is highly confidential. Emailing drafts by the Internet was considered insecure and prior to the introduction of QP, fax transmissions were used to exchange drafts that often were more than 50 pages long. This involved a very complex coordination process with only a cumbersome infrastructure to support it. The original incentive to use QP for the coordination of the translation process was thus the complex security measures.

QP was originally chosen and set up by the manager of the translation section. He initiates the translation process upon receiving the almost final English master for the quarterly or yearly financial reports. The master document is distributed to the translators via a new room created for that purpose in the QP. The translators work in parallel on the texts and usually in different geographic locations. The frequent changes to the master document right up until the deadline have to be propagated throughout the section. When each translator has completed a part of the documents, he or she uploads it to a language specific folder in QP with a specifically versioned name. It then becomes available to all others for their work and in this way the progression of the work becomes visible in QP. The manager can track the status instantly and the members can see how the others are performing thus revealing whether they e.g. are behind schedule. The way QP is used when the translation of financial reports takes place is an illustrative example of how complex coordination work is carried out using QP as part of a coordination mechanism.

The coordination involved in the collaboration of the translators is complex, while the work of e.g. translating individual documents might be less difficult even though it can be complicated work in a linguistic sense. QP is the artefact in a computational coordination mechanism supporting the coordinating work by mediating mutual dependencies (Schmidt & Simone, 1996). In addition QP provides an overview of the process as well as performing some of the tedious footwork that the collaboration entails. Using QP in this way has led to a substantial reduction in the complexity of coordination compared to using fax transmissions – both among the translators and for other involved actors responsible for publication of the final financial report.

The manager of the translation section has put a serious effort into integrating the technology to the work practices of the translators. An important motivation stemmed from the problems experienced using fax transmissions and problems foreseen if exchanging documents as attachments to e-mail - as he stated: "E-mail is a mess for this purpose!" Even if the issue of security was resolved, the versioning of the translated documents is complex and problematic when mediated via e-mails: This would require all involved actors in the translation process to build and maintain private archives storing the frequently distributed new versions of the documents. Using these archives (typically stressed by time pressure) would inevitably lead to errors working on a wrong version of a document.

With the introduction of QP the manager produced guidelines for the proper use and on occasions he phoned up people to help and/or persuade them to use the QP correctly. In our understanding this has proven instrumental in promoting the use of the QP, since in his position, ranking at least one level above the translators, he can act as personnel manager, section manager, and manager of QP as well as facilitator. Integrating QP as part of a coordination mechanism required restructuring of work practices and explicit agreements on how to use the application alongside tailoring of the artefact with different rooms, folders, templates etc. The recurrence of the translation of the financial reports every three months creates a 'naturally occurring' opportunity for reconsidering the use of QP, since it provides occasions for evaluation and re-design. In addition to this the character of work is well suited for the emergence of a coordination mechanism, since the protocol of the coordination work is well defined.

The context for carrying out the recurrent task is relatively well known and stable surroundings make it easier to focus the efforts to integrate the groupware.

4.2 Employing Groupware in a Development Project

In Beta an elaborate way of organising distributed projects for change processes has been developed and implemented. All projects are organised aiming at an overall 6 months time box. Corporate development projects present a highly complex work setting, both geographically distributed and managerially heterogeneous as they involve IT-departments that were 'independent' before the merger. The conditions for performing coordination work within a development project are thus relatively diverse and shifting compared to the recurrent task, since the tasks and members change from one project to the next. Thus collaborating on the subject matter of the project requires a great deal of coordination work including negotiations of the means and goals of the project itself. This was indeed the case for the project evaluating the possibility of creating a single customer security architecture.

Establishing meetings and workshops for a group of IT-specialists and IT-managers distributed throughout four countries is not an easy task. They are all very busy people and they have to travel several hours to meet. The project members got together at meetings as often as practically possible and the main body of interaction took place in these occasions. These meetings also provided occasions for clarifications and agreements on how to proceed with the project work.

The project manager experienced difficulties getting through the agenda he had planned for the meetings: Informing each other in order to establish the current status often took up most of the time leaving little time for discussing possible solutions based on the investigations and analyses done so far. He wanted to use QP in order to enable this coordination to happen even between the meetings. Then the meetings could focus more on the subject matter of the project in terms of discussing problems and alternative designs of security solutions. One meeting concluded by identifying questions about eight issues on the IT infrastructure for each national IT-section in Beta. The manager asked the individual members to examine these questions in their respective countries and report back to the project via a response in QP. He created the questions and documents in the QP and expected the members to post their answers as responses to the document. The idea was that when a member had posted his initial answer, other members could take this into account concerning their answers. In the QP they could see each other's answers, and they would also have the possibility to respond to individual answers and e.g. ask clarifying questions or make comments. This would have enabled the project manager to present a final answer at the next meeting. However, such an openness to information can also be a barrier for using the artefact. How to go about presenting the local practices can be a delicate matter of strategic disclosure and nondisclosure. It can be difficult or impossible to foresee the consequence of sharing information uploaded to the QP considering an issue to be negotiated. As opposed to face-to-face meetings the control of other members immediate interpretations and subsequent use of the material is lost. Using QP to mediate negotiations might thus have unforeseen impacts on the agenda and how an issue will be discussed. It might entail misunderstandings and „sidetracking“ of the negotiation as well as weakening the negotiating position of individual actors. As a result, the members did not respond via the QP. Instead they continued to bring their answers to the next meeting and the coordination of the solutions to the particular questions was carried out during the meeting.

The observed use of the QP in the development project resembles a project archive where the results of the project were developed and maintained. The QP was, as expressed by the project manager "used as a place for documentation. Here is the collection of documents that are the result of our work." In this way QP primarily supported the post hoc documentation of the project work. QP was a 'nice-to-have' for the project members in order to get their work done, since other means for coordinating work such as e-mail and phone are more immediately gratifying. However the project manager viewed the QP as a 'need-to-have' when managing the issues and deliverables. The case demonstrates how difficult it can be to integrate a coordination mechanism in the work practices of a

development project. Agreeing on a new protocol that relates to a new artefact meets several barriers, while the familiar protocol of preparing for meetings works fine. The tight timeframe of projects also puts a limit on how much is invested in the deployment and tailoring of QP.

5 DISCUSSION

Table 1 presents a summarising characterisation of the factors for the two situations described in the previous sections. Based on these characteristics we identify and discuss lessons learned in terms of factors that influence the integration of groupware in each situation.

Table 1. Six factors actively influencing the integration of protocol and artefact

Factor \ Situation	Recurrent task	Development project
Management position	Within section (status as personnel manager)	Within project (among peer experts)
Membership	Continuous	Transient
Evaluation and re-design of coordination mechanisms	In between iterative tasks	Difficult due to short life cycle
Reduction of complexity	Substantial	None
Identified need	Need (for all)	Need (mgr.), nice (others)
Facilitator	Present and active	None

The character of work is very different in the two situations. The translation section is responsible for a time critical recurrent task with predefined procedures that is performed intensively over a short period of time. A high degree of systematisation is required to cope with the strong mutual dependencies among the members in the section. The ways of coordinating work are well defined and the protocol and artefact are integrated in a coordination mechanism effectively supporting the collaboration. Any changes to the protocol have to be carefully prepared in advance enabling the necessary coordination to happen smoothly avoiding misunderstandings or other disruptions that may cause sudden halts in the translation process. In the project the development of solutions involves relations to a range of issues. The character of the work – especially in the early phases of a project as in this situation – is highly focused upon negotiation even of the goals and means of the project itself. Negotiation involves implicit protocols (e.g. with regard to how to prepare and present a case for the meeting's agenda) that might be challenged dramatically when integrated with an artefact. This situation has a great need for support but there are several barriers to overcome before the emergence of coordination mechanisms will occur.

5.1 Management Position

Establishment of a new protocol of coordination as well as getting acquainted with the artefact requires all involved actors to adjust current work practices. An influential factor is management's position when promoting the use of groupware for coordinative purposes. In the case of the translation section the manager had a rank as a personnel manager one level above all involved users. The project manager was managing the project while the project members were managers for their respective IT departments. Thus the relationship among all project members is a collegial peer relationship among experts sharing the same profession. This means that changes in work practices in order to establish new coordination mechanisms – in terms of a new protocol that requires using QP – cannot be expected to happen solely because the manager believes this is a good idea. He must also convince his fellow project members that there are obvious benefits from investing resources in this in addition to following up on the agreements.

5.2 Membership

Beta is a relatively new organisation, still there is a difference in how well the members in the translation section and the project know each other. The translation section was established shortly after the merger in order to take care of the upcoming quarterly financial report. The members in this section form a continuous group that share the same aim. They often perform the task under stress and this contributes to a congenial relationship among them. Projects are transient and the project members form a temporary group that meet by virtue of the project over a short period of time. Continuous membership supports a situation of mutual trust and confidence in roles, competencies, power relations, and responsibilities etc., which support coordination work. Collaboration within a newly formed group faces a number of challenges with regard to the establishment of coordination involving mutual agreements and social accountability, considering who is doing what and when. The short lifecycle of a project results in transient memberships that make it difficult to harvest the benefits from investing in establishing new protocols and using a specific technology to mediate them.

5.3 Evaluation and Re-Design of Coordination Mechanisms

The generic nature of groupware such as QP along with the continuous changes in the organisation, necessitate a periodical evaluation and re-design of QP and on the agreed protocols stipulating its use (Schmidt & Simone, 1996). Even though the work practice of a development project has room for experiments with different ways of coordinating work, evaluation and re-design are difficult simply due to the short life cycle of the projects. The initial tailored 'setup' of QP is thus usually a one-shot trial. This might suggest that new coordination mechanisms should be addressing issues that are repeated from project to project such as the overall project concept or method, use of mandatory or general techniques and tools, etc. The section handling recurrent tasks has a naturally occurring opportunity for reconsidering the use of QP where former experiences can be evaluated and subsequent adjustments incorporated in the coordination mechanism. The recurrent task has an obvious advantage in this respect, since it provides such frequent occasions for evaluation and re-design, and because the character of work is well defined and has been tried several times before.

5.4 Reduction of Complexity of Coordination

The purpose of establishing a coordination mechanism is to reduce the complexity of the coordination work. In the case of the section performing the recurrent task the work practice was transformed to accommodate a new protocol along with QP leading to a significant reduction of the complexity of coordination for all involved: The problems handling fax machines were eliminated and an instant monitoring of the status of the overall process was established. In the project it was the manager that had an immediate need for making the meetings more effective. The project members did not expect a reduction in the complexity of coordination qua the artefact. On the contrary the visibility of the documents, that the project manager encouraged them to upload, might potentially have lead to an increase in the complexity of coordination: The meetings could have become even more complicated to conduct with the addition of a QP based coordination mechanism, due to the member's unfamiliarity with a new protocol dealing with such delicate negotiations. Thus the protocol of coordination was unchanged and the complexity of the coordination remained at status quo.

5.5 Identified Need

Possibly the strongest driver for using QP in the translation section was the earlier experienced problems of coordinating using fax transmissions as the artefact. This created an obvious need for new coordination mechanisms that would reduce complexity. The solution to the problem of coordinating translations entailed a completely new protocol and established QP as a highly critical application. The coordination work had to be completely redesigned but the complexity was foreseen to be drastically

reduced. The result is an immediate and sufficient benefit for all and thus a good return of the investment, and in addition a return that can be harvested repeatedly in the quarterly translation processes to come. The project experienced a different situation in this respect, since using QP was suggested as a means to coordinate a process of negotiation that otherwise still could be conducted without serious problems – at least not serious problems related to coordination work. In a single project running for 6 months the need for investing resources in changing work practices must be evident and the return of investment must be promising within the remaining project period. In the reported situation this might only have been the case regarding the project manager resulting in disparity in work and benefit (Grudin 1994) and a potentially conflicting situation for the other project members.

5.6 Facilitation

The change of the articulation work in the translation section by introducing QP was both very extensive and did also entail a strong commitment to use QP. The manager took the role as an active facilitator to ensure that all involved adopted the new work process. He conducted well-prepared introductions explaining the new protocol and artefact, and he actively contacted the translators to follow up when the translation process was initiated. The involved actors were not IT specialists and since the manager also was the manager of QP he became the person to contact when questions arose regarding using the QP. The continuous membership in the section along with an open and confident atmosphere significantly contributed to the establishment of an effective facilitation. Such a facilitator role was apparently more difficult to establish in the project where the members themselves were IT-specialists and IT-managers. The project manager left it to the members alone to get acquainted with QP and he did not overcome the obstacles of taking an active facilitating role – neither with regard to following up on the new protocol he suggested nor using QP for this purpose.

6 CONCLUSION

The study shows integration as not only involving the question of tailoring the artefact and involving the question of agreeing on and establishing social accountabilities for revised or new protocols, but as also involving complementary questions of integrating protocol and artefact.

We have demonstrated the applicability of the CSCW framework of coordination mechanisms as an analytic tool eliciting six general factors that actively influence this integration: 1) Authoritative management or obvious benefits for all to invest needed resources; 2) Continuous membership or other means of securing confidence in the coordination mechanism in question; 3) Conditions in the work organisation that support continuous evaluation and re-design; 4) Substantial reduction of complexity of coordination, bearing in mind that such a reduction for some might be seen as an increase in work or complexity for others; 5) Identified need for example based on prior experiences with problematic coordination (nice is not enough); and 6) Conditions enabling the establishment of an active facilitating role.

The achievement of complex collaboration involving geographically distributed actors requires considerable amounts of coordination work. An understanding of how coordination mechanisms unfold over time with the gradual integration of protocol and artefact, might further these endeavours in research and practice.

Our enquiries uncover convoluted interdependencies of collaborative work in a way that allows for discussion and comparison of individual cases. The elicitation of the general factors from the case studies is a way of examining the relations between organisational and technological aspects in order to understand the character of distributed work and the felicitous conditions for coordinating work with groupware.

ACKNOWLEDGEMENTS

We would like to thank the informants in Beta, who provided opportunities for studying groupware in practice, our colleagues, Keld Bødker and Kristian Billeskov Bøving, for collaborating on this study, and the anonymous reviewers for useful comments. The DIWA research programme is sponsored by the Danish Research Councils and the IT-University of Copenhagen has also partly sponsored the research.

REFERENCES

- Bansler, J., and Havn, E. "Information Systems Development with Generic Systems" *Proceedings of ECIS*, 30-31 May, Breukelen, The Netherlands, Nijenrode University Press, 1994, pp. 707-715.
- Bentley, R., Horstmann, T., and Trevor J. "The World Wide Web as enabling technology for CSCW: The case of BSCW" *CSCW* (6:2-3), 1997, pp. 111-134.
- Berg, M. "Accumulating and Coordinating: Occasions for Information Technologies in Medical Work" *CSCW* (8:4), 1999, pp. 373-401.
- Bowker, G. C., Star, S. L., Turner, W., and Gasser, L. (eds.) *Social Science, Technical Systems, and Cooperative Work: Beyond the Great Divide*, New Jersey: Lawrence Erlbaum Associates, 1997.
- Bullen, C. V., and Bennett, J. L. "Learning from User Experience with Groupware" *Proceedings of the Conference on CSCW*, October 7-10, 1990 Los Angeles, California, ACM, New York, 1990, pp. 291-302.
- Carstensen, P. *Computer Supported Coordination*, Ph.D. Thesis, Writings on Computer Science No. 61, Roskilde University, Denmark, 1996.
- Golden-Biddle, K., and Locke, K. *Composing Qualitative Research*. London, UK: Sage Publications, 1997.
- Grudin, J. "Groupware and social dynamics: Eight challenges for developers", *Communications of the ACM* (37:1), 1994, pp. 92-105.
- Harper, R. "The Organisation in Ethnography: A Discussion of Ethnographic Fieldwork Programs in CSCW", *CSCW*, (9:2), 2000, pp. 239-264.
- Mark, G. "Conventions for Coordinating Electronic Distributed Work: A Longitudinal Study of Groupware Use." Hinds, P. and Kiesler, S. (eds.). *Distributed Work*, Cambridge, MA: MIT Press, 2002, pp. 259-282.
- Mørch, A. and Mehandjiev, N. "Tailoring as Collaboration: The Mediating Role of Multiple Representations and Application Units", *CSCW* (9:1), 2000, pp.75-100.
- Orlikowski, W. "Learning from Notes: Organisational Issues in Groupware Implementation", *Information Society* (9:3), 1993, pp. 237-250.
- Orlikowski, W. "Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organisations", *Organisation Science* (11:4), 2000, pp. 404-428.
- Plowman, L., Rogers, Y. and Ramage, M. "What Are Workplace Studies For?", *Proceedings of the Fourth ECSCW*, September 10-14, Stockholm, Sweden, Kluwer, 1995, pp. 309-324.
- Schmidt, K. and Bannon, L. "Taking CSCW Seriously: Supporting Articulation Work" *CSCW* (1:1-2), Kluwer, 1992, pp. 7-40.
- Schmidt, K. and Simone, C. "Coordination Mechanisms: Towards a Conceptual Foundation of CSCW Systems Design", *CSCW* (5:2-3), 1996, pp. 155-200.
- Star, S. L., and Strauss, A. "Layers of Silence, Areas of Voice: The Ecology of Visible and Invisible Work", *CSCW* (8:1-2), 1999, pp. 9-30.
- Weigang, W. and Haake, J. "Tailoring Groupware: The Cooperative Hypermedia Approach", *CSCW* (9:1), 2000, pp. 123-146.