

Association for Information Systems AIS Electronic Library (AISeL)

AMCIS 2000 Proceedings

Americas Conference on Information Systems
(AMCIS)

2000

Knowledge Sharing in High Technology Companies

Inger V. Eriksson

University of Turku, inger.eriksson@cs.utu.fi

Gary W. Dickson

North Carolina State University at Raleigh, gary_dickson@ncsu.edu

Follow this and additional works at: <http://aisel.aisnet.org/amcis2000>

Recommended Citation

Eriksson, Inger V. and Dickson, Gary W., "Knowledge Sharing in High Technology Companies" (2000). *AMCIS 2000 Proceedings*. 217.
<http://aisel.aisnet.org/amcis2000/217>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2000 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Knowledge Sharing in High Technology Companies

Inger V. Eriksson, Dept. of Computer Science, TUCS, University of Turku, inger.eriksson@cs.utu.fi
Gary W. Dickson, Dept. of Business Management, North Carolina State University,
gary_dickson@ncsu.edu

Abstract

This paper reports on the results of studying the applicability of a model for Shared Knowledge Creation (SKC). The model is based upon a previous pilot study and was tested in a New Product Development (NPD) setting involving four projects in two high technology companies located in the Nordic countries. In particular, four factors presented in the model were explored: (1) the SKC process; (2) IT infrastructure in support of the process; (3) catalysts; and (4) organizational issues and SKC. Implications are drawn for practice and for future research.

Knowledge and Knowledge Management

Knowledge management (KM) has become an increasingly important area of interest in contemporary organizations. Knowledge is considered to be a strategic asset for companies and as a basis for competition. Globalization and internationalization amplify the requires for smooth functioning communication and knowledge sharing. Moreover, greater levels of competition requires shorter product development cycles and thus a knowledge-related creative and supportive organizational atmosphere. Continuous and rapid learning on both individual and organizational level has become a must. In response to these conditions technology, particularly Information and Communication Technology (ICT), presents both a push and a pull promising support in enabling solutions through knowledge management.

Besides business, to whom knowledge management presents practical and economic attractiveness, academia is also heavily involved in this area. Academicians ask: "What is knowledge? What is knowledge management? Can knowledge be modeled and what are the components of the model in this case? How can the effects of knowledge management be measured? How can knowledge management be improved?" All these are theoretical issues with practical importance.

In this paper we will present an attempt to address some of these questions based on field research experiences in high-tech companies. We do not promise THE answers, but rather some ideas to consider and

reflect upon, and perhaps be able to isolate important areas in which to continue research.

A Model for Shared Knowledge Creation

Knowledge management can be approached from different organizational perspectives. There are at least three conceptualizations of business knowledge in the research literature (El Sawy and Hars, 1997). These views are interrelated, but it is useful to understand their nuances as they lead to different foci of attention. One view regards business knowledge as an *object*, i.e. knowledge as codified and storable information. This view highlights a perspective of knowledge management that focuses on building and managing knowledge repositories. A second view regards knowledge as a *capability* that has potential for future action. This view brings forth core competencies, understanding the strategic advantage of know-how, and creation of intellectual capital. The third view conceptualizes knowledge management as a *process*. This view focuses on the processes of knowledge creation and sharing and their relationships to learning and collaboration among persons in work context. It is the latter, process view, that was adopted in the research serving as the basis for the following discussion.

This research created and tested the usefulness of a Shared Knowledge Creation (SKC) model in a field study. New product development (NPD) was selected as the environment in which the research was conducted. This environment is attractive when studying knowledge management for a number of reasons including: (1) the activity is highly creative and technology intensive; (2) the project members doing the work are well educated knowledge workers, and (3) intensive communication among the members of product teams is a necessity.

At the time the study began, there was not a great deal of empirical research upon which to draw upon in this environment. Consequently, the research team decided to learn more about the subject matter, test the theoretical pre-understanding of SKC, and develop research tools in a pilot study. An explorative field study was conducted in an R&D center of an international telecommunications equipment manufacturer located in the United States. The pilot study focused on: team dynamics, learning strategies, knowledge sharing, and

business processes. The major findings of the pilot study, for this paper, can be summarized as follows (see El Sawy et al., 1998; Eriksson et al., 2000 for background to the work that is reported in this paper which differs from previous work in that the focus here is on organizational aspects of SKC):

- Apart from the tacit/explicit continuum of knowledge, professionals can identify and operationalize a hierarchy of knowledge management activities that they think lead to SKC including:
 - informing (passing information back and forth),
 - coordinating (synchronizing activities and interdependent outputs), and
 - collaborating (true joint problem solving).
- The role of knowledge catalysts to SKC. The team shares knowledge among its members but there are also knowledge catalysts who may play a major role in amplifying SKC. These are persons outside the team.

Based on the results from the pilot study, the researchers developed a theoretical frame of reference (model) to be tested in a follow-on main study. The new model (see Figure 1) is based on defining, or redefining, some of the essential concepts that were used going into the pilot study. By this revision in thinking, SKC-space consists of four factors which we consider to be central: (1) SKC-processes; (2) ICT-infrastructure; (3) catalysts; and (4) the organizational context including values, norms and procedures.

In the revised model, SKC is defined as a set of processes, both cognitive and behavioral, that take place when a group of people create and shape new knowledge together. The togetherness, is believed to be that which makes a difference in working settings. While SKC includes sharing of existing knowledge among people, it also implies that new knowledge is created through simultaneously sharing and using it with others. The pilot study also indicated that informing, coordinating, and collaborating are activities that comprise SKC. So, our original SKC was redefined to become SKC-spaces that allow collective understanding.

ICT-infrastructure includes the tools that are used to support collaboration, coordination, and informing. Catalyst represents the role of an outsider to the group, a role which was identified in the pilot study and (see also, Hedlund, 1994 for a related view of this role). Organizational context includes the social and cultural setting which affects how and what people and the whole organization learn.

The model indicates the possibility of influencing the functioning of the SKC-space by modifying some of the factors. The practical importance of this notion is that it may be possible to achieve greater levels of knowledge sharing and creation in a specific situation in an enterprise. To do so, one must understand the relative importance of the different factors (in a given context).

Thus, the path taken by the research was to begin to examine these relative levels of factor importance.

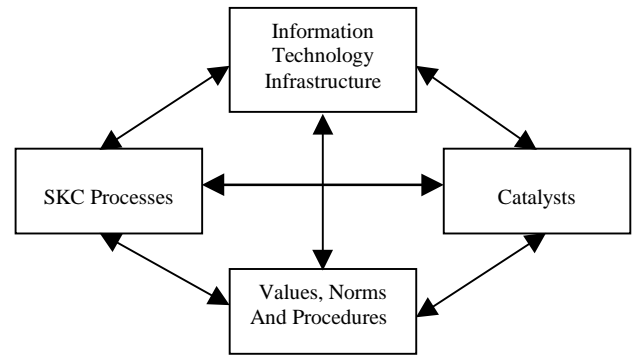


Figure 1. Model of an SKC Space for a Group

The pilot study led to a deeper understanding of the KM field on the part of the research team. The next step was to test the usability of the revised SKC-model in a full scale field study. Again, NPD served as the environment. The setting for this study was in two companies headquartered in Finland but with operations in other Scandinavian countries, an electromechanical company and a pharmaceutical company. Both are high-technology companies and heavy users of ICT. The rationale for the inclusion of these two companies in the study was that one has a long NPD development cycle, and the second company a relatively short one. This difference is critical in order to detect the presence of an issue of importance to the research team, the 'fast-to-market requirement.' Within each company, we also wanted to have two different projects to follow, preferably in different development phases since the team wanted to explore the notion that SKC is not equally intensive in all project phases. Projects were also selected which could be contrasted on whether they were more of research or a development nature. Table 1 summarizes the cases and their attributes.

Company	NPD Cycle Time	Focus	Phase	Site
Pharmaceutical	Long	Development	Middle	Finland
	Long	Research	Final	Finland
Electromechanical	Short	Development	Middle	Sweden
	Short	Research	Start	Finland

Table 1. Characteristics of the NPD Groups in the Study

Research methods and tools were employed that were tested in the pilot study. We conducted a pre-study by interviewing project managers and individuals serving in a project liaison function. Questionnaires were guided by the SKC-model and its factors and included four sets of questions related to: (1) organizational factors affecting the NPD process; (2) the NPD process itself; (3) the role of ICT in supporting the process; and (4) interaction around the NPD process. The questionnaires were

distributed to the members of the four projects participating in this study. The answers were quickly analyzed to allow fast follow-up interviews. Interviewees were selected based on their responses coupled with our interest in covering as many expertise areas, organizational levels, and different degrees of expertise as possible within the time constraints under which the researchers were working.

After data analysis and interpretation, closing and feedback sessions were organized in both companies. This was done partly to give the companies feedback as a benefit for their participation in the study and partly to check the validity of our findings. The most important findings were summarized in somewhat provocative tables to stimulate discussion and thus help the companies identify opportunities for better design of SKC-spaces for their special needs. Table 2 is an example showing, for brevity, just part of an actual summary table used to identify opportunities for improvement of SKC-spaces in the electromechanical company.

Electromechanical /Research
Headquarters Finnish Not responsible for entire project
Faster, but do not share well or collaborate well in teams
Few outside catalysts
Do not document well, and document in Finnish
Many good ideas generated between meetings
Electromechanical/Development
Non-headquarters Swedish Responsible for entire project
Good at formal shared knowledge creation as teams, but slower
Many outside catalysts influence the process
Laboriously document formal meetings and document in English. Do not document informal meetings
Many good ideas generated between meetings

Table 2. Illustrative Sample of Items Used in Company Feedback Sessions

The research team found the SKC-model useful in studying knowledge management with all its factors and complicated interrelations. It helped in structuring and focusing the research and interpreting the results. Both practical and theoretical benefits could thus be identified. In the following section we will briefly discuss a few findings focused on components of the model. This discussion is intended to be illustrative of what can be done using the current version of the model and attempts to highlight components indicated to be of particular importance to SKC.

The Relative Importance of the Components of the SKC-model

The SKC-model itself was used to structure the analysis of the results. Thus there are four sets of issues to be addressed:

1. How knowledge is created, shared and preserved from loss
2. The nature of interactions around SKC and the role of a knowledge catalyst
3. The use of IT in supporting SKC
4. The organization and SKC

The first two sets of issues have been quite thoroughly reported in (El Sawy et. al., 2000) so we will just summarize the main findings briefly here. Issue sets three and four is where we will focus, but because of the space limitations will concentrate on key aspects.

How knowledge is created, shared and preserved from loss

We had questions about when and where useful knowledge is created, shared and preserved. The study indicated that the most useful knowledge is created between meetings rather than during meetings, and in informal meetings rather than formal ones. The latter finding shows the importance of coffee breaks, or around the copy machine. One implication is that restricting such forms of communication in the name of efficiency may be counter productive. We are not saying that formal meetings are unnecessary, but relying strictly on such meetings can cause some important content to be missed. Moreover, often formal meetings were considered 'killers' by participants. Of course, one problem with informal meetings is the lack of documentation coupled with the risk of forgetting agreements that may have been reached. A balance between formal and informal meetings should thus be found. Further, the role of collaboration and trying to find consensus rather than working alone and keeping one's own views, was found to be supportive of collective learning.

The nature of interactions around SKC and the role of knowledge catalyst

Network analysis software was used to study the interaction within and between the groups as well as with parties external to the groups. The tool allowed measurement of the frequency of communication, the experienced ease of communication, the experienced importance of sent and received messages, and the type of communication. The ease of communication was not found to be a central issue. To illustrate, if contacts were considered important, participants did not request any particularly convenient user interfaces. Frequency of

communication between co-working groups was surprisingly low (monthly to more seldom), on our scale.

Critical features and the type of interaction were found to be important. The importance of one group's output and the that of a receiving group's input should be symmetric. If such is not the case, then a trouble spot is indicated worthy of analysis. Imbalance between the type of interaction (informing, coordinating, collaborating) becomes critical in the case of such parties. . Again, to illustrate in the case of a customer/supplier type of relationship, consider a situation in which one party, e. g, the customer, believes they are collaborating while the other party, e.g., the supplier, feels that they are only informing their counterpart. Such situations require serious analysis to avoid problems between the parties in SKC activities.

The role of catalysts was also studied. We found that external catalysts influence the effectiveness of SKC processes. However, they were not directly perceived as participants in the process nor was their role recognized by the NDP groups. This is one of the factors whose function and influence in the SKC-model should be studied more in depth.

The use of IT in SKC

Information technology (IT) is generally considered to enable knowledge sharing and creation. New tools supporting teamwork are constantly being offered for many types of interaction. Here, one can distinguish between media supporting communication, access to information, co-working, and coordination. The choice, use, and preferences of different media is not a plain technology issue but concerns also individual and organizational values. Psychological considerations as well as levels of human interaction also affect the use and choice of media (media richness theory has often been used to explore this phenomenon). Our interest in this study focused on the kinds tools considered useful for teamwork, particularly when different modes of interaction are considered. Both the existing situation and wishes for improvements were investigated.

The questionnaires that were distributed to the participating project group members included general questions about the use of IT in the company, file sharing, tools for communication, satisfaction with online information, and ranking of tools for different levels of interaction. Questions about a 'dream tool' allowed the participants to describe their preferences and wishes for ideal IT tools as well as new features to support teamwork.

As would be expected in high-tech companies as represented in the study, respondents indicated that the use of IT was supported by management, and the technical level of the organizations was first rate. Training was judged to be a gesture of caring, not only a practical necessity. As a practical matter, the benefits of good

training can have a twofold benefit--training people for efficient performance, and making them feel positively oriented towards the company.

IT tools that were available and used for different levels of interaction were investigated. Not surprisingly we found that face-to-face meetings were preferred to any IT-supported environment for collaboration. One surprise, however, was the major role e-mail is played. E-mail has been considered a lean medium and thus best suited for more formal interaction, such as informing. In this study we found that e-mail was the dominant tool for coordination and informing within project groups. For interaction between the groups e-mail was the most used media on all levels of interaction. Also for communication with externals to the group e-mail is becoming the dominant medium. In order not to conflict with the media richness theory we suggest that e-mail no longer is so lean but rather rich medium today (this result is consistent with that observed by DeSanctis, et. al., 1996). With regard to their 'dream tool' with all the features they really would like to have, this very IT-knowledgeable group of users had few recommendations and no radical wishes. This result suggests that one might look for revolutionary ideas for development from other sources than the user environment.

The organization and SKC

In this sub-section concentration is on how organizational procedures, norms and values influence shared knowledge creation. These concepts imbed tacit knowledge which can be hard to observe let alone measure. In a knowledge creating organization, such 'hidden' knowledge is an important part of the organizational mind. Values, norms and procedures are reflected in the roles of managers. Managing knowledge workers and building appropriate conditions for knowledge sharing and creation are challenges for success.

This part of the study was directed toward describing how management and organization affect shared knowledge creation. Five empirical questions were included in the questionnaire to address knowledge creation practices, goals, the role of managers, formal ways to manage, and group norms. Three topics: (1) the need for integration of knowledge; (2) the role of managers; and (3) shared knowledge creation are used to report results on these issues.

The fact that the two companies had very different types of products, production, and development cycles provides one dimension for analysis. A second useful dimension is the type of projects--namely those that were more developmentally oriented contrasted with those that were more research oriented

The pharmaceutical company is strictly ruled by government regulations and requirements of extensive documentation. Thus a more hierarchical and formal

organization is present here. The experts focus on their part of the product development and the interaction is more of the nature of informing rather than collaborating. Additionally, internal knowledge as well as external knowledge is heavily relied upon. Information distribution is one of the management's main roles in this company.

The electromechanical company (see Tables 1 & 2), on the other hand, is less restricted by external rules and regulations. The company is 'engineer-driven.' In this company, the two projects which were included in the study had, as their main goal, to produce a joint product. Communication was highly informal and facilitated by open office landscapes in one of the sites and in everybody being located along a common corridor in the other site. Corridor discussions and Friday afternoons joint beer sessions was employed in this company to improve socialization in the groups. Group members felt they were friends rather than competitors which facilitated collaboration and joint problem solving. One problem in this company that was created by the informal management style was the lack of good documentation. This could become a problem, especially when people leave, but also in dealing with the interaction between the two projects which are located in different countries.

In contrast, the pharmaceutical company relies on documentation for its knowledge integration. Management's role is important in knowledge creation and in creating frameworks. Shared knowledge creation, in this company, is more explicit and based on communication. Looking at the electromechanical company along the same lines we find that knowledge creation needs means creating a system for the product development and for improved system quality. Management's role is less important in knowledge creation here, rather it is in creating frameworks. In this company, shared knowledge creation involves both tacit and explicit knowledge and is conveyed via cooperation. Our findings thus reflect the organizational structures with different levels of hierarchy and formality

A comparison between the research oriented projects and the more developmentally oriented projects shows some differences as well. The major one is between the roles of general management. Only in selecting products to be developed was there an agreement between both types of project. For all other proposed management tasks (thirteen in the study all together) opinions differed according to project type.

In all other areas--goals, plans, and organizational conditions--differences showed up. The development oriented projects involved more planning than the research oriented ones. Also the clearness and realism of goals were more focused and precise for the projects that were development oriented. Speculation is that this result may reflect the freedom and flexibility that a research oriented group experiences compared to the more formal management of the development oriented groups.

From these observations, one can see that to develop suitable instances of SKC-spaces the values, norm and procedures are central issues for consideration. But, in addition, our results suggest that different organizations, types of products, traditions and many other aspects must be also be considered in order to find the proper knowledge management style for a given setting.

Conclusions

In this short paper we have tried to present the main points in a study on SKC-spaces. Based on theoretical and empirical studies, we developed a model for SKC-spaces. We identified four factors, the SKC-processes, IT-infrastructure, catalysts, and the organizational context which all influence knowledge sharing and creation. We also stated that there are several instances of the spaces and by changing some of the factors it is possible to develop new ones. For companies it would be useful to find out what type of SKC-space and which instances, would be most supportive for knowledge management activities. Using four projects in two companies we explored the relative importance of the four factors. For each of the factors studied, some summary implications we can draw are:

1. The creation of useful collective knowledge around business processes is facilitated by organizational environments that enable informal group meetings in which shared views can be developed.
2. The more balanced and symmetric the interaction between groups, the richer the SKC mode in terms of having more collaboration between the groups.
3. Information technologies are necessary but not sufficient for improving SKC around NPD.
4. Effective SKC-spaces must be matched to the management context of the NPD process.

Acknowledgements

The research was partly funded by the Carnegie Bosch Institute and the Academy of Finland.

References

DeSanctis, G, Dickson, G., and Poole, M.S.: The Dynamics of Teams and Technology: A Field Study of Groupware in a Network Organization, *Proceedings of the International Conference on Information Systems*, New York: Association For Computing Machinery, 1996

El Sawy, O.A., Eriksson, I., Carlsson, S., and Raven, A.: Understanding the Nature of Shared Knowledge Creation Spaces Around Business Processes: An International Investigation, Carnegie Bosch Institute, Working Paper 98 – 11.

El Sawy, O.A., Eriksson, I., Raven, A., and Carlsson, S.: Understanding shared knowledge creation spaces around business processes: precursors to process innovation implementation, *Journal of Technology Management*, in press, 2000.

El Sawy, O.A. and Hars, A. (Eds.), *The Three Faces of Knowledge Management*, Working paper, Marshall School of Business, University of Southern California, 1997.

Eriksson, I., Dickson, G.W., El Sawy, O.A.: Reflecting Back on Designing Field Research for Nascent IS Topics: The Case of Knowledge Management, *Communications of the AIS*, Vol. 3, article 6 (March 6, 2000) <http://cais.isworld.org/articles> (current April 28, 2000)

Hedlund, G.: A Model of Knowledge Management and the N-form Corporation, *Strategic Management Journal*, Vol. 15, pp., 73-90, 1994.