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THE ROLE OF KNOWLEDGE MANAGEMENT IN ERP IMPLEMENTATION: A CASE STUDY IN AKER KVAERNER

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Abstract

The aim of this study was to examine the role of knowledge management (KM) in the ERP life cycle with a main focus on the implementation phase. A literature review on ERP and KM was conducted as the basis for a case study of the SAP implementation in one company within Aker Kvaerner, a global contractor of engineering services. The study indicates that the use of KM can make ERP implementations more effective by improving the knowledge sourcing ability among the implementation partners. Cost reductions and strategic business advantages are only some of the potential benefits of this. Several implications for practice were also identified, including the development of efficient communication routines in ERP implementations through improved knowledge transfer and reuse between the implementation partners.

Keywords: Enterprise systems, ERP implementation, knowledge management, change management

1   INTRODUCTION

The organizational implementation of an enterprise resource planning (ERP) system has been documented as a complex process, where change management, communication and stakeholder involvement are equally important as the technical implementation (Akkermans et al. 2002, Al-Mudimigh et al. 2001, Kemppainen 2004). The difficulties in transferring knowledge efficiently between the different actors in an ERP implementation (client, vendor and implementation partner) has spurred an increasing interest in how knowledge management (KM) may support this process (Haines et al. 2003, Sedera et al. 2004). Knowledge management is defined as a "*Planned and ongoing management of activities and processes for leveraging knowledge to enhance competitiveness through better use and creation of individual and collective knowledge resources* (Knowledge Board 2004). Some of the challenges that have to be overcome involve the identification and elimination of different knowledge transfer barriers in the form of technical jargon, language, motivation etc. As a consequence of this it has been suggested that KM may be an antecedent for enterprise system success (Sedera et al. 2004).

The use of KM in ERP implementation holds considerable potential both in order to alleviate the implementation process and to provide synergetic effects in the shape of advanced ERP use. More empirical research is therefore needed in order to understand the exact benefits that can be achieved from the alleged complementary processes. The aim of this study is to contribute to this by investigating an ERP implementation project from a KM perspective. The study focused primarily on the implementation phase, but also covers later phases in the ERP lifecycle. Rather than reporting on ERP implementation issues in general, the research focused primarily on the potential synergy effects between ERP and KM. The research question guiding this study can be stated as follows: *What role can knowledge management play in supporting the implementation of ERP systems?*

The study was carried out as a case study at a Norwegian engineering company and also involved the company's implementation partners. While the implementation partners together possessed the required knowledge that was needed on the project, several problems were encountered during the implementation. These were to a large extent caused by inefficient knowledge sourcing routines and it was found that the use of formalized knowledge transfer and reuse procedures could have helped alleviate the implementation process.

The next section presents a review of relevant literature related to ERP implementation and KM. This is followed by a presentation of the research approach, and the case organization and implementation process. The results are then presented and discussed related to previous research. The final section presents conclusions and implications for practice and further research.

2   FORMER RESEARCH

2.1   Critical success factors for ERP implementation

A major part of the research on ERP implementation has focused on identifying critical success factors (CSFs) for this type of project (e.g., Akkermans et al. 2002, Al-Midimigh et al. 2001, Esteves et al. 2000, Legare 2002, Nah et al. 2001, Somers et al. 2001). As a foundation for characterizing the ERP implementation process studied in this case we conducted a review of the research literature on ERP implementation. Table 1 summarizes the 10 most frequently cited CSFs in this review. The CSFs have not been ranked according to importance. Rather, the likelihood of ERP implementation success is considered to increase if a majority of these factors are present (Somers et al. 2001). Interestingly, most of the CSFs are "soft issues", related to the organization, project and users.

Critical Success Factors for ERP implementation	
Top management support	Project champion
Project team competence	Empowered employees and decision makers
Clear goals and objectives	Change management
Communication and cooperation	Adequate BPR
Adequate training	User involvement and participation

Table 1. Critical success factors for ERP implementation

2.2　　Knowledge management and ERP synergies

The term Knowledge Management Systems (KMS) is used to denote a class of IT-based information systems developed in order to support the following KM-related processes in organizations: *knowledge creation, storage/retrieval, transfer and application* (Alavi et al. 2001). Accordingly, the role of KM in ERP implementation could be said to encompass methods for creating, organizing, storing and transferring knowledge related to core organizational processes. This can be achieved through the implementation of a KM strategy which has been defined as: "*A declaration of how the organization will use KM methods, tools, processes, and practices to achieve business objectives by leveraging its content, people and processes and how KM will support the organization's overall strategy.*" (Knowledge Board 2004).

It has been suggested that KM and ERP are synergistic solutions, but few studies have been able to provide much evidence for the combined effect of KM and ERP initiatives when enacted within a single organization (Huang et al. 2002). Results from a study that examined whether KM and ERP initiatives were complementary or contradictory when implemented within a global engineering firm suggested that: "*with a common goal of improving profitability and competitive advantage, these two initiatives were considered to be two major milestones for the company for radical innovation*" (Huang et al. 2002, p. 636).

Competitive advantage is said to be found not in the knowledge itself, but in its application (Sedera et al. 2004). The use of KM in ERP implementation has the potential to facilitate effective product and process innovation and thus fulfill the potential that lies within an ERP system (Huang et al. 2002). The synergy effects between ERP and KM consequently include more efficient implementation methodologies, reduced implementation costs, increased user satisfaction as well as strategic business advantages achieved through innovative ERP use.

In order to benefit from KM related to ERP, the different actors must adopt different strategies based on their role in the implementation process. The implementation partner has to possess the ability to efficiently source knowledge to the client (Timbrell et al. 2001b). If there is a mismatch between the ability to transfer and absorb knowledge, it would become difficult to achieve the desired results. Larger organizations have more resources and can therefore more easily assign the resources that are needed in order to implement a KM strategy that can be used to facilitate effective product and process innovation and thus fulfill the entire potential that lies within an ERP system (Huang et al. 2002).

Chan et al. (2001) present a three dimensional framework to structure knowledge for enterprise systems, that may be used to identify who possesses what knowledge, where it is needed, and in which phase of the ES lifecycle it may be needed. This knowledge is classified along three dimensions; the stages of the knowledge lifecycle, the phases of the ES lifecycle, and the types of knowledge required (the knowledge content). The knowledge lifecycle proposes a strict sequence of identifying, creating, transferring, storing, (re)-using and unlearning knowledge. By cross-referencing the ES and KM phases it is possible to identify the different types of knowledge that are required by the organization. It is also inferred that the framework can be used to provide specific knowledge resources according to need throughout the implementation phase (ibid.).

In her work on knowledge reuse, Markus (2001) identified four different types of knowledge reuse situations, involving shared work producers, shared work practitioners, expert-seeking novices, and secondary data miners. The professional distance between the knowledge creator and knowledge reuser was recognized as a significant barrier to achieve efficient transfer of knowledge. Knowledge reuse and transfer is important in an ERP context, as efficient knowledge sourcing has been identified as essential to fulfill the potential of ERP systems (Huang et al. 2001, Timbrell et al. 2001b). Although causal links between effective knowledge transfer and successful ERP implementations have yet to be empirically verified, it is assumed that knowledge transfer leaves the client organization better positioned to maintain, evolve and generate returns from the ES investment (Timbrell et al. 2001a). It is in this context Markus' theory on knowledge reuse should be applied.

In order to understand how successful knowledge transfer can take place it is important to identify the most important knowledge transfer barriers. The origins of "knowledge stickiness" (Szulanski 1996) provide a useful framework for this. Timbrell et al. (2001a) applied the framework in an ERP context and identified many potential barriers to successful knowledge transfer such as unproven knowledge, a barren organizational context, lack of recipient motivation, lack of recipient absorptive capacity, and lack of recipient retentive capacity.

Successful transfer of knowledge between the client, implementation partner and vendor is important in order to successfully implement an ERP system. According to the framework by Chan et al. (2001) knowledge transfer and reuse take place in the ERP implementation and use phases and involve technical, product and company content. The lack of efficient interaction between the involved knowledge owners may lead to ERP implementation failure (Chan et al. 2003). This is consistent with the findings from the study by Timbrell et al. (2003) that examined knowledge reuse situations in an enterprise systems context and found that it was difficult to retain knowledge initially required from the implementation phase. Management usually regarded KM during this phase as a failure.

Internal training programs were found to be important to counter the effect of knowledge transfer barriers, but it is crucial here that the organization's own employees receive the hands on training, and not the consultant. Vendor consultants were also found to be a valuable source of technical knowledge imperative for implementation success, because of their close ties with the vendor organization (Haines et al. 2003).

A thorough understanding of potential barriers to knowledge transfer together with a less formal organizational environment and adequate internal knowledge, should therefore be considered as possible prerequisites to achieve efficient knowledge transfer and thereby increase the chance for enterprise system success.

3 RESEARCH APPROACH

A qualitative research approach was adopted for this study to obtain an in-depth understanding of the ERP implementation process in the case organization. The research was conducted in the form of a case study, with the unit of analysis being KM-related aspects of the SAP implementation process in the case company (Yin 1994). Aker Stord, a Norwegian company in the global Aker Kvaerner engineering group was selected as case organization because the company had recently concluded the implementation of a new ERP system, as the first company in Aker Kvaerner. Thus, the case organization also had an interest in documenting experiences from this project as the basis for subsequent SAP implementations in the group. The case study also included the implementation partners of the case company: Aker Kvaerner Business Partner (AKBP), the internal service provider, and SAP Norway as the vendor. More information on these companies are provided in Section 4.

Interviews and a limited document analysis were used as data collection methods. A total of 12 semi-structured interviews were conducted in the period from February to March 2005. These interviews included eight persons from Aker Stord, two from AKBP and two from SAP Norway. The roles of the respondents included that of project manager, SAP consultant, super user, and end user. These persons

were selected together with a contact person from Aker Stord in order to provide a representative selection of respondents. The interviews lasted around one hour each, and were digitally recorded and transcribed. Different interview guides were used in order to provide the different respondent groups with relevant questions. The questions covered characteristics and experiences from the implementation process, with a special focus on how knowledge had been transferred between the different actors during the project. The document analysis provided complementary background information about the case project and case organization.

The data analysis was conducted as an iterative process, involving annotation and categorization of the data and interpretation to discover relationships (Miles et al. 1994). Internal validity was achieved by presenting the results to both the contact person from the case organization and the individual respondents for approval.

4   CASE DESCRIPTION

This section provides a brief presentation of the case organization, the implementation partners, and the implementation process studied. Aker Kvaerner ASA is a global contractor of engineering services, manufacturing, technology products and overall solutions. Today there are 22000 employees in more than 30 countries, and annual turnover is about 4 billion Euro. Aker Stord, one of Aker Kvaerner's juridical units, was established in 1919 as a fish meal and oil plant, but after the oil crisis in 1973 the company has mainly been producing oil rigs. Today the focus is shifting more and more towards shore based building projects, as most of the oil and gas findings are diverted ashore via pipelines.

Aker Business Partner (AKBP) is Aker Kvaerner's shared service partner and is responsible for the centralization of shared services in the company. The company's goal is stated as to enable a competitive and flexible cost base and group wide IT/IS support for standardized business processes. SAP Norway represents the software vendor for the ERP system implemented at Aker Stord. SAP Norway was established in 1994 as a fully owned subsidiary of SAP AG, with 90 employees located in Oslo. SAP Norway is the foremost supplier of e-business solutions and ERP in the Norwegian market and has more than 300 customers, most of them in the small to medium sized business market.

The starting point of the project was the establishment of AKBP and the concept of a shared service concept in early 2002. There were then ten unique application environments in Aker Kvaerner, and six to seven application portfolios. Using, coordinating and maintaining this many legacy systems was not found to be ideal. The implementation of SAP across the different Aker Kvaerner companies was called "Change to harmony" (C2H) and the vision was "*to harmonize all major business processes by utilizing SAP standard*". Work on the blueprint phase started late in 2003 but was merged with a project run by Kvaerner Oil Field products in early 2004. The project was then redefined to a program that contained a program management that supervised several projects. Work on system design and configuration continued through March 2004 while user training and system testing took place during April and May that year. There was a great deal of uncertainty about the solution and its grade of completion before start up, but the decision was taken and the system went live on June 1st, 2004.

Several problems were encountered after the new system came online:
- The new system had not been tested properly and could not cope with the transaction volume.
- The processes at Aker Stord had not been documented properly in the blueprint and the new system did not have all the required functionalities at first.
- It was not possible to transfer data from the old system as it was incompatible with the new one.
- End user training had been insufficient.
- Too few resources had been allocated to change management and soft skills.
- System support from AKBP was at first not adequate and could not deal with all the requests.

Through skill and hard work the implementation partners and the employees at Aker Stord managed to get through the crisis and by the end of 2004 the system had been stabilized. There were still minor flaws and problems that were being sorted out at the conclusion of the interviews in March 2005. The next section presents the results from our analysis of knowledge management related issues in the C2H project.

5   RESULTS

Neither Aker Stord nor AKBP had implemented any dedicated KMS that could be used to gather, store or help organize and distribute information prior to the implementation of SAP. SAP Norway did however make several of their tools, experience databases and repositories available for the C2H project. A methodology called Accelerated SAP ("ASAP") was used in the project to provide a step by step explanation of the different tasks that had to be completed. While this methodology was very useful for structuring and organizing information on the C2H project, it was not explicitly designed to support KM initiatives. What turned out to be a big challenge was thus how to successfully transfer this information to AKBP and Aker Stord:

"I feel that we communicated very well with the SAP consultants on the project when it came to solving problems and such, but I do not think that SAP made good enough use of their earlier experiences on the project. They started from scratch according to my head so that you could almost believe that…they are very competent in SAP but you can not believe that they have been involved in a single SAP implementation earlier!" (Aker Stord respondent)

This statement indicates that efficient reuse of previous project experiences was a problem. It seems like a lot of previous project experiences had been codified and stored by SAP Norway, but that this was not accessed and reused efficiently. This is supported by the following statement:

"They [SAP Norway] *have a lot of experience and I think they have taken these with them, so I think it is more about the process of communicating experiences (…)."* (Aker Stord respondent)

The consequences of this soon became evident as the deadline approached and system tests were conducted:

"They [The management at Aker Stord] *said that it was a big uncertainty about the solution and the degree of complexity, before going live. The work processes* [at Aker Stord] *did not fit with the new ones. There was no accordance between how it was decided that SAP should use the work processes and how they actually worked* [Aker Stord].*"* (AKBP respondent)

"When SAP talks about best practice they refer to the way they work, their way of running projects. I quite simply believe that we have been misled in the moment of purchase and sale when they talk about best practice for our line of business." (Aker Stord respondent)

The vendor also addressed the challenge of mapping the local business process at Aker Stord, and distinguishing these from those of Aker Kvaerner:

"We tried to cover all of Aker Stord's requirements, but it is possible that these reflected Aker Kvaerner's demands and not Aker Stord's! So it is possible that there should have been more commitment in order to make sure that we actually covered their value chain. But we did use the value chain as a starting point for all of the process designs and down to the transaction level in SAP." (SAP Norway respondent)

We have also seen that most of the resources that were made available for the project were concentrated on the technological part while the change processes and soft skills part only received minor funding. This was also evident during the early project phases. When asked about how well the project was able to transfer knowledge to Aker Stord, one of the respondents replied:

"To a certain degree... and the reason why I say to a certain degree is that very few persons were provided by Aker Stord in order to take part in that knowledge transfer. Some of them performed admirably but they quickly became overworked because they were so few, at least compared to previous projects. (…) Normally we got a two or three to one relationship. For each SAP consultant there are supposed to be two or three customer

consultants or customer participants in the project. In our project we often had a one to one, we even had a one to zero in some instances, and there were also a few one to two occurrences." (SAP Norway respondent)

This statement indicates that the personnel from Aker Stord had to absorb more information than they were capable of. A lot of valuable know how and know why was probably lost because of this. This is a problem that may not have been identified because there were no mechanisms in place that could actually verify that the information that had been communicated had been absorbed and acted upon:

"*We feel that we have tried to communicate, but there were no check points in place to make sure that the message actually had been received.*" (SAP Norway respondent)

SAP Norway admits that they should have tried to make sure that their messages were properly understood, but at the same time they also felt that Aker Kvaerner signaled that they were in control of the events:

"*They* [Aker Kvaerner] *meant that they could handle most of it by themselves. So we ended up in a situation where the customer had not factored in that we were needed because they could do it themselves* [support the system after going live]. *We tried to tell them that they almost certainly were going to need more help than they thought then, but they would not listen to us. But it was not Aker Stord that would not listen, it was Aker Kvaerner and the IT management that would not listen based on the success factors cost, time and usefulness!*" (SAP Norway respondent)

It is not an unknown factor that many previous SAP implementations have been difficult, but the extent to which the potential problems and consequences have been communicated from SAP Norway to Aker Kvaerner can be questioned:

"*It has been done to the highest degree* [communicate the consequences of not implementing the system correctly] *and we think that we have done things correctly – and then it turns out that we have not done so after all.*" (SAP Norway respondent)

Too much focus on potential problems can undermine a company's credibility in a very competitive market, but again there seems to be a divergence between what has been communicated and what has actually been perceived. Proper communication and soft skills are often taken for granted according to one respondent:

"*It is this thing about soft and hard skills again, 'everyone can communicate' – you can write a nice e-mail and then everyone has been informed! One underestimates how demanding it is to establish a proper communication concept, e.g. write a good communication. It is totally underestimated what is needed in order to succeed here.*" (SAP Norway respondent)

The same respondent also questioned whether Aker Kvaerner had the required competence that was needed to handle a change management project themselves:

"*Aker Kvaerner planned to handle the change management task with internal resources. But then it turned out that there were no experienced resources available to do the project, so I was hired in as a consultant. Nevertheless, this function was quite understaffed during the first roll out*" (SAP Norway respondent)

In general, it was a common understanding that more resources should have been allocated to soft skill initiatives like training and change management, as illustrated by the following statement:

"*We got a user manual and the opportunity to attend a course, well course and course, you went down and learned how to enter hours. 'Click here, click there and click there!* [Thumps his fist into the table] *But everything else, including how it all worked together we certainly did not get to know - at least not there!*" (Aker Stord respondent)

A final issue is the use of technical jargon and English system documentation. Personnel from Aker Stord that worked on the project together with most of the system end users were often not familiar with the many technical terms that were being used by the project consultants:

"*It was almost like we went into a primeval forest, and then you had to try to find a path and hold your course, but I also see that…it is limited how long you can cut your way through all of this.*" (Aker Stord respondent)

6 DISCUSSION

This section discusses the main findings from our study, related to the characteristics of the implementation process, knowledge transfer and reuse, and potential synergy effects between ERP and KM.

6.1 Process characteristics

Based on the findings reported in the previous section, Table 2 summarizes characteristics of the implementation process related to knowledge and change management.

Area	Process characteristics
Knowledge Management and KMS	• KM was said to play an important role at SAP Norway but was not presented as an independent domain during the C2H project • KM at SAP Norway was mostly represented in the form of template tools and experience databases • Little use was made of previous project information
Communication and knowledge transfer	• There were not established any routines on the C2H project for effective transfer and reuse of knowledge • Good interal communication in the C2H project team provided for efficient knowledge transfer internally on the project • A mismatch between project requirements in the C2H project and Aker Stord management indicates ineffective knowledge transfer routines • The representatives from Aker Stord on the C2H project were unable to transfer knowledge efficiently to and from the project • The C2H project was only partially successful in transferring project know how and know why to the end users • At times it was attempted to transfer too much information to many of the end users during the training sessions • The management at Aker Stord received much information from the C2H project but did not always manage to convey this on to their subordinates • The transfer of knowledge from super users to end users was relatively efficient • The transfer of know how between end users was unstructured but nevertheless effective
Change management	• The organization at Aker Stord was open to change but some user resistance was encountered as the system went live and problems were encountered • Inadequate focus on change management made it very difficult for the small number of personnel to prepare Aker Stord for the major changes that were necessitated by the implementation of the new ERP system • Aker Kvaerner overestimated their ability to handle change management activities themselves • Most of the persons that worked with change management were only part time resources

Table 2. Summary of case process characteristics

Several different IT systems were used to support the SAP implementation at Aker Stord and played an important role in most of the activities that were carried out during the case process. While all of these technologies were useful and made information more readily available there was a lack of an overall strategy that could coordinate and optimize their use. People on a project have to work closely together and coordinate their activities in order to create synergy, and the same is the case with IT and KMS systems. This brings us to the important question of whether KMS is the same as KM? The few respondents that had heard about KM usually referred to IT tools when asked to elaborate. According

to Alavi et al. (2001) the role of KMS is to *support* KM. If the application of IT and KMS systems is not supported by a general KM strategy their efficiency will be much reduced as there will be limited synergy effects.

When comparing the characteristics of this implementation project with the CSFs listed in Table 1, only the following five were identified in this project: top management support, project team competence, clear goals and objectives, empowered employees and decision makers, and user involvement and participation. This is in agreement with the assessment of the case process as a troublesome ERP implementation. If more of the CSFs had been in place it is likely that fewer problems had been encountered. It is interesting to see that three of the five CSFs that were not present can be directly related to KM, namely communication and cooperation, adequate training, and change management. The existence of a KM strategy could potentially have improved all of these processes by facilitating more efficient communication and knowledge transfer routines. The difficulties that were encountered in the case process were countered by a closer cooperation between the implementation partners. This also supports the statement that organizational aspects are more important than technological ones (Esteves et al. 2000).

In the following we discuss in more depth the issues of knowledge transfer and reuse, and synergy effects between ERP and KM.

6.2   Knowledge transfer and reuse

According to the theory of knowledge reuse (Markus 2001) four different types of knowledge reusers are set apart by the 'knowledge distance' between those who possess the knowledge and those who do not. At least two of the knowledge reuse situations depicted by this theory could be identified in the case process, i.e. that of the shared work-producers and the expert-seeking novices.

The C2H project team is an example of shared work producers. Internal knowledge transfer in the project functioned well because the project members were situated closely together and were able to exchange knowledge quickly through the process of socialization. The biggest difficulty included knowledge transfer between the relatively few Aker Stord representatives on the team. They were simply not able to absorb all of the knowledge that the consultants tried to transfer, which indicates a lack of recipient absorptive capacity.

When the new SAP system went live at Aker Stord a lot of users suddenly found that they were in need of expert knowledge. This is consistent with the role of the expert-seeking novices. The significant knowledge distance that existed between the posessors and users of knowledge created problems, and several of the knowledge transfer barriers discussed by Szulanski (1996) were identified in the data analysis:
- *Unproven knowledge* – caused by system unreliability
- *A barren organizational context* – result of inadequate user training and change management
- *Lack of recipient motivation* – consequence of system inadequacies
- *Lack of recipient absorptive capacity* – information overload
- *Lack of recipient retentive capacity* – caused by inadequate hands on training.

Most of the users at Aker Stord were also unfamiliar with the jargon that was used and found the use of a foreign language (English) troublesome. All of these barriers acted as noise between source and recipient and made efficient communication and transfer of knowledge in the project difficult. Several of the respondents stated that most of the problems that were encountered during the case process had been well documented, but it was still difficult to put theory into practice. This indicates the existence of a gap between what is actually known within the organization and what it puts to use (Szulanski 1996). This does not happen because the organization does not want to learn, but because it does not know how to. One of the problems was that there were no mechanisms in place that could make sure that information that had been communicated had really been received and understood by its intended recipients.

6.3 Synergy effects between ERP and KM

Several respondents felt that it was difficult to locate information about the new SAP system. If project knowledge had been structured and distributed in a more controlled manner it would have been possible to avoid this. The three dimensional framework to structure knowledge for enterprise systems (Chan et al. 2001) could have been used as a basis to organize specific knowledge resources according to the needs throughout the case process. This could have been achieved by identifying who possessed what knowledge, where it was needed, and in which phase of the ERP lifecycle it was needed (ibid.).

Stage	Knowledge types	Organization	Role of KM	Locus of knowledge
Selecting	Business	SAP Norway/AKBP	Identifying	Aker Kvaerner business units
Implementing	Technical	SAP Norway/AKBP	Creating	Aker Stord processes
Using	Product	Aker Stord/AKBP	Transferring/ Using,Storing	Aker Stord end users
Changing	Company/Project	Aker Stord/AKBP	(Re)Using/ Unlearning	Aker Stord end users

Table 3. Knowledge structure table

Table 3 illustrates how this could have been achieved. The different stages in the ERP lifecycle are represented together with different knowledge types, the organization in need of this knowledge, the role of KM, and the location of the knowledge. It would have been necessary to connect the different knowledge types together in a database that was indexed according to content. This would create a type of "yellow pages" repository that made it easy to locate the right information. Templates for each of the different knowledge types according to role, organization, state and location could then be created.

To enable users to engage in advanced use and gain the full benefits of an ERP system it is necessary to go beyond the basic capabilities of the system (Sousa et al. 2003). It has been stated that advanced ERP use by organizations should take place upon a solid foundation formed by CSFs like change management, organizational culture, and ERP training. The findings of this study suggest that KM should also be added to this foundation. Core knowledge itself may not be sufficient for organizations that want to reap the benefits of advanced ERP use, as this is stated to constitute a minimum (Zack 1999). Organizations that wish to use their ERP system to provide them with strategic business advantages should therefore attempt to increase their KM maturity level (Natarajan, 2005) in order to achieve differentiation through developing advanced and innovative knowledge that their competitors can not easily duplicate or imitate.

7 CONCLUSIONS AND IMPLICATIONS

This article has reported the findings from a case study on the implementation of an ERP system in a Norwegian engineering company, focusing on the actual and potential role of knowledge management in this process. The study included interviews with all three organizations involved in the implementation project, thus capturing different perspectives on the implementation process. Several barriers to efficient knowledge transfer between the case organization and its implementation partners were caused by system unreliability, inadequate training and change management, system inadequacies, and information overload. This is consistent with the idea that transfer of best practices within the firm can be "sticky" or difficult (Szulanski 1996). The use of KM in ERP implementation has the potential to enhance organizational efficiency by leveraging people, processes and technology. To achieve this it is important that the communication processes between the implementer and its implementation partners are as efficient and flawless as possible. The role of KM should therefore be

to help coordinate the information flows and the interaction between people and technology in order to create synergy effects.

Only half of the ten most important CSFs that were identified in the literature review were found to be present in the case implementation process. The majority of the CSFs not present were related to soft skill processes like communication, change management and system training, thus reflecting how the case implementation process was conducted as an IT project rather than a change project. Change management is clearly an important aspect of any ERP implementation. The ideal role of KM in the case organization would be to integrate change management and corporate information management by means of an ERP system.

Previous resesrach has documented how organizations find it difficult to store and reuse past experiences, and thus are compelled to repeat their mistakes. While the C2H project made ample use of IT in order to support the case process, no overall strategy had been put in place that could coordinate and optimize its use. This made it difficult to identify and extract codified knowledge from databases and repositories in order to make use of previous experiences. Organizations should seek differentiation through a more efficient and controlled utilization of their resources. An ERP system can help in achieving this, but major synergy effects will more easily be realized if it is supported by an efficient KM process that facilitates the identification, storage, transfer, and distribution of knowledge between people, and thus helps improve the interaction between people and technology.

If organizations want to obtain strategic business advantages from their ERP system they have to develop advanced and innovative knowledge that is difficult for competitors to copy and imitate. This would not only make it possible to leverage organizational capabilities and resources, but also help turn the corporation into a learning organization that is better able to learn from its experiences and eventually develop the ability to engage in advanced ERP use that can provide strategic business capabilities.

Efficient transfer and absorption of knowledge has been identified as an important factor in ERP implementation. This study illustrates how it is difficult to make sure whether the content of a message has not only been received, but also absorbed by its recipients. This indicates the existence of noise and knowledge transfer barriers in various forms that should be investigated more closely. Research in this field should be directed towards identifying methods and mechanisms that can be used to reduce these barriers. Other possibilities for future research lie in the evaluation of the actual benefits that can be achieved from the synergy effects between KM and ERP, by studying ERP implementation projects where KM constitutes an explicit, strategic element in the implementation process.

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