

Knowledge management in renewing software development processes

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Abstract

In this paper, we aim to identify what kinds of knowledge management (KM) challenges are typical in the renewal of software development processes, and to propose solutions to the identified challenges. The research is a qualitative case study of a large software company renewing its software development processes towards reuse of software code, i.e. component-based-software-engineering (CBSE). The research is carried out from business and management points of view, not from the software engineering point of view.

1. Introduction

In software business the pressure to continuously develop business processes in order to stay competitive is great. The productivity of companies is heavily founded on the effectiveness of their software development processes. It has been stated that component-based-software-engineering (CBSE) is one way to increase the effectiveness of software development [see e.g. 20] in several technically oriented studies, as it decreases the amount of overlapping work.

However, the renewal of software development processes towards CBSE is not only a technical issue; it is very much a general management problem, too. In this paper, we study the renewal of software development processes from the business point of view, concentrating on knowledge management (KM) perspective. We argue that KM is a highly relevant perspective to the phenomenon, as a software development process is typically characterized as knowledge intensive and also the outcome of the process, software, is very much a knowledge intensive product. Furthermore, the renewal of software development processes is usually a rather extensive organizational change, in which the role of effective flow of knowledge and sharing knowledge is essential [see e.g. 7; 31].

The objective of this paper is to identify the central KM challenges in the renewal of software development

process. By presenting possible solutions to these challenges, we aim to provide some helpful insights for managers dealing with the challenge of renewing software development processes. Furthermore, we aim to contribute to KM literature by empirically examining typical KM challenges in a specific research context, the software business. However, as we deal with a qualitative case study, the results of the research are not directly generalizable in other contexts.

The central issues in this study are software business and the software development process as representing the specific context of this research. The renewal of software process means in this study an intended shift towards CBSE. Theoretically this paper is based on business and management literature, especially on KM literature. The main idea of KM is to make the reuse of existing resources effective [29].

The paper is structured as follows: The introduction of the research context, i.e. the software business and special characteristics of component-based-software-engineering, starts the paper. It is typical of a case study that the borders between the phenomenon and its context are hard to define, thus the context-bound nature of this study is highlighted by this order of discussion in the paper. Furthermore, the context of the study also directs the theoretical discussion, which follows right after the presentation of the context. In the theoretical discussion, the application of KM thoughts in the context of componentization is emphasized. After this, the research methods and the case study are presented. The paper ends with presenting the results of the study and some conclusive thoughts.

2. The research context

Software plays an important role in our modern society [19]. Many of our everyday tasks are based on the utilization of software. However, it is not always clear what can and cannot be labelled as a part of the software industry and what cannot. Thus, measurements regarding the software industry and its size, importance, and growth rates are not easy to make.

One possible way to better capture the essence of the software industry is to divide the software industry into smaller segments. This helps to understand more clearly the different ways of doing business related to software and the position of the services in relation to them. One rather commonly used way to break down the business is to consider embedded software, professional software services, enterprise solutions, and packaged mass products as involving separate types of business, as suggested by Hoch et al. [15].

Embedded software refers to programs integrated as inseparable parts of system products that include also hardware other than standard computing platforms. Professional software services refer to the work of the software project business [see e.g. 2] or to tailored software [see e.g. 28]. Software products that are provided as they are to several customers are typically called packaged mass-market software. Software that is produced for the quite specific needs of customer organizations, and usually based on general technological solutions and often also on standard application frameworks, is referred to as enterprise solutions.

The case organization of this study mostly represents the segment of enterprise solutions, although it also has characteristics of professional software services (e.g. customization of the software for specific customer needs is typical of the company) and of software products (e.g. there are "product categories" visible to customers).

It can be argued that the ideology of reusing software code is easier for software product companies to adopt than for professional software service companies or even for enterprise solution companies. This is due to the pressure of customer specific needs and customization demands that are typical of professional software service and enterprise solution companies, but not so much of the product companies. However, the professional software service and enterprise solution companies would benefit a great deal from CBSE, too. This is noticed also in the case organization of our study.

Decentralized and centralized component based production are two main ways to organize componentization. In the centralized production, component creation and component use are separate things: component creators and component users are different, specialized people [16], [6]. There is often a dedicated unit responsible for the creation and production of components. Instead, in the decentralized way of componentization anyone can be a creator or user of components in addition to their normal job responsibilities. The organization of componentization can also be a mixture of these two [16]. The exchange of resources and interaction between the people

developing and using reusable software is an important factor in enabling the componentization in any chosen model [23].

3. Theoretical insights

3.1. Knowledge management

According to the knowledge based review of the firm, knowledge is a critical element in many organizations' success [see e.g. 8]. As knowledge is a focal component in organization's success, critical knowledge should be recognized and utilised effectively. Still, one of the challenging questions for organizations is the difficulty to recognize what knowledge is needed in which situation (Lave 1988, Reeves and Weisberg 1994, Thompson, Gentner and Loevenstein 1998 according to [13]). It is typically a big problem that employees do not know about all the available knowledge already existing in the organization. Therefore, they cannot look for it or utilize it in their own work. However, the creation of new ideas would be most effective if old knowledge could be attached to new situations and in this way be cultivated and developed [13; 12; 14]. After reflecting the aforementioned aims of knowledge management it can be said that the idea of reuse is very close to the idea of knowledge management.

Knowledge management tries to overcome the aforementioned challenges. To move knowledge and experience in the organization from its origin to places where they are novel can be seen as a purpose of knowledge management [1]. Basically it can be said that the main idea in knowledge management is the effective diffusion and promotion of the reuse of existing resources [29]. Administration and goal oriented management of knowledge, skills, competence and communication are essential things in knowledge management [25]. Knowledge management comprises of carefully designed operations to channel and govern the human capital and intellectual property of an organization [24] to maximize the performance. The management of knowledge sharing and application as well as the improvement of knowledge creation can be seen as the aims of knowledge management [18].

It has been stated that in organizations an attitude of wisdom (members of an organization are willing to search for knowledge inside their organization and also willing to share their own knowledge) is needed for knowledge management to work well [11]. However, getting people to talk and share their knowledge could be considered to be the biggest obstacle to effective knowledge management [4].

Knowledge flows inside the organization can be increased by social interaction. Through social

interaction organizational units have more opportunities to share their resources and ideas. [26] Despite this, in many companies there is a lack of attitude of wisdom. Still, it would be needed for knowledge to flow efficiently. One reason for this might be that, besides the fact that different organizational units are expected to collaborate with each other, they also still quite often compete with each other [26]. Social interaction promotes trust and reduces uncertainty [26]. So it can be said that social interaction is indispensable while creating attitude of wisdom, which is needed for sharing knowledge between different units. As benefits of interunit knowledge sharing have been presented for example innovativeness [27] and efficiency in project completion times [9].

A quite commonly known way to put knowledge management into practice is to apply either the codification or personalization strategy [10]. The main idea in the codification strategy is to concentrate on codified knowledge and information technology. The purpose is to codify knowledge carefully and store it in databases. Through this anyone in the company can access and use the knowledge easily. While implementing the codification strategy, the focus is on technology-oriented issues. The other perspective in executing knowledge management is to take the personalization strategy into use. There the main idea is to concentrate on tacit knowledge and person-to-person contacts. Information technology is used to help people network and communicate. [10] In the personalization strategy the emphasis is on human-oriented issues.

It has been stated that an organization should make a choice between these two strategies. When choosing one strategy the other should not be totally neglected. The balance between these two strategies has been suggested to be 80/20. [10] In spite of this some suggest that the balance could be something else than 80/20 in software companies. The suggestion is that codification and personalization strategies should go more hand-in-hand and there should be a dual process of codification and personalization. [22]

Whatever the balance between the two strategies is, they create a good perspective to view a software company's shift to componentization. Through this division it is quite easy to recognize the important elements from knowledge management perspective. No matter what the knowledge management strategy is, both technology and human oriented issues should be taken into consideration. By this division it is easier to consider all the important elements.

3.2. Knowledge management in renewing software development processes

While the goal of knowledge management is the effective reuse of existing knowledge, KM can be seen as an integral element in the shift to componentization. The choice to renew software development towards componentization can be seen as a choice towards a codification strategy of knowledge management. Despite the emphasis on codification strategy, it should be still remembered that the personalization strategy should not be forgotten totally. Only by noticing both of these aspects (despite the fact that the emphasis is on codification strategy) proper knowledge management approach to software development can be seen.

Componentization is a wise choice to do software development, when representing the segment of enterprise solutions. Componentization can help to meet the challenge of combining specific customer needs, and general technological solutions and standard application frameworks at the same time. Through componentization existing knowledge can be used effectively. In componentization the emphasis is typically on codified knowledge. Still, to be able to create unique solutions to meet the specific customer needs, the human side (tacit knowledge) of knowledge management should not be neglected. The flow and usage of tacit knowledge should be ensured.

In a research on implementing software reuse by Morisio, Ezran & Tully [21], it was found that third of reuse cases fail. The lack of processes dedicated to reuse and the adaptation of existing processes were the main reasons for the failure. In such case the processes do not support reuse, i.e. there is no means or time for reuse and componentization. In order to work componentization requires careful planning and adjustments in an organization. [21] It has also been stated that often componentization projects fail because it is thought that they fit the existing structures with little motivation and technical training [9]. The human factor has also often been neglected [21]. Typically also the pressure coming from the customers and financial goals takes the attention away from componentization.

It is possible that independent or physically dispersed units even compete with each other (Lynex & Layzell according to [17]) and this leads to a situation where there is no willingness to share software code. There is some evidence that social interaction enhances interunit knowledge sharing [see e.g. 26]. Thus the role of social interaction might be crucial when introducing componentization, as its point is to get people to share knowledge in the form of components which are creations of other person's knowledge.

4. Introducing research methods and the case organization

4.1. Research methods

This paper presents a qualitative case study. Case study [30] was chosen as the research strategy to ensure the achievement of an in-depth and holistic understanding of the research phenomenon [5] that is strongly tied to its context, the software industry. The study is a single-case study of a large software company that is renewing its software development processes.

Data gathering and analysis were carried out by using qualitative methods [3]. In gathering the data, altogether 32 theme interviews were made. The themes utilized in the interviews were developed based on a careful theoretical review. Thus, the reversion between the theory and the empirical data, which is typical of case studies, was already visible in the phase of gathering the data.

The interviews were done on various hierarchical levels – the levels of management (the steering group and the architect group members), middle management (team and unit leaders) and operational level (software programmers and sales people). The reason for selecting the interviewees from different hierarchical levels was to get an extensive picture of the phenomenon.

The architect group consisted of managers or specialists that were responsible for planning and implementing the renewal process. All the members (6 persons) of the architect group were interviewed. Few of the architects were also members of the steering group. Through these interviews the aim was to get a picture of the renewal from the management level.

Also all of the team/unit leaders (15 persons) were interviewed. Through these interviews the aim was to get a picture of the renewal from middle-management's/superiors' perspective. Furthermore, 11 persons from the operative level (programmers and sales persons) were interviewed to get a picture of the renewal also from the operational level.

All of the interviews were tape-recorded. Also all of the interviews were typed as detailed interview memos. Qualitative analysis of the data was done by using both theoretically driven categories and categories generated from the data [3].

Due to the confidentiality reasons, the case organization is presented as anonymous in the following case description. For a qualitative study, the utilization of direct quotes of the interviewees would have been recommendable to justify our conclusions drawn up from the empirical data. However, due to the

limitations in space, we are not able to use direct quotes in this paper.

4.2. The case organization

The case organization is a large software company operating in business-to-business markets. In the segmentation of the software industry, the case organization stands mostly in the segment of enterprise solutions. It provides large and complex ICT systems and solutions for its organizational customers.

The company is quite dispersed. The operations of the company are based on independent teams. The teams differ in many ways. They have different organizational backgrounds, different technologies in use, different products and customers and also very different compositions. Each of these teams is responsible for their own software development, production and sales. In addition to this, they can be quite separated from each other even physically. This makes it difficult to know what others in the organization are doing. Even the team leaders do not mostly know what the others, on an equal level in the organization, are working on. Due to this, the teams are making the software from scratch fairly often. This also leads to a problem that too often the teams do overlapping programming and software development work. This unnecessary overlap in the software development process naturally causes extra costs for the company.

The toughening competitive situation is forcing the company to renew its software development process to a more efficient way of working. The aim is to root out redundancies and to improve productivity. To get to that point the full utilization of the knowledge inside the organization is needed. Thus, improvements in the knowledge flows and closer collaboration between teams and individuals throughout the organization are necessities.

The organization tries to tackle the aforementioned problem by switching to decentralized component based software engineering. In addition to doing their day-to-day tasks as before the teams must try to identify potential components, i.e. products, subparts or features that could also be used in other teams and environments. This should be done by all the employees, but especially by the team leaders. After being approved as a component the component should be entered into the component library to be available for the others in the organization.

In the case organization work has been strictly team- and project-based. Thus, the current organizational structure does not support the interactions required by componentization. There has not been either time or motivation to make software code for the public good.

Hence the transition from a team-oriented way of working to a productized, more holistic software development process is a great challenge for the whole organization. In addition to a change in the organizational structure, the case organization has decided to take an advantage of using one shared technology, i.e. programming environment and language, across the organization. This technology is already in use in a few teams, but is new to the most.

5. Empirical findings

5.1. Organizing the renewal

Two stages of proceeding were identified in the renewal process: the design and preparation phase and the implementation phase. The design and preparation phase includes the preliminary assessment of the available, thus possible technologies; the analysis of the current process; the remodelling of practices; the division of responsibilities; a preliminary allocation of resources and finally the technological decisions.

Already in the preparation of the componentization shift, a dynamic, functional cross-team group of specialists, the architect group, has been set up. The task of the architect group is to critically monitor the actions and needs of the teams. The architect group will scrutinize and decide whether a suggested part is suitable as a component for the component library. This is based on the suggestions of the team leaders. From the library each entitled member of the organization can use and reuse components. To be fully usable and even further developed for and by other teams the component must be well documented. Due to this, carefully planned specifications for the documentation have been made.

The planned practices are put into action and anchored into the organization in the implementation phase. In this phase they should monitor the process and support the correct actions. The aim of these two phases is to ensure the proper implementation of new practices and technologies.

5.2. KM challenges in the renewal

The renewal of software development process by introducing componentization comprises many challenges from knowledge management perspective. The fundamental idea in the renewal to componentization is to share knowledge effectively to be able to reuse it. Before getting to that situation several knowledge management challenges can be seen in the case organization.

As renewing the software development process by introducing componentization, the case organization is emphasising technology-oriented KM strategy. The focal element is the component library where the knowledge is explicated.

Besides the utilization of components from component library the programmers still need a lot of their own and others' expertise and tacit knowledge to effectively develop and produce software. Thus the human side should never be neglected in the case organization. Due to this the knowledge management challenges (and solutions) of the renewal are described by dividing them into technology-oriented and human-oriented challenges (and solutions). The knowledge management challenges in the renewal of software development process in the case organization are introduced in table 1.

Table 1. KM Challenges in different phases of the renewal process

	Design and preparation phase	Implementation phase
<i>Technology-oriented challenges</i>	<ul style="list-style-type: none"> · Different kinds of teams and demands · Finding a viable common technology that meets the needs of different teams · Usability and exploitability of the component library 	<ul style="list-style-type: none"> · The fit between the initial and new technology · Lack of competence of a new chosen technology · Component interfaces that are general enough · Lack of time for training and experimenting
<i>Human-oriented challenges</i>	<ul style="list-style-type: none"> · Prejudices towards new technology · Fear and uncertainty caused by not-knowing the future 	<ul style="list-style-type: none"> · Information and knowledge flow between teams · Social interaction between the teams · Attitude problems towards change · Attitude problems towards a new technology

The great diversity of the teams in their initial situation is one of the main sources of knowledge management challenges in the renewal of software development process in the case organization both in

design and preparation phase and in implementation phase. Both technology-oriented and human-oriented challenges can be seen to derive from the diversity of the teams.

In the design and preparation phase the heterogeneous nature of the teams makes it challenging to find a right common technological solution that could fit the technological demands of all the teams. It is a difficult and trying task to find a technology to support the existing software produced and maintained by the teams because of the different nature of the software developed in the different teams. A challenging question is also how the component library should be structured so that it is really usable and exploitable by the members of the organization.

In the implementation phase there is a great challenge of making the chosen technology fit with the initial technologies used in different teams when the initial technologies are in use. There is an aim to make a transition to the new chosen technology throughout the organization. This creates a challenge as there is a lack of competence on the new chosen technology. The challenge to make the component interfaces general enough when the components are created can also be considered a technology-oriented challenge in the implementation phase. There is also a lack of time for training and experimenting related to the new technology. When there is not enough time to train and experiment the new technology the members of the organization do not have enough knowledge to utilize this new technology properly. Overall there are quite demanding technology-oriented challenges in the shift to componentization.

In the design and preparation phase there are also human-oriented challenges. There are prejudices towards new chosen technology. People have questioned the superiority of the chosen technology and there is also a challenge as many people would like to continue with the old familiar technology which they are used to. Typical to a change situation, also in the case organization it is recognized that some members are frightened as they feel that by the change the future is unknown.

Also in the implementation phase there exists the challenge of getting the information and knowledge flow between the teams. The heterogeneous nature of the teams in the case organization also has an effect from the human-oriented aspect by adding some contradictory or controversial notions to the knowledge sharing between the members of different teams. The members of different teams are not used to sharing knowledge with the members of other teams. The social interaction between the teams is weak. Prejudices and attitude problems such as lack of trust and “love” towards the own code are significant reasons for this.

Overall, there are attitude problems towards the change. Questions have been arisen related to, for example, the whole idea of componentization and the technological decisions being right.

6. Proposed solutions to KM challenges

There are many possible solutions to the aforementioned KM challenges. The possible solutions to KM challenges were created through the ideas of codification and personalization strategy. The interesting feature of knowledge management practices is that the effects of the actions taken are multiple and sometimes even difficult to point out. This is the reason why the solutions to KM challenges introduced in Table 2 cannot all be matched to a certain challenge introduced in Table 1. The purpose is that by applying the suggested solutions, the organization creates the right circumstances for meeting the challenges. The possible solutions are represented in table 2.

Table 2. Solutions to KM challenges in different phases of the renewal process

	Design and preparation phase	Implementation phase
<i>Technology-oriented solutions</i>	<ul style="list-style-type: none"> · Plan the implementation and the schedule of the implementation of the new technology properly · Approve the parallelism of old and new technology in some situations for some time · An expert pool to find a “right” technology · Designing the component library with experts and representatives of different teams 	<ul style="list-style-type: none"> · The new technology must be agile enough to accommodate the needs of the teams · The new technology must be adaptable by organization members · Resources and possibilities for training of the new technology · Clear architectural design and structure
<i>Human-oriented solutions</i>	<ul style="list-style-type: none"> · Proper communication of the change · Training for the chosen approach 	<ul style="list-style-type: none"> · Pilot cases to act as an example · Creation of formal and informal communication places and spaces between the teams

In the design and preparation phase one of the main issues from technology-oriented perspective is to plan well the implementation and the schedule of the implementation of the new chosen technology. Experts and members of different teams should be involved in this process. In addition, as early as in the design and preparation phase, it would be wise to consider letting some teams to use old technologies as long as they are required for maintaining software that are made with old technology and that will not adapt to new technology. This should be allowed only in situations where the integration of old and new technology is impossible and only if it is truly necessary. When choosing the new technology the knowledge of the experts inside the organization should be utilised to make sure that the choice is right from a technological perspective (and from different teams' perspective) and so also to rationalize and justify the choice. The experts should also be involved in the designing and preparation of the component library. This helps to build a library where a usable and exploitable knowledge is found.

Choosing the new technology in the design and preparation phase has a direct effect on the implementation phase. Regarding the technological side to the whole change, it should be considered that the chosen technology is, and must be, agile enough to enable the continuance of the work of the individual teams. The new technology should also be such that it fits at least on some level with the old technology. Only this guarantees that old and new knowledge goes hand-in-hand and no knowledge is missed. When choosing the technology it should be also made sure that the members of the organization are either already familiar with it or have the ability to learn how to use it. When learning how to use the new technology there has to be different kind of training possibilities to meet people's different ways of learning. The managers should also budget time and money for the employees to adapt to the new technology. In the implementation phase the usage of the components is the main idea. Thus to ensure the usability of the components, clear definitions and guidelines for the components should be made. Through this it could be made sure that the component interfaces are general enough for everyone to use.

The human-oriented challenges of the design and preparation phase that are related to prejudices, fear and uncertainty could be met with proper communication. Through proper communication about the change the different gray areas may be elucidated and the uncertainties lifted. It is important to communicate the message of the renewal clearly all the way down to individual teams and groups within the organization. It is also wise to arrange training for the chosen approach

already in the design and preparation phase. Through training different prejudices may be diminished.

To meet the challenges in the implementation phase successful try-out or pilot cases could be helpful in showing the employees that this kind of new way of working is possible, functional and typically helps everyone. To make sure that information and knowledge would flow between the teams in the implementation phase, different kinds of places and spaces where people could meet and create mutual trust would be useful. Examples of this are job rotation between the teams, formal and informal meetings of team members, regular team leader meetings, shared coffee rooms and game rooms and visits of a team member to the meetings of other teams. To put it simply, if the people know what is going on, they are less concerned and more confident and trusting for a better future. Also the team leaders' meetings could be (at least occasionally) visited by a member of the top management to do the promotion of the process. In turn the team leaders could promote the message of the management to their own team members. In these middle level meetings various training needs could also be discussed and developed.

7. Discussion

In our case organization the main idea behind the componentization was, in fact, an attempt to avoid overlapping work and to utilize the existing knowledge better across team and project boundaries. Thus, the role of effective knowledge sharing was recognized in the case organization. However, there were still several knowledge management-related challenges that should have been considered more carefully. Based on the empirical results, we argue that by recognizing these challenges more proactively already in the design and preparation phases of the renewal process, the movement to CBSE would have happened more effectively in the case organization.

It can be said that leading the change systematically is critical in this kind of an endeavour. The individual teams in the case organization all have their own business as usual -modes. In the renewal process they are expected to renew them. A major adjustment can be seen on a mental level. All teams and individuals need to adjust their functions and even change the technology that is being used. Some must learn and adapt to an altogether new technology and way of working. To achieve these changes a new way of thinking and readiness to adapt to change are needed. Thus the attitude of wisdom is needed, as it has already been stated in previous studies. This can be achieved properly and in all functional levels only if leaders create the right circumstances and provide all the

necessary resources. This also supports the existing theory as it states that without means or time reuse typically fails. Hence it can be said that leading and leadership in this kind of undertaking and setting are crucial for a successful outcome.

What is essential in the beginning of this kind of a renewal process, is short-term success. A counterforce to the human resistance to change is needed. The organization and its members need to see positive examples to overcome the difficulties. Successful pilot cases should be promoted on the company level (i.e. via intranet). Also communication of the renewal should be done well. This way a better and more thorough picture of the process would be given to the employees. The opinions and notions should be better taken into account as well.

Monitoring and guiding the componentization is extremely useful. As the future of monitoring and guiding was blurry, it has to be said that some control is needed or even vital for a successful result of a renewal process and especially for the new fashion to actually become the usual way of working. This is also due to the fact that this kind of change needs promotion through well-executed organization-wide communication. Promotion is more likely to be taken care of and be functional if done by dedicated personnel, even if their main tasks would lie elsewhere. It is also wise that a known and appreciated person inside the organization would be nominated to be a leading person in the change.

As it has been stated, the chosen technology should be agile enough to meet the needs of individual teams. Still, as the teams and their products are so variable, there may be unexpected challenges or even difficulties in finding such a technology. Another alternative is to make compromises in the way the new chosen technology is implemented and in the length of the transition period.

The ultimate goal of the whole operation in the case organization is a permanent change in the ways of working. This can also be seen as taking knowledge management practices as an everyday functions inside the company. In this kind of situation it is typical that this kind of a procedural change may well take time up to two to three years or even be continuous, a sort of on-going change.

8. Conclusions

This paper has discussed the knowledge management challenges on the basis of a case study. We analysed a renewal of software development process of a large software company representing the segment of enterprise solutions, from KM perspective. The aim was to track from the empirical data KM

challenges that appeared during the renewal process and based on KM literature, to propose possible solutions to the identified challenges.

Based on the empirical data, we were able to identify several challenges related to the renewal process from the viewpoint of knowledge management. Still, it can be said that knowledge management is also a key to help this renewal to go forwards. By discovering knowledge management challenges these challenges can be faced and handled.

This paper has presented initial results of our research, which will further continue by a more detailed analysis of the empirical data by utilizing more carefully the perspectives of different organisational levels (management, middle-management and operative level) involved in the renewal process. However, already at this point of our research, it clearly seems that the results of the study support the previous KM studies, even though the KM approach was applied in our study in the specific context of software business and CBSE. For example, it can be argued that software companies that are renewing their software development processes towards CBSE would benefit a great deal from applying KM practices already at the design and preparation phases of the renewal process. Thus, KM practices should already be considered in the design phase of the change to ensure smooth progress of the change. Another significant issue to be brought up is that both technological and human perspectives of KM are needed in the renewal of software development process. Technology is needed for making things easy and efficient. Still, it is more important to have a right attitude towards knowledge sharing, and in this, reuse is the key element. This has already been stated in many KM studies as for example Desouza [4] has stated that "The biggest obstacle to effective knowledge management is not implementing a cutting-edge IT solution, but getting people talk and share their know-how."

The managerial implications of such a reform can be considered significant. Qualifications and features required from leaders in this kind of situation are not necessarily easy to meet. To master the technological side of the whole change process is one big thing, but the organizational and human side may be even a bigger one to handle. It is very challenging to think which organizational changes are needed and it is even harder to figure out how they should be implemented.

As the meaning of human issues was emphasised in the results and as there are signs that maybe the 80/20 relation of KM strategies is not necessarily the right one [22], it would be interesting to conduct further research on the balance between the two KM strategies.

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