

Facts, Processes and Common Understandings: The Management of Knowledge in Project Based Organisations

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1. Introduction

During the last couple of decades, project based organisations (PBOs) have been on a strong increase (e.g. Prencipe and Tell, 2001; Whitley, 2006) as the fast changing environment and conditions for conducting business call for more flexible, innovative organisational designs. Project teams are one way to organise for these changes. PBOs are especially suited to react to changes and initiate team learning, and they are also said to be the key learning unit in organisations (Senge, 1990). In this way PBOs can be seen as small knowledge intensive factories where knowledge is created, adapted, and re-framed.

However, PBOs face a number of challenges. One of these is not to “reinvent the wheel” as organisational knowledge can be fragmented and very team specific. In such organisations it may be difficult to know what knowledge is available in the organisation if there are no formal mechanisms or established department responsible for capturing, storing and sharing knowledge in and between project teams. More specifically one has to assess whether the organisation is able to capitalise on knowledge gained in one project and transfer it to other projects. Will team members with diverse skills – who work together for a limited period of time, who might not know each other, and who may not expect to collaborate again – be able and willing to share knowledge? Do team members even have to handle multi-teaming? All these issues, and more, aim at an effective understanding of knowledge management.

Paying attention to the role of knowledge management as well as the role of social processes, practises and patterns is relatively new in relation to knowledge management in projects and PBOs as Bresnen et al. (2003) have pointed out. According to Ajmal and Koskinen (2008) the benefits of knowledge transfer have long been recognized in PBOs, but the effectiveness of the knowledge transfer varies considerably.

Effective knowledge management is complex, but essential. Therefore, this paper focuses on how the alignment between an organisation's strategy, products, and knowledge management strategy can help clarify which knowledge management initiatives will be most effective.

The aim is to discuss how different types of knowledge enable various ways of managing knowledge, i.e., how they create, share and transfer knowledge in and between projects. Therefore, we study how more views on knowledge management and related initiatives in

relation to developing and sharing knowledge in projects can extend the managerial palette of options and how it might help project managers choose the most effective knowledge management tools to facilitate knowledge management activities in general. Further, we examine how a particular project management model used in two specific organisations differs when the package of knowledge management tools differs.

The significant role of knowledge and effective knowledge management in PBOs is for instance essential for improving the utilisation of core capabilities and technological platforms and reduce development time in projects (Oshri et al., 2005). Aamodt and Plaza (1994) argue that 4R, i.e., Retaining, Retrieving, Reusing and Revising previously developed knowledge from other projects, is an essential goal of knowledge management in PBOs as this previously generated knowledge is to support future project work. This approach supports the view that knowledge can be retained, retrieved, revised and reused, which corresponds to what is called the artefact oriented perspective (e.g. Christensen & Bang, 2003; Christensen & Bukh, 2005) in this article. This perspective is rooted in the decision support literature which means that the 4Rs constitute the backbone of knowledge management in the sense that they support new problem solving by using previous knowledge. The artefact oriented perspective focuses on the explicit dimension of knowledge where information can be captured, stored, retrieved and re-used using knowledge management systems.

An alternative way to view knowledge management is the process oriented perspective (e.g. Christensen & Bang, 2003; Christensen & Bukh, 2005) which primarily focuses on the interplay between the tacit and explicit dimensions of knowledge. From this perspective the context for understanding the information is more important, and it is emphasised that the essential issue of knowledge management is the process of creation and sharing of knowledge. This perspective is in agreement with the organisational culture perspective presented by Ajmal and Koskinen (2008, p. 8) which "encourages informal interactions between individuals to ensure that knowledge is created and transferred".

By using these two perspectives to analyse knowledge management in two Danish PBOs: The development division at Bang & Olufsen and FKI Logistex Crisplant, this article shows how project management, which on the surface looks alike – as it is based on the same basic project management model, i.e., Cooper's (2001) stage-gate-model – might be very different in practice as important differences are found.

The article shows how project management in the two companies differs and how it, together with the differences in the production processes, influences how the involved knowledge resources are managed. In the conclusion it is suggested that if a company offers standardized products, a codification strategy departing in the artefact oriented perspective will be most effective, whereas the personification strategy departing in the process oriented perspective will be most effective if a company offers customized solutions. Further, the analysis from the two perspectives may contribute to understanding the implications of the lack of agreement on what knowledge management is (cf. Firestone, 2008).

The remainder of the article is structured in the following way: Section 2 introduces knowledge management in projects and the two perspectives on knowledge management. Further, two different strategies for knowledge management are discussed. In Section 3 the methodology is presented and a short description of the two companies is given. In section 4 the companies' different initiatives in relation to knowledge management are presented and it is illustrated how knowledge management is an integrated part of project management. In section 5 knowledge management is analyzed from the two different perspectives, and

finally, section 6 discusses how the perspectives may help to show a more balanced picture of knowledge management by focusing on different aspects of knowledge management.

2. Knowledge management in projects

In management literature there has been an overwhelming interest in the concept of knowledge and knowledge based resources. This is not only reflected in the importance of knowledge-intensive companies but also in an interest in how knowledge based resources interact in the creation of value in companies and how knowledge can be managed. Paying similar attention to the importance of knowledge, knowledge based resources and processes as well as the role played by social processes, practises and patterns in relation to the management of knowledge in projects and project organisations (e.g. Huang & Newell, 2003; Cummings, 2004; Brookes et al., 2006) is, however, a more recent phenomenon as was emphasised already by Bresnen et al. (2003).

This is somewhat surprising as PBOs are becoming an increasingly important mode of organising and as product development and innovative activities, which are often based on project organisations, are the prototype of knowledge intensiveness (Brookes et al., 2006). The importance of knowledge management in PBOs arises from several aspects of the role of knowledge as well as the characteristics of PBOs (e.g. Koskinen, 2004). Employees are the primary carrier of knowledge in PBOs opposite more functionally based organisations with established departments responsible for knowledge storage and sharing (Ajmal and Koskinen, 2008).

This demands special attention. Projects are often based on a specific task with a budget, assigned project members and a schedule to be kept (e.g. Reich et al., 2008), and they are evaluated based on their performance in relation to specific task related milestones. However, projects are also expected to function as a place where knowledge is shared and developed. Individuals, teams and organizations are expected to optimize performance and learning, but learning and performance often work at cross-purposes – especially in teams (Bunderson & Sutcliffe, 2003; Singer & Edmondson, 2008; cf. O’Leary et al., 2011). Regularly, changes in projects often disrupt the time schedule which can be very costly. Therefore, Senaratne and Sexton (2009) argue that understanding the role of knowledge and what type of knowledge is shared and developed in the project during the change event is crucial.

Additionally, the amount of R&D activities carried out in projects has increased dramatically (von Zedtwitz et al., 2004), and knowledge management has been argued to facilitate integration between R&D and marketing (Sherman et al., 2005). Further, the increasing geographical distribution of projects and project members affects how project management can be carried out, and knowledge management becomes a difficult task because of distance and cultural barriers (Evaristo et al., 2004; Ajmal & Koskinen, 2008).

Finally, knowledge is in general a vital resource in project based industries as Love et al. (2003) remark, and effective knowledge management, in project organisations for instance, is essential for establishing a learning project organisation (e.g. Kasvi et al., 2003) and for improving the utilisation of core capabilities and technological platforms and to reduce development time in projects (Oshri et al., 2005). Thus, knowledge management in projects and PBOs is expected to be of importance, and it strives for an effective understanding of knowledge management.

2.1 The two perspectives on knowledge management

The discussion of the concept of knowledge is still an ongoing process. Several categorisations and frameworks have been suggested (e.g. Blackler, 1995; Li & Gao, 2003; Meyer & Sugiyama, 2007), however, Polanyi's (1966) dichotomy of tacit and explicit knowledge is still a point of departure for understanding the nature of knowledge as it was found by Alavi & Leidner (2001) as well as Jennex & Croasdell (2005), cf. Jennex & Olfman (2006).

The notion of implicit knowledge has often been used to span the two poles (e.g. Frappaolo, 2008; Li & Gao, 2003; Meyer & Sugiyama, 2007), and the continuum perspective, in which knowledge has both an implicit and explicit dimension in a specific context, is developing (Jasimuddin et al., 2005; Klein, 2008; Kogut & Zander, 1992; Mohamed et al., 2006). When managers as well as scholars discuss knowledge, different perspectives are often taken. The difference often consists of the way in which knowledge is perceived. In other words, the basic epistemologies differ. Although for example Nonaka & Takeuchi (1995) use the term 'tacit' knowledge, we will follow Klein's (2008, p. 42) suggestion and mainly distinguish between explicit and implicit knowledge. The latter is a subset of tacit knowledge since Polanyi's (1966) notion of tacit knowledge implies a kind of knowledge that fundamentally cannot be shared. Further, the distinction between the artefact oriented and the project oriented perspectives will be outlined in more details below.

The first perspective on knowledge and knowledge management will be termed the *artefact oriented* perspective. Focus is often on information technology and the ways in which technology may be applied for the codification of knowledge. It is more or less explicitly assumed that everything can be described, and the more data a company collects, the more knowledge it possesses. Knowledge management is therefore mostly based on collecting, storing and distributing knowledge, for example, in the form of documents and specific information (e.g. Huber, 1991; Lyles & Schwenk, 1992).

From the artefact-oriented perspective, knowledge management focuses mostly on project memory (cf. Jennex & Olfman, 2006; Kärreman et al., 2004) and manuals for organisational processes (Malone et al., 1993). This is in agreement with the R4s – retrieve, reuse, revise and retain – emphasised by Aamodt and Plaza (2004). According to Karni & Kaner (2008) R4 constitutes the backbone of case-based reasoning which was developed to support new problem solving by using previous knowledge. See also a similar perspective termed "knowledge as a solution" suggested by Snider and Nissen (2003); cf. Ajmal and Koskinen (2008, p. 8).

Many authors (e.g. Blackler, 1995; Tsoukas, 1996) have indicated that the artefact oriented perspective has become insufficient when handling management challenges in relation to the complexity of the knowledge society and hence has criticised the reductionist view of knowledge expressed by the artefact oriented perspective emphasising instead that knowledge is situated in social and organisational practises as well as relationships (Tsoukas & Vladimirova, 2001). The problem is not lack of documents, data, or access to information. The limitation is rather to be found in the quality, content, and organisation of the material. This has given rise to the second perspective, which we term the *process oriented perspective*. Here, knowledge is related to experience and is more dependent on the context as it is socially created, to use Snider and Nissens (2003) expression.

The process oriented perspective is most clearly exemplified by Ikujiro Nonaka's research in which knowledge is perceived as a "dynamic human process of justifying personal beliefs

as a part of an aspiration for the 'truth'" (Nonaka 1994, p. 15). An essential point is that focus is on the process in which knowledge is created and not on the documents or the rules based on the process. This implies that continuous and dynamic adaptation to 'real life' takes place.

From the process-oriented perspective knowledge creation and sharing is considered to be a continuous process where knowledge is transformed between tacit and explicit knowledge and between people and technology. Here the point of departure is the so-called SECI-model (Nonaka & Takeuchi 1995) which consists of four types of processes, identified by Nonaka & Takeuchi (1995) as central in relation to knowledge management: Socialisation, Externalisation, Combination and Internalisation. According to Nonaka & Takeuchi (1995, pp. 70-71) the development of organisational knowledge is a continuous and dynamic interaction between tacit and explicit knowledge.

More effective knowledge management may also result from adapting management tools that fit the prevailing perception of knowledge. For instance Marr et al. (2003) state that knowledge management practises will be perceived as more effective if they match the personal epistemology of the employees. In relation to an in-depth study of knowledge management in a project case study in an Australian industrial engineering organisation, Sense (2007, p. 17-18) documents similarly that the project members favour knowledge sharing techniques that align with their cognitive style type and further that they acknowledge the personal bias towards specific modes of sharing knowledge.

2.2 Strategies for knowledge management

Hansen et al. (1999) argued that two strategies dominate practice in general: the *codification strategy*, which is associated with the understanding of knowledge management in the artefact oriented perspective and the *personification strategy*, which can be related to the process oriented perspective. Even though the two strategies may be presented as alternatives, they are often seen as supplementing each other instead of being mutually exclusive. While the codification strategy is a cornerstone in the bureaucratic organisation, the personification strategy is seen to have its strength in knowledge intensive organisations. As knowledge complexity grows, capturing the context and culture information needed to ensure that knowledge is reusable becomes more difficult (Jennex & Olfman, 2006) and the personification strategy gains more importance. While Hansen et al. (1999) originally claimed that one of the strategies often will have a more prevailing position in the organisation's consciousness, other authors (e.g. Jennex & Olfman, 2006, p. 58) argue that the two strategies may be of equal importance.

Although recent knowledge management researchers favour a combination approach as mentioned above, many find that practice is often grounded in one of the two perspectives (e.g. Christensen & Bukh, 2005; Hoegl & Schulze, 2005; Liebowitz & Megbolughe, 2003; Pretorius & Steyn, 2005). In a case study of knowledge management in a South African Bank, Pretorius & Steyn (2005) find that management of explicit knowledge has the most focus in relation to projects. So while explicit knowledge could be captured in project documentation such as schedules and technical reports when a codification strategy is followed, implicit knowledge is most easily transferred between people.

One reason that a codification strategy seems to be widespread in PBOs could be that project team members are often dispersed organisationally and geographically (Kasvi et al., 2003) thus reducing the possibility of face-to-face communication which otherwise has a positive

effect on implicit knowledge transferring as was concluded by Koskinen et al. (2003). Further, as a project has a limited duration there will be a tendency for people not to get familiar enough with each other to develop the trust necessary for a personification strategy to work (Bresnen et al., 2003; see also Pretorius & Steyn, 2005).

3. The methodology

The practises studied in the companies include activities that are not perceived beforehand as knowledge management initiatives in the two companies. Therefore a case study approach seems appropriate. Such an approach offers the possibility of dealing with a variety of evidence, documents, questionnaires, interviews and observations in a flexible manner (Yin 2003). In the present context this means the opportunity to observe and describe a complicated research phenomenon in a way that allows analytical (Eisenhardt, 1989; Tsoukas, 1989) or analogical (Smaling, 2003) generalisations of the observations.

3.1 Focus on the perception of knowledge

The view of knowledge pervading much research especially from the artefact oriented perspective – but not limited to that – is positivist, i.e., it follows the Platonic view that knowledge is ‘justified true belief’. However, recent knowledge management researchers (e.g. Nonaka & Takeuchi, 1995; Christensen and Bang, 2003; Ajmal and Koskinen, 2008) have initiated a move away from seeing the subject in a static, cognitive relationship to propositions stating facts about the empirical world (see also Jackson & Klobas, 2008).

Following this recent tradition we adopt an approach where knowledge, neither as an object to be managed nor as a research object, is strictly defined beforehand. As the basic idea of simultaneously working with different perspectives on knowledge as presented in the previous section, we let the nature of knowledge be based on the individual’s set of beliefs or mental models used to interpret actions and events in the world. This opens up for different perceptions of knowledge and knowledge management. In an organisation such as Roos & von Krogh’s (1995, p. 1) this is reflected in their statement that “[w]hat you see depends on who you are”, which implies that knowledge should be regarded as a subjective term.

3.2 The data collection

The empirical material includes ten semi-structured interviews, five in each of the two companies. The five respondents in each company held similar positions across the companies. We interviewed the senior executive responsible for the development projects, a project manager, a manager responsible for project methods and two engineers (one who had been with the company for many years and one who had been with the company less than 2 years) actually working on the projects.

The interviews were structured according to the interview guide shown in Figure 1. The overall themes were followed in each interview but the questions listed under each theme were only a tentative list of areas to be covered in the interviews. First, the interviewees were asked to tell about the company’s history. Next, according to the interview guide, they were asked to enter conversation about how knowledge management affects their daily work, how knowledge is created and shared, as well as how they work with different tools (e.g. project models and IT-systems). The interviews lasted approximately 1½ hours on average, and they were taped and transcribed.

A: What is the overall purpose of knowledge management?
Why do you work with knowledge management? What are the expected gains, short and long term?

B: How does the company work with knowledge management?
How are the activities organized? How are project teams formed and how are they organized? How is co-operation in the teams facilitated? What knowledge does the firm acquire, how is knowledge shared, stored and used in daily work? Are any models or frameworks used in the work with knowledge management?

C: How is knowledge created, stored, retrieved, and shared?
What about knowledge in projects and teams? How do you avoid losing knowledge, e.g., when employees leave? How are tasks coordinated? How is the relevant competences brought into projects? How do personal networks affect the work? How are information technologies and systems used? How are experiences from projects collected, stored and reused?

D: How does the project management model function?
How do you actively work with the phases in the model? How does it affect daily practice that you work with gates? Does it make a difference that you use gates and not milestones? What does it mean for the collection, storing and sharing of knowledge? How do you collect knowledge in the evaluation of projects and learn from experience?

E: How are systems and technologies used?
What kinds of systems support your project work? How are these systems used? What kinds of knowledge are stored and retrieved from these systems? How is knowledge organized in order that it can to be retrieved and reused? How do you feel about the technological support for sharing of knowledge? What kinds of communication take place in projects? What form of communication is the most important?

Fig. 1. Interview guide

The interviews at B&O were collected through the period 28-29 August 2003, whereas the interviews at Crisplant were collected almost two years earlier, i.e., they took place in the period 29 October to 12 December 2001. Moreover, documents, reports, and observations were collected. General attitudes will be expressed by the company name, whereas the respondent's function is emphasized where this is of importance in connection with a statement.

3.3 The two companies

Bang & Olufsen (B&O), which is known for its distinguished design and quality, manufactures and sells products to the audio, video and multimedia market. In recent years the company has also increased its revenues from audio systems developed exclusively for automotive manufacturers such as Aston Martin, AMG and Audi. Development of new products is a decisive competitive parameter and Research & Development costs represent more than 9 per cent of the company's revenue. At the time of interviewing, the export share was 83 per cent of the revenue of DKK 3,613 millions (Euro 480 millions), and the B&O group employed approx. 2,700 people. This article only addresses knowledge management in the product development division of B&O.

FKI Logistex Crisplant A/S (Crisplant) develops, produces, and installs solutions within the so-called automatic high-speed transport and sorting systems (ATS) area which forms a substantial part of operations at airports, postal centres, libraries, mail order businesses, distribution centres etc. all over the world. Their systems are developed and implemented in close cooperation, not only with the customer, but also with a number of other companies. These supply various parts of the installation of which the sorting system must be an integrated part. At the time of interviewing, Crisplant had approximately 700 employees and a revenue of DKK 840 millions (Euro 113 millions).

4. Knowledge management in the two companies

The two organisations were chosen because they represent two different types of PBOs both focussing on product development. B&O has organised product development in a department separated from production with products being manufactured at assembly plants and sold as a mass product to customers all over the world. Crisplant develops customer specific solutions in projects more like a construction company with development and installation at the customer site being separate phases of the same project.

Product development as it is undertaken in both companies has traditionally been described a knowledge intensive activity (Meyer & Utterback 1993). Managers, engineers and technicians apply the knowledge they have developed through formal training and from experience. At the same time they enhance their skills and capabilities through the project. Such knowledge-intensive companies are dependent on their employee based knowledge resources. However, neither B&O nor Crisplant have a separate strategy for knowledge management. Instead, the analysis stresses the importance of knowledge management being an integrated part of the companies' processes and management activities embedded within an organizational culture which encourages development, sharing, and anchoring of knowledge.

4.1 Knowledge management in Bang & Olufsen

In the first phases of a development project in B&O, knowledge management is based on personal interactions where employees meet across departments and enter into a dialogue where creative ideas are being conceived and new knowledge generated. Thus, the dissemination of existing knowledge is important in B&O. Further, the company is dependent on tacit knowledge or unique competencies such as employees who have "a pair of good ears", as it was expressed by a project manager, which are able to hear precisely when a loudspeaker or an amplifier sounds correct. Such knowledge is very difficult to transfer and therefore B&O is committed to the fact that this kind of knowledge transfer takes place through close cooperation where competences are disseminated in the organisation.

The development processes are built around the unique knowledge resources of key people in a way that makes it difficult for competitors to imitate B&O's products. To disseminate the specialist knowledge in the interviews, the importance of the availability of these "knowledge keepers" is stressed to the organisation. It must be known who possess specific types of knowledge so that, instead of being a hidden resource, the individual key person becomes an available resource to be relied on all over the organisation. A manager at B&O explains:

We have a culture in the development division where everybody walks around and talks to everybody about the problems they encounter ... when an employee is designing something, the person knows that he needs to go and talk to a specific colleague because the colleague knows something special about this. And then he does so and they have a chat about it. So in most cases there is free and open access to all the knowledge available, you could say, via personal contact.

Consequently, making the implicit explicit will improve the knowledge management of an organisation (Matzkin & Cupcham, 2011). This may be part of the culture (Ajmal and Koskinen, 2008) or enabled by the autonomy that employees are granted by management similarly to what Oshri et al. (2005, p. 16) found in a case study of knowledge transfer in a multiple-project environment. Further, key employees' expert knowledge is made available to the organisation by holding a large number of internal courses at B&O where the employees teach each other.

However, explicit and codifiable knowledge is also applied to a great extent in all development projects. It may both be knowledge which is unique to B&O, and at the same time it may be knowledge which in principle is available on the world market. To capture knowledge, B&O uses the so-called TOP-model, an adopted version of Cooper's (2001) stage gate model, in all development projects. In practice this means that when the first phases of a development project (physical proximity and face-to-face contact) are completed, only a few people from the quality department are responsible for making sure that knowledge is shared both in the individual project and across projects.

In addition to this, B&O has strict documentation requirements during the development projects. This is partly due to the company's ISO-certification and partly due to the internal strategies for knowledge sharing where the possibility to reuse earlier developed elements in future products is seen as important. In this way explicit knowledge becomes a focal point similar to what Tsai (2001) demonstrated in a study where transferring knowledge from one base project to other projects enhanced organisational innovation and performance. B&O thus is very conscious about the importance of documentation. It attempts to extend the documentation activities further so that the company may reuse more knowledge and thus reuse more solutions by building up modular products.

4.2 Knowledge management in crisplant

From development over production to implementation, all project activities in Crisplant are project-organised and run according to Crisplant's Project Management Model (CPMM), which is also an adapted version of a state gate model (cf. Cooper, 2001). Due to the nature of the customer specific solutions, the context is somewhat similar to that of the construction industry where for example Bresnan et al. (2003) emphasise that organisations face substantial obstacles to be overcome in "capturing knowledge and in re-cycling of project based learning that stem from the relatively self-contained, idiosyncratic and finite nature of project tasks" (ibid, p. 158).

Crisplant develops solutions with a high degree of customisation, the individual projects are very different from each other, and the composition of project teams takes place more on the basis of employees' competencies than on the basis of specific technical components which must be included in the project. Thus, knowledge management has to focus specifically on employees, and as a consequence the development, sharing, and anchoring of the accumulated knowledge is an integrated part of the company's way of working. In an interview it was for instance said that: "It is natural for us to live by having knowledge and

trying to give our customers value through a continuous development and creative use of our knowledge”.

Thereby, knowledge management becomes an integrated part of the management activities that influence organisational culture and support the overall main strategic goals. Furthermore a manager at Crisplant says: “Knowledge management is about presenting favourable conditions for the creative process of the individual in cooperation with others and hence set the knowledge resources of the company at play”.

But Crisplant also uses a range of IT-tools for supporting the creation and transfer of knowledge as standardised and codified knowledge collected by the project leaders in progress reports each month.

This is of importance in relation to documenting the experience from the separate development phases. Crisplant is, however, of the opinion that the employees’ implicit knowledge is essential for the company’s progress and growth.

The company is convinced that the informal knowledge sharing taking place daily as “face-to-face” contact is by far of greatest strategic importance. Crisplant’s management thus attempts to make the frames for knowledge sharing and knowledge creation available by focusing on teamwork in the project organisation and by integrating a dialogue-based company culture which cultivates trust norms and shared values by which projects take the character of communities of practice (Brown & Duguid, 1991, 2001).

The manager responsible for organisational development explains that “the day-to-day knowledge sharing and knowledge creation to a wide extent is expressed through the work with CPMM as well as a continuous focus on creativity in all processes”. To improve creativity, Crisplant works intensely with a model internally named the ‘Creative Working Model’ (CWM). This model facilitates the process at all levels, from structuring a project, over the way a certain meeting is structured, to how the individual employees structure their working day.

The CWM consists of five phases. A *seeing phase* which focuses on dialogue about expectations with regard to the final goal and thus which objectives must be obtained to reach the overall goals for the task or project. Following this comes the *idea phase* in which it is established how the objectives and goal should be obtained. The third phase is the *planning phase* which is carried through in interaction with Crisplant’s Project Management Model. When the planning is done, the project participants begin *executing* the plan as the fourth phase, and subsequently, the project group goes into a *seeing again phase* where the course of events is evaluated and the project team learns from its experiences. Additionally, the CWM is accomplished in each of the phases in the CPMM.

4.3 Knowledge management as project management

B&O’s product development division as well as Crisplant are organized as PBOs. Competent, efficient and reliable project implementation is decisive for business success in B&O as well as Crisplant. For several years, both companies have applied a project management model inspired by Cooper’s ‘stage gate model’ (Cooper, 2001).

At Crisplant, the purpose of working with the Stage-Gate model is to establish “a common set of rules for project control, management and execution internally as well as in cooperation with customers, suppliers and other partners” (Crisplant, 1999, p. 4). In the product development division at B&O, the Stage-Gate model has a more direct role as knowledge management tool. Also, the method department continuously adjusts it according to the experiences from different product development projects. At B&O, the

Stage-Gate model thus functions as a dynamic model according to which knowledge is accumulated and later disseminated through the application in the individual projects.

Each phase of the Stage-Gate models ends with a *gate*. In this connection, the project managers of both companies prepare a gate report on the status of the project, both with regard to progress and budget. At the same time, major replacement among employees often takes place in between the individual phases. Therefore a gate also represents a critical point in relation to knowledge management, as knowledge needs to be transferred from one team to another.

With respect to knowledge, B&O has high documentation requirements in all projects, but at the same time, the company is aware of the value of face-to-face knowledge transfer along the way. The Method Manager in B&O expresses it in the following way:

it is not such an explicit transfer taking place at each individual gate. It is not the documentation that ensures knowledge transfer in the projects ... it is only because people talk together and we agree on how things should be that it works ... it is not due to our documentation.

Like B&O, Crisplant is aware that not all types of knowledge can be passed on in written-down documentation, and therefore it works with the CWM-model.

Both companies apply pre-determined checklists which the project manager goes through. On this basis he prepares a phase report after each individual phase of the Stage-Gate model. These phase reports are saved and used for example when the project management tool is being updated at B&O. At the end of a project, a project evaluation meeting is held at both Crisplant and B&O. Here the project's experiences, good as well as bad, are collected in a final report.

5. Knowledge management in perspective(s)

In the following two subsections the project management of the two companies is analysed according to the two epistemological perspectives on knowledge management: the artefact oriented and the process oriented. Hereby, it is illustrated how the presentation and the perception of knowledge management depend on the epistemological starting point.

5.1 Artefact-oriented perspective

As a part of B&O's codification strategy, artefacts in the form of process documentation, product specifications, development documentation etc. are pointed out as essential elements of the knowledge management activities. At Crisplant, such documents also form an important part of the knowledge collecting process which the Managing Director at the time expressed in this way:

"...As we work out a concept proposal and a solution to our customer, we document the thoughts and ideas we have concerning the solution to a specific project. Thus, the knowledge stays in the company so to say - because it has been put down in writing."

From this perspective, knowledge in both companies is about writing and documenting in order to make the company capable of leaning from previous project descriptions etc. when new quotations are given and on the whole when working on the projects. Thus, the project management systems function as a repository for routine solutions where explicit knowledge can be reused (cf. Markus 2001, p. 59). Within the artefact-oriented perspective,

knowledge management thus focuses on the types of knowledge which may be explicated, formalized, and ultimately codified. Project management in the two companies appears to consist of more or less the same components. Although, the continuous update of the stage-gate-model is more important in B&O than in Crisplant, whereas the process based on the basic principles in the model is more important in Crisplant than in B&O.

From a pure artefact oriented perspective having knowledge management such as management control systems, databases, administrative systems etc. ensures knowledge management. At both B&O and Crisplant artefact oriented knowledge management focuses on consistent documentation of development activities via Stage-Gate models, quality management, and data collection. In the artefact oriented perspective less focus is on the context in which knowledge was created because the underlying assumption is that this knowledge can be re-used even though the context in which it was created is less explicit. From this perspective knowledge management looks similar in the two organisations.

5.2 Process oriented perspective

Contrary, from a process-oriented perspective (with emphasis on the SECI model), knowledge management is also apparent in both B&O and Crisplant. This may be illustrated by the fact that the companies, besides anchoring knowledge through progress reports, Stage-Gate models and quality control systems, focus on personal relations. Crisplant has systematized the transfer of knowledge between project phases in the Stage-Gate model. This has been achieved through support from the CWM, and B&O works with mentor arrangements and which creating a dialogue-based culture. By sharing knowledge across the organizations, the companies attempt to internalize employee knowledge.

At Crisplant the process-oriented perspective is predominant in the work with the CWM which structures the processes, ensures the process and becomes instrumental in creating, sharing, and internalizing knowledge. At both B&O and Crisplant, the socialization phase is stressed by attaching importance to physical meetings between project teams. These are utilized to share opinions, values, and knowledge and to obtain a common framework of understanding.

The externalization phase should be understood as the phase where the employees express their ideas. Nonaka et al. (2000) stress that the use of images, metaphors, analogies etc. in this phase may help employees express a point without really being able to explain it. This is exactly what happens in the idea phase of the CWM at Crisplant. When all thoughts and ideas have been aired and placed on the boards, these are combined and reduced in order to make a realistic plan for the development of the project. At B&O the idea phase is not formalized in the same way. The ideas from Crisplant's idea phase and B&O's development department are both incorporated in the companies' Stage-Gate models which structure the development of the projects. This is the equivalent of what takes place in Nonaka's combination phase in the SECI-model.

The internalization phase is the last phase of the SECI-model. In this phase the objective is to embody common guidelines, goals and objectives. In Crisplant this is accomplished in the executing phase of the CWM and the phases in the companies' Stage-Gate model where the products are actually developed and installed at the customers site. Although, our study is based on the development division at B&O, and B&O does not install their products at the customer's site and thereby share knowledge and get feedback from the customers. This

may, however, be done by their retailers. Either way, the experiences gained during the projects are incorporated as far as possible in the stage gate model in order to be available for later project.

5.3 Knowledge management strategies in the two companies

Crisplant's highly customized products are assembled and implemented at the customer's site often in collaboration with the customer and suppliers of subparts causing changing settings from customer to customer and from project to project. This is in agreement with the predominant personification strategy based on CMW, which according to Hansen *et al.* (1999) is the optimal knowledge management strategy for highly customized products.

B&O's knowledge management strategy is not as clear as it involves more elements from both the codification strategy and the personification strategy. In the same way as Crisplant, B&O acknowledges the importance of face-to-face communication, but in B&O it is more a question of making the structures and frameworks available to the organisation, thus leaving it to the initiatives of the employees to communicate when needed. Thus the experiences from B&O is in line with Keegan & Turner (2001) who in a study of learning across projects found that the informal networks within companies are the most important conduit for transferring knowledge between projects (cf. Sense, 2007).

The ideal context of knowledge creation and sharing depends on the type of knowledge. For instance, both B&O and Crisplant find it important that the members of a project team meet physically in the initial phases where the objective is to express thoughts and ideas concerning the project. At B&O, product development begins in a separate organisational unit known as *Idea Land* where a group of designers are seated closely together. Later, in the construction phases physical proximity is not imperative to the same degree.

Following the process oriented perspective both implicit and explicit knowledge and not least the interplay between the two knowledge types are in focus. From a process oriented perspective the second and third phases of the SECI model (Externalization and Combination) differ the most between the two companies, whereas the first and last phases (Socialization and Internationalization) are more similar. In the Externalization phase the employees at Crisplant meet physically and discuss their ideas: At B&O the freedom of the projects are restricted by directions from the designers from *Idea Land*, and the rest of the project members must make their ideas and components fit. In the Combination phase, knowledge management is primarily centred on working with the Stage-Gate models and the use is very different. In B&O the state gate is continuously adapted and used as a knowledge management tool within and between projects, whereas it is primarily used for notification in Crisplant. In the Internalization phase the specific development work is conducted, and contrary to B&O, Crisplant still give priority to physical proximity in the last phase, as Crisplant focuses on a common internalization phase for the group in preference to the individual.

6. Concluding remarks

The analysis illustrates how the understanding of specific project related activities differs depending on the perspective taken in the analysis. In practice, an understanding of different perspectives will give a company a more nuanced picture of the organization,

knowledge, and management, thereby expanding the optics which is used for identification of potentials or problems in relation to the management of knowledge.

In the analysis of the knowledge management activities in Crisplant, the process oriented approach was most prevalent. All activities, from meetings to large projects, were structured according to the CWM model used by the firm. Further, the sharing of knowledge is encouraged by initiatives where the employees are physically located in relation to the projects so as to enable a 'space' for communication.

However, when an organisation is project based, project leaders need to be very attentive and create an atmosphere of trust and care to encourage the project members to share knowledge with each other. Otherwise it may be difficult to perform as a team and achieve the overall goal, keep the budget, the schedule etc. This directs attention to the personification strategy, which is in accordance with Hansen et al. (1999) who emphasize the importance of implicit and human interaction in the development of new products.

Knowledge management in the development division at B&O is not equally clear. This may reflect the fact that the development division acts as an intermediary between the department termed Idea Land, where knowledge management is based on the process oriented perspective, and the rest of the organisation, where knowledge management is more oriented towards the artefact oriented perspective. For instance, this is expressed by the higher priority continuous documentation and updating of the state gate model is given in B&O compared to Crisplant.

As B&O's end products are mass products, they supports Hansen et al.'s (1999) finding that knowledge management in relation to mass produced products is most effectively managed following the codification strategy. However, in the development division and in particular in Idea Land, the knowledge management activities are primarily based on the process-oriented perspective. In practice both tacit or implicit knowledge as well as explicit knowledge seem to be of equal significance in B&O, which means that the company combines the personification and the codification strategy. And the dominating strategy depends on which part of the company is in focus. Generally seen, it also fits the line of thought that B&O's design structure includes a special department, the methods department, to continuously adjust and update the Stage-Gate model enabling all employees to use the experiences gained by colleagues.

The evidence from the two companies does not allow for a statistical generalisation. However, based on analogical generalisation (Smaling, 2003), we suggest that the more standardized solutions a company offers, the more a codification strategy will be effective. This results in a knowledge management strategy which departs directly from the artifact oriented perspective. Further, when a company provides more customized solutions, complexity increases, the process-oriented perspective comes in focus, and the personification strategy is most effective. In both cases the primary strategy should be supported by the secondary strategy.

The two strategies call for different factors to enable successful knowledge management. Several studies (e.g. Ajmal et al., 2010; Bresnen et al., 2003; Lindner & Wald, 2010) have identified various factors which specifically enable or prevent effective knowledge management in projects as they also need to compensate for the lack of organisational routines and organisational memory. Most studies (e.g. Ajmal et al., 2010; Bresnen et al., 2003) are based on a single or a few case studies limiting the generalisability of the results. However, most scholars (Ajmal et al., 2010; Ajmal & Koskinen, 2008; Lindner & Wald, 2010) agree on the factors, only the ranking varies.

Lindner & Wald (2010), for instance, did a cross-industry study based on 414 organisations. They argue that cultural factors are the most important for successful knowledge management as they bridge the various organisational design gaps. This is in line with the process oriented perspective. Further, Lindner & Wald (2010) highlight not only availability to systems – but that the quality and usefulness of the supporting communications systems (ICT) for sharing, storing and retrieving knowledge are essential, and if multi-teaming, the design element is also important. Systems and design support the artefact oriented perspective. However, successful knowledge management depends on balancing the interplay of the two perspectives and thereby also their respective enabling factors.

If differences in epistemological assumptions have to be taken into consideration in managerial practice, this is likely to place heavier demands on the manager. It is no longer sufficient 'only' to act and make decisions. Conscious reflection in relation to own behaviour and acts and the opportunity to take another point of departure involving another decision become part of the decision process. The reflective manager must be familiar with different epistemologies, which is also emphasized by Venzin et al. (1998, p. 36), as this provides a much larger managing scope and ensures a better understanding of the limitations to the various sets of actions. More effective knowledge management may result from adapting management tools that fit the prevailing perception of knowledge. The more the organization focuses on knowledge, the more important it becomes to understand the epistemological implications.

The two perspectives on knowledge management bring different activities and priorities into focus. As was especially evident in the case of B&O, the perceptions of knowledge management and thus also the priorities may differ between different parts of the organisation. In general this has implications for the cross-functional co-operation and multi-teaming in an organisation. In PBOs this may be especially important as employees from different parts of the organisation are brought into the projects (for limited time).

As projects pass through different phases, cf. the stage-gate model, different people may be involved in the projects and the importance attached to different initiatives may differ. We did not follow the life of specific Projects. Consequently we were not able to assess the consequences of the changes in emphasis during projects. Yet, based on the study we expect that managerial awareness of the epistemological differences may improve knowledge management in projects.

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