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## **Knowledge management in projects: insights from two perspectives**

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**Karina Skovvang Christensen\***

School of Economics and Management,  
Aarhus University,  
Building 1322, Bartholins Alle 10,  
DK-8000 Aarhus C, Denmark  
E-mail: kschristensen@econ.au.dk  
\*Corresponding author

**Per Nikolaj Bukh**

Department 3, Aalborg University,  
Fibigerstraede 4, Room 72,  
DK-9220 Aalborg Ø, Denmark  
E-mail: pnb@pnbukh.com

**Abstract:** The article focuses on how managerial options in relation to development and sharing of knowledge in projects can be extended by analysing project management from two different, but complementary, knowledge management perspectives: an artefact-oriented and a process-oriented perspective. Further, the article examines how a similar project management model is used in two different organisations and how its role in knowledge management differs dependent on other knowledge management initiatives and how the production processes are structured. Following the artefact-oriented perspective, the explicit dimension of knowledge can be captured, retrieved and reused using knowledge management systems. From the process-oriented perspective, focus is on the tacit or implicit dimension of knowledge and the context for understanding the information is more important. It is concluded that if a company offers standardised 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 customised solutions.

**Keywords:** knowledge management; knowledge management perspectives; knowledge management strategies; knowledge management studies; KM; project management; case study; knowledge management practice; stage-gate model.

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**Biographical notes:** Karina Skovvang Christensen is an Assistant Professor at the School of Economics and Management, Denmark. She has published a number of articles on knowledge management, innovation management, intrapreneurship and strategy. She teaches organisational behaviour and is currently doing research on motivation and action.

Per Nikolaj Bukh is a Professor at the Department of Business Studies at Aalborg University, Denmark (<http://www.pnbukh.com/>). He has published about 200 articles, book chapters, reports and books on a number of subjects including balanced scorecard, knowledge management, intellectual capital reporting, benchmarking and strategy. In addition to his research activities, he often contributes to postgraduate programmes and conferences.

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## 1 Introduction

Many different researchers have introduced the concept of knowledge in academic discussions within varying fields. Mouritsen et al. (2001) focus for instance on the management of intellectual capital, whereas Prahalad and Hamel (1990) describe the company's strategic work based on core competencies. In other parts of the management literature, both Leonard (1995) and Nonaka (1994) are concerned with knowledge in relation to innovation, whereas Huber (1991) and Lyles and Schwenk (1992) focus on organising of information so that it can be collected, stored and reused in other connections. A common characteristic of these theories is that knowledge is an important factor, which is structured in ways that ensure the applicability of knowledge in accordance with the strategies of the company. However, neither these streams of research nor the knowledge management literature in general agree on what knowledge management is (cf. Firestone, 2008).

In relation to projects and project organisations, the attention to knowledge management as well as the role that social processes, practices and patterns have in effectively managing project knowledge is relatively new as Bresnen et al. (2003) have pointed out. Knowledge is, however, a vital resource in project-based industries and well working knowledge management for instance is essential for improving the utilisation of core capabilities and technological platforms in project organisations and reduce development time in projects (Oshri et al., 2005).

The aim of this article is, on one hand, to demonstrate how an analysis of project management from two different perspectives on knowledge management can extend the managerial palette of options in relation to development and sharing of knowledge in projects and how this awareness might help managers choose the most effective knowledge management tools and facilitate knowledge management activities in general. On the other hand, the aim is to examine how a similar project management model is used in two different organisations and how its role in knowledge management differs dependent on other knowledge management initiatives and how the production processes are structured.

The article is based on a study of knowledge management in two Danish project-based organisations: the development division at Bang & Olufsen (B&O) and FKI Logistex Crisplant. On the surface project management in the two organisations seems similar as it is based on the same basic project management model, i.e., Cooper's (2001) stage-gate model, but when analysing the practices in the two companies using two different knowledge management perspectives – an artefact-oriented and a process-oriented perspective – important differences are found.

The artefact-oriented perspective focuses on the explicit dimension of knowledge where information can be captured, retrieved and reused using knowledge management

systems. The process-oriented perspective focuses on the tacit or implicit dimension of knowledge where the context for understanding the information is more important. This article shows how project management in the two companies is different and how it, together with the differences in the production processes, influences how the involved knowledge resources is managed. In the conclusion, it is suggested that if a company offers standardised 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 customised 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 the following section, 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 analysed 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 the management literature, there is 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. A similar attention to the importance of knowledge, knowledge-based resources and processes as well as the role that social processes, practices and patterns in relation to the management of knowledge in projects and project organisations (Huang and Newell, 2003; Cummings, 2004; Brookes et al., 2006) is, however, a more recent phenomenon as was already emphasised by Bresnen et al. (2003).

This is somewhat surprising as project-based organisations 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 project-based organisations arises from several aspects of the role of knowledge as well as the characteristics of project-based organisations.

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 e.g., 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).

Finally, knowledge is in general a vital resource in project-based industries as Love

et al. (2003) remark and well working knowledge management in project organisations for instance is essential e.g., for establishing a learning project organisation (e.g., Kasvi et al., 2003) and for improving the utilisation of core capabilities and technological platforms and reduce development time in projects (Oshri et al., 2005). Thus, knowledge management in projects and project-based organisations is expected to be of importance.

### 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; Keen and Tan, 2007; Li and Gao, 2003; Meyer and 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 was found by Alavi and Leidner (2001) as well as Jennex and Croasdell (2005), cf. Jennex and Olfman (2006).

The notion of implicit knowledge has often been used to span the two poles (e.g., Keen and Tan, 2007; Li and Gao, 2003; Meyer and 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 and Zander, 1992; Mohamed et al., 2006). When managers as well as researchers discuss knowledge, different perspectives are often taken. The difference often consists in the way in which knowledge is perceived. In other words, the basic epistemologies differ. In this article, the dichotomy of implicit and explicit knowledge will be used, and the distinction is made between artefact-oriented and process-oriented perspectives, which will be outlined in more details below.

The first perspective on knowledge and knowledge management will be termed as 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 in the form of e.g., documents and specific information (e.g., Huber, 1991; Lyles and Schwenk, 1992). From the artefact-oriented perspective, knowledge management focus for instance on project memory (cf. Jennex and Olfman, 2006; Kärreman et al., 2004) and manuals for organisational processes (Malone et al., 1993).

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 restricted view of knowledge expressed by the artefact-oriented perspective emphasising instead that knowledge is situated in social and organisational practices as well as relationships (Tsoukas and Vladimirou, 2001). The problem is not lack of documents, data or access to information. The limitation can rather be found in the quality, content and organisation of the material. This has given rise to the second perspective, which we term as the *process-oriented perspective*.

The process-oriented perspective is most clearly exemplified by Ikujiro Nonaka's research where 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; Nonaka and Takeuchi, 1995]. 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 as 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 and Takeuchi, 1995) which consists of four types of processes, identified by Nonaka and Takeuchi (1995) as central in relation to knowledge management: socialisation, externalisation, combination and internalisation. According to Nonaka and Takeuchi (1995, pp.70–71), the development of organisational knowledge are a continuous and dynamic interaction between implicit and explicit knowledge. Although Nonaka and Takeuchi (1995) use the term 'tacit' knowledge in this article, we will follow Klein's (2008, p.42) suggestion and mainly distinguish explicit and implicit knowledge since Polanyi's (1966) notion of tacit knowledge more implies a kind of knowledge that fundamentally cannot be shared.

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 practices will be perceived as more effective if they match the personal epistemology. In relation to an in-depth study of knowledge management in a project case study in an Australian industrial engineering organisation, Sense (2007, pp.17–18) document 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 to 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 the knowledge intensive organisations. As the knowledge complexity grows, the ability to capture the context and culture information that is needed to ensure that knowledge which is reusable becomes more difficult (Jennex and Olfman, 2006) and the personification strategy gains more importance. While Hansen et al. (1999) originally claimed that often one of the strategies will have a more prevailing position in the organisation's consciousness, other authors [e.g., Jennex and Olfman, (2006), p.58] argued 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 often is grounded in one of the two perspectives (e.g., Hoegl and Schulze, 2005; Liebowitz and Megbolugbe, 2003; Pretorius and Steyn, 2005). In a case study of knowledge management in a South African bank, Pretorius and Steyn (2005) find for instance that management of explicit knowledge has the most focus in relation to projects. 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 project-based organisations 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 have 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 best (Bresnen et al., 2003; see also Pretorius and Steyn, 2005).

### **3 The methodology**

Knowledge is a complex term and the literature does not agree on an exact definition (Firestone, 2008). Further, the practices studied in the companies include activities that are not beforehand perceived as knowledge management initiatives in the two companies. Therefore, a case study approach seems appropriate.

The approach offers an ability to deal with a variety of evidence, documents, questionnaires, interviews and observations in a flexible manner (Yin, 2003), which in this context means an opportunity for observing and describing 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., the Platonic view that knowledge is ‘justified true belief’. However, the more recent knowledge management researchers, e.g., Nonaka and Takeuchi (1995), Von Krogh and Roos (1995), Mouritsen et al. (2001) and others have initiated a move away from seeing the subject at standing in a static, cognitive relationship of certainty to propositions stating facts about the empirical world (see also Jackson and Klobas, 2007).

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 individuals 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 much like Roos and Von Krogh’s (1995, p.1) reflect 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, which means that 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 for less than two years) actually working in the projects.

**Figure 1** Interview guide

<p>A: What is the overall purpose of knowledge management?</p> <p>Why do you work with knowledge management? What are the expected gains, short- and long-term?</p> <p>B: How does the company work with knowledge management?</p> <p>How are the activities organised? How are project teams formed and how are they organised? How is cooperation 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?</p> <p>C: How is knowledge created, stored, retrieved and shared?</p> <p>What about knowledge in projects and teams? How do you avoid losing knowledge, e.g., when employees leave? How are tasks coordinated? How are the relevant competences brought into projects? How do personal networks affect the work? How are information technology and systems used? How are experiences from projects collected, stored and reused?</p> <p>D: How does the project management model function?</p> <p>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 it is 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?</p> <p>E: How are systems and technologies used?</p> <p>What kinds of systems support project work? How are these systems used? What kind of knowledge are stored and retrieved from these systems? How is knowledge organised in order that it can 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?</p>
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The interviews were structured by 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 one and a half hours on average and they were taped and transcribed for later use. The interviews at B&O were collected through in the period 28–29 August 2003, whereas the interviews at Crisplant were collected almost two years earlier, i.e., 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 emphasised where it is of importance in connection with a statement.

### 3.3 *The two companies*

B&O design and manufacture electronic consumer products. The company is known for its distinguished design and quality products within audio and video which are the company's core business areas. Development of new products is a decisive competitive parameter to B&O and is ascribed much attention. At the time of interviewing, the export share was 83% of the revenue of DKK 3,613 million and the B&O group employed approximately 2,700 people. Development costs represent more than 9% of the company's revenue. 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. These systems are developed and implemented in a close cooperation, not only with the customer, but with a number of other companies which supply other 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 million.

## 4 **Knowledge management in the two companies**

The two organisations were chosen because they represent two different types of project-based organisations 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, is often generically described as a knowledge intensive activity (Meyer and Utterback, 1993) where managers, engineers and technicians apply the knowledge they have developed through formal training and over time form experience while at the same time enhancing 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 organisational culture which encourages development, sharing and anchoring of knowledge.

### 4.1 *Knowledge management in B&O*

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 that 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 key persons' unique knowledge resources 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, we sense that in most cases, there is free and open access to all the knowledge available via, you could say, personal contact."

In this situation, the sharing of knowledge is 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, it means that when the first phases of a development project (physical proximity and face-to-face contact) is 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 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, the focus on making knowledge explicit similar to what Tsai (2001) demonstrated in a study where transferring knowledge from one base project to other projects enhances organisational innovation and performance. B&O, thus, appear to be very conscious about the importance of documentation and it is attempted 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*

All project activities in Crisplant are, from development over production to implementation, project-organised and are run according to Crisplant's project management tool, Crisplant project management model (CPMM), which also is an

adopted version of a stage-gate model (cf. Cooper, 2001). Due to the nature of the customer specific solutions, the context is somewhat similar to the construction industry where e.g., Bresnen et al. (2003) emphasise that organisations face substantial obstacles to be overcome in ‘capturing knowledge and in recycling of project-based learning that stem from the relatively self-contained, idiosyncratic and finite nature of project tasks’ [Bresnen et al., (2003), p.158].

Crisplant develops solutions with a high degree of customisation, the individual projects are very different 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 influencing the organisational culture and supporting 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, which is of importance in relation to documenting the experience from the separate development phases. Crisplant is, however, of the opinion that it is the employees’ implicit knowledge which is essential for the company’s progress and growth.

Crisplant 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 that cultivates trust norms and shared values where projects take the character of communities of practice (Brown and 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 named internally as 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 focus on the 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* where 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 CPMM. When the planning is done, the project participants begin *carrying out* the things 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 for the phases in the CPMM.

### 4.3 Knowledge management as project management

B&O's product development division as well as Crisplant are organised as project organisations. 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 (2001) so-called 'stage-gate model'.

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 as it is continuously adjusted by the method department according to the experiences from different product development projects. At B&O, the stage-gate model, thus, functions as a dynamic model where 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, often major replacement among employees takes place in between the individual phases and 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 creation, Crisplant focuses on how knowledge is collected, stored and passed on in each phase of the project through extensive documentation requirements. B&O works with similarly high documentation requirements in its projects. At the same time, at B&O, the awareness of the value of face-to-face knowledge transfer along the way is present; as the method manager in B&O expresses it:

“... it is not such an ‘over the wall’-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 that we agree on how things should look 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, work with the CWM.

Both companies apply predetermined checklists which the project manager goes through, and on that basis, he prepares a phase report after each individual phase of the stage-gate model. These phase reports are saved and used e.g., 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, where 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, 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 an essential element 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 on 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 is thus focused on the types of knowledge which may be explicated, formalised and ultimately codified. Project management in the two companies appear to consist of more or less the same components. From a pure artefact-oriented perspective, knowledge management is ensured by having supporting systems such as budget control systems, databases, administrative systems, etc. The artefact-oriented knowledge management is about consistent documentation of development activities via stage-gate models, quality management, and data collection at both B&O and Crisplant. In the artefact-oriented perspective, there is much less focus on the context in which the knowledge was created, as the underlying assumption is that the knowledge can be reused even though the context in which it was created is less explicit.

### 5.2 *Process-oriented perspective*

Knowledge management seen through a process-oriented perspective (with emphasis on the SECI model) is also apparent in both B&O and Crisplant. It may be illustrated by the fact that the companies, besides anchoring knowledge through process reports, stage-gate models and quality control systems focus on the personal relations. Crisplant uses the CWM to support the transfer of knowledge between project phases in the stage-gate model and B&O works with mentor arrangements and on creating a dialogue-based culture. By sharing knowledge across the organisations, the companies attempt to internalise knowledge into more persons.

At Crisplant, the process-oriented perspective is predominant in the work with the CWM which structures the processes and becomes instrumental for creating, sharing and internalising knowledge. At both B&O and Crisplant, the socialisation phase is also stressed by attaching importance to project teams meeting physically to share opinions, values, and knowledge and to obtain a common framework of understanding.

The externalisation phase should be understood as the process where the employees express their ideas. Here, Nonaka et al. (2000) stress that the use of images, metaphors, analogies, etc. may help the employees to 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, they are combined and reduced in order to make a realistic plan for the development of the project. At B&O, it is not formalised 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 internalisation phase is the last phase of the SECI model where the objective is to embody common guidelines, goals and objectives corresponding to Crisplant's executing phase in their CWM and the phases in the companies' stage-gate models where the products are actually developed and installed at the customers site. In our study at B&O, we only focused on the development division, but experiences gained from the projects are here as far as possible incorporated in the stage-gate model in order to be available for later project.

As knowledge sharing in Crisplant builds mainly on the CWM, the personification strategy is predominant in Crisplant's knowledge management activities. 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 and Turner (2001) who in a study of learning across project 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 a project team meets physically in the initial phases where the objective is to express thoughts and ideas concerning the project. At B&O, the 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 (externalisation and combination) differs the most between the two companies, whereas the first and last phases (socialisation and internationalisation) are more similar. In the externalisation 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 the *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 stage-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 internalisation phase, the specific development work is conducted, and contrary to B&O, Crisplant still gives priority to physical proximity in the last phase, as Crisplant focuses on a common internalisation phase for the group in preference to the individual.

## 6 Concluding remarks

The analysis illustrated how the specific project related activities which were brought into focus in the analyses, i.e., the content of knowledge management, differ, 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 organisation, knowledge and management, thereby, expanding the optics which is used for identification of potentials or any 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, and further, the sharing of knowledge is encouraged by initiatives, where the employees physically are seated in relation to the projects to enable a 'space' for communication. In addition to this, other knowledge management initiatives become visible, e.g., in relation to the collection of data and experiences from the projects, when the departure is the artefact-oriented perspective. All this support the personification strategy, which is in accordance with Hansen et al.'s (1999) statement that customised products are best managed departing in the personification strategy, where implicit and human interaction plays a crucial role.

Knowledge management in the development division at B&O's is not so clear. It may reflect that the development division acts as an intermediary between the 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 documenting and updating of the stage-gate model is given in B&O compared to Crisplant. As B&O's end products are mass products, it supports Hansen et al.'s (1999) finding that knowledge management in relation to mass produced products are most effectively managed based on the codification strategy. However, in the development division, and in particular, the Idea Land, the knowledge management activities are more based on the process-oriented perspective. In practice, both tacit or implicit knowledge as well as explicit knowledge seems to be of equal significance in B&O, which mean that the company combines the personification and codification strategy. And the dominating strategy depends on which part of the company is in focus.

Although evidence from two companies does not allow for a statistical generalisation, we suggest based on analogical generalisation (Smaling, 2003) that the more standardised solutions a company offers, the more a codification strategy will be effective and thereby a knowledge management strategy departing directly in the artefact-oriented perspective or in the process-oriented perspective supported by the artefact-oriented. Further, when a company provides more customised solutions, complexity increases and the process-oriented perspective comes in focus and the personification strategy is most effective.

If significant importance is attached to epistemological assumptions, heavier demands are to a certain extent placed on the manager. It is no longer sufficient 'only' to act and make decisions because conscious reflection in relation to own acts and the opportunity to take another point of departure involving another decision becomes part of the decision process. The reflective manager must be familiar with different epistemologies, as mentioned by Venzin et al. (1998, p.36), as it 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 organisation 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 cooperation in an organisation, and in project-based organisations, this may be especially important as employees from different parts of the organisation are brought into the projects. Further, 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, and consequently, we were not able to assess the consequences of the changes in emphasis during projects, but based on the study, we expect that managerial awareness of the epistemological differences may improve knowledge management in projects.

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