

Interacting with Customers for Knowledge Creation

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Abstract

Our concern is with how interaction with customers affects knowledge creation in product development projects. Customers have a crucial role in stimulating innovation, but previous research has not identified what effects the interaction has on knowledge creation nor at what point in time interaction with customers should be sought. Through case research in high velocity industries we identify the effect customer interaction has on knowledge creation processes inside new product development projects and therefore ultimately innovation. In particular we highlight the effects the interaction has on tacit and explicit knowledge, and the need to acknowledge the difference between the two.

Keywords: *knowledge creation, customer interaction, innovation, organizational slack, case research*

INTRODUCTION

Our concern in this paper is with how interaction with customers affects knowledge creation in new product development projects. Griffin and Hauser (1993) argue that it is necessary build in “the voice of the customer” in the development process to identify, structure, and prioritize the customer needs. As a consequence it has been argued that a development team should have close contact with lead customers (von Hippel, 1986). This contact ensures that the company understands what the users’ needs are and that these are translated into solutions for the customer (Zirger & Maidique, 1990). A complementary view is given by Brown and Eisenhardt (1995) who argue that external communication, e.g. with customers, opens up the project team to new information.

However, it is not exactly clear at what point in time customers should be involved in the product development process, since there are few discus-

sions in the literature concerning the issue of timing (Brown & Eisenhardt, 1997). It has also been argued that customer interaction may reduce the innovation ability in a company through hampering the knowledge creation process (Richtnér & Åhlström, 2006). Furthermore, Christensen (1997) argues that there is an inherent tension between customer focus and innovation, where being too customer-focused may hamper disruptive innovation.

The purpose of this paper is to identify how interaction with customers affects knowledge creation in new product development. Knowledge creation has been shown to be a prerequisite for innovation (Leonard, 1995; Nonaka & Takeuchi, 1995; Schulze & Hoegl, 2006a), hence studying the link between customer interaction and knowledge creation can lead to insights regarding innovation ability (Goffin & Koners, 2011; Nonaka & von Krogh, 2009; Schulze & Hoegl, 2006b, 2008). In particular our study complements Bonner’s (2005), and Schulze & Hoegl’s (2006a) studies on the effect of customer

interaction on knowledge creation and product development performance.

The paper is organized as follows. First the literature on customer interaction and knowledge creation is reviewed. Next we describe how data were collected and analyzed. Based on our empirical findings we draw more general conclusions on the effect customer interaction has on knowledge creation. The paper concludes with a discussion on managerial implications and directions for future research.

THEORETICAL REVIEW

Customer interaction

The importance of interacting with customers and being market-oriented are stressed by both practitioners and researchers, and several different mechanisms exist to enhance customer interaction and to identify customer needs (for a review see Goffin & Mitchell, 2005). A complementary view is given by Bonner (2005) who discusses how formal controls, in particular output, process, and team rewards, can be used to influence the degree of customer interaction during a product development project. The main conclusion is that using team rewards and output controls leads to higher customer interaction. Similarly Brown and Eisenhardt (1995) argue that new information is given to the project team through external communication with outsiders. Once the strategic direction and scope of a product development project is set it is necessary to develop mechanisms such as phase-gate processes, to monitor the progress of the product development project (Wheelwright & Clark, 1992) or use different methods to support the involvement of customers in different ways (e.g. lead-user analysis, QFD) (Kaulio, 1998). An underlying assumption in this view of the product development project is that the development process is a relatively static process which can be controlled through formal measures (Jaworski, 1988).

Yet, concerns have been raised that it is not enough to focus on formal controls as product development is a process characterized by much uncertainty, making the process difficult to predict. Particularly difficult is deciding on when to involve customers in the process and there are few studies

concerned with the issue of timing (Brown & Eisenhardt, 1997). Interacting with customers is a learning process (Richtnér & Åhlström, 2006), and is more than only a means to create explicit knowledge through passive acquisition of customer input via feedback on specific issues. Customer interaction can thus be seen as a socially-oriented process, instead of being solely task-oriented, if (break-through) innovation is sought (Mascitelli, 2000).

As we are concerned with customer interaction existing during a project, we have chosen to focus on knowledge creation instead of innovation. A focus on knowledge creation allows us to study new product development processes as they unfold, which facilitates determining cause and effect (Leonard-Barton, 1990). A strict focus on innovation would require the project to have finished, since innovation is measured through variables such as patents and project success (Tidd, Bessant, & Pavitt, 2001, p. 376-377).

Knowledge management and knowledge creation

The literature on knowledge management is fragmented, but tends to converge in the identification of two distinct kinds of knowledge; "explicit" and "tacit" knowledge (Gourlay, 2006). Tacit and explicit knowledge are mutually complementary entities, which interact with and interchange into each other. Through a "social conversation" process, tacit and explicit knowledge expand in terms of both quality and quantity. Lam (2000, pp. 490-491) argues that the innovative capability of an organization is dependent upon the organization's ability to create knowledge, which in turn involves: (1) the use and generation of tacit knowledge, and (2) the ability of an organization to mobilize tacit knowledge and foster its interaction with explicit knowledge.

The literature also distinguishes between different levels of analysis (cf. Venzin, von Krogh, & Roos, 1998), from macro-level knowledge-based theories of the firm to micro-level treatments of organizational knowledge. In between the macro and the micro level of analysis lies the perspective on knowledge we have chosen, where studies focus on how knowledge is created in projects within the company (Inkpen & Dinur, 1998). This knowledge creation influences the knowledge in the organiza-

Table 1: Knowledge conversion modes

Socialization	Externalization	Combination	Internalization
The sharing of experiences through observation, imitation and practice, thereby creating tacit knowledge such as shared mental models and technical skills.	The process of articulating tacit knowledge to explicit concepts, is triggered by a dialogue among employees using metaphors, concepts or models to generate an understanding of what is going to be developed.	Combining different kinds of explicit knowledge. Through adding, sorting and re-categorizing explicit knowledge new knowledge is developed.	Embodying explicit knowledge into tacit knowledge, occurs as different employees share mental models and technical know-how, cf. "learning by doing". For explicit knowledge to be turned into tacit it is often helpful if the knowledge is verbalized into manuals, oral stories or documents.

tion and ultimately affects innovation. Our expectation is that as there is a change in the interaction with customers tacit and explicit knowledge is affected.

Following the pioneering work by Nonaka (1994; Nonaka & Takeuchi, 1995), we conceptualise knowledge creation as the ability to share and transfer knowledge among employees in the organization (cf. Crossan, Lane, & White, 1999). The process of creating knowledge takes place in the continuous and dynamic interplay between tacit and explicit knowledge, which involves four different patterns of interaction (see table 1): *socialization* (tacit to tacit), *externalization* (tacit to explicit), *combination* (explicit to explicit), and *internalization* (explicit to tacit). These patterns of interaction are a representation of the ways that existing knowledge may be transformed into new knowledge (Nonaka, 1994; Nonaka & Takeuchi, 1995).

Organizational knowledge is created in the continuous and dynamic interplay between tacit and explicit knowledge, which occurs when there is a shift between the four modes of knowledge conversion. Schulze & Hoegl (2006a) identified that there are different effects on the four knowledge conversion modes depending on phase in the product development process. Particularly, Schulze & Hoegl point out the risks of not acknowledging the benefits of using the "right" knowledge creation modes in a certain project phase, which may be due to habit, reward systems, etc. The result of not paying attention can be a poor project performance (in terms of budget and time). However, Schulze & Hoegl do not comment at all on the interplay with customers in the development process, and they explicitly

make calls for studies investigating knowledge creation in regards to customers and their involvement. In our paper we answer this call.

RESEARCH METHODOLOGY

Due to the relative lack of studies on the topic our research utilizes the case study methodology – a methodology that allows us to investigate the phenomenon of interest in depth.

Sample selection and case selection

We chose to conduct our study in one industry, being the high-velocity industry. The reason for choosing one specific industry to focus upon was to isolate the effects of strategic context and other potentially confounding factors (cf. Sousa & Voss, 2001). To select the relevant population, theoretical sampling was used to find cases that can be expected to replicate or extend emergent theory (Eisenhardt, 1989, pp. 536-537), assuring the cases are not chosen randomly. The reference population (companies) in this study is not equal to being a case (product development projects) (Voss, Tsikriktsis, & Frohlich, 2002). As a result it is possible to have more than one case inside one company. Specifying a research population by using different sampling criteria reduces extraneous variations and relates the findings to a specific well-defined domain (Laverty, 1996). Four different criteria were used: 1) listed companies, 2) clockspeed, 3) existence of R&D, 4) and finally, number of employees. The sampling criteria are summarized in table 2 below.

After considering the four sampling criteria the reference population included seven compa-

Table 2: Sampling criteria used to identify the reference population and the resulting number of companies.

Criterion	Description	Number
1. Listed	Listed companies on a northern European country stock exchange.	379
2. High-velocity industries	Information Technology, Telecommunication and Media and Entertainment, following standard classifications.	119
3. R&D	Companies that have entered an amount for their R&D expenses in their income statement (excludes companies that have included their R&D cost in employee expenses).	30
4. Employees	Companies with 1 000 employees or more have been included.	7

nies. Only four companies were contacted to avoid basing the research on competing companies and two agreed to participate in the study: henceforth called Communication Ltd. and Support Inc. Within the two companies, we studied six product development projects (two at Communication Ltd., and four at Support Inc.), or cases, based on our unit of analysis.

Data sources and collection of data

An initial semi-structured interview was conducted with the V.P. of Technology in both companies, identifying its strategy, major competitors, importance of R&D, and suitable R&D projects to study. The chosen projects were of polar types (Pettigrew, 1990) in terms of being platform or derivative projects. We thus chose six on-going projects, meaning that by the time we initiated the study the projects' outcome was uncertain. Next we conducted 30 interviews with senior R&D managers, project managers and project members. Some of the interviewees held multiple roles and no primary role could be identified, meaning that the number of roles exceeded the number of interviews. Each interview ranged from 1 hour to 2½ hours, typically lasting 2 hours. To guide our questions during the interviews, we used a case study protocol including questions on customer interaction and knowledge creation. We conducted the interviews at different points in time over a period of 1½ years.

In addition to interviews, we continuously reviewed information about the companies in the business press and official company documents (e.g. annual reports and company websites), before, during and after the study to gain an understanding of the companies' context. We had access to documents concerning the projects, giving an additional

and complementary view of the development of the projects. We cross-checked the information given in the interviews with the information found in the documents where possible, to achieve triangulation and so enhance the confidence in the findings (Eisenhardt, 1989; Jick, 1979).

Below we briefly present the two companies and six product development projects we studied. Communication Ltd. is a global company in the telecommunication technology industry that has moved from developing and producing single products to offering more complex compound products (Processor and System project). Support Inc. is a global software company developing and producing various types of software-based products (Component, Integration, Message and Java project).

Data analysis

We built our analysis on Glaser and Strauss's (Glaser & Strauss, 1967) constant comparative method, which implies having a continuous and interactive process in which there is interplay between data and theory throughout the process. The outcome of the analytical process is to identify themes helping us to identify how interaction with customers affects knowledge creation in new product development.

The preliminary stage of analysis consisted of data reduction (Miles & Huberman, 1994, p. 10). As the interviews were conducted we developed case write-ups (Voss et al., 2002) for each of the six cases respectively containing both primary data, from the interviews, and secondary data. The case write-ups enabled us to not only see unique patterns, through becoming intimately familiar with each case (Eisenhardt, 1989), but also to see infor-

Table 3: Summary of the six studied projects

Characteristic	Processor project	System Project	Component project	Integration project	Message project	Java project
Company	Communication Ltd.	Communication Ltd.	Support Inc.	Support Inc.	Support Inc.	Support Inc.
Product (Platform or derivative)	Derivative , upgrading a previous product	Platform , a totally new product for the whole organization	Platform , developing a tool for enterprise application systems	Platform , developing a tool for enterprise application systems	Platform , developing a new product for enterprise application systems	Derivative , changing the code base in an existing product
Duration	About 1 year	About 2 years	About 1½ years	About 2 years	About 1½ years	About ½ years
Customers	External , the goal was to make a standard product and then get customer specific input	External , the goal was to make a standard product and then get customer specific input	Internal , tool for enterprise application systems	Internal , tool for enterprise application systems	External , component in enterprise application for new and existing customers	External , change the code base of an existing product
Outcome	Failure , did not reach market	Failure , did not reach market	Semi-successful , reached market late	Successful , did reach market	Successful , did reach market	Semi-successful , reached market, on time, but with many errors

mation on the same theme from different cases (data triangulation) (Jick, 1979; Yin, 1994, pp. 91-93).

The first step in the data analysis was to reduce data into categories (Miles & Huberman, 1994), to find patterns in respondents' answers, using three sets of research variables: (1) customer interaction, (2) knowledge creation, and (3) innovation and (expected) outcome, complemented with information about the respondent and company information. Second, using the case protocols as a basis, a more careful analysis was made concerning knowledge creation. In the case protocols we began, where possible, to code (manually using a pen) each of the knowledge conversion modes following the operationalizations developed by Nonaka et al 1994. Third, we used Excel as our main coding-tool to identify how customer interaction affected knowledge creation. The following two questions guided the analysis: 1) Was there any changes in the interaction with the customers? If yes, then 2) How did the interaction influence the knowledge conversion modes (socialization, externalization, combination, internalization)?

In the fourth step of the analysis process, we performed cross-case analysis and searched for patterns that cut across the six cases, to help us go beyond the initial impressions (Eisenhardt, 1989). In the fifth and final step of the analysis, we returned to the original model by Nonaka (1994; Nonaka & Takeuchi, 1995) and the description of each of the knowledge conversion modes and compared these descriptions to the case protocols to cross-check our findings. The purpose of the highly iterative fifth step was to help increase the general nature of the findings and to help explain them (cf. Eisenhardt, 1989). Here we also compared and examined if there were similarities or differences between the projects depending upon their characteristics, and we examined the following characteristics: 1) type of customer (internal vs. external), 2) type of project (derivative or platform), 3) hardware vs. software, 4) duration of the projects (less than one year, over one year). It turned out that regardless of the projects' characteristics no differences could be identified among the projects.

Table 4: The nature of customer interaction in the six projects

	System	Processor	Component	Integration	Message	Java
The interaction with customers	Little throughout the project.	Little throughout the project.	Initially little, then increased, to be reduced again in the end.	Initially little, somewhat increased towards the end.	Fairly much throughout the project.	Much throughout the project.

CHANGES IN CUSTOMER INTERACTION IN THE STUDIED PROJECTS

To illustrate how the nature of changes in customer interaction in the projects throughout their life cycles, we develop below the main findings from the case in this respect, summarized in table 4. Due to space limitations we have used the Processor and the Message projects as illustrations to illustrate table 4 in more detail.

Customer interaction in the Processor project

Initially the Processor project was given large freedom to develop a standard prototype, which could be offered to a wide range of customers, and there was no interaction with customers during this initial phase, or follow-ups from top management; the only restriction was on the product's performance. Around halfway into the project a customer was signed and the project was pushed to deliver a customer-specific product. During this phase the initial freedom in the project was reduced. The interaction with the customer can be characterized as the customer coming with very strict specifications of what the product should look like and consist of. Although this did speed up the development process, project members had few possibilities to interact and experiment. However, for various reasons the customer decided to cancel the contract and the Processor project once again was faced with developing a standard prototype.

Customer interaction in the Message project

The Message project almost immediately had an internal customer at Support Inc. During this initial phase there were formal follow-ups every second week where goals and timeframes for different activities were discussed. Shortly into the project an external pilot customer was signed and after inten-

sive work the product was successfully implemented. The next challenge for the project was to develop a general product to be offered to more customers. In order to accomplish that the Message project group sat down and discussed and evaluated different solutions – and managed to identify critical issues. As the end of the project when work together with customers became more intensive there was no time available to wait for formal feedback and monthly reviews. Instead there was a constant flow of input and output.

EFFECTS OF CUSTOMER INTERACTION ON KNOWLEDGE CREATION

The aim of this paper is to identify how customer interaction affects knowledge creation in new product development projects. It is clear that customers had an important effect on knowledge creation, through their interaction over time with the studied projects.

The effect of customer interaction on socialization

Customer interaction had a positive effect on the process of socialization through pushing the projects to, together with customers, share experiences concerning the development of the product and what should be included in the product. This underline the benefits of customer involvement in product development (von Hippel, 1986). For instance, the Component project worked with a pilot customer and were given knowledge and input, facilitating the development of the product. The customer demands on the product also meant the Component project had to get in touch with other projects and people within the organization – further facilitating the sharing of experiences.

However, customer interaction also had a negative effect on the process of socialization, through creating time pressure and a focus on details, as the

Message project illustrates. As the interaction with the customer increased there was no time for members of the Message project to interact and as a result the remaining project members became focused on developing their own specific part – which hampered the process of socialization. As a result, the overall understanding of what the end product was supposed to do declined among the project members.

The effect of customer interaction on externalization

Customer interaction had a positive effect on externalization, through allowing for the projects to develop their own metaphor of what the project should do. It should be noted though, that this evidence was not particularly strong. The System project illustrates this effect. At the outset the project members tried to understand what the rather vague specifications given by top management meant, since management were the project's initial customer. The members in the project discussed the general solution, but not specific details, indicating the use of metaphors.

Customer interaction had a negative effect on the process of externalization through the emphasis on the delivery of products. The reason is that customers focused on the more explicit details of the projects, instead of the vagueness of a concept, which is often the result of the use of a metaphor. There was no time for dialogues among the members of a project and customers about the product being developed, e.g. what is the benefits of this product, etc. For instance, when a customer was signed to the Processor project the customer changed and began deciding the overall goal and what the end product should do and look like, not allowing for the members of the project to engage in a dialogue around the creation of a concept. The benefit was that deliveries and deadlines became much clearer. However, the project members experienced the lack of opportunities for dialogue in concept creation and about the concept as negative.

The effect of customer interaction on combination

Customer interaction had a positive effect on the process of combination through creating a focus on

the explicit details of the project, such as prototypes, deadlines and product specifications. The result was that customers focused on the prototypes being developed in the projects, the ability to meet deadlines in the projects or any other explicit development of the product. For instance, in the Processor project the customer emphasized the need for developing the product. The consequence was that the project members tried to combine their experiences through various meetings and the development of documents, facilitating the combination process.

The negative effect of customer integration on the process of combination was that it did not allow for the project members to transmit newly created concepts to other parts of the organization. In the Message project there was solely a focus on deliveries and reaching stipulated deadlines, and less attention was given to spreading the knowledge developed in the project to the rest of the organization, hampering the process of combination.

The effect of customer interaction on internalization

Customer interaction was positively related to the process of internalization in the projects studied. When the projects interacted with customers it triggered the project members to understand the whole product, i.e. sharing technical know-how, which facilitated the internalization process. When the customer was signed to the Processor project its members strived to reduce the ambiguity in the project, by having more detailed feedback from the users of the product. Similarly, by getting detailed feedback it became easier for the members of the Message project to share technical know-how as the feedback forced the work to focus on the benefits from a customer's point of view, which is important in the internalization process. No negative effects from customer interaction on the process or internalization could be identified.

DISCUSSION

Our findings indicate that interaction with customers affects knowledge creation in product development projects in different ways. For a summary see table 5. It is important here to note that we are not concerned with the content of the information

Table 5: Summary of findings regarding the effects of customer interaction on knowledge conversion

	Positive effect	Negative effect
Socialization	Push to get in touch with potential customers enabled experience sharing.	Time pressure hampered the interaction among project members.
Externalization		Focus on explicit details instead of the vagueness of a concept and no time for dialogues among project members.
Combination	A focus on getting a product on the market created a focus on explicit details such as prototypes and presentations.	Did not allow the project members to transmit newly created concepts to other parts of the organization.
Internalization	Interventions regarding deadlines and prototype development triggered project members to understand the whole product.	

being exchanged in the interaction with customers. Thus, we are not attempting to determine the effect the information being exchanged had on the actual solution being developed. What we are concerned with is the effect customer interaction had on the knowledge development processes.

Even though positive and negative effects of customer interaction can be identified in the knowledge conversion modes, some were more pronounced. In particular there is a tendency that customers focus on explicit knowledge as they interact with product development projects. This implies that the knowledge conversion mode *combination* is positively affected through more meetings and follow-ups on tangible issues such as deadlines, relationships and discussions with customers, prototypes, and to a lesser extent, visions and the development of a mutual understanding of what the projects should do in the projects.

Yet, customer interaction had in particular a negative effect on the *socialization*, and the *externalization*, but also the *combination* modes. This is because customer interaction emphasized project goals with little ambiguity, and wanted to reduce uncertainties. To summarize, as product development projects interact with customers there is an emphasis on the explicit knowledge in the projects.

Compare these findings with Nonaka and Takeuchi (1995, p. 66) who emphasize that the use of figurative language and imagination is the key to bringing out the tacit knowledge of project members. In our study interaction with customers made it more difficult for the projects to bring out their

tacit knowledge. This is because few possibilities are given to the projects to have a dialogue (*externalization*) using a figurative language, or interact in the projects to share experiences and technical skills (*socialization*) in order to create the vision.

Thus, the processes of socialization and externalization are hampered by customer interaction. According to Nonaka and colleagues (1994; Nonaka & Takeuchi, 1995) it is of crucial importance to have an interplay between tacit and explicit knowledge in order for knowledge to be created. Customer interaction seems to reduce the possibilities for a project to focus on tacit knowledge, hampering the ability to create knowledge and ultimately innovation. Our findings from examining how customer interaction influences the knowledge creation process are similar to Schulze & Hoegl (2006a) in their study of knowledge creation in different phases of product development projects. Similar to the findings of our study they argue that it is important to distinguish between concept (early) phases and development (late) phases in product development processes, where the former benefits from much activity fostering socialization, and later phases should have more combination.

CONCLUSIONS AND FURTHER RESEARCH

The main implication of our findings is that customer interaction within a product development project influences the creation of knowledge in different ways. In particular we identify that customers focus on explicit knowledge, and not tacit knowledge, which may reduce the ability for knowledge creation and ultimately innovation. Thus, on

an overall level, our findings relate to the view that the challenge for companies and top management is to balance order and disorder, and constantly be adaptive (e.g. Eisenhardt & Tabrizi, 1995; Jelinek & Bird Schoonhoven, 1990).

More specifically our study shows that it is not enough to have customer interaction in order to have a certain outcome in knowledge creation and ultimately innovation. Considerations must be taken to the needs of the individual product development project, since customer interaction has different influences on the knowledge conversion modes. The knowledge conversion modes in turn affect the creation of knowledge and the company's innovative ability. In particular, it is important to acknowledge that as customers enter a project it is often equated with demands on formal procedures and explicit knowledge.

The advice, or perhaps challenge for managers, is to know when to interact with customers, when not to, and what type of relationship is to prefer. Input from customers into product development projects clearly has a number of benefits, we are not arguing with that. However, our results indicate that customer interaction in the early phases of a project can have adverse effects on knowledge creation, since it is often important during this phase to facilitate the process of knowledge creation and bringing out the tacit knowledge from the project and its members. In later phases of the project, where there are demands for results, customer interaction can have a positive influence on the project, since the emphasis is on reducing project ambiguity and uncertainties to have a focus on explicit knowledge.

As with all research, ours is not without limitations. More research is clearly needed in order to validate our findings. The limitations stem from several categories. We chose to conduct our research in the information technology and telecommunication industry. More research is needed to examine if there is a difference when it comes to customer interaction depending upon the type of interaction. Could it be so that early interaction with customers who seek clarity and specificity can hurt as shown above, but early exposure and interaction with customers to understand not the specifics but the big picture can in fact be positive? In

such a way the projects get ideas of where to energize their creativity but not being constrained in their thinking. Examining this question could either be done through case studies, but perhaps the best opportunities lie in doing survey-type research.

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