

# ENHANCING PRODUCT DEVELOPMENT THROUGH ICT-BASED RELATIONSHIPS WITH CUSTOMERS AND CONSUMERS

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## Abstract

*An important source for a firm's competitive advantage is its external knowledge-related relationships. Absorptive capability is a firm's ability to recognize the value of new, external information, assimilate it, and apply it to commercial ends. It pertains to knowledge creation and utilization that enhances a firm's ability to gain and sustain a competitive advantage. Four capabilities compose a firm's absorptive capacity: acquisition, assimilation, transformation, and exploitation. This paper focuses acquisition, which is a firm's capability to identify and acquire external information and knowledge. Information and communication technologies (ICT) and Knowledge Management Systems (KMS) can play an important role in inter-organizational knowledge processes and flows. The paper discusses how ICT and KMS can be used to enhance knowledge acquisition. The core business process used for illustration is (new) product development.*

*Keywords: Absorptive capacity, knowledge management, ICT, product development, innovation, dynamic capability,*

## **1 INTRODUCTION**

Knowledge is displacing natural resources, capital, and labor as the basic economic resource (Drucker 1995) and it is argued that firms' competitive advantages flow from their unique knowledge and knowledge management (KM) processes (Barney 1991, Boisot 1998, Spender 1996, Nonaka & Teece 2001). Some scholars even state that the only sustainable competitive advantage in the future will be effective and efficient organizational knowledge management (Wikström & Normann 1994, Nonaka & Takeuchi 1995, von Krogh et al. 2000).

The interest in organizational knowledge has prompted the issue of how to manage knowledge to a firm's benefit and to the use of information and communication technologies (ICT) and Knowledge Management Systems (KMS) for managing knowledge. Generally, knowledge management (KM) refers to identifying and leveraging the individual and collective knowledge in a firm to support the firm in becoming more competitive (Davenport & Prusak 1998, O'Dell & Grayson 1998, Cross & Baird 2000, Baird & Henderson 2001). Research suggests that an important source for competitive advantage lies in firms' external relationships (Gulati et al. 2000). For many firms a critical dynamic capability is the firms' absorptive capacity: the ability to "...recognize the value of new, external information, assimilate it, and apply it to commercial ends." (Cohen & Levinthal 1990).

We have some answers to the question: "Why do firms invest and engage in KM," but we have fewer answers to the question: "How can firms enhance their absorptive capacity through the use of ICT" The paper addresses the latter question. We acknowledge that other means for firms to acquire knowledge-assets exist, for example, through intra-organizational processes and by buying or renting knowledge assets (Davenport & Prusak 1998). We focus primarily on "designed" knowledge related processes. Knowledge can of course also be created, integrated, and shared in informal and naturally emerging channels, relationships, and processes. The remainder of the paper is organized as follows: the next section sets the scene by briefly discussing knowledge, KM, and KMS. Next we present a current view on absorptive capacity as a dynamic capability. This is followed by a presentation and discussion of the use of ICT and KMS to enhance absorptive capacity. We will primarily focus on knowledge acquisition, that is, how ICT can be used by a firm to identify and acquire externally information and knowledge that is critical to its operations. The core business process chosen for illustration is (new) product development. The decision is, in part, based on Nonaka's argument: "When markets shift, technologies proliferate, competitors multiply, and/or products become obsolete almost overnight, successful companies are those that constantly create new knowledge, disseminate it widely throughout the organization, and quickly embody it in new technologies and products." (Nonaka 1991). The final section presents conclusions and suggests further research.

## **2 KNOWLEDGE, KM AND KMS**

Numerous knowledge views and definitions are discussed in the information systems (IS), strategy, management, and organization theory literature as well as in the philosophy and philosophy of science literature (Blackler 1995, Sparrow 1998). These different views and definitions lead to different conceptualizations of knowledge management and on the roles of ICT/KMS in knowledge management (Carlsson et al. 1996, Alavi & Leidner 2001). Our starting point is "knowledge as resource". This is in accordance with the resource-based view (RBV) of the firm. The main reason for this choice is that this view can be used to address the links between knowledge, knowledge management, and firm performance. There is a debate about what "knowledge as resource" means. One strand argues that "knowledge as resource" focuses on knowledge per se, meaning that knowledge is something that can be transferred, recombined, licensed, codified and put into a computer-based knowledge repository, and used to create value to a firm. Another strand argues that it is not knowledge per se that should be in focus, but "knowing". This means an emphasis on the context where knowledge is created, shared, integrated and put to use. The latter view has primarily a

process and flow view, while the former has primarily an object view. The view taken here is the process and flow view, which means that the design and structuring of knowledge processes and flows form the basis for achieving competitive advantage. Hence, our focus is a firm's ability to through inter-organizational relationship-based knowledge processes and flows create new knowledge and to share and employ existing knowledge to solve problems, make decisions, and take actions.

We refer to knowledge management (KM) as a capability pertaining to knowledge creation, knowledge organization and storage/retrieval, knowledge transfer, and knowledge applications which enhances a firm's ability to gain and sustain a competitive advantage (Pentland 1995, Davenport & Prusak 1998, Boisot 1998).

Knowledge management systems (KMS) refer to a class of information systems applied to managing individual and organizational knowledge processes and flows. They are ICT-based systems developed and used to support and enhance the organizational processes of knowledge creation, storage/retrieval, transfer, and application. While not all KM initiatives involve the use of ICT and KMS, and warnings against an emphasis on the use of ICT/KMS for KM are not uncommon (Davenport & Prusak 1998, O'Dell & Grayson 1998, McDermott 1999, Swan et al. 1999, Walsham 2001), many KM-initiatives rely on ICT and KMS as important enablers. We acknowledge the warnings against a heavy emphasis on the use of ICT and KMS, but this paper focus on how ICT and KMS can be used to support and enhance inter-organizational relationships. For the relationships we will discuss, ICT and KMS can be a necessary, but not sufficient, condition for effective and efficient knowledge management.

### **3 KM IN RELATIONSHIPS WITH CUSTOMERS AND CONSUMERS**

Using existing theories, this section presents our view of knowledge management within the context of inter-organizational relationships. Our starting point is in business strategy theory, and specifically the resource-based view (RBV) of the firm. The main proposition of the RBV is that competitive advantage is based on valuable and unique internal resources and capabilities that are costly to imitate for competitors (Barney 1991, Wernerfelt 1984). Resources are assets available in the firm or which the firm can acquire. Capabilities are developed by combining and using resources; these resources can be capabilities. The knowledge-based view of the firm states that these resources and capabilities are knowledge-related and knowledge-intensive resources and capabilities (Grant 1996, 1997). A number of questions can be raised in relation to this view. First, what sources can be used to create, acquire, and integrate knowledge in knowledge-intensive processes, for example, in new product development (NPD) processes? Second, how can knowledge-intensive processes be designed in the first place, how can the processes be redesigned and adapted to changing technological and market conditions, and what resources and capabilities can be used to design the processes?

An answer to the first question can be found in the research suggesting that an important source for competitive advantage lies in a firm's external relationships (Gulati et al. 2000, Nohria & Ghoshal 1997, Kale et al. 2001). The RBV argues that competitive advantage is an outcome of resources and capabilities residing within the firm, but these capabilities can be "directed" towards the environment of the firm. For example, a critical capability in an NPD process can be to use the Internet to communicate with customers to fast incorporate new or changed customer preferences in new products. If the firm is able to exercise this capability faster than its competitors it can give the firm a competitive advantage. Support for that capabilities can be "directed" towards the firm's environment, can be found in the literature discussing how the RBV can be "extended" to inter-organizational relationships (Eisenhardt & Schoonhoven 1996, Choudhury & Xia 1999).

An answer to the second question can be found in the discussion on the RBV, absorptive capacity, and dynamic capabilities. Most RBV-writings focus on stable rents that are costly, or impossible, to imitate. Some writers have addressed the dynamic nature of resources (Tece et al. 1997, Eisenhardt & Martin 2000). From a KM-perspective this points to the importance of dynamic aspects of knowledge processes. Teece et al. (1997) point out that the RBV recognizes, but does not attempt to explain the

mechanisms that enable a firm to sustain its competitive advantage. According to Cohen and Levinthal (1990), a firm's "absorptive capacity" is critical to its innovative capacity and competitive position. Absorptive capacity is a firm's ability to "...recognize the value of new, external information, assimilate it, and apply it to commercial ends." (Cohen & Levinthal, 1990). Recently, Zahra and George (2002a, 2002b) proposed a reconceptualization of absorptive capacity as a dynamic capability "...pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain a competitive advantage." (Zahra & George 2002a). Zahra and George (2002a) argue that four distinct but complementary capabilities compose a firm's absorptive capacity: acquisition, assimilation, transformation, and exploitation. Acquisition is a firm's capability to identify and acquire external information and knowledge that is critical to its operations. A firm's routines and processes allowing the firm to process, analyze, interpret and understand the information and knowledge from external sources is referred to as assimilation. Transformation is a firm's capability to design and redesign the routines that facilitate combining existing knowledge and the newly acquired and assimilated knowledge. Exploitation capability "... is based on the routines that allow firms to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired and transformed knowledge into its operations." (Zahra & George 2002a). The primary emphasis is on the routines that allow firms to exploit knowledge. An important distinction is made between potential absorptive capacity and realized absorptive capacity (Zahra & George 2002a). The former makes a firm receptive to acquiring and assimilating external information and knowledge and the latter reflects a firm's capacity to leverage the knowledge which has been acquired. Hence, the literature suggests that for innovative firms a crucial capability is the ability to recognize new external information and knowledge and through processes apply it to commercial ends. The dynamic capability and absorptive capacity views suggest that profits not just flow from the assets structure of the firm and the degree of imitability, but also from the firm's ability to reconfigure and transform. This ability is especially critical for firms in turbulent and high-velocity environments (Eisenhardt & Martin 2000).

The above points to two main uses of ICT and KMS in inter-organizational relationships. First, as a general support in a firm's absorptive capacity; especially in its potential absorptive capacity. That is, to use ICT and KMS to identify and acquire external information and knowledge, and to process, analyze and interpret this information and knowledge. An example of the former is environmental scanning on the Internet using advanced search techniques and an example of the latter is knowledge discovery in databases—using data mining techniques—employing databases containing external information. Second, as a support (resource or capability) in a specific knowledge process so that the outcome of the process will lead to a competitive advantage for the firm. For example, a firm can in an NPD process use the Internet to get customers' opinions about different product features. Using the Internet can lead to: 1) a faster process, speeding up the NPD process, and 2) an increased reliability in that more customers can be involved, leading to products with a better fit with customer expectations.

As noted by several researchers, the notion of inter-organizational relationships is not new (e.g., Venkatraman and Subramaniam 2002); firms do not conduct all their business activities internally. It is well known that firms, based on transaction cost criteria, use outsourcing to lower costs despite the firms having the necessary resources and capabilities internally. In the knowledge economy inter-organizational relationships are also created because firms do not possess the required knowledge-related resources and capabilities internally. Furthermore, inter-organizational relationships can also be used to create new knowledge faster and embody it in new services and products which can reach the market faster or create a new market—the former is related to "time to market" and the latter to "competing for the market." Inter-organizational relationships are also created to share and disseminate knowledge, for example, for the purpose of influencing emerging standards or for the purpose of influencing other firms to develop new products and services based on products, services, or knowledge of the disseminating firm.

## 4 ICT IN INTER-ORGANIZATIONAL RELATIONSHIPS: SOME CHANGES

ICT and computer-based IS (CBIS) have primarily been used to gain and sustain competitive advantage through economies of scale or economies of scope. In the knowledge economy, ICT and CBIS (especially KMS) will also be used to gain and sustain competitive advantage through “economies of knowing.” Before addressing how firms can enhance their absorptive capacity through ICT, three technology changes and trends are worth noting: 1) easier access through knowledge portals, 2) increased mobility, and 3) infrastructure and architecture for inter-organizational KMS.

One consequence of the paper’s view is that building, using, and maintaining inter-organizational relationships is a critical capability, and can in some cases be a dynamic capability. ICT and KMS can be a significant means for enabling and enhancing inter-organizational relationships, for example, they can link a firm with different nodes, like, customers and consumers, and enable electronic communication across time and space. Increasingly, we will see that the gateway to ICT-based inter-organizational relationships will be portals (Vering et al. 2001)—in the case of knowledge management: “knowledge portals” (Mack et al. 2001, Tsui 2003). Knowledge portals (KP) are digital knowledge “workplaces” that have been designed to provide a single access point to internal and external applications, information, and services for an organization’s knowledge workers, partners, customers, suppliers, and other persons/organizations that an organization is cooperating with. The KP is an entry point to information, applications, and services available primarily via the Web. The information and knowledge, applications, and services made available through a KP can be personalized depending on participation in inter-organizational relationships. The use of KP will make it easier to develop and change inter-organizational relationships, for example, to add and delete participants as well as to add and delete information, applications, and services. Applications and services made available in a KP can include:

- Technologies to automatically capture and gather external information, for example, customer information.
- Document capturing, analysis, and organization technologies (incl. technologies for categorization and clustering of documents).
- Technologies for browsing and searching documents.
- Support for analysis, synthesis, and authoring of information (incl., for example, applications like statistical analysis and data mining tools).
- Communication tools, including, for example, e-mail, bulletin boards, instant messaging, IP telephone, audio- and video-conferences.

In the last years many KM-tool vendors have re-positioned their product offerings to align with the growing portal market (Tsui, 2003).

A problem with many KMS is that the intended users have to come to the KMS, for example, by finding a PC hooked up to the Internet. Knowledge workers, partners, customers, etc. are not always tied to specific places when participating in knowledge-intensive processes. Increasingly, the needs of knowledge workers and other persons (like customers) involved in knowledge management activities are real-time, situational, and unpredictable (Keen & Mackintosh 2001). Mobile KMS can be a means for overcoming the real-time, situational, and unpredictability problem. This means that the gateway in many cases will not only be a KP, but actually a mobile KP (m-KP). KP makes it possible to have a personal gateway to desired information and knowledge, applications, and services. Mobile-KP can further reduce persons’ burdens of getting access to desired sources and resources at moment of relevance and truth. For example, an organization can make it possible for a customer—using a Wap-phone—to make comments (feedback) about a service or product at the moment of experiencing the product or service.

In the last years, hardware and software companies, as well as service providers, have been promoting a new approach to organizational information systems. The approach is based on the idea that

organizations will increasingly buy and rent parts of their ICT and services over the Internet rather than owning and maintaining their own hardware and software (Hagel 2002). The approach is launched under a number of different concepts: “.Net” (Microsoft), “Web services” (IBM), “network services” (Oracle), and “open network environment” (Sun). A result of this trend is that previous proprietary architecture—where companies built and maintained unique KMS—will to a growing extent be substituted by an open architecture where companies can rent data storage, processing power, specific applications, communication capabilities, and other services from different types of external service providers. Hagel and Brown (2001, Hagel 2002) describe the approach as an architecture having three layers: 1) software standards and communication protocols, 2) service grid, and 3) application services. The first layer contains different foundation standards and foundation protocols—the former, for example, UDDI (Universal Description, Discovery, Integration), XML (eXtensible Markup Language), WSDL (Web Services Description Language), and WML (Wireless Markup Language), and the latter, for example, TCP/IP (Transmission Control Protocol/Internet Protocol), SOAP (Simple Object Access Protocol), and HTTP (HyperText Transfer Protocol). This layer allows data to be exchanged “easily” between different applications and it also allows data to be processed easily in different types of applications. The second layer, the service grid, builds upon the protocols and standards and provides: 1) shared utilities, e.g. security, 2) service management, e.g. monitoring, 3) resource knowledge management, e.g. data brokers and data transformation, and 4) transport management, e.g. filtering (Hagel 2002). The application service layer contains different application services. For example, Application Service Providers (ASP), such as Zoomerang, are offering web-based surveys and a number of other ASP have announced commercial applications for the design of web-based surveys. Some of these applications make it possible for a firm to, through a web-based menu-driven system, choose product/service features and feature levels to be tested. Given this information, the ASP sets up the web-page to be visited by the respondents. The ASP also sets up the database, collects data, and makes analysis. Using an application like the described, a firm can gather sophisticated market information in a few days and, for example, improve its new product development process. It can speed up the process and also get inputs from more customers or potential customers.

The described approach—renting and buying ICT and services over the Internet—and the three-layered architecture suggest a number of changes regarding using ICT and KMS in inter-organizational relationships. For example, inter-organizational KMS will increasingly be built and maintained using non-proprietary hardware, software, and data. Furthermore, these KMS can be more flexible and dynamic which could make it easier to develop and change inter-organizational relationships.

## **5            ENHANCING PRODUCT DEVELOPMENT THROUGH ICT-BASED RELATIONSHIPS WITH CUSTOMERS AND CONSUMERS**

Having described some general changes and trends affecting the development and use of ICT-based inter-organizational relationships, we now address KMS in inter-organizational relationships. For illustration we choose a critical core business process: new product development (NPD). There are several reasons for the choice. First, NPD is a business process that is highly knowledge-intensive and one of the key business processes for creating new organizational knowledge (Nonaka & Takeuchi 1995, Madhavan & Grover 1998). Second, in many industries NPD projects are under pressure to accelerate development cycles and decrease development costs, while increasing design quality and flexibility (Towner 1997, Iansiti & MacCormak 1997). Third, from an organizational learning perspective, NPD is the context from which the firm is most likely to transfer methods (resources and capabilities) to other areas of the firm. NPD is seen as a main driver of organizational renewal. It is a continuous process of knowledge-related activities, in which the organization is adapted to its changing environment and technologies (Dougherty 1992). Nonaka and Takeuchi say it most elegantly: “Organizational knowledge creation is like a ‘derivative’ of new-product development. Thus, how well a company manages the new-product development process becomes the critical

determinant of how successfully organizational knowledge creation can be carried out.“ (Nonaka & Takeuchi 1995). Hence, what we discuss should be applicable to other core business processes. Fourth, in NPD, as well as in many other core business processes, knowledge-related activities play a critical role, and thus provide excellent leverage points for ICT- and KMS-enhancement.

NPD can be viewed and described in many different ways (Cooper & Kleinschmidt 1986, Brown & Eisenhardt 1995). For our illustration, we will use a model consisting of three major phases: 1) creation phase, exploration, 2) development phase, exploitation, and 3) diffusion and ending phase, exportation (Ancona & Caldwell 1990). Exploration, exploitation, and exportation require different types of KM-activities. Therefore, relationships, ICT, and KMS supporting NPD must facilitate diverse patterns of KM processes and activities.

*Creation phase (exploration): Opportunity identification, ideas and concepts generation.* The role of customers as information and knowledge sources of new product and service ideas and opportunities is well documented in the literature (Lengnick-Hall 1996). ICT-based relationships open up new ways to involve the customers in the creation phase. Using a “gated-community” approach in the creation phase a firm can involve those customers perceived to be useful idea generators and innovators (the term customer denotes both current customers as well as potential customers; it denotes both industrial customers as well as consumers). For example, Hallmark Inc. uses its Hallmark Knowledge Creation Community to together with its lead retailers generate ideas on new product designs, e.g., new greeting cards (Kambil et al. 1999). Using an open approach in the creation phase a firm makes it possible for any customer to participate in the phase. It can lead to an input from a larger number of customers, but the firm must have an elaborate way to manage the many, and maybe diverse and inconsistent, ideas. There is a risk that the firm ends up with extraneous information that can complicate the creation phase and lead the NPD process astray. Fiat used an open approach to generate design ideas for its Punto model. Fiat invited customers to select features for the car on its web-site. More than 3000 people took the chance and gave Fiat valuable design information—this is a good example of co-creation using the Internet (Iansiti & MacCormack 1997).

A number of ICT-based tools and services are available to use. As noted above, Zoomerang (zoomerang.com) offers a web-based application service that can be used by firms in the creation phase (can also be used in the other phases). The service allows a firm to seek out ideas. Through a web-based menu-driven system the firm can create a survey, for example, for concept testing, and customize it in different ways. The created survey can be sent to customers from the firm’s e-mail list or to a sample provided by Zoomerang. It can also be placed as a link on a Web-site. It is also possible to manage the survey, for example, controlling status and inviting new customers. Based on the responses, Zoomerang calculates the result and presents it in tables and graphs.

Dahan and Hauser (2002) present and review other web-based methods for generating and capturing knowledge from customers. One method is the information pump (Prelec 2001). The information pump (IP) is a “focused group” and in essence IP enables customers to interact (discuss) with each other through a web-based game. This is a way for customers to verbalize the product features that are most important to them. The customers pose and answer each other’s questions. Individual incentives are “bootstrapped” by comparing the information provided by one customer against that provided by other customers at the same time. A customer gets credits for “...presenting statements that are non-redundant on what has previously been said and that are recognized as relevant (an ‘a-ha’) by the others.”(Prelec 2001). One of IP’s strengths is its ability to gather customers’ language. This means that it can be useful in generating and testing integrated concepts that can be hard for customers to articulate or when customers have problems generating and evaluating specific features.

Although, KMS can be used in the creation phase, there is a number of critical question to be addressed before using inter-organizational KMS in the phase: 1) what customers should we try to involve and how can we establish links with them, 2) what incentives can create and foster customer participation, and 3) how should the acquired customer knowledge be integrated into our internal NPD-process. It is also critical to ask the right question to be able to acquire relevant knowledge.

Some argue that involving customers in idea generation will lead to imitative and unimaginative products and services. Ulwick (2002) argues that organizations should stop asking customers what they want. Instead, they should ask what the customers want the products and services to do for them. Some of the available ICT- and Web-based tools can be used for generating ideas on what products should do for the customers.

*Development phase (exploitation): design and engineer.* Customers can also play critical roles in the development phase. Customer involvement can range from design to development and engineering. In the software industry it is common to have customers as members of NPD projects. For example, to use a gated-community approach, like Xerox (Sawhney & Prandelli 2000), to involve a selected group of customers to participate in product design and development—these customers represent the most valuable and important customers. Using an open approach, the statistical software package developer and seller Stata encourages its customers to develop add-on modules for performing the latest statistical techniques. The best of those are adopted and incorporated in later releases of the firm's products. Using an open approach in the development phase can be problematic if a large number of customers would be interested in participating. A problem will be to handle a large number of designs. Firms can also use an open approach, for example, to offer customers the possibility to design their products, within given constraints—more on this below.

User design (UD) can also be used in the development phase. UD has some similarities with what some firms, like Dell (Dell.com) and Gateway (gateway.com), are offering customers today. The firms offer customers the possibility to configure and order products by selecting features from drop-down menus. By using UD in an NPD process it is possible to show to a customer the results of choices interactively and to track the process (i.e., tracking the customer-system interaction). UD enables an NPD-project to understand feature interactions, even for complex products. It also allows customers to learn their own preferences for new products and product features. Using web-based UD makes it possible to show real and virtual features to a customer and to display changes interactively. This makes it possible for an NPD-project to have better knowledge when determining what products and product features to offer customers.

An alternative approach is to actually allow customers, using “tool kit for customer innovation,” to design and develop their specific products (Thomke & von Hippel 2002, von Hippel 2001). A “tool kit for customer innovation” is a user-friendly “package” developed using new ICT and techniques and used by customers to develop the application-specific part of a product. The tool kit gives customers the possibility to “...develop their custom product via iterative trial-and-error. That is, users [customers] can create a preliminary design, simulate or prototype it, evaluate its functioning in their own use environment, and then iteratively improve it until satisfied. As the concept is evolving, toolkits guide the user to insure that the completed design can be produced on the intended production system without change.” (von Hippel 2001). Putting a tool kit in the hands of customers changes an NPD process. It means that a firm can abandon its attempts to really understand customer needs in detail and transfer the design and development of need-related aspects of products and services to customers. A firm can capture tool kit interactions and feed this knowledge into its NPD-processes. Given the development in technology and techniques we can expect to see more of tool kit design and development by consumers. We can also expect to see third parties developing tool kits that can be used to design a number of different products (e.g., cameras, DVD players) or a specific product (e.g. a copying machine) from different suppliers—the tool kit can be an application service (discussed in Sect. 4).

*Diffusion and “ending” phase (exportation): testing and support.* In the diffusion and ending phase customers can provide information and knowledge through acting as testers of the “final” product. They can also provide information and knowledge based on their experiences on various aspects of product use. ICT-based relationships can be set up for testing a product. In the case of digital products, like software, customers can act as beta testers and the product to be tested can be distributed to the testers over the net. In the case of a gated community this means that the organization will select a few customers to act as testers. In the open approach it means that the firm will allow all customers to act

as testers. Compared to if the test is done in-house, using customers as testers can lead to a speed-up of the testing process, decreased cost for the test, and a more varied test of the product. The testing of a product, like software, can continue even after the product has been launched. For non-digital products, virtual concept testing offers an alternative way to test products (Dahan & Hauser 2002). In virtual testing, consumers view new product concepts and products and indicate what concepts they are likely to buy at varying prices. With the development of multimedia concept representations and increased bandwidth, virtual concept testing can reduce the time and cost of testing. Also, it can lead to that an increased number of concepts can be tested as well as the number of testers can be increased.

Consumers can also play a critical role in the diffusion and ending phase as expert users of the product—consumers as expert user (Nambisan 2002). Some organizations are creating online communities for their customers (McWilliam 2000). In these communities the customers can exchange experiences (knowledge) on ways of using the product, new ways to use the product, and problems in using the product and how to solve these problems. In general, exchange of knowledge of how to enhance the overall value of the product. Online communities can be a valuable source for customers, but they can also be a value source for the product firm. The exchanged knowledge in a community can be captured in fed into the firm's NPD processes. Firms like Artificial Life (artificial-life.com) offer tools that can be used to retrieve and analyze information from online discussions using neural networking, fuzzy logics, and statistical analysis (McWilliam 2000). Artificial Life also offers smart bots that can be used to bring a human-like presence and appearance to the points of contact between a firm and its customers (smart bots are intelligent software products that integrate computer interaction and natural language understanding). Using these types of products it is possible for a firm to make online communities easier to use and more attractive as well as it is possible for the firm to turn electronic discussions into knowledge that can be used in NPD processes.

Our conceptualization and examples suggest that the relationships differ in critical ways. Moving from the gated community approach to an open approach the following are likely consequences for a firm using the ICT-based relationships for knowledge management activities in NPD:

- Decreased possibility to govern the relationship leading to a lower degree of disciplined knowledge management, for example, a lower level of NPD as disciplined problem solving.
- Decreased degree of stability of the relationship leading to a more chaotic knowledge management—can also lead to creative destruction.
- Increased degree of openness to the external environment and an increased amount of information and knowledge is available. This can lead to a higher level of NPD as a “communication web.”

## **6 DISCUSSION, CONCLUSION AND FURTHER RESEARCH**

Using a conceptual-analytic approach we presented a view of a knowledge management in inter-organizational relationships. The paper is a step in the development of our understanding of “economies of knowing.” Further theoretical work is needed to tighten the conceptualization. Empirical research is also critical in helping us understand how firms get to be good at knowledge management in inter-organizational relationships, how they sometimes stay that way, why and how they improve their knowledge management, and why sometimes knowledge management decline. We also need more theoretical and empirical work on how ICT can be used for knowledge management in inter-organizational relationships. The presented view and exemplifications can be used to generate new research issues in inter-organizational knowledge management. A number of issues have not been addressed in the paper, for example, legal aspects, like licensing and patents issues related to that products and services are developed in inter-organizational relationships.

Furthermore, increasingly “open source”-liked relationships and communities affect “traditional” NPD processes, most notably is the open source movement and the development of Linux. In the software industry, firms are increasingly forced to react to the open source movement and they also increasingly have to “manage” knowledge processes in these new environments. IBM's decision to place in-house tools into the public domain exemplifies this (Thompke & von Hippel 2002, Sawhney & Prandelli

2000). IBM placed \$40 million of in-house tools for developing software into the public domain to encourage people to develop programs that run on Linux. This means a major change from how IBM traditionally develops software and might have a major impact on how IBM “manages” software knowledge. Being part of an open source community means that a firm is outsourcing a portion of a knowledge-intensive process to participants (like customers) in the open source community (Thompke & von Hippel 2002). This can be an effective approach for speeding up the development of new products better suited to customers needs or for tapping into the knowledge created and shared within the community. Research on the effects of these changes is needed.

The paper suggests that the potential for using ICT and KMS in inter-organizational relationships is there, but no one can guarantee the outcomes. Although there is a growing number of enabling and emerging technologies that can be used in knowledge-based inter-organizational relationships and used to develop absorptive capacity (a dynamic capability), strategy research stresses the importance of path dependence that influences a firm’s decision to develop new processes, adopt new technology, or to provide new products and services (Zahra & George 2002b).

In our example we have used NPD and customers, but the underlying idea, the technology, and the techniques presented can be used in other core business processes where firms like to use inter-organizational relationships to create and capture knowledge. Also other stakeholders and groups like suppliers, partners, and complementors can be used as sources.

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