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ROLES OF INFORMATION TECHNOLOGY IN DISTRIBUTED AND OPEN INNOVATION PROCESS

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Abstract

In the era of open and distributed innovation, Information Technology (IT) must be leveraged by organizations to reach, record and review ideas from internal (eg. employees) and external sources (eg. business partners). IT can support and enable this process, but only when its roles are understood and when properly deployed. Existing research has inadequately established these roles. Using the "process-value-of-IT" lens, we apply a two-step exploratory research. First, the integration process is uncovered; second, the roles and potential of IT are discussed. Three distinct conceptual roles have been identified from the literature review and from interviews in 30 US and European companies that successfully collaborate with externals: Understanding and managing sources, Documenting idea history and source interactions, and Distribution and sharing of ideas. Some of the existing and emerging approaches to support cooperative activities (tool kits, idea management software, wikis) have been considered in context to outline opportunities and trends in the era of open, distributed, and IT-enabled innovation.

Keywords: *Information Technology, IT, Innovation management, Open Innovation, Customer integration, Process value of IT*

Introduction

One of the most important organizational capabilities is ability to technologically innovate and create new products for the market (Kim et al. 1997). Organizations must innovate to survive in today's highly competitive marketplace: to satisfy customers and hold and increase their market share (Govindarajan et al. 2005). One of the world's biggest toy manufacturers Mattell estimates that 70% of its yearly sales is generated by new toys introduced within the last year (AT Kearney 2002). In automobile industry, new vehicle development costs of 'average' manufacturer are USD 500mil higher than the costs of 'best in class' manufacturer (SAP 2004). Yet, organizations continue to struggle with the lack of effectiveness and efficiency in the innovation cycles. In example, 95% of new consumer products (1996-2001) lost money or broke even (SAP 2004).

A great deal of innovative ideas fails due to lack of market orientation, new products being over-engineered and inadequately addressing customer needs. Until recently, organizations followed the model of "closed" innovation (Chesbrough 2003). Organizations made investments in centralized R&D departments, hired the best people, and zealously guarded their intellectual property. However, organizations today cannot depend on their R&D departments alone for innovations because of an increasingly competitive landscape and shrinking profit margins (Prahalad et al. 2003). Organizations need to create products and services faster and more effectively. External entities such as suppliers, customers, business partners, etc., are brought into the innovation process, as they can share existing knowledge and create new relevant knowledge (Baloh et al. 2006; Desouza et al. 2005). To perform that well, successful innovative companies push to make their innovation process (1) open and distributed, (2) transparent, and (3) supported and enabled with information technology (IT) (Awazu et al. 2006).

First, organizations need to focus on incorporating external entities into the innovation process. The positive influence of customer involvement in the innovation process has been demonstrated by several empirical studies (e.g. Bacon et al. 1994; Desouza et al. 2005; Gruner et al. 1999; Kristensson et al. 2002; Murphy et al. 1997), which show that such early integration leads to a more successful product portfolio. Similarly, innovation projects must be conducted by working together with business partners: customers and suppliers, who are (just as more and more internal sources) residing at scattered locations nationally or even globally.

Second, it is impossible to manage innovation process if it is considered as a black box. Such approach results in innovations by serendipity rather than by deliberation. Having an open and transparent innovation process makes it easier for both internal and external stakeholders to participate and contribute to the process. Integrating external parties leads to the challenge of creating knowledge together with externals, and supporting the process and the absorption with help of information technology tools. To incorporate ideas and suggestions from both internal and external customers and make innovation as collaborative and as efficient as possible, a better understanding of the role of IT in innovation process is needed. Integrated IT system is necessary to support the innovation process (Koch 2006).

However, there are hardly any studies looking explicitly at this process and the role information technology may play in it. Only recently, Kohn and Huesig explored how innovation software is used in German SMEs (2006) (yet not addressing the 'distributed' and 'open' characteristics of contemporary innovation processes), and Markides and Anderson (2006) only briefly discussed how IT enables strategic innovation. Research efforts have not yet placed the IT role in the open and distributed innovation process adequately and this paper tries to close some of the mentioned knowledge gap. The key to look at this issue is, first, to understand the distributed and open innovation process, and second, to explore the ways IT is being used to support that particular organizational context.

This research is theoretically grounded in the "process value of IT" theory, which argues that enterprise-level impact of IT can only be measured through intermediate contributions (Barua et al. 1995; Barua et al. 2000; Sambamurthy 2001). While early IT-business value studies analyzed a direct connection between IT resources and firm performance, Barua et al. (1995; 2000) proposed that the effects of deployed IT occur at the business process level. IT can only deliver business value through improved process performance. This means that the design of a technological solution and evaluation of its success can only be discussed in connection with a deep understanding of a particular process into which the IT is being introduced.

Applying that lens, our research was conducted in two steps. First, we uncovered the process of partner integration. Second, based on understanding of the process and data collected, a conceptual outlook is given pointing at the possibilities to facilitate partner integration into the innovation process through modern IT-tools. Practitioners will benefit from actionable insights contained in the paper to manage innovation agendas better. We conclude with an outlook on future research areas.

Methodology

In order to answer the research question, we have considered inputs from both primary and secondary data. From existing research in technological innovation, strategic management, information systems and knowledge management, outline of relevant characteristics of contemporary innovation processes and issues surrounding them have been derived. Recent

published reports about organizational innovation practices have also been examined. The issue with the chosen companies, even though they were mature in integrating externals into the technological and new product innovation processes, was, that only few had mechanisms in place that would deliberately tackle the issue of IT support for all of the stages of the opend and distributed innovation process. For that, our final findings are not only based on cases analyzed but also on secondary data.

Next, as part of an ongoing large-scale research project, exploratory multiple case study research has been undertaken. This design was chosen as case studies are particularly useful for problems where the context of action is critical (Benbasat et al. 1987), and the research and theory are at formative stages or call for a revision of understanding (Lee 1991). Using this approach, researchers can gain a rich understanding of the context of the research (Saunders et al. 2003). A case study approach focuses on describing actually existing relationships in local contexts and enables capturing the relationships that exist in reality in local contexts in greater detail (Galliers 1992). Concepts may be broadly applied to a case, but research is performed to both gain a holistic view of the context and try to identify, explore, and explain how all the factors in a particular setting are related and interdependent.

We have chosen multiple sources of evidence to facilitate deeper understanding of the research phenomenon and improve possibility to generalize (Miles et al. 1994). Our sample of over 30 US, German, Austrian, Swiss, and Slovenian companies was diverse, ranging from financial services to information technology, advertising agencies, non-profits, manufacturers, retailers, and pharmaceutical organizations. Data collection involved semi-structured interviews with senior executives from R&D, marketing, and product management areas. They usually appointed additional top or middle management member to discuss particularities and details of the integration process, and the roles IT plays in it.

Two researchers attended most of the interviews. Extensive notes were taken, and half of the interviews were digitally recorded and later transcribed for analysis. We also examined the technology artifacts (e.g. applications, IT solutions) that were put in place. The interview data were complemented by analysis of corporate and annual reports, company presentations, and business press. In follow-up sessions, findings and interpretations for each company were reviewed and validated with the help of key informants to improve the credibility of the findings.

Partner integration in the innovation process

Most approaches to describe innovation processes (cf. Koen et al. 2001) incorporate three generic steps: a phase where ideas are collected or generated (“idea generation”), another one to develop and specify those ideas (“idea development”) and finally the last one where value creation takes place by transforming ideas into products (“idea commercialization”). Before actual knowledge creation (i.e. joint product development) can take place, partners need to be integrated into the innovation process. Early stages of the integration are crucial in partner integration undertakings (Baloh et al. 2006; Wecht 2006), thus, we explain the process briefly first.

In the area of strategic management many studies have dealt with R&D cooperations (e.g. Kirchmann 1994; Marxt 2000; Staudt et al. 1992). Since the integration of externals into the innovation process is a special form of cooperation, the same steps can be applied to structure the process. Out of existing approaches and through our case study research, the following three general segments have been condensed: initialization, preparation, and realization. To understand the context into which we deploy IT, we will conclude this section by focusing on the realization of the integration, where the actual knowledge is created and utilized: ideas generated, products designed, processes reengineered.

Initialization of partner integration

At the beginning of a partner integration is the realization of the necessity and strategic decision for external cooperation. As part of the strategy process value creation, projects that may be realized together with externals have to be identified and evaluated (Wecht 2006). The decision to open the innovation process has to be made in accordance with the overall and technology strategies. The expected partner contribution and the resulting specific partner roles are crucial for the design and execution of the whole process (Wecht 2006). The next important step is to specify the cooperation goals to clarify expected results. Those goals can be further clustered into result, cost, and time related objectives. They will be used to assess and select partners, to monitor the integration process and evaluate its success. Together with the goal definition, the company has to carve out certain areas where the integration will take place. To secure the competitive position, technological areas of core competencies need to be recognized, as for them, an in-house development is preferred. Complementing those areas are the external competencies to be integrated during the cooperation.

Preparation of partner integration

After deciding to reach out to partners and after defining the expected results, partners need to be selected and common agreements reached (Yoshingo et al. 1995). The search has to be systematic and must consider contextual factors like competition, market situation, and existing experiences.

The establishment of a precise search profile, the search process, and the final selection are the steps within this stage. The goals established in the initialization stage provide a way to discuss potential business partners as well as suggesting methods for evaluating what the organization could bring to those partners as incentives. Besides the role specific selection criteria, strategic and cultural aspects need to be included when considering the "fit" of the partners. Strategic fit (e.g. Rotering 1990) is related to the danger of opportunistic behavior from one partner. Importance of cultural factors is often underestimated (Marakas 1999). The cultural fit increases when decision-process and work related values are similar. The willingness to adapt to differences, we found in the companies analyzed, improves the fit.

One of the very important parts of this step, our study shows, is developing common goals and establishing contracts regulating the cooperation, which need to be discussed openly and set as soon as possible. They may differ significantly from the respective goals of each individual partner; however, these should be encapsulated in the common goals. In addition, aspects of intellectual property rights emerging from the cooperation should be captured in contracts.

A recent example is Samsung's partnership with MTI MicroFuel Cells of (MTI), a little-known US company that had $8 million in sales in 2005. MTI has extensive technological knowledge in the area of "green," micro-sized electricity sources. Samsung committed $1 million to the joint development of fuel cells, one of the largest publicly disclosed commitments to the technology by a major manufacturer in years. Goals, knowledge security, and the question of intellectual property were explicitly defined in advance. The joint development deal will last about 18 months, and neither company will work with any other company to develop fuel cells for use in wireless phones. Samsung secured an exclusive license to use the technology from MTI, and any patents that result from the research will be assigned to MTI (Hesseldahl 2006).

Realization of partner integration

This stage, where the actual creation of value takes place, starts after fitting partners have been found and the general set-up has been clarified and articulated to each partners' satisfaction. The necessary steps are to shape the cooperation considering the respective business partner roles; to realize the integration on operational level; and to utilize the results of joint efforts in the integrating company. Aspects of organizational design, human resources, and financial management regarding the cooperation with the integrated business partner must be considered and operationalized.

Organizational interventions need to be constructed for efficiency and effectiveness in reaching the goals of the innovation effort. Managers are faced with the challenge of identifying and selecting those knowledge management methods that enable creation and utilization of newly created knowledge through assimilation and deployment. While ever-popular efforts involving capture, access, and transfer of knowledge can lead to increased efficiency, new knowledge generation is the key to growth (Nonaka et al. 1995; Ruggles 1998). Even if there is no consistent model to link innovation and knowledge (Barker 2002) the creation of new knowledge and its application is the main aim of any innovation (Leonard-Barton 1995; Madhavan et al. 1998). However, the already complex task of implementing a successful KM strategy is enhanced in complexity and fuzziness, as collaborating parties are geographically distributed and even external to the company:

> *"It is difficult to get to your customers' minds. You need to be creative when thinking of what is going to work best to get to what they really want. And we can't have them all here at the same time. So we get bits from one that is in Germany in March and bits from another that is in Russia in April. But once we have learned from them, it is my people who present the challenge for me then. Again that what we learned from them [customers] has to be learned and digested again by my people. But it is critical to know as much as you can." – Executive director of development and innovation, Iskratel*

Middle managers are responsible to adjust the organizational design and inject the stages of the innovation process with KM mechanisms (e.g. supporting collaboration, knowledge transfer…) within the organization and across the partnership. Diffusion of newly created knowledge within integrating company has to be ensured.

Moving on towards the core of our paper, the next section now discusses possible IT roles and functionalities that can and are being used in practice in the realization phase of external partner integration.

The roles of IT in distributed and open innovation process

From the analysis of the initialization, preparation and realization phases of integrating external partners into the innovation process, different information, and knowledge needs can be evident. In the preparation phase, IT will provide functional support in the tedious search-process and communicational support for extensive communication with potential external partners. In the realization phase, there is a salient need for support of efforts towards efficient and effective knowledge utilization, capture, storage, dissemination, and knowledge creation. Even though ability of organization to create and utilize its knowledge depends heavily on social factors, many researchers and practitioners (e.g. Alavi et al. 2001; Fahey et al. 1998; Vance et al. 1998; Zack 1999) are convinced that technologies such as document management systems, forums, instant messaging, etc., can be used fruitfully in these tasks. Some companies, such as Ford, Chevron, and Texas Instruments estimate that their knowledge management systems have saved them millions of dollars (Bose 2004).

In the early stage of innovation, innovations benefit from ideas. The sources can be internal (e.g. employees) or external (e.g. customers, business partners, etc). Ideas can range in granularity from high-level abstractions to specific and detailed solutions to problems. Ideas can be generated with help of formal mechanisms, such as brainstorming and creativity workshops, or can emerge serendipitously. Diversity in idea sources and idea generation mechanisms means that this particular phase of innovation ought to be as flexible and inclusive as possible. Another major challenge for organizations is to manage a wide assortment of sources that generate ideas as flexibly and efficiently as possible. To do so, an organization must be able to identify sources that provide ideas, then enable the capturing and sharing of ideas, and finally support collaboration for idea development. IT plays a significant role as an supporting and enabling agent to increase the effectiveness and efficiency of these activities, yet, there have been no coherent research efforts to cover this field.

Table 1 illustrates examples of IT deployed in the two core stages of an innovation (before the idea is commercialized). Out of these, our study in companies that successfully integrate external partners in their innovation process, identified the following three conceptual roles IT can have in open and distributed innovation process: *Understanding and managing sources, Documenting idea history and source interaction*, and *Distribution and sharing of ideas.* The continuation of the paper discusses them in detail.

Table 1: Examples of IT use in crucial stages of distributed and open innovation process

Innovation Stages	**Idea Generation and Development**	**Design, Testing, and Refinement**
IT Use (Company)	Data collection – website (Yahoo) Data collection – RFID (Walmart) Customer feedback data-mining (Amazon) Data mining user-drive content (MySpace, wikipedia) Interactive CRM data collection - (Dell, KLM) I-Mentors, I-Pipe Knowledge Capturing System - After-action reports (U.S. Army) Innovation E-Space (Whirlpool) Internet-based tools (Bush Boake Allen from Nestle) Insight (FedEx) IdeaCentral (Cargill) Idea management (Iskratel) Democratic evaluation of ideas (MicroArts) Network-based collaboration practice (Lego, BMW) Wiki (Nokia, Angel.com)	Product Life Cycle Management System: supplier-customer cooperation (ZF Friedrichshafen) Flex – Modularization of business activities (Cisco) DSS – Dynamic synchronization system (Cemex) Simulation (BMW) Simulation – Virtra (U.S.Army) Virtual Studio Collaboration (Dreamworks, Hewlett-Packard, PepsiCo, AMD, Procter and Gamble)
Nature of IT	More flexible and effective application of IT is possible. Certain human functions can be enhanced (e.g. problem-identification, solution-seeking). IT can be seen as enabling agent for flexible generation and distribution of ideas.	More powerful, faster IT with better UIs make the computerization of complex business processes possible.

IT Role: Understanding and managing sources

The first role of IT is to help organizations understand the sources that generate ideas. For example, organizations can use IT-tools to get a sense of how their customers use their products and services by examining demographic data, usage, and other collected information. In example, customer databases can be used for data mining and for other forms of information segmentation to identify customers to target. Knowledge about the partners is primarily generated through information processing activities. Today, organizations have an abundance of information on partners, which is collected from multiple sources, such as credit reporting agencies and local stores. Information collection and identification devices like store cards and radio-frequency identification (RFID) devices enable collection of accurate information on the purchasing behavior. RFID devices can be attached to products in a store to track their movement within the store, a practice common in Walmart stores. On the B2C side, customers can find their queries answered and problems resolved online through chat rooms, e-mails, and reasoning systems. For instance, software developers use interactive websites that allow their customers to find answers and debug problems with their products. Using IT to support customers, organizations can understand their issues, which can form the basis of idea development and future innovations.

This web-based approach is an operationalization of strategic understanding that accurate capture of partners' opinions can provide valuable competitive edge. Through its web-based information systems service, Dell allowed customers to have control over their orders, yet managed to capture high-quality knowledge about customers' behavior. With this, Dell's market forecasting ability is far superior to its competitors (Govindarajan et al. 2001). This trend will continue. Although few volume retailers, with the exception of Amazon, have actively mined customer feedback, the success of volunteer-based user network sites such as Wikipedia indicates trends in this direction.

IT Role: Documenting idea history and source interaction

The challenge of understanding and capturing ideas in distributed and open innovation revolves around great number of stakeholders involved and their needs. Knowledge capturing systems can be very effective when they take a human-centered view of knowledge, that is, to 'capture' knowledge needs or ideas *in situ*. To address these issues, increasing number of organizations deploy user toolkits that enable partners to join in innovating new products and services (Franke et al. 2003; Thomke et al. 2002). However, this is becoming more difficult as user needs change more rapidly, technology lifecycle time decreases, and firms have to expand into niches – sometimes even serving "markets of one".

With user toolkits for innovation, manufacturers, under certain circumstances, no longer have to try to understand their partners' wishes in detail. Need-related aspects of product and service development may be shifted to users, who are provided with appropriate toolkits that have the following four characteristics. First, the kit enables users to carry out learning cycles during the process of designing their custom products. This capability is highly important since problem solving in product design is fundamentally based upon trial-and-error learning. Second, toolkits have to be user-friendly, meaning that users must be able to use their existing skills. Additional training may be necessary; however, it should take as little additional effort as possible. Often, internal training can be more cost-effective because a corporate IT group understands and routinely interacts with its users. Third, based on existing experiences, a toolkit has to include libraries of useful, already-tested elements and modules. Fourth, toolkits must contain information about the solution space within which partner can unfold creativity. Those limits may be determined by the production process used to manufacture the future product. This ensures that a user's design will in fact be producible.

In the food industry, Bush Boake Allen, acquired in 2000 by the world's leading creator of flavors and fragrances, IFF Inc., has allowed clients like Nestlé to develop their own specialty flavors using an Internet-based tool. Customers can create a customized flavor by using a database of flavors, and then send the new flavor design to an automated machine that manufactures a sample within minutes. After tasting the flavor, the customer can make modifications and request a new sample.

Extremely important role of IT is thus, to provide a toolkit that documents what happens with the customers' ideas and even enables the construction of a product prototype.

IT Role: Distribution and sharing of ideas

The third role of IT is to enable distribution of ideas, knowledge creation and diffusion of new insights. Knowledge needs in the realization phase are about new knowledge creation and its utilization. Ideas generated at one source may be applicable in other places. Moreover, ideas need to be complemented by feedback or input from other sources; hence, the need to gain synergies from idea combination is critical –through recombination of different views innovation gets created (Schumpeter

1934). Buchel (2001) also states that the greatest benefit technology offers is to open communication within organizations. Next, consider idea management tools and wikis as prime examples of knowledge utilization and creation tools.

Idea management tools

Cargill, one of the largest companies in the food industry, has a managed "box-of-ideas" process supported by a web-based application. Using Imaginatik's "Idea Central," Cargill is able to easily capture ideas from employees, distribute them throughout the organization, and have them evaluated by peers or formal review teams, who add their views and knowledge: Consider the following comment:

> *"One of [tools] strengths is that once an idea is submitted, it is easy to build on that idea, fostering collaboration between the idea submitter, his/her peers, and the review team assigned to evaluate ideas. Communication before and during an idea campaign can highlight collaboration opportunities. Besides the focused business objective for an idea campaign, efficient evaluation, action and feedback on ideas submitted, and diversity of input are the most critical success factors for managing the idea early in the [innovation] process", Director of US Scientific Knowledge Services, Cargill*

Iskratel, a company that develops telecommunication products and service solutions (such as convergence and data networks, fixed and mobile networks etc.) for global operators, also uses an idea management tool, similar to Idea Central. Instead of personalizing or customizing an off-the-shelf product, Iskratel developed their own tool, which conforms to the particularities of their idea management process. Since the institutionalization of the process and introduction of IT, both companies have significantly increased the rate of existing product- and process- improvement. Very importantly, they opened up the communication inside the company - ideas are discussed and developed openly from the earliest stages not only in hierarchical but in horizontal manner. Furthermore, contributions of others to the idea are traceable, which proved (external and public recognition) to be a significant factor in promotion of a sharing culture and creativity.

Wikis

Wiki is a promising new technology with functionalities that fit to particular knowledge needs of the discussed process. As collaborating parties often do not have the possibility of same-time/same-place conversations, live chats/video conferences are limited to scope of conversation participants, lack of storage and organizing functionality. Wiki emerged as an answer to many-to-many broadcasting need with functionality such as storage, organization, cross-linking, done in effortless manner. It supports "conversational" knowledge creation and sharing and as opposite to weblogs, it enables many-to-many broadcast (Wagner 2004). It offers fast knowledge creation (without need of editing, publishing, authorization by experts as with FAQ's or content management systems), making it useful for environments such as early innovation process where ad-hoc knowledge creation is required. Wiki acts as supportive and enabling knowledge creation tool, bringing together people from different locations to a centralized location, where knowledge can be edited (created) by everyone, as in dialogue. Moreover, wiki overcomes the "same-time" issue (vs. scheduled chat) as knowledge is stored around concepts and does not need to be created in a particular point in time. As a conversational technology, wikis are most effective for ad-hoc problems with decentralized knowledge sources, meaning they are a fitting IT tool for integration of externals into innovation process, enabling creation and diffusion of newly generated knowledge.

The openness of wikis facilitates a highly organic collaboration that rapidly moves ideas from their infancy to adoption and commercialization. The "Corporate Strategy" department of mobile communications giant Nokia has four active wikis on both open-source and proprietary platforms. The organization has more than 50,000 employees, and 1,000 to 1,500 of them use wikis. Nokia says they saved human time and effort previously dedicated to the task of distributing and storing corporate intelligence. Following the successful implementation of wikis on a small scale, Nokia is now funding a companywide wiki.

CONCLUSION AND FUTURE RESEARCH

Our findings fit the broader context of the open innovation paradigm that suggests cooperative innovation processes are imperative for success in today's challenging business environment. That is, for firms to capitalize on knowledge outside their borders, careful integration of externals (i.e. customers, business partners) becomes necessary. This paper uncovered some of the salient design elements of such integration process, focusing specifically on the role and potential of IT.

As more parties that are external are involved in innovation efforts, IT solutions for internal users are no longer effective. Distributed and open innovation requires active and effective application of IT within and across organizational boundaries. With contemporary IT, organizations are provided with a new set of possibilities in how to engage in innovative projects, collaborate with entities, test out new ideas, and share concepts and knowledge. Advances in hardware and software make contemporary IT more widely applicable for various stages of innovation, where it can add a competitive edge to realization of the process. We first uncovered the process of partner integration in order to understand the business context, and based on that, analyzed existing and potential IT practices that are or could be deployed in this process.

Achieving the goal of this paper, three distinct conceptual roles were identified in organizations that successfully integrate externals into their innovation process: *Distribution and sharing of ideas*, *Documenting idea history and source interactio*n, and *Understanding and managing sources*. Some of the existing approaches to support certain aspects of cooperative innovation activities have been considered in more detail: IT in data collection (web, RFID), user tool kits for innovation, idea management tools, and wikis.

This paper contributes to the IS, KM and management of technology bodies of knowledge. It addresses a deficit in the existing body of literature, namely, the lack of studies that focus on roles of IT to support specific partner contributions during the innovation. By focusing on realization of the partner integration, on stages of partner integration, on open innovation process, and on the role of IT-support, we look at highly relevant areas of open innovation. Suggesting IT-approaches to facilitate this integration ensures the relevance for practitioners. For the KM research, this paper provides some guidance on how to go about (re)designing technological solutions that support knowledge utilization and creation. On a IS-discipline-wide-scale, our study hopefully encourages more process-related IT research, where existing organization- and management-science concepts are merged with functionalities of contemporary IT tools, leading to findings, from which principal consumer of IS research, IT practice community, will benefit the most, as suggested by Benbasat and Zmud (2003).

We must acknowledge the limitations of our work. First, the above-discussed three conceptual roles are only one possible explanation of the roles that IT might play in the phases of open and distributed innovation. Second, even though the companies we analyzed have all collaborated with external partners, each of them only had only some of the portions of the process supported and enabled by IT. Further research could thus be aimed at designing IT instantiations for collaborative activities, where as a starting point, it might be worthwhile to adjust and merge existing approaches. Third, our analysis does not address contingency issues. The situative factors that could be considered in further research include market environment, the competitive situation, product specificity, level of technologies, partner characteristics, and company's in-house innovation culture. Additional empirical research will reveal deeper insights into the organizational design of the integration process and the viable IT support, based on key layout elements and parameters. Fourth, future research should also thoroughly consider economics of using IT to enable innovation processes - cost and benefit analysis, and pros and cons of adopting IT tools comparing with other traditional approaches. Finally, the findings presented are based on limited number of organizations. We acknowledge and understand the issue of generalisability, and have taken necessary steps when designing our research. We view our study as exploratory and preliminary, yet insightful. We wish to lay the foundation for future enquiry and therefore to contribute to the highly relevant research stream of showing the role and potential of enabling and supporting demanding open and distributed organizational processes.

On the final note, acceptance phase of organizational innovations such as adoption of new processes, organizational structure, or information technology, is often difficult due to power and political agendas in organizations (Markus et al. 2002). While acknowledging importance of cultural, social, and motivational factors that guide everyday working practices and human behavior, this research addresses the technological aspect of innovation process. Our findings should thus be seen as being embedded in the larger context of human actors, technology, and institutional properties, where technology is only one of many elements of social context that influence patterns of action (Barley 1986; Orlikowski 1992; Orlikowski et al. 2001). Technology can however, as argued by the process value of IT lens, affect the organizational performance, when deployed in a manner that is appropriate for the organizational context into which is being introduced.

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