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ABSTRACT

The paper examines requirements for IT support in open innovation within companies. Based on an in-depth single-case study, we derive four major levels of IT requirements: incentive & inspiration, information & knowledge, communication & collaboration, and feedback & feed-forward. The multitude of requirements identified on each level clearly points to the need for IT support during the internal open innovation process. The paper concludes that many findings from prior research on innovation management systems apply to the internal open innovation context as well, but with some interesting differences. An IT system for open innovation within a company should pay particular attention to the incentives and inspiration of employees. The system should motivate all employees to participate in open innovation and stimulate innovative ideas by indicating clear benefits as well as recent needs, challenges and developments in their company's context. Furthermore, a virtual community seems to be a powerful concept for driving open innovation in the company. It fosters the activity of and the interaction between employees, thereby addressing all of our requirement levels. To build and run such an intra-organizational open innovation community, social software offers useful concepts and applications. Based on the identified requirements, we present initial concepts for their implementation.

Keywords: Internal Open Innovation, Innovation Process, IT Support, Requirements, Social Software.

INTRODUCTION

In the last years, there has been considerable research on innovation in the scope of new products, services and business models (Garcia and Calantone, 2002). One major reason is that the ability to generate, refine, and develop ideas through an effective and efficient process towards commercially valuable innovations becomes more and more crucial for companies in order to succeed in their markets (e.g., Cohen and Levinthal, 1990; Brown and Eisenhardt, 1997; McGrath, 2001). The importance of this ability is even fortified by the continuous shortening of product life cycles and the increasing globalization (Tan, Kannan, Handfield and Ghosh, 2000).

Traditionally, a company's innovation process was located in the research and development (R&D) department where dedicated specialists developed solutions in a more or less closed environment (Chandler, 1990). In an attempt to reduce the dependency on the "single genius" and to leverage external know-how, companies increasingly opened their innovation processes in recent times, integrating customers and other external partners (Chesbrough, 2003; von Hippel, 2005; Reichwald and Piller, 2006). A very successful example for implementing the open innovation paradigm can be seen in the open source software industry. West and Gallagher (2006) contributed considerable research on challenges and strategies in this industry and pointed out the need to transfer the open innovation approach to other industries.

However, one important group of potential innovators has been quite neglected in practice and research so far, namely the employees of a company. At present, innovation management from an employee perspective is usually limited to the idea submission by means of a physical or virtual mailbox. If accepted, an idea is typically handed over to the internal R&D department and then processed without further interaction with the idea initiator. This process can be regarded as a major shortcoming of current innovation management as significant potential for innovations can be found at the interfaces of organizational units and between actors (Tsai, 2001; Shipton, West, Dawson, Birdi and Patterson, 2006). Therefore, we seek to integrate all employees of a company along the innovation process, what we call internal open innovation management.

Even though, open innovation usually refers to the inclusion of externals; we believe that the open innovation paradigm can also be transferred to an internal setting. Therefore, our understanding of this paradigm includes all innovation activities which are performed outside of a dedicated R&D organization or organizational unit respectively.

Of course, when integrating an increasing number of actors in the innovation process, new Information Technology (IT) systems should be taken into account to accelerate productivity growth (Bartel, Ichniowski and Shaw, 2007). For designing and implementing an IT solution adequate for supporting internal open innovation, in a first step, it is necessary to gain a detailed understanding of the concrete requirements. This phase is particular crucial as mistakes cascade through all following phases of system design and implementation (Browne and Rogich, 2001).

Research and practice have already produced a sound body of knowledge and a considerable number of IT systems for traditional innovation management (Cooper and Kleinschmidt, 1990; Cooper, 2008). In addition, easy to use and cooperation-oriented Web 2.0 concepts and applications – like social networks, wikis, and blogs (O'Reilly, 2005; Ma and Agarwal, 2007) – seem to be promising for fostering open innovation. Here, we can observe a growing number of practice-driven web platforms for open innovation across companies. However, none of these platforms explicitly addresses the unique challenges of internal open innovation. Consequently, we do not know to what extent these approaches can satisfy the specific requirements of open innovation management systems within a company.

The paper at hand aims to fill this gap by examining, and extending where appropriate, the key conclusions from this stream of research within the specific context of internal open innovation. It addresses the following research questions: "*What are IT requirements for supporting the internal open innovation process?*" and "*How can these requirements possibly be implemented?*" To examine these research questions, we employed a qualitative approach using an exploratory interpretive in-depth single-case study.

The paper is structured as follows: the next section positions our research in the context of prior literature and existing innovation management systems. We then describe our research methodology. Finally, we present our results and conclude by discussing the paper's findings and implications.

THEORETICAL BACKGROUND

Innovation Management Approaches

The starting point for any innovation is an initial idea. In this paper, we focus on all kinds of innovative ideas (see classification by Garcia and Calantone, 2002) which enable enterprises to reinvent and diversify their already existing business fields as well as to adapt new fields (Tushman and Anderson, 1986; Schoonhoven, Eisenhardt and Lyman, 1990). To drive an idea towards a commercial innovation, which means the successful commercialization of an innovative solution on the market, the integration of different actors is required. Regarding the scope of this integration, we distinguish between four approaches for innovation management. These approaches can be classified along two dimensions: (1) the underlying *paradigm* which spans from closed to open innovation, and (2) the *sourcing decision* which ranges from internal to external innovation. The different approaches and the associated key stakeholders are illustrated in Figure 1.

Figure 1. Innovation management approaches and key stakeholders

Traditionally, innovation management was mainly rooted within a firm's R&D department (Chandler, 1990). We call this classical approach **internal closed innovation** management. Here, innovation management is solely performed within a dedicated internal domain of knowledge, usually even within an organizational unit. In the last years, companies have

directed their attention to external R&D firms and outsourced innovation management activities to such firms (O'Connor, 2006). We consider this approach as **external closed innovation**. While the paradigm still relies on dedicated innovation specialists, it leverages external know-how.

Evidence suggests that companies have to extend their innovation process towards an interactive, distributed and open environment (Chesbrough, 2003). Consequently, we were able to observe an opening of the innovation process in the recent past. This phenomenon is described by terms like "interactive value creation" (Reichwald and Piller, 2006), "democratizing innovation" (von Hippel, 2005), and "open innovation" (Chesbrough, 2003). In this context, companies integrate external stakeholders into their value creation (e.g., by means of Internet platforms) in an effort to develop innovations. Therefore, we call this approach **external open innovation**.

As pointed out by prior research, there is still a huge potential for innovation located within each company (Tsai, 2001; Shipton et al., 2006). Hence, we believe that one major group of stakeholders received too little attention in regard to innovation management up to now, namely the employees of a company. This stakeholder group holds a significant innovative potential for several reasons: First, it is familiar with the company. Second, it links internal R&D and external stakeholders. Third, it is particularly interested in the long-term success of the company. Finally, it has a high influence on the successful implementation of an innovation (O'Connor and Ayers, 2005). Thus, we devote our research to the so called **internal open innovation** (see grey matrix field in Figure 1) which aims at opening up the innovation process to all employees of a company.

Innovation Management Process

In prior literature, there exists a multitude of different process models for innovation management (e.g., Crawford, 1994; Hughes and Chafin, 1996; Vahs and Burmester, 1999). This can be traced back to the variance of goals, emphases and underlying problems in innovation management. Furthermore, the company industry and culture have a significant impact on the applied process model. However, prior research does not suggest a specific process model for (internal) open innovation in regard to phases and their sequence. Here, we assume that the differences between the four innovation management approaches introduced above are rather located in the single process phases, i.e. in the specific actions taken according to the characteristics of each approach. As a consequence, we use a generic five-phase innovation management process in the style of Tidd and Bessant (2009), which is shown in Figure 2. This general process also ensures an adequate flexibility for our research.
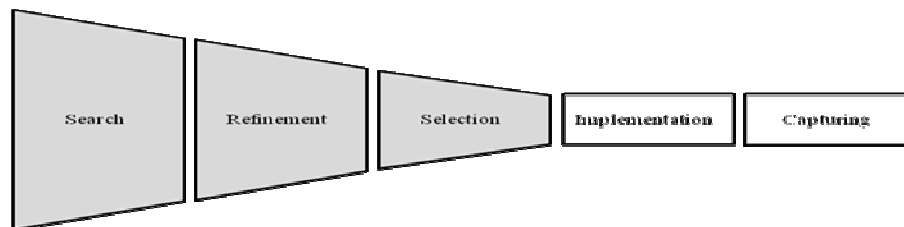

Figure 2. Generic innovation management process

In our research study, we focus on the fuzzy front end of the innovation management process; more precisely the search, the refinement, and the selection of innovative ideas (see grey highlighted phases in Figure 2). This can be reasoned by the particular criticality of these early phases. In contrast, we exclude the implementation phase, due to its traditional project management character, and the capturing phase, due to its retrospective point of view. These two phases incorporate a totally different set of actions, methods and stakeholders, and therefore require a dedicated research study.

The initial **search** phase deals with the identification of existing problems and the generation of basic ideas that might grow into innovations (Tidd and Bessant, 2009). In the **refinement** phase, an initial idea gets shaped and concretized, attracts contributors and enhancing ideas, shortly, it incubates (O'Connor, 2006). This phase is particularly important as a basic idea behind an innovation requires a certain time in its fuzzy front end (Khurana and Rosenthal, 1997; Verworn, Herstatt and Nagahira, 2008). The goal of the **selection** phase is to assess the potential innovation, for instance, in terms of costs and benefits as well as strategic and competence fit (Tidd and Bessant, 2009).

At this point, it has to be emphasized that innovation management processes are rarely linear. Rather they run sporadically and are influenced by random changes in the environment (Rice, O'Connor, Peters and Morone, 1998). As a consequence, innovation management projects often resemble more a trial-and-error (Gerpott, 2005) than a structured gate process.

Innovation Management Systems

Classical idea and innovation management systems are primarily workflow-driven. They mainly target at experts and their evaluation of an idea or an innovation (compare Ardilio, Auernhammer and Kohn, 2004). Thereby, these traditional systems often neglect the social interaction between users as well as the integration of other potential contributors, for instance, a company's employees.

A significant trend, based on the paradigm of open innovation, is the rising number of cross-company innovation platforms on the Internet. Basically, the ambition of such platforms like Innocentive, Fellowforce, Tekscout, or Ideawicket is to match seekers (actors describing a concrete problem from their specific industry or domain) and solvers (actors offering a respective solution). Usually the search for a solution is based upon an idea contest, offering financial incentives for the winner(s). Beside these cross-company platforms, single companies are also implementing platforms in an effort to collect ideas, suggestions, and feedback on potential trends from their customers and partners via the Internet. Popular examples include the DellIdeaStorm and MyStarbucksIdeas.

However, all of the web platforms are unidirectional and, thus, do neither support the mutual exchange of ideas, the incremental improvement of innovative concepts, nor the development of a collaborative innovation community. Given the lack of innovation management systems supporting interactive open innovation in general and internal open innovation in particular, it is important to collect and structure relevant IT requirements as well as to reveal possible ways for implementing these requirements.

RESEARCH METHODOLOGY

Given the lack of prior research on IT support in internal open innovation and our interest in studying this phenomenon in its organizational context, we decided to use a qualitative approach. Due to the fact that important influencing factors still remain unknown (Creswell, 2003) and that existing theories cannot be applied to the examined topic (Morse, 1991), we felt this was an appropriate approach.

To gain a deeper understanding of the phenomenon under study, we chose an exploratory interpretive in-depth single-case study (Stebbins, 2001; Yin, 2003). The research objective – exploring how internal open innovation can be supported by IT – asked for an exploratory design. We conducted the research project through an interpretive epistemological lens which led us to the grounded theory method (Stebbins, 2001). This method fits well with the exploratory case study approach. It allows for a detailed understanding which is an essential prerequisite for generating theory inductively from the data (Glaser, 1978). Furthermore, this method helped us to refine the scope of our research, and guided the search for relevant concepts and categories in the empirical data. The implementation of the grounded theory method is characterized by an iterative process (Pandit, 1996). This is reflected in our procedure for data collection and analysis, and allowed us to link theory and data (Eisenhardt, 1989).

Data Collection

In order to find answers to our research questions, we needed a revelatory case containing a firm that is currently adopting the idea of internal open innovation. As we were asking this firm to share with us their experience, it was important to have a trustworthy relationship with it. Thus, we decided to do our study with a firm from the IT service sector with which we have a longstanding and excellent relationship. In this firm, we found an internal team dedicated to develop innovative solutions for a new business field. The team consisted of 14 employees, thereby covering all relevant domains of expertise of the selected company, i.e., from innovation to business and IT. Our interviews were semi-structured, combining closed- and open-ended questions. Here, we tried to establish a predominantly conversational atmosphere which allowed the interviewees to describe their innovation work related experiences and needs. Initially, our questions covered three major fields of interest: (1) professional background as well as innovation management tasks and experiences, (2) IT support requirements related to innovation-work in general and internal open innovation in particular (for each phase of the innovation process), (3) and familiarity with social software and its potential contribution to open innovation within a company. Depending on the expertise and knowledge of each interviewee, we followed up and delved deeper on specific points. This setting allowed us to gain deep insights into the requirements for an internal open innovation management system.

Firstly, we conducted a total of twelve interviews for our primary data collection, resulting in 18 hours of interview time and more than 100 pages of field notes. Unfortunately, we were not able to interview two team members due to access difficulties resulting from employee fluctuation and sabbatical. However, as hardly any new insight was gained from the last interviews

(Glaser and Strauss, 1967), we felt convenient with relying on the collected data. Table 1 provides information on the interviews, including the interview duration and participants.

We conducted interviews with team members from both the management (six interviews) and the staff level (six interviews). The benefit from including both perspectives was to get a more complete picture of the phenomenon under study. The interviews were held in a semi-structured manner and were carried out by two members of the research team. The average interview time was one hour and 15 minutes, although we also had interviews which lasted more than two hours. In an effort to ensure the open nature and the authenticity of the informants' statements, we decided to keep written records of the relevant contents rather than to record them (Urquhart, 2001). We transcribed the interviews immediately after each interview session (Eisenhardt and Bourgeois, 1988; Walsham and Sahay, 1999).

	First iteration	*Second iteration*
Number of interviews	9 (all onsite)	3 (all onsite)
Total duration	12 hours	6 hours
Interviewee [code]	Innovation Managers (2x) [A-B] System Manager [C] Team Manager [D] Business Analysts (4x) [E-H] Technical Analyst [I]	Innovation Managers (2x) [J-K] Business Analyst [L]

Table 1. Overview of interviewing iterations

In a first iteration, we conducted nine interviews over a period of two months. Based on the analysis of these interviews, we realized that we were about to generate valuable insights. However, we also realized that we needed additional data to theoretically saturate the identified concepts and categories. Thus, we carried out three more interviews between July and August 2009. In this second iteration, we asked more focused questions related to the concepts and categories derived from the first interviews.

In addition to the primary data, we collected secondary data for triangulation purposes. This included workshop materials and meeting protocols. Furthermore, we received project and status presentations as well as tool documentations. We compared the primary data collected from the interviews with the secondary data for data triangulation purposes. This increased the reliability of our findings.

Data Analysis

The collected data was analyzed and interpreted by all authors, enabling investigator triangulation. The overall goal was to develop a substantial theoretical contribution in an interpretive and inductive fashion (Glaser and Strauss, 1967; Eisenhardt, 1989). In the style of Beck, Gregory and Prifling (2008), our process for data analysis consisted of three phases.

In the first phase, we sorted the field notes, interview notes, and secondary data to write an analytical description of the case. Writing up the case, we organized relevant findings according to frequently mentioned topics and the hierarchy level of the interviewees. This initial organization of the data helped us to integrate different perspectives on similar issues and was consistent with our selection of the interview partners. After the completion of the first interview round, we entered into an iterative process of analyzing the collected data and searching the existing innovation management literature for relevant concepts and categories. Having identified four core categories, we refined and narrowed our questions on these categories in the second iteration. This gave us the opportunity for a more detailed analysis and a theoretical saturation of the identified categories and concepts.

In the second analysis phase, we coded the collected data along the theoretical categories and concepts which we derived from the first and second interview round. In this phase, we moved back and forth between the data analysis and possible theoretical conceptualizations. Through this iterative process, we ensured that our interpretations fit with the theoretical definitions (Eisenhardt, 1989).

The third phase of our analysis was a theorizing phase. To assure the consistency and validity of our results, we re-evaluated the derived categories and concepts within the research team. Here, we identified critical issues and discussed possible interpretations. Such an approach is consistent with the exploratory and interpretive research design chosen for this study (Stebbins, 2001; Walsham, 2006).

RESULTS

Based on prior literature on virtual collaboration (e.g., Gross and Koch, 2007) and IT support for innovation management (e.g., Leimeister, Böhmann and Krcmar, 2005) as well as our in-depth case study, we were able to derive four core categories or levels of requirements for an IT system supporting open innovation within the company. First, the system should attract employees to participate in their firm's innovation management activities (*incentive & inspiration*). Second, it should provide employees with all relevant contacts, data, documents etc. in their firm (*information & knowledge*). Third, it should facilitate to build virtual teams of employees working on a problem, idea or innovative concept, as well as to collaborate and communicate within these teams (*communication & collaboration*). Finally, it should drive the exchange of information and opinions between such a virtual team and other employees outside this team (*feedback & feed-forward*). The resulting IT requirement levels are illustrated in Figure 3.
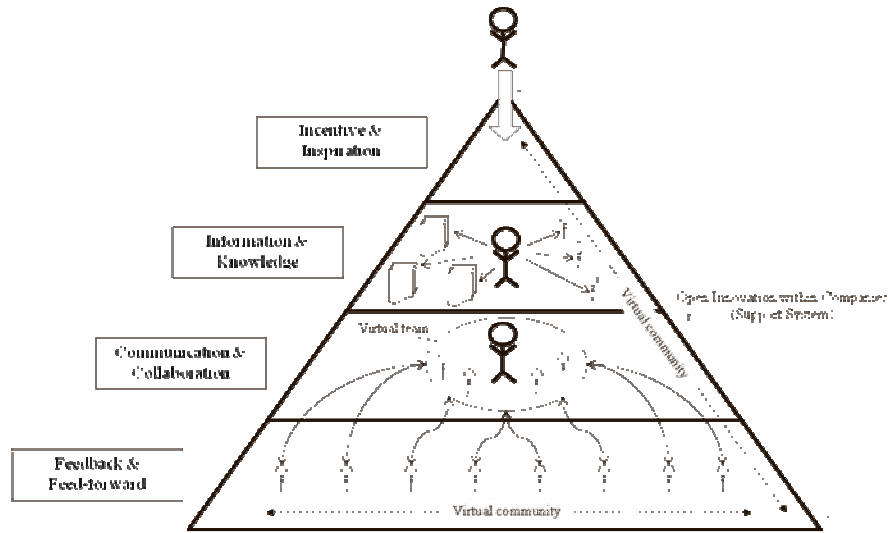
Figure 3. Levels of IT requirements for an internal open innovation support system

Combining these levels of requirements with the phases of the innovation process we focus on, we were able to derive more specific IT requirements for internal open innovation management. These requirements are summarized in Table 2. Here, we merged the refinement and selection phases as the selection of an innovative concept often happens within the refinement process in an iterative manner. Therefore, it is difficult to draw a clear border between the requirements of these two phases.

Phase / Level	Search	Refinement & Selection
Incentive & Inspiration	Enable posting of a problem / idea Show current problems / ideas Publish contributor rankings Call attention to recent developments Create "we-spirit"	Keep people informed about ideas Bring people together Let people get publicity for their ideas
Information & Knowledge	Structure and visualize ideas Connect problems with former ideas Inform people on status of current ideas	Make existing knowledge & skills transparent Show idea context Integrate relevant information & knowledge
Communication & Collaboration	Find relevant people Facilitate making contacts Enable offline integration	Provide a virtual desk Facilitate task management Offer approved evaluation methods
Feedback & Feed-forward	Allow for first evaluation Avoid redundancy Send out notifications	Enable detailed evaluation Send out reminders Allow for merchandising of ideas

Table 2. IT support requirements for internal open innovation

The matrix above shows our core concepts on the different requirement levels along the focused process phases. In the following sections, we describe each concept in more detail by explaining its implications and presenting possible concepts for its implementation. If suitable, we highlight literal quotations from our interviews in an attempt to further clarify the basic idea behind a concept.

Incentive & Inspiration

Search: During the search phase, it is important to provide employees with a company-wide platform where they can post existing problems and ideas. Such a "posting board" should be implemented in a semi-structured way. This is helpful because, on the one hand, employees should not be "squeezed" in a pre-defined structure. On the other hand, some form of structure helps employees to clearly describe their thoughts. Further, a virtual "posting board" would create a sufficient transparency of current problems and ideas. This might encourage people to contribute to their colleagues' thoughts, thereby depicting additional aspects of an outlined problem or heading suggested ideas into further directions.

The publication of contributor rankings (e.g., "most innovative people") might stimulate the ambition, and therefore the activity of people. Besides publishing such rankings within the internal open innovation support system, these rankings can also be integrated into popular places on the Intranet.

To inspire employees as well as to align their thinking with corporate goals, it is important to call attention to recent developments in the company and industry environment. Relevant contents can reach from general developments like new technologies to more specific developments like recent legislative changes. Here, the offering of (personalized) RSS newsfeeds or podcasts (as technological means) and the provision of summaries could be auxiliary.

"People do not wake up until they feel themselves as part of a community." [Interviewee A] [1]

Another major challenge is to create a community-like "we-spirit". This shall enable interaction with other employees and the formation of interest groups. Furthermore, it unhinges people from daily business, allowing them to think freely and to discover new ideas. As personal profiles form the basis for a community, the customization of the level of anonymity can be regarded as crucial to gain trust.

Refinement & selection: To inspire and incentivize people within the idea refinement and selection phase, it is important to keep them informed about the status of (their) ideas. This requirement addresses the process transparency and can be implemented by means of personalized notifications.

In an effort to extend classical idea management systems, an internal open innovation system should drive interaction among employees. As a consequence, people might not feel themselves to be "lone fighters" but "part of something bigger" (e.g., interest groups). This "we-spirit" may also help to overcome the frequently observed attitude towards blocking the transfer of knowledge.

"It is nice to know something which others don't know." [Interviewee G]

To motivate people, it is important that the system supports the selling of an idea. Here, for example, the "idea of the week" (based on user ratings) could be published on the start screen. By getting publicity, an innovative idea might create its own momentum. First, potential helpers may be attracted to contribute to this idea. Second, a group of supporters may promote this idea across the company, thereby making it more difficult for others to reject a potentially good idea. Third, management attention may be drawn to this idea, possibly increasing the likeliness of later implementation.

Information & Knowledge

Search: When searching for information and knowledge, employees request an integrated pool of relevant data and documents. This could be implemented by the integration of a company-wide wiki system. Further, employees request methods and tools to structure and visualize information and knowledge which is related with an idea. Basically, this can be done via some form of mind mapping functionality. Such a mind map allows attaching important notes and references (e.g., documents, persons) to an idea in a systematic and graphical manner. In this context, it is of particular importance to define a minimum set of mandatory fields which are necessary to adequately describe the idea.

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[1] All interviews were conducted in German. For this reason, the interviewees' statements have been translated to English. For privacy reasons, we used an alphabetical coding scheme to specify the interviewees.

From our interviews, we learned that the connection of current problems with former ideas represents a fundamental requirement. Particularly in larger enterprises, it is often not transparent which possible solutions have already been discussed in the past. From a more technical perspective, this issue could be addressed by an idea and problem database. Based on a network approach, such a database should provide advanced search functionalities in an attempt to find related ideas as well as similar problems. Moreover, to keep people informed on the status of current ideas and problems, system components like RSS newsfeeds, podcasts, and blogs were suggested by the interviewees.

Refinement & selection: Particularly in the process of refining an idea, it is crucial to know which employees possess which skills and knowledge. The IT support system should make this information transparent. Based on a skill database similar to a social network, employees should be in the position to create their own profile in which they store relevant experiences (especially former projects) and qualifications, as well as to search for profiles relevant for their idea or problem.

"It is important to understand the context and the history of an idea, how else is one able to work on the idea." [Interviewee F]

When working on an idea, we were able to infer from several interviews that the context of an idea is eminently important. Primarily, this context should comprise information on the status and the history of an idea, the people behind and interested in an idea, related ideas, as well as the initial idea and problem. Further, the idea context (or profile) should also be the place where related knowledge from different domains comes together. Hence, the context should also contain all relevant hard facts in the sense of documents as well as media and other files. A useful function for organizing these hard facts might be tagging: a system user realizes that a document could be interesting for a specific idea. By "tagging", the user automatically adds this document to the context of the respective idea. As different (groups of) people work on an idea during its life cycle towards an innovation, a clear and easy organization of relevant facts avoids double work.

Communication & Collaboration

Search: Within the initial search phase, it is essential to easily find colleagues who might be helpful for an idea or a problem. To find these employees, the system user should be able to search the skill database (see section 0) for the required characteristics. Alternatively, the system should propose relevant employees on demand based on a matching between idea und user profiles. Once a relevant employee was found, it should be easy to contact this employee. This requirement is aimed at the immediate availability of relevant contact data (e.g., building, room, phone number, mobile number, e-mail address, chat nickname) as well as the immediate possibility to make contact with this colleague (e.g., instant messaging, invitation to join an interest group).

"It is important to link creative cells." [Interviewee A]

Another requirement deals with the unpredictable nature of creativity. As creativity appears randomly, the system should provide an offline integration to capture user ideas and comments at any place or time. This is particularly critical when people do not have (constant) access to their firm network (e.g., on travel or at home), or have to sign on to the network each time they want to use the system. In an extended version, it would be imaginable that employees can use a mobile device to store their input in the system, for instance, by sending a short message to a specific number.

Refinement & selection: As the employees working on an idea are often spread over different locations, the system should provide an appropriate environment for distributed work, what we call virtual desk. Beside the integration of all relevant information, the virtual desk should enable easy communication between the virtual team members. In this context, the system should support both synchronous (e.g., instant messaging, voice over IP, and video conferencing) and asynchronous communication (e.g., private messages, discussion forums, and micro blogging).

To enable an efficient collaboration within the virtual team, the IT support system should ease task coordination and management by offering basic project management functionality. Here, it should be possible to structure work packages, set tasks and deadlines, schedule virtual meetings, as well as to define and assign roles to team members. The latter sub-requirement is particularly important as someone ("idea lead") must drive the idea and the collaboration in the team respectively.

"For selecting ideas, sophisticated evaluation methods are required as it is important to investigate several dimensions of an idea." [Interviewee B].

In an effort to select ideas which should be further refined or even implemented, the IT system should provide approved evaluation methods. These methods can range from relatively simple checklists to more sophisticated frameworks, which

evaluate an idea along pre-defined dimensions. In addition, the system could support an idea review process by proposing suitable experts from different domains (e.g., business and IT departments) and coordinating the process flow.

Feedback & Feed-forward

Search: Feedback in the search phase should be restricted to simple rating and commenting functions, allowing for a first evaluation of the idea. Based on this evaluation, ideas can be ranked by different criteria (e.g. best rated or most commented ideas). Such rankings can also be regarded as feed-forward mechanism as they can create (management) awareness for top ranked ideas.

"Experiences and opinions of others are helpful and must be shared." [Interviewee D]

To avoid redundancy, the system could automatically search for related contents whenever someone wants to store an idea or a problem. If the system finds a similar data record, it should ask the user whether his input is identical to the record in the system. Such a matching functionality might help to bundle a firm's resources and intellectual capital from different domains or departments. In addition, the system should send out notifications on newly posted ideas and problems, ongoing creativity sessions, and recently added comments. Here, the users should be able to personalize the notification service by defining relevant events and topics as well as by determining the notification media (e.g., e-mail vs. system message) and mode (e.g., immediate vs. aggregated).

Refinement & selection: Feedback during the refinement and selection phase should enable a more detailed evaluation of an idea. In addition to ratings and comments, scoring and polling can be named as relevant feedback mechanisms for this phase.

To support the management of tasks within the virtual team, automated and personalized reminders about open tasks and upcoming deadlines seem to be useful. Additionally, after a preset period of inactivity, the system could send out reminders to the team members. Moreover, the system should assist the merchandising of an idea. Here, an embedded posting and mailing functionality, which also supports the identification of persons to be included in the mailing list, would be helpful.

DISCUSSION

In this paper, we conducted an in-depth analysis of the IT requirements for an internal open innovation management system. Here, we concentrated on the fuzzy front end of the innovation process, i.e., the idea search, refinement, and selection. By structuring our findings, four levels of IT support emerged: First, mechanisms for *incentivization and inspiration (I&I)* shall activate employees to participate in the creation and the collective development of new ideas. Second, adequate solutions for accessing and sharing already existing *information and knowledge (I&K)* are required. Third, as multidisciplinary and geographically distributed actors are involved in the different process phases, their needs of formal and informal *communication and collaboration (C&C)* have to be met by the system. Finally, *feedback and feed-forward (F&F)* help to keep an innovative idea on track and enrich the idea concept. With regard to these IT support levels, our case study revealed possible concepts for the implementation of the specific requirements on each level. Required functions and supporting IT technologies and tools, with special regard to social software, are summarized in Table 3.

Level	Requirement	Phase		Application				Functionality							Technology / Tool				
		Search	Refinement & Selection	Blog	Social Network	Wiki	Collaborative Filter.	Forum	Commenting	(Instant) Messaging	Microblogging	Rating	Social Bookmark.	Tagging / Tag Cloud	AJAX	Pod-/Videocast	RSS-Newsfeed	Voice over IP	Mashup / Widget
A&I	Posting board	●		●	●	●		●			●			●		●			
	Rankings	●	●		●	●		●											
	Trend radar	●				●		●				●	●	●					●
	"We -spirit"- community	●	●		●			●	●	●	●	●	●	●				●	
	Updates/notifications		●		●	●			●					●	●			●	●
	Interest groups		●		●			●	●				●	●					
	Idea-Marketing		●	●	●	●		●	●			●	●	●		●	●		

Level	Functional requirement																		
I&W	Structuring/visualization	●			●							●	●	●		●			●
	Problem-idea-matching	●			●		●					●	●						
	Status updates	●	●	●	●	●			●		●		●			●			
	Skill search		●		●		●				●		●	●					
	Idea context		●	●	●	●		●	●			●	●	●		●			●
	Information integration (data and documents)		●	●	●	●		●				●	●	●		●			●
K&K	Find and facilitate making contacts	●	●		●			●		●	●		●					●	
	Offline-Integration	●							●										●
	Virtual whiteboard and workplace	●	●		●			●	●		●		●	●				●	
	Task management		●		●			●	●	●								●	●
	Evaluation methods		●		●	●	●					●		●					
F&F	First evaluation	●						●			●								●
	Avoid redundancy	●						●											
	Give and get comments	●	●		●			●	●	●	●							●	
	Notifications	●	●		●			●	●								●		
	Detailed evaluation (scoring /polling)		●				●				●								
	Idea market place		●		●	●		●			●	●	●	●	●		●			

Table 3. Functional requirements and supporting technologies / tools

In a recent study, Leimeister et al. (2005) have identified four levels of IT support for innovation management in general: research, knowledge, project, as well as feedback / feed-forward. These levels basically confirm three of our four IT requirement levels: *information & knowledge* (knowledge), *communication & collaboration* (project), and *feedback & feed-forward*. Due to our focus on concrete IT requirements for supporting the fuzzy front end of the internal innovation process, as well as our discovery and description of the additional *incentive & inspiration* level, we were able to deepen and extend their prior work.

An important aspect of our IT requirements model for an internal open innovation management system is the integration of the company and idea context. Consequently, our model is particularly suitable for discontinuous innovations. Prior literature confirms that this type of innovations requires a considerably higher degree of context sensitivity than incremental innovations (Rice et al., 1998). In this connection, it has to be mentioned that the administrative overhead of an IT system in line with our requirements model might be too big for supporting incremental innovations. However, we believe that a respective system is in principle also applicable and beneficial to incremental innovations. By including all employees of a company, it may release a valuable momentum with regard to the development of an incremental innovation or reveal other associated (discontinuous) innovations.

The paper has significant implications for practice. Most importantly, it clearly points to the need for IT support during the internal open innovation process. Numerous informants acknowledged that such a support can deliver a considerable value added in this process. By integrating relevant information and knowledge as well as relevant stakeholders, it significantly increases transparency. Further, by facilitating social interaction, it addresses fundamental needs of an intact community.

When designing and implementing an IT support system for internal open innovation, companies should pay particular attention to the incentivization and inspiration of their employees. To make a valuable contribution, employees must be aware of recent needs and challenges of their company as well as recent developments in their company's context. Furthermore, they must know and understand their own and their company's benefits resulting from participating in internal open innovation.

Finally, companies should aim at creating a virtual community within an internal open innovation system. This might be a powerful approach for driving the innovativeness of the company as a virtual community addresses all of our requirement levels: it motivates employees to share ideas and to give feedback on ideas. Further, it propels the exchange and cooperation between employees (Gross and Koch, 2007), thereby shaping a pool of (hidden) information and knowledge. In this context, social software can make a major contribution to build and run a virtual community. For instance, by offering user profiles as well as mechanisms to manage user relationships, social networks drive the externalization of secondary knowledge and

hidden competences (Nonaka and Takeuchi, 1995). Moreover, wikis allow for the cooperative integration of information and the provision of feedback.

The above implications for practice must be viewed in light of some limitations of the paper. First, consistent with its theory building orientation, the paper is based on one in-depth case study. This prevented us from applying statistical methods, for example, to rank and pre-select a set of particularly relevant requirements, or to test relationships between requirements. Moreover, the reliance on a single case study makes it difficult to transfer our results to other companies or industries in their entirety. However, based on the discussion of our results with other industry partners, we found that our basic requirement levels and associated concepts are also valid in their environments.

Second, our research has been conducted within a specific group of employees devoted to the creation of innovative ideas and concepts. Although the group members have multidisciplinary backgrounds and spend most of their time on daily business issues, they already share the common vision of internal open innovation. As a consequence, we do not know whether the IT requirements stated by the group members are fully congruent with those of employees outside this group.

Third, in regard to the identified IT requirements, the paper only suggests basic implementation concepts which were named by the interviewees. Further research must extend and refine this mapping by additional and concrete implementation concepts. Here, we propose a more detailed perspective which already translates relevant concepts into technical requirements and software applications.

In conclusion, another major opportunity for future research emerges from this study. The paper has derived a comprehensive set of IT requirements. To evaluate and implement these requirements, the development of a software prototype might represent a next logical step towards an internal open innovation management system (Hevner, March and Park, 2004). This artifact may generate valuable data and experiences for the evaluation and the implementation of the identified requirements.

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