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Visualization of Problems in Experience Sharing

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Abstract
The focus on knowledge management has long since been recognized in the literature and undoubtedly has benefited organizations. More recently, companies claim to be 'knowledge-driven'. Indeed, the concept of *knowledge-driven* incorporates experiences. Typically, factual knowledge has a transparent management approach, whereas experience sharing is highly prioritized but not straightforward. This study addresses experience sharing and proposes a perspective to support reflection upon practice in innovation projects. The study builds on a longitudinal acquisition of empirical data obtained in a manufacturing company acting in a global market. In particular, early innovation projects have been a source for data collection. Interviews with knowledge workers, observations from daily work activities, and readings from internal documents provide the empirical material for the study. The study has resulted in a visualization of different kinds of issues concerning experience sharing. The visualization has been a base for highlighting industrial implications and proposing actions.

Keywords: Experience Sharing, Knowledge Management, Team Based Innovation

1 Introduction

Knowledge transfer has long been recognized as important to organizations [1], and knowledge management (KM) has been stressed also as a social process. KM is claimed to be an instrument of organizational learning, and not just management and transfer of a technical procedure [2]. Product development builds on internal as well as external knowledge sources [3], and such knowledge needs to be managed in some way or, rather, in some ways. KM includes different approaches, one controlling and monitoring factual knowledge and one addressing experience sharing to empower daily project work [4]. Doing either or is not an option because the different concepts of knowledge are interrelated [5] and necessary for executing innovation activities. Experiences come from reflecting *in* and *upon* practice [6], and thus relate to pre-knowledge and perspectives of individuals. Members of innovation projects possess—due to the explorative nature of the work—a vast number of experiences. Thus, capturing and disseminating experiences is undoubtedly a vital concern for organizations.

A major challenge for knowledge transfer is accurate communication [7], which means that knowledge must be treated according to how it might be used in a given situation—thus how it will be useful for others. Consequently, *"knowledge with a proven record of past usefulness is less difficult to transfer"* [7]. Because factual knowledge has a transparent management

approach, it eases the knowledge transfer process. In contrast, experience sharing is highly prioritized but not as straightforward as the situation described above because of its abstract nature and immature state. This study addresses experience sharing and therefore focuses on the social/know-why type of knowledge—that is, the experiences that evolve in day-to-day activities in engineering teams and often fall into the category 'lessons learned'.

2 Methodology

The study builds on a longitudinal acquisition of empirical data obtained in a manufacturing company acting in a global market. The company has been recognized as an innovative organization and is becoming more and more global in their development activities. The company's different divisions are situated all over the world: manufacturing, research and development, as well as sales offices. The parent company is located in Scandinavia, which is also the case for a large part of the R&D; nevertheless, most projects are global. Data are gathered from three different company sites. In particular, early innovation projects owned by the R&D organization have been a source for data collection. The company can be described as project-based; typically not all functions are available—or even desirable for being utilized—from the same site. A manager can be located on the opposite side of the world, as is the core engineering team. Thus, the organization consists of both vertical and hierarchical structures that influence knowledge conversations.

In addition to participation in local meetings, participation in distributed meetings between partners from different sites has contributed to a holistic view and a more detailed understanding of challenges in such collaboration. Besides observations, data are gathered from interviews and workshops with employees from two types of projects. One deals with technology investigation and conceptualization activities (owned by R&D) and the other project type deals with industrialization and exploitation—that is, execution projects. It is natural that the first type of project follows the second one in sequence, and thereby knowledge transfers and experience sharing are crucial activities that drive the progress of product development.

In this study, 17 interviews with knowledge workers (i.e., engineers, managers, and experts) have been conducted at different sites; the duration of the interviews was 30–120 minutes. The interviews followed a semi-structured approach, meaning that no precise question guide was used. Rather, the use of key topics articulated areas of interest in which the informants could, and should, formulate their answers freely in relation to the themes. The themes were: knowledge transfer and experiences and, also, the formalization of them. The interviews were performed both face-to-face with the informants and by using technologies for distributed communication. The semi-structured approach encourages the informants to explain their personal views; thus, such an interview format provides a rich breadth of qualitative data [8] and can result in new, unexpected patterns that originate from the informants.

The observations were done by shadowing daily activities, but also by observing distributed work (from one site) among global teams. Participatory observations also have been done while making longer visits at the company's sites—for example, six weeks at the parent company and one week at the other global sites. Field notes were taken during the observations to make it possible to go back and reflect on activities but also to exemplify situations as is done in this paper. Finally, the company provided free access to project portals and, thus, the possibility of following the projects' daily work and tests on distance. Finally, reading internal documents provided additional empirical material for the study.

3 Knowledge transfer and experience sharing

In early development projects, the body of knowledge is a mix of different domains, competences, and skills that can be possessed by the stakeholders involved. The work involves knowledge activities, which provide the base for eventually building up a *'complete formula'* to accomplish the goal of a project [9]. During development work, numerous decisions have to be made, although the body of knowledge and information on which these decisions are based is not only immature, but also changes over time. Thus, there is a need for a continuously on-going and dynamic process [10] of knowledge creation in which individuals communicate and interact.

Knowledge creation is commonly explained in terms of explicit and tacit knowledge. The two types are outlined as two separate entities, although they should be seen as complementary [10][11][12]. The category *explicit knowledge* can be described by the concept of *'know-what'*, which relates to theoretical and formal knowledge [10] and also to facts. The category *tacit knowledge* can be exemplified by experiences, which are deeply rooted in actions and often refer to the concept of *'know-how'*, that is, practical knowledge built up within a specific context [13].

Individuals learn from successes, but also from mistakes if they reflect upon their actions—that is, they gain experiences from daily work activities. Experiences are personal and refer often to practical and local knowledge in a specific context [13]; however, experiences also are relevant for others to learn from. If that is so, a major challenge is to capture and disseminate the experiences. Individuals need to reflect upon their own previous knowledge to be able to learn from a new situation—that is, to gain *'actionable understanding'* from others' experiences.

The literature discusses that at least two parties need to be involved in knowledge sharing [13]: one of them possesses experiences that the other person needs to acquire. Knowledge sharing is often labelled as either of two concepts: knowledge transfer [1] or knowledge sharing [13]. Knowledge transfer is mainly used to describe the movement of knowledge between larger units, for example, between departments, divisions, or the organization itself [1][13]. The literature claims that transfer can occur implicitly without articulating the knowledge [1], although knowledge transfer is, as it is presented in the literature, mostly applicable in situations where explicit knowledge is communicated. Knowledge sharing refers to a collaborative interest by individuals in making knowledge available to other individuals [13].

Experiences, which are part of both knowledge transfer and knowledge sharing, need a context to be understood by another individual. The transfer or sharing between individuals—from and to the inside and/or outside of an organization—thus depends on the transfer or sharing of the context also [7]. The importance of knowing the context will be even more evident in global development teams, which face the advantages and challenges of a so-called *'double periphery'*, meaning that the teams have to work across horizontal/geographic boundaries and vertical/hierarchical boundaries [14]. Research has shown, on the one hand, that for one-way communication and for conferencing solutions, technological supports (e.g., ICT) are invaluable [15]. On the other hand, technological support also becomes a barrier to experiencing conversations. For example, a large part of the time in distributed meetings is spent on 'working the technology' rather than on working together [16]. Consequently, the contemporary technologies, which are used to support knowledge transfer in global development teams today, do not fully support the social and experience sharing dimensions

of collaboration. Many companies work with innovation and early development tasks in a project-based organization format—that is, a temporary organization for solving a specific task over limited time and with an allocated budget [17]. The project-based format intentionally gathers individuals with different skills and experiences from different knowledge areas. This also can be described as an initiative for a learning environment—a *'learning laboratory'* [18]—in which team members interact and create new knowledge as well as generate new experiences from daily work.

The daily work in projects typically is reflected on after the project has ended, the opposite of learning in which reflection occurs continuously. The creation of new knowledge in collaborative teams builds on the interactions between the team members and the sharing of their experiences. It is stressed in the literature that the procedure for how sharing is carried out is of utmost concern [19]. For example, Sveiby's [20] model of knowledge transfer strategies distinguishes three knowledge transfer structures: internal structure, external structure, and individual competence. This model thus describes not one, but three different procedures. The nature and the characteristics of the knowledge contribute to the difficulties of knowledge transfer, for example, the culture/work environment [7][13], knowledge leakage, and stickiness [21]. When knowledge is not transferred or shared, a gap is created between what is known in a given context—or in Sveiby's [20] words, a given structure—and what knowledge actually is in use. It is emphasized that knowledge gaps occur because organizations do not know how to share experiences [7].

The iceberg metaphor is commonly used in the literature to illustrate that there are dimensions or aspects in an organization's knowledge base that are hidden: the larger part of the iceberg that is hidden under the water represents tacit knowledge (e.g. [22]). The metaphor indicates simultaneously that the organizational knowledge base depends on people's activities and that KM systems might cover only the visible parts of an iceberg. An aspiration of using KM is therefore to manage those daily work activities of knowledge workers [2] to make their knowing into an organizational asset—to 'bring it to the surface'. A knowledge worker is a person who works with tasks of developing and/or using knowledge; the percentage of routine work is hence very low. Knowledge workers manage, coordinate, and possess technical and socially constructed experiences, but they also need to identify, capture, store, access, share, use, learn, and generate/acquire knowledge as part of a knowledge life-cycle [3][23].

4 Knowledge management problems

The analysis of the empirical data for this study resulted in a view of different KM problems. Inspiration from the iceberg metaphor rendered a metaphor of a mountain instead (see Figure 1), because it was found difficult to illustrate and discuss KM problems based on only the analysed categories. The idea of introducing a mountain can be linked to previous literature of learning and competence, the different stages where water pours down the mountain relates to e.g., 'platforms' in the ladder of competence [24], and the 'water cycle' links to knowledge life-cycles [3][23]. It has also been found that, depending on the role of those who are looking at the visualization, different realities and challenges were seen in the problems. The knowledge mountain showed that the respondents were able to pinpoint both knowledge leakage and stickiness, but were also inspired to discuss how to deal with the identified problems. The benefit of discussing knowledge flows is that it starts a continuous learning process [3].

- Company knowledge creek (A in Figure 1): Product development is often described as knowledge-intensive work, and companies begin to view themselves as knowledge-

driven organizations. They acquire knowledge over the years, which represents a large portion of the organizational assets that need to be continuously maintained and updated. Discovering how to renew and complement existing knowledge is increasingly important for manufacturing companies, which intend to make the movement towards becoming solution providers and entering new markets that require a life-cycle perspective on their offers.

- Refreshing rain (B in Figure 1): A new employee requires more time, support, and training to complete a work task; companies say that it typically takes at least six months for a new employee to become acquainted with the basics and years before the new recruit has developed confidence in most tasks. In addition, guidance in whom to ask in daily work is often lacking. An informant stressed this issue: *"Once, I needed an expert; I asked my colleagues and after a while I found one guy sitting 10 meters from my desk."* This indicates that employees—and new recruits in particular—do not know with what tasks others are working.
- Bridge to partners (C in Figure 1): Identifying and closing knowledge gaps supports moving towards knowledge-driven development that can provide more flexible product development, for example, in addressing life-cycle offers. If companies are not creating new knowledge to close the gaps, any development project risks repeating mistakes and *'reinventing the wheel'*. One informant did stress the issue of not being able to find the missing pieces and argued for an internal source; *"I think we have the competence to do this … some say the opposite and invest money in taking in external knowledge for something we could do ourselves. That's very frustrating!"* 'Bridging the gap' to partners and gaining new insights from their perspectives of a development problem were also found to contribute to an overview of what happens in a wider area, for example, within the industry or within the area of a technology. Simultaneously, employees need to be acknowledged for their efforts and challenged to learn anew.
- Management dam (D in Figure 1): KM is well established in the manufacturing industry, although existing support manages mainly the explicit dimensions of knowledge by using so-called 'heavyweight' [26] tools, for instance, Knowledge Based Engineering (KBE), Product Data Management (PDM), and Product Life-Cycle Management (PLM) systems. Calling them 'heavyweight' stresses that maintenance of them is needed if they are to stay up-to-date and provide relevant and reliable results; they could therefore be categorized as the first wave of KM [25]. The tools support knowledge creation, but knowledge sharing is delimited to formal documents due to the tools' function as repository systems and their purpose aimed mainly at control. Individuals do not share knowledge just through formal text-based documents. One informant said: *"Communication just in text is tricky; you get no feedback on whether the text is interpreted as intended. There are dimensions 'lost in translation'."* Knowledge sharing is part of the daily work, and few efforts empower creative knowledge workers to reflect and learn.
- Leakage stream (E in Figure 1): Facts, reports, results from calculations and analysis, and final project results are well known by the team members involved in a specific project. Experiences, design intent, or similar reflections are not shared easily in a traditional KM tool. Experiences are individual and context dependent, often shared on an operational level, although sometimes they 'leak' to colleagues or others irrespective of their actual contribution to the project. Sometimes they are not fully shared. One informant explained his view; *"Sharing my experiences and lessons learned? As it is, I'm not sure it could be done."* This could be interpreted as any attempt to share experiences coming with a certain degree of 'leakage', in which the content of the experience evaporates in the 'stream.

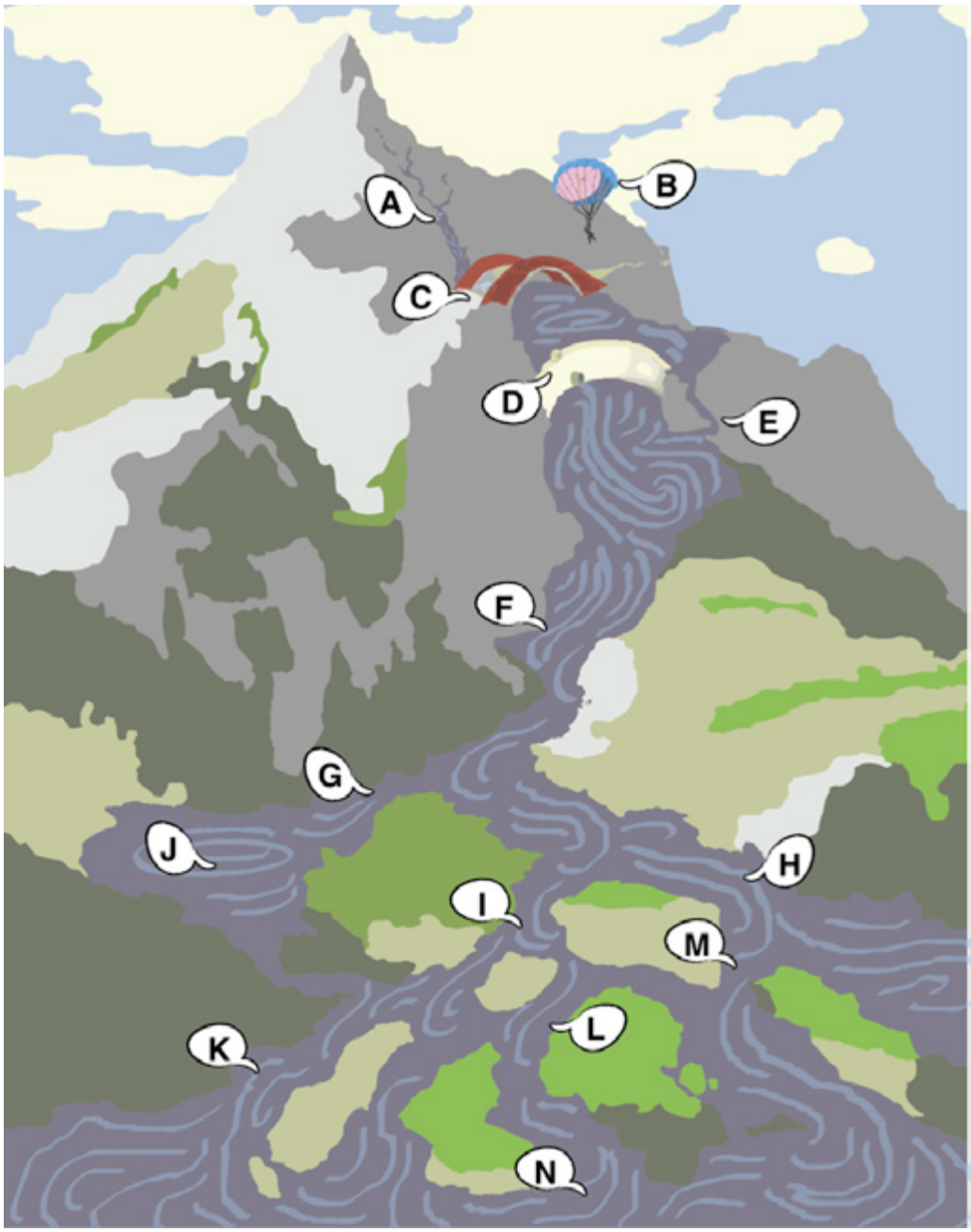

Figure 1. Knowledge Mountain: a way to discuss knowledge problems

- River of competence (F in Figure 1): Experiences acquired by individuals in previous problem-solving situations save time and effort in future projects under the conditions that the experiences have been contextualized and transferred and that they make sense in relation to actual knowledge. Knowledge sharing adds to the river of competence, but the fact that experiences are individual and context dependent was highlighted by one informant: *"You have to walk in someone's moccasins to understand how they do and think."*

- Watercourse of turnover (G in Figure 1): Hardly any mid-term or long-term project retains the same individuals throughout the entire project time. Significant efforts are spent on introducing and recapping the work for new project members, but losing a project member, either to another higher prioritized project or to another company, is critical. An informant stated that *"...everyone knows that knowledge goes with any employee leaving the project, but few efforts really address this problem."* Further, a limited number of employees possess domain specific experiences; consequently, they cannot be used in all projects where they are needed. If one of those employees changes his or her role or leaves the company, the handover to others and/or the formalization of experiences are vital.
- Floodgate of reinvention (H in Figure 1): Personnel that have worked for the company a long time are often invaluable sources of experiences; when they retire, their knowledge is lost for new projects. Often 'old' knowledge is sought as a base, for example, in projects that have the intention to draw from the reasoning in an old project because the technology is mature enough at the current point. As emphasized by one informant: *"I cannot know how they reasoned about this particular problem in the 70s and 80s. I guess they were skilled. But, in my situation now, this would be new development and pretty much 'reinventing the wheel' similar to how they did it at that time."*
- River systems delta (I in Figure 1): The introduction of support for knowledge sharing often involves new tools or platforms, but nowadays this is seen often with scepticism: *'Yet another storage system'*. Employees have to search for information, knowledge, facts, measures, and so on in different systems, and in turn they have to feed in their information into different systems. This takes time, and the actual search requires some pre-knowledge of whether the right document can be found. Support is typically built up over time, subsequently ending in a mess of systems that frustrate rather than help the users.
- Lake of competitors (J in Figure 1): An established structure to harvest external knowledge is vital for companies to stay competitive. For example, important activities include keeping up-to-date with trends and changes in the business environment by 'benchmarking' the competitors' products, by 'bench-learning' from other business units, or by screening patents and reports. These activities also go in the opposite direction; competitors are investigating the company to gain from its experiences.
- Access water (K in Figure 1): Informants clarified that *"it is very difficult to access information; we build watertight bulkheads between us. Sometime knowledge should be protected, but sometime it needs to be shared."* Not all information and knowledge assets can be accessible for all personnel; most large companies have restrictions and manage employees' access. For example, project portals are restricted to project members; if any other person needs information, he or she has to ask for it. Yet, the problem also has another dimension, which is related to the work tempo and the slower process of learning—simply, sharing experiences needs conversation and reflection, while projects have to manage deadlines.
- Flood of lost files (L in Figure 1): Different departments develop their own jargon in parallel to the company's formal language. The meaning of different terms change over time, and experiences are interpreted differently depending on the project context. An informant explained, "*There is a lot of information stored in the wrong places."* This is not done intentionally, but results from different ways of understanding the situation. Nevertheless, the result is that necessary files cannot be found when they are needed. Occasionally, the keywords (a name of a person, a name

of a project, a name of a technology, a document number, etc.) for the search are the core problem.

- Fresh idea flow (M in Figure 1): Written documents that are approved by an expert or manager are used with more confidence in projects, but in daily activities, conversations are found to be an invaluable source for new ideas. One informant concluded; *"The day you believe that written text can replace human communication – then you are smoked!"* In order to get a rich flow of fresh ideas, knowledge conversations fill a purpose in complementing management systems when it becomes evident that capturing and formalizing the new ideas into experiences are important.
- Ocean of oblivion (N in Figure 1): Commonly, project experiences and knowledge are captured and formalized after the project has ended. In this way, the last lessons learned—the final concept or the final product—are kept in mind. The different rationales, the logics of critical decisions, the reasons why one solution was discarded in favour of another, and so on, are typically forgotten and are hard to share in hindsight. Further, too much knowledge and too many sources also are related to the problem of forgetting what and where to find information. One informant said, *"We have KBE, PDM, PLM, LL systems, we have white books. We have team place, email, and conferencing systems, I scribble down notes on meetings, and I have a lot stored in my head. Sometimes it feels like too much and everywhere."*

The presented KM problems have implications for the performance of activities on the individual as well as the organizational level. The different aspects such as structures, roles, processes, relationships, contexts, directions, motivations, and so on, address situations that could be managed in different ways if they were done in solitude. One implication of this study is that acting on the problem in solitude creates loose couplings to the relations between the distinct problems. Using the visualization supports company representatives' ability to stress concerns and point at parts of the knowledge mountain to explain their view of a situation in the organization. Further, how to deal with these challenges seems like a possible implication of introducing the knowledge mountain and this way of highlighting/discussing KM as a human-centred activity. The presented issues show that KM problems—to a higher or a lower degree—influence one another, and that different knowledge sources need to be maintained and updated to support experience sharing. Looking at the KM problems in isolation provides a view where there are no connections between them, but they all have an effect on the knowledge sources that are implemented to support product development. Having a single view, or snapshot, means that the breadth and depth of the organizational knowledge base is not obvious. Bringing them together, at least conceptually, leads to a description of different perspectives and provides a base for connected solutions.

5 Concluding remarks

Knowledge-intensive projects are highly dependent on making use of previous experiences to shorten start-up times and get a steeper learning curve. Organizations hence need to improve the way experiences are gained and direct the insights to individuals who can benefit from learning from them. Companies emphasize the importance of knowledge in their development work, but it might be good advice to say that just because the project is successfully completed, the experiences gained by the team members are not necessarily also successful. Judging the quality of a learning process by its outputs is not always viable. Reflections on the initial intentions and the output partially build up the team's experiences, but this requires the possibilities and support to do so. For future studies and for 'packaging' experiences from this research, a set of 'sound questions' is under construction. The effort includes incorporating reflections on a suitable social context [27] and a method to spread local

knowledge for broader use. Moreover, directing the experience statement, for example, in white books, to a certain receiver [28]—to persons in specific roles, for example, experts, managers, or engineers—is already implemented in a suggested method. This approach has been found helpful because it does not support high-level lessons learned, but is more practical.

This study has addressed, in general, experience sharing and its particular challenges. The empirical data has been visualized aided by the metaphor of a Knowledge Mountain. The Knowledge Mountain supported the discussions by bringing at least some tangibility into the social/know-why type of knowledge, that is, experiences from day-to-day activities in engineering teams. The study highlights knowledge leakage and knowledge stickiness to both individuals and to project teams, and discusses the consequences of each. All in all, knowledge conversations that take place more often and not only at the end of projects, for example, as lessons learned, might be a doable recommendation from this study.

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