MANAGEMENT
in project-based organizations: AN INVESTIGATION INTO MECHANISMS

ABSTRACT

In a context of the project-based organization’s (PBO) reinforcement, the question of knowledge management (KM) has become an important issue for companies as well as for research in management. This paper focuses on highlighting and examining the mechanisms that are used to manage knowledge together with projects. Our research is based on a qualitative approach centered on a multiple case study in four PBOs operating in different sectors: IBM, Hewlett-Packard, Arkopharma, and Temex. The analysis of the four case studies enables us to identify and discuss the different mechanisms underlying knowledge management in PBOs. The paper is original because it investigates the framework of mechanisms to improve the understanding of knowledge management in PBOs.

However, the link between these two managerial requirements does not occur without difficulties. The first difficulty concerns learning times. KM and project management are deployed over different temporal horizons of learning. Whereas knowledge takes time to develop and become reliable, project management increasingly meets the requirements of reducing deadlines in the design and development of new products and services. The second difficulty arises in terms of different objectives and results. Whereas KM aims to improve intellectual assets of organizations, projects result in a product, service or technology with objectives of quality, cost, and deadlines. Projects are not prompted by knowledge development. However, project development necessarily involves knowledge development, because tomorrow’s projects will be based on the maintenance and renewal of today’s knowledge. Faced with these two difficulties, we consider that the link between knowledge and project is fundamental to ensure the durability of companies. We have the intimate conviction that this joint management will allow companies to maintain and strengthen their knowledge, gain in effectiveness, and increase their innovative capacity.

From a theoretical point of view, the literature recognizes the need for simultaneously thinking “knowledge” and “projects” (Pruince and Toll, 2000; Kaavi et al., 2003; Lowe et al., 2003; Schindler and Epley, 2003; Brooks et al., 2006; Lindner and Wald, 2014; Horner Reich et al., 2013). Studies of KM in project environments have emphasized the difficulties of learning from projects – not only within individual projects, but also across and between projects (DeFillippi, 2001). Nevertheless, as Lindner and Wald (2014), we consider that contributions are limited in the specification of mechanisms that are used to manage knowledge together with projects. The aim of our study is precisely to highlight and examine the different mechanisms of this joint management. We define project knowledge management (PKM) mechanisms as the mechanisms for creating, storing, using, and sharing knowledge that will aid in the performance of project tasks. In other words, we seek to provide answers to the following question: What are the mechanisms underlying knowledge management in PBOs, and how are they used?

To address this question, our research is based on a qualitative approach centered on a multiple case study in four companies organized by projects and operating in different sectors, including computer services, computer software, food supplements, and electronic components. The four PBOs are IBM, Hewlett-Packard, Arkopharma, and Temex.

The paper is organized as follows. In the first section we carry out a literature review on KM within PBOs (1). We then briefly describe our research methodology (2). We report our findings, highlighting eight mechanisms underlying the link between knowledge and projects (3). We discuss and comment on the lessons learned for KM in PBOs (4) and finally, we conclude our findings (5).

1. Knowledge management in project-based organizations

In the stream of the resource-based view (Wernerfelt, 1984; Barney, 1991), knowledge management refers to the set of practices an organization applies to create, store, use, and share knowledge (Probst et al., 1998). Firms employ KM strategies to: (1) enrich their resources, to encourage innovation and value creation, so as to enhance their performance. This is a process of learning and creating new knowledge (Nonaka and Takeuchi, 1995); (2) emphasize the stock of knowledge as a potential source of competence. This is a process of capitalization and sharing knowledge (Hansen et al., 1999).

Much like KM, PBO has received increasing attention in recent years as an emerging organizational form (DeFillippi and Arthur, 1998; Hobday, 2000; Lindkvist, 2004; Sydow et al., 2004; Söderlund, 2005). However, the interest in PBOs reflects a complex and multipart formality of this organizational form. Hobday (2000) identifies two types of project organizations: project-led organizations, “in which the needs of projects outweigh the functional influence on decision-making and representation to senior management, but some coordination across project lines occurs” (p. 878), and PBOs, where “the project is the primary business mechanism for coordinating and integrating all the main business functions of the firm (with no formal functional coordination across project lines)” (p. 874). Moreover, DeFillippi and Arthur (1998) talk about “project-business enterprises” as organizations that manage production functions within a temporary project organization setting, e.g., cultural industries (film production and theatre) and professional services (public relations and event management). Söderlund (2005) calls these project-business enterprises: “pure temporary organizations”, and defines them as temporary ventures designed and implemented for a one-shot and non-repetitive operation. In this paper, we will concentrate on PBO, which seems to be the most accepted term used to refer to firms that conduct the majority of their activities in project mode and/or privilege the project dimensions over functional dimensions in their structure and processes (Lindkvist, 2004). More precisely, our study focuses on the activities of new product development projects (NPD) and services. The products and services considered are new for the company that develops them, but not necessarily for the markets. The innovation lies mainly in the modification of an already existing product or service within the company.
The link between knowledge and project: a relevant topic

The link between knowledge and project is recognized as essential by researchers (Prencipe and Tell, 2001; Kavi et al., 2003; Love et al., 2003; Schnidler and Eppler, 2003; Brooks et al., 2006; Lindner and Wald, 2011; Horner Reich et al., 2013) and is also outlined in the Editorial state in their Editorial to the Special Issue in the International Journal of Project Management that knowledge is a vital resource for project-based industries and that managing this resource is a new and challenging process for these industries. Due to their special nature as a secondary type of organizational form (i.e., limited time and resources, pressure, great complexity, new teams), projects are especially suitable for learning (Landaud and Midler, 1998). Nevertheless, due to their uniqueness and short-term orientation, PBOs are faced with three particular difficulties in their KM.

First, every project contains both required knowledge necessary to manage the project (for example, the Project Management Body Of Knowledge (PMBOK) PMI, 2012 - identifies nine project management knowledge areas like scope management, cost management, time management, etc.) and emerged knowledge from the project. The effect induced by this dynamics is “surprising”, the project produces knowledge that produces, in turn, the project. Consequently, knowledge is at the heart of the projects as it corresponds to the “inputs” and “outputs”. Thus, the project allows using the company’s existing knowledge (learned by exploiting) as the incorporation of new knowledge (learning through exploration) (Charwe-Duboc and Midler, 1998).

Second, it seems difficult to capture and share knowledge project at the end of the project. Lindner and Wald (2011) cite different authors (Prencipe and Tell, 2001; Sydow et al., 2004), and underline that, in the PBO, there is a lack of mechanisms to capture, store, and disseminate knowledge, and also for organizational learning. After a project is finished, the constellation of people working together is replaced and fragmenting knowledge, and also for organizational learning. The dimensions of project knowledge management (PKM) in the literature review of KM in PBOs (Prencipe and Tell, 2001; Kavi et al., 2003; Love et al., 2003; Schnidler and Eppler, 2003; Brooks et al., 2006; Lindner and Wald, 2011; Horner Reich et al., 2013), we have found three main dimensions of the process: analytic process, temporal, and space dimensions.

Third, in the current competitive environment where intensive and repeated innovation, plays a fund role in the creation of new knowledge (Brown and Eisenhardt, 1997; Hatchuel and Weil, 1999), the PBO raises specific problems about the renewal of company knowledge. Therefore, this mode of organization leads to solving problems in an emergency with severe constraints: performance, cost, schedule, and quality of products and services delivered. Consequently, the control of the project cost and deadlines, the actors prefer looking back through codified knowledge rather than looking forward and come up with a creative solution. Under these conditions, Fong (2005) and Bohl (2007) consider the emergency and on-going stress generated by the time constraints imposed on projects as a hindrance to attaining and learning new knowledge. Projects lack “natural” learning mechanisms (Lindner and Wald, 2011). Lendle (2008) also shows that the fundamental tension between exploitation (looking backward) and exploration (looking forward), first analyzed by March (1991), applies to project management.

A recurring tension within PBOs appears to be the immediate task and performance demands of the project versus the opportunities for learning and disseminating project practices that can be useful for future projects. Accordingly, actors try to limit the creation of new knowledge within projects. They cannot, by themselves, ensure the strengthening of company knowledge. The updating of knowledge require PKM mechanisms other than the project.

The dimensions of project knowledge management (PKM)

In the literature review of KM in PBOs (Prencipe and Tell, 2001; Kavi et al., 2003; Love et al., 2003; Schnidler and Eppler, 2003; Brooks et al., 2006; Lindner and Wald, 2011; Horner Reich et al., 2013), we have found three main dimensions of the process: analytic process, temporal, and space dimensions.

Process dimension: codification, socialization, and learning

The literature specialized in KM in PBOs is organized in three KM processes: knowledge codification, knowledge socialization, and exploration learning. The first two processes refer to the strategy of capitalization and sharing knowledge (Hansen et al., 1999). The last is a process of learning and creation of new knowledge (Nonaka et al., 2000; Fong, 2003).

Knowledge codification transforms information into transferable and directly accessible information (Kogut and Zander, 1992), thus allowing the passage from individual knowledge to collective knowledge, which can be repackaged and duplicated on a larger scale. The first strategy for managing knowledge is referred to, by Choi and Lee (2002), as system strategy (from document to person).

Knowledge socialization (or personalization) emphasizes the importance of interactions between people (Nonaka and Takeuchi, 1997). Knowledge can be obtained from experienced and skilled people. Here, tacit knowledge is the heart of the cohesiveness of the company. Choi and Lee (2002) referred to this strategy as human strategy (from person to person).

Finally, exploration learning enables generating new knowledge that is not embodied in new product or service development projects, but may enable some of these to be initiated in the medium or long term (Fong, 2003). The authors who have worked on this process of exploration learning seek to explain and understand the mechanisms of knowledge creation within a project (Nonaka et al., 2000; Fong, 2003). In particular, Fong (2003) studied knowledge creation processes in multidisciplinary teams and described knowledge creation as an interwoven and boundary-crossing process of knowledge-sharing, knowledge-integration, and knowledge generation.

Temporal dimension: synchronic vs. diachronic

According to Fong (2003), inter-project learning can be seen as gaining knowledge from a previous project and using it directly or indirectly to other subsequent or concurrent projects. It can be both concurrent and sequential. In concurrent transfer, a project transfers knowledge to another project before the tasks of the current project are completed. This corresponds to diachronic inter-project learning (projects to future projects). Sequential transfer occurs when knowledge and experience from a completed project are transferred to a subsequent project. This corresponds to synchronic or project-level learning (projects to ongoing projects). PBOs should therefore spread the new knowledge generated by projects, diachronically and synchronically.

Space dimension: inside versus outside

In the current hypercompetitive environment, the development of new knowledge is less within projects, but more outside projects, so that the knowledge level is as high as possible at the beginning of the project. In fact, the ideal would be to start with a significant level of knowledge, i.e., access to knowledge and experience bases already exist. Indeed, the project team does not start from a “blank page” to develop a product or service. Instead, the team members will rely on the experience accumulated from problems encountered and on existing solutions. Their concern is then to find the best way to organize multiple projects, ensuring continuous development of knowledge between projects.

Despite the contributions of past research, as Lindner and Wald (2011), we have identified one unique feature: prior research remains limited in an operationalization of KM in PBOs. Indeed, past research does not study how to effectively operate the link between knowledge and projects, in other words, we know little about the mechanisms used by practitioners to operate this link. Accordingly, we seek to provide answers to the following question: What are the mechanisms underlying knowledge management in PBOs, and how are they used?

2. Methodology

To address this question, we implemented a qualitative, exploratory methodology centered on a multiple case study following subsequent projects managed by projects and operating in different sectors, including computer services, computer software, food supplements, and electronics components. These four companies are IBM, Hewlett-Packard, Arkopharma, and Temex. More precisely, after defining the type of organization that could be studied (project-based organization for the design and development of new products and/or services), an inventory of potential companies within this field was carried out. These companies were then contacted. The case studies were selected using the theoretical sampling criteria recommended by Eisenhardt (1989). (1) The cases present common features, ensuring the comparability of the study.
son and production of similar results (theoretical representation criteria). For example, for each product or service developed, a project team was created with a beginning and a predetermined end and extended over the long term (several months to several years). (2) The search for specific knowledge allowed us to obtain variety to increase the understanding of the phenomenon and the validity of the findings. Our four selected cases were different in terms of industry sector, size, turnover, nationality of the company, and maturity of PKM. Table 1 shows an overview of the four case studies.

Individual interviews were the principal data source. For the four companies studied, 64 interviews, lasting on average one hour and thirty minutes, were conducted with operators in different functions and positions in product and service development projects. These interviews gave us an overall and impartial view of the phenomenon studied. We met 5 people from the head office, 7 in the human resources department, 26 functional directors and managers, 12 project managers, and 14 project team members (product managers, scientific or technical experts, and engineers). The interviews were semi-structured, and based on an interview guide, covering a range of previously defined issues, hence enabling us to determine the studied phenomenon. This guide was drawn up after our literature review and while identifying the cases, and it was expanded and revised as the empirical study progressed. These interviews were supplemented by documentation (technical, management procedures for projects to develop new products and/or services, files and personal notes of the actors, etc.), on-site observation (conducted while we were on company premises to perform the interviews), and informal dialogues (including conversations with the interviewees via email, telephone, or conversation without any prior arrangement). These four sources of data ensured the richness of the findings and the purpose of triangulation (Yin, 2008).

Prior to data analysis (interviews, documents and research notes), we used a variety of tools, mostly recommended by Miles and Huberman (1994). First, each interview, after being recorded and transcribed in full on a computer, was summarized on an index card. The documents were annotated, sometimes summarized and systematically listed under the themes they addressed. The analytic strategy (Yin, 2008) consisted of the main technique of “thematic coding” (Miles and Huberman, 1994). Thematic coding was used to identify mechanisms underlying the three process dimensions of PKM (codification, socialization, and exploration learning). All data were coded: interviews, documents, daily journal, and e-mails. To ensure the stability and reliability of our codes, we used the data analysis software ATLAS Ti and based our data analysis on inter-coder agreements. Also, to summarize and to present, and analyze the multitude and variety of data collected, we used many tables, in keeping with the recommendations of Miles and Huberman (1994). This is why, in the presentation of findings in the next section, there are four analysis tables. In each table, we used scores (+) and (-). The “score” should be interpreted as an important action for KM in PBOS (high score) or no existing action (low score). We considered a high score (+), when the mechanism was mentioned by at least two actors in each company, and a low score (-), when the mechanism was mentioned by zero actor or solely one actor in each company. Finally, a report of approximately fifty pages was written about each of the four companies and submitted to the key actors identified in each case, to obtain their agreement, validate our interpretations, and thus increase the construct validity and the internal research validity (Yin, 2008). Due to space constraints, the study only presents the outcomes of the cross-case analysis.

3. Case study findings

The analysis of our four case studies enables us to identify and discuss eight mechanisms underlying KM in PBOS: formalization of project management, post-project analysis, project documentation and its computer storage, professional communities of practice, physical proximity of the actors, staff inter-project meetings, occupational projects, and Research and Development (R& D) upstream. These mechanisms are summarized in Table 2. For the presentation of our findings, we highlight PKM mechanisms underlying the three processes of KM in PBOS: knowledge codification, knowledge socialization, and exploration learning. In addition to the general findings described below, we also provide illustrations and quotes.

Knowledge codification mechanisms

The case analysis highlights the existence of three mechanisms of knowledge codification, supporting capitalization and sharing of knowledge: formalization of project management, post-project analysis, and project documentation and its computer storage.

Formalization of project management

In the four companies studied, operational knowledge (or know-how) is formalized in project management rules and procedures (methodologies, management processes, quality procedures, drafting of standard documents, project tracking tools, etc.). This formalized knowledge serves as “a cue for action” and must be implemented by all actors in the projects. It is the result of knowledge codification acquired by the actors in the company during their project experiences. Also, the procedural knowledge gradually develops and improves as they deal with projects and the problems encountered. Therefore, each particular project allows reciprocating on project management in general.

Post-project analysis

The procedures are part of our daily life. (…) They are the accumulation, the result of years and years of experience in the organization, plus the thousands of people who have each made their own contributions [Quality Manager, HP].

The project management process is changed and improved, progressively from carried out projects (1). Every time there is a problem on a project, we try to see how we can prevent it from happening again [Project Manager, Arkopharma].
Within their project management process, IBM, HP, and Temex have included post-project analysis as the basis of feedback between projects. More specifically, one phase of the formal process includes the meeting of all project participants to review the positive and negative aspects of the project and to identify the lessons to be drawn for future projects. This meeting results in a report written by a designated person (usually the project manager) summarizing the strengths of the project, any points which need improvement and the way in which problems were dealt with. This post-project analysis is then emailed to team members. For this collective learning experience to benefit the whole company, the post-project analysis is filed in a database of lessons learned during projects.

- The “post-project analysis” phase is important, because it is during this phase that we capitalize on experience gained during a project. I divided it into three stages: (1) the first stage is the retrospective of the project; (2) the second phase consists in filing and finding information; (3) the third phase provides a number of recommendations from the basic question: if I had to redo this project, what would I do again or not? [Research and Development Director, Temex]

However, the informants acknowledge that the post-project analysis is not always done systematically. The reasons given are lack of time and lack of priority given to knowledge capitalization (the priority being customer satisfaction by respecting requirements, deadlines and costs of the project or the priority of a new project over a meeting about a past project). Finally, it seems difficult to reuse the post-project analysis, i.e., to motivate people to consult these specific databases to search for a similar experience. All these limitations reduce the effectiveness of post-project analysis as learning media for inter-project knowledge.

- It is true that we would like to do post-project analysis for each project but, in reality, we don’t always do so for one simple reason: when you finish a project, there are four others which are waiting to be dealt with. The project manager hurries to handle new projects, rather than to stop and analyze the last project with his team [Program Management Director, Temex].

Project documentation and its computer storage

In the four companies studied, the projects produce a considerable amount of documentation (specification, development plans, product data sheets, analysis files and reports, quality reviews, meeting reports, etc.). All these documents developed during the projects add to the post-project analysis and ultimately the feedback between projects. They constitute the documentary memory of projects for later capitalization and reuse. For this memory to benefit the entire company, the documents produced by the projects are then integrated into the company’s information system so that any user can consult them, with predefined access authorization. Information and communication technologies (ICTs) are therefore powerful tools to make the knowledge generated during the projects accessible with relevance and speed to everyone in the company. ICTs thus aim to make knowledge available. The box below reflects the operating and recovery of a database dedicated to projects within IBM.

Table 3 provides a synthesis of these three mechanisms underlying knowledge codification and their function on KM in PBOs.

Knowledge socialization mechanisms

The case analysis also highlights the existence of three mechanisms of knowledge socialization, supporting capitalization and sharing of knowledge: professional communities of practice, physical proximity of the actors, and staff inter-project meetings.

Professional communities of practice

IBM and HP are the only two of our panel of companies to recognize the communities of practice as the foundation of knowledge sharing. We point out that “a community of practice is a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their understanding and knowledge of this area by interacting on an ongoing basis” (Wenger et al., 2002, p. 41. In IBM and HP, the community of practice recognized as the most active is that of the project managers. Regular conferences, the project management Intranet site, the yearbook, forums, and lunch meetings are among the opportunities for the participants to identify their peers, exchange information, increase their expertise, and develop their network.

- The objective of project managers’ community is to maintain a sharing atmosphere and exchange ideas and experiences, through the organization of internal conferences, where each one comes to present a project or to provide ideas to advance the profession of project manager. The objective is thus that there is a community which can evolve together (Project Manager, IBM)

Moreover, in the works of Garrety et al. (2004), and those of Ruuska and Vartiainen (2005), we can qualify the communities of practice identified at IBM and HP, as professional communities of practice. They address the lack of relationships and exchanges between individuals within a profession, whether this lack is due to the geographical or organizational dispersion of business actors over several projects, or to a lack of cognitive unity or strongly shared professional identity. Accordingly, the community of practice is an intermediary between projects and professions. More specifically, it gives the project participants professional benchmarks and “identity fragments”, which allow knowledge sharing between projects.

The KM database dedicated to projects within IBM

With the advent of services, a tool called Knowledge Management (KM) was established in the mid-90s to manage the intellectual capital of the company. The implementation of this tool shows a new pulse of the top management to make the knowledge sharing within the company a major focus of its development. The KM tool uses ICTs such as the intranet, groupware, discussion forums, etc.

In the KM tool, the company has established a database dedicated to projects, the “Intellectual Capital Management” (ICM). This database allows to capitalize and disseminate knowledge related to projects, in order to make them immediately available for future projects. Among the readily available knowledge on projects, there are the technical specifications of the architecture for the computer solution, business documents outlining the criteria used to make key decisions in developing the solution, post-project reviews, original experiments project, etc. Thus, for each major project, it is possible to find details on the history (including problems, decisions), but also people who worked on the project. IBM encourages each individual to enter personal project experience in the database, through a process of internal recognition (the internal certification procedure). This knowledge memory of the company’s projects is regularly refreshed and updated by “reviewers”, who are experts in project management.

- In the office, there is another project manager who is sitting next to me. We discuss a lot, we help each other because sometimes, I

In order to assess the importance of mechanisms, we assigned to each firm a score of “+” in case of an important action and a “-” in case of no existing action. We considered a high score (+) when the mechanism was mentioned by at least two actors in each company, and a low score (-), when the mechanism was mentioned by zero actor or solely one actor in each company.

<table>
<thead>
<tr>
<th>Mechanisms</th>
<th>Function on PKM: creation of common database</th>
<th>IBM</th>
<th>HP</th>
<th>Arkopharma</th>
<th>Temex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formalization of project management</td>
<td>Coldly operational knowledge of projects</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Post-project analysis</td>
<td>Promote the experience feedback between projects</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Project documentation and its computer storage</td>
<td>Build project memory</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Physical proximity of the actors

While we were on the premises of the four companies, we observed the structure of the workplaces. We noticed similarities between HP, Arkopharma, and Temex. In particular, the companies do their utmost to encourage the geographical proximity of the project managers’ offices, and the physical proximity between functional actors and their business manager. This physical proximity of actors has an important role in inter-project knowledge sharing, as it enables functional actors to exchange and share their project experience with their peers, directly and on a regular basis (and thus mainly synchronously, i.e., between ongoing projects).

- in the office, there is another project manager who is sitting next to me. We discuss a lot, we help each other because sometimes, I

In order to assess the importance of mechanisms, we assigned to each firm a score of “+” in case of an important action and a “-” in case of no existing action. We considered a high score (+) when the mechanism was mentioned by at least two actors in each company, and a low score (-), when the mechanism was mentioned by zero actor or solely one actor in each company.

| TABLE 3. Synthesis of mechanisms underlying knowledge codification in PBOs |
**Synthesis of mechanisms underlying exploration learning in PBOs**

To accelerate the process of creation and exploration of new knowledge, Temex has chosen to distinguish two types of projects: (1) the product development projects (called "product projects"), which systematically meet a market need or a request from an identified customer (responses to calls for tenders); (2) the "occupational projects" which aim to develop new technological knowledge for future company "product projects". This structure of "occupational projects" ensures, on a given technical function, the technological survey, analysis of competitive products, development of technical knowledge, acquisition of new tools and techniques for modeling, follow-up of innovations, and the optimization of products and processes.

"Occupational projects"

To accelerate the process of creation and exploration of new knowledge, Temex has chosen to distinguish two types of projects: (1) the product development projects (called "product projects"), which systematically meet a market need or a request from an identified customer (responses to calls for tenders); (2) the "occupational projects" which aim to develop new technological knowledge for future company "product projects". This structure of "occupational projects" ensures, on a given technical function, the technological survey, analysis of competitive products, development of technical knowledge, acquisition of new tools and techniques for modeling, follow-up of innovations, and the optimization of products and processes.

**Mechanisms**
- Professional communities of practice
- Physical proximity of the actors
- Staff inter-project meetings

**Function on PKM: knowledge sharing in face-to-face**
- IBM
- HP
- Arkopharma
- Temex

**Table 4.** Synthesis of mechanisms underlying knowledge socialization in PBOs

<table>
<thead>
<tr>
<th>Mechanisms</th>
<th>Function on PKM: knowledge sharing in face-to-face</th>
<th>IBM</th>
<th>HP</th>
<th>Arkopharma</th>
<th>Temex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional communities of practice</td>
<td>Facilitate knowledge sharing</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Physical proximity of the actors</td>
<td>Encourage direct contact and sharing of project storytelling</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Staff inter-project meetings</td>
<td>Exchange experiences of projects</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

**Table 5.** Synthesis of mechanisms underlying exploration learning in PBOs

<table>
<thead>
<tr>
<th>Mechanisms</th>
<th>Function on PKM: learning by experimentation outside projects</th>
<th>IBM</th>
<th>HP</th>
<th>Arkopharma</th>
<th>Temex</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Occupational projects&quot;</td>
<td>Develop new technological knowledge for the company's future &quot;product projects&quot;</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>R&amp;D upstream</td>
<td>Be devoted exclusively to the development of technological knowledge in the company and to the exploration of subjects in the long term</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**The mechanisms of inter-project knowledge capitalization and sharing: towards a balance between codification and socialization**

As previously noted in our literature review, Hansen et al. (1999) consider that companies follow two strategies to capitalize on knowledge: the strategy of knowledge codification (from person to document) and the strategy of knowledge socialization (from person to person). From our findings, our analysis of mechanisms underlines such distinction. Indeed, on the one hand, formalization of project management, post-project analysis, and project documentation and its computer storage correspond to knowledge codification. On the other hand, professional communities of practice, physical proximity of the actors, and staff inter-project meetings correspond to knowledge socialization.

Nevertheless, according to Hansen et al. (1999), it is important to avoid "mixing" the strategy of knowledge codification and the strategy of knowledge socialization. Instead, as Cross and Baird (2000) and Prencipe and Tell (2003), we believe that the distinction between these two strategies is only analytic, because in action, codification and socialization need to be articulated. Indeed, the knowledge socialization strategy is complementary to that of codification. On the one hand, the absence of key actors who can bring the knowledge sought after from past projects (absence due to large part to dismissal and retirement) implies a knowledge codification on formal supports (rules and procedures, post-project analysis, documents, databases, etc.). This codification allows the reuse of knowledge independently of the individuals who have initially developed knowledge (strategy of knowledge codification). On the other hand, although in recent years there have been important efforts toward formalization, modeling, and storage of knowledge, people still prefer informal face-to-face communication (strategy of knowledge socialization). Some quotations support this finding.

"My main sources of knowledge are my experience and sharing with other people [Project Manager, HP]."

"Today, sharing lessons learned is still oral policy [Human Resources Director, Arkopharma]."
The necessary complementarity between diachronic inter-project learning and synchronous inter-project learning

From the analysis of mechanisms identified in our four case studies, we consider that the complementarity between the strategies of knowledge codification and knowledge socialization can meet the continuing tension between the diachronic and Project Body of Knowledge (PBoK) perspectives of inter-project learning (Fong, 2003). Indeed, the strategy of knowledge socialization is based largely on synchronous learning, with daily face-to-face interactions (professional communities of practice, physical proximity of the actors, staff inter-project meetings). This strategy balances the strategy of knowl- edge codification which essentially comes from diachronic learning (rules and procedures of project management, professional communities of practice, practice, professional communities of practice, practical aspects of the actors, staff inter-project meetings). In a nutshell, it is the investigation of the complementarity between the different mechanisms identified. It is also pertinent to ask whether a manager must privilege one mechanism more than another.

Ultimately, we hope to have offered a deeper understand- ing of the mechanisms for managing knowledge in PBoKs. More generally, this paper constitutes a step forward, among others, in the understanding of KM in PBoKs.

Acknowledgements

We thank the four companies (IBM, Hewlett-Packard, Arkopharma, and Tenex) for welcoming us to allow us to conduct the case studies, as well as all the people who participated in the interviews. We cannot name them here, but without them this research would have been impossible.

Our work highlights eight mechanisms underlying KM in PBoKs: (1) project-based research, post-project analysis, project documentation and its computer storage; (2) participating in the interviews, we cannot name them here, but without them this research would have been impossible.

The authors

Sabina Loufrani-Fedda is Associate Professor in Human Resource Management and Project Management at the University of Nice Sophia-Antipolis in France. She is a member of the research center CEDIS, UNED (University of National Scientific Research). Her main research topics are compa- ny processes management and internationalization. She is a member of the European Group for Organizational Studies and the French Information System of Human Resources Management.

Laurence Seguier is Professor of Project Management at the University of Nice Sophia-Antipolis. She is a member of the Research-Center CEDIS, UNED (University of National Scientific Research). She studied and worked in the area of Decision Sciences. She joined the University of Nice Sophia-Antipolis in 2002. She is member of the French Information System of Human Resources Management. She is Coordinator of the International Conference on Knowledge Management and Leadership (KML) and is a board member of the International Conference on Knowledge Management and Leadership (KML). She is a member of the European Group for Organizational Studies. She is member of the International Association for Information Management and the Association of KM (Association Information Management).

Stephanie Missiaen is professor of Project Management and Knowledge Management at the Institute of Information System in the University of Sheffield, SACCS, School of Computing and Management Information System, Institute of Organization, Information Management and Knowledge Management, and the University of Sheffield. She is member of the Society for Information Management and Knowledge Management. She is a member of the International Conference on Information System and the European Group for Organizational Studies. She is member of the International Association for Information Management and the Association of KM (Association Information Management).


