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TECHNOLOGICAL INNOVATION PROJECTS: PROPOSAL FOR AN INTEGRATIVE MODEL BETWEEN PROJECT MANAGEMENT AND KNOWLEDGE MANAGEMENT IN A CUSTOMER-SUPPLIER PERSPECTIVE

Edval da Silva Tavares
Escola Superior Nacional de Seguros, Funenseg, São Paulo, SP, Brazil

Marcelo Schneck de Paula Pessoa
University of São Paulo, POLI/USP, São Paulo, SP, Brazil

ABSTRACT

In face of strong competition, companies in Brazil have increased their financial investments in automation, offering new products and services and reducing operating costs. These companies are focusing their efforts on core competencies and, therefore, they often lack the internal expertise to implement new projects, especially those that bring technological innovation. For this reason, we use the processes of outsourcing or subcontracting to help implement such projects. The unit of analysis in this study is the project and the object of the study to analyze the process of knowledge transfer from a provider to a customer during the duration of the project, which involves new technologies. The main motivation of this work is to address the acquisition and retention of new knowledge related to projects designed for business customers. We have developed a study of three cases of multiple financial firms that buy new technologies and two suppliers of information technology. As a practical result, a management model of knowledge transfer and retention of knowledge in client companies is proposed and incorporated into project management.

Keywords: Knowledge Management; Project Management; Innovation; Information Technology

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Address for correspondence / Endereço para correspondência

Edval da Silva Tavares, Escola Superior Nacional de Seguros, Funenseg. Bachelor's and Master's in Business Administration, Feausp. Ph.D., Polytechnic School of USP, Department of Production Engineering. Adjunct Professor, Escola Superior Nacional de Seguros, Funenseg. Consultant, PricewaterhouseCoopers. GTI Researcher—Management in Information Technology, Department of Production Engineering, USP. Previously employed at Unibanco S/A, Fatec College of Technology SP, Vanzolini, Senac, Brasilprev, and Zurich Insurance. Address: Av. Paulista, 2421 – 1st floor, CEP:01311-30, Consolação, São Paulo, Brazil. Phone: +55 11 3062-2025, Email: est@terra.com.br

Marcelo Schneck de Paula Pessôa, Polytechnic School of USP, Department of Production Engineering. Electronic Engineer, M.Sc. and Ph.D. Polytechnic School of USP. Associate Professor in Management of Information Technology, 2009. Professor and researcher, GTI, Management in Information Technology, Department of Production Engineering, USP. Have worked on projects related to computers, telephone exchanges, railway and industrial automation systems. Address: Av Almeida Prado travessa 2 n.128, CEP 05508-070, University City, São Paulo, Brazil. Phone: +55 11 3091-5363. Email: mpessoa@usp.br

1. INTRODUCTION

This article addresses the issue of implementing projects with technological innovation in an organization that is internalizing such new knowledge. The need for innovation is caused by the competitiveness that forces organizations to invest in product and service innovations to ensure their survival (Tidd et al, 1997; Febraban, 2003).

Innovative products and services in a complex environment of Information Technology (IT) require structured projects that can be custom developed by third parties (Blechar, 1998; Cleland, 1991; Pressman, 1995).

The distinction between the most innovative companies is made apparent by the right supplier-customer relationship. Those companies are the most concerned with anticipating market trends and innovative practice of substantive character, Torres-Freire & Henriques (2013).

The need for structured projects requires knowledge of Project Management (PM). Due to the focus on core competencies (Quinn, 1999; Prahalad, 1998 Dacorso & Silva 2013), and the internal knowledge gap, PM subcontracts to bring innovation to an organization. This gap in technical knowledge is natural in an organization before it implements new technologies in an IT project and creates two important risk factors: (Keil et al, 1998) the risk created by the project itself and the risk created by lack of knowledge, Ansari (2013).

System integration projects are those that need to relate to various existing systems and are of relative complexity. These projects require new technologies, which often lack internal knowledge.

This article describes a survey focused on complex projects involving new technologies unknown to the buyer. This focus is important because this context characterizes the problem that is addressed and the existence of a gap in technical knowledge on the part of the client company in relation to the supplier's knowledge.

This article is organized by the following chapters: Introduction, Conceptual Aspects (technological innovation, knowledge management and acquisition management), Problem (characterization of the problem and model of the problem), Grouping Hypotheses (proposed model of knowledge transfer), Study Cases (research planning, developing cases, step by step implementation of the study and research limitations), Results (consolidation of the research results, score-based analysis of adherence to the model, comparison of results between suppliers and customers level, interaction between customer and supplier knowledge transfer process, process of knowledge transfer, whether a process is conducive to knowledge management, and knowledge transfer), Results of Questions, Future Research, and Final Thoughts. See article summary in Figure 1, below.

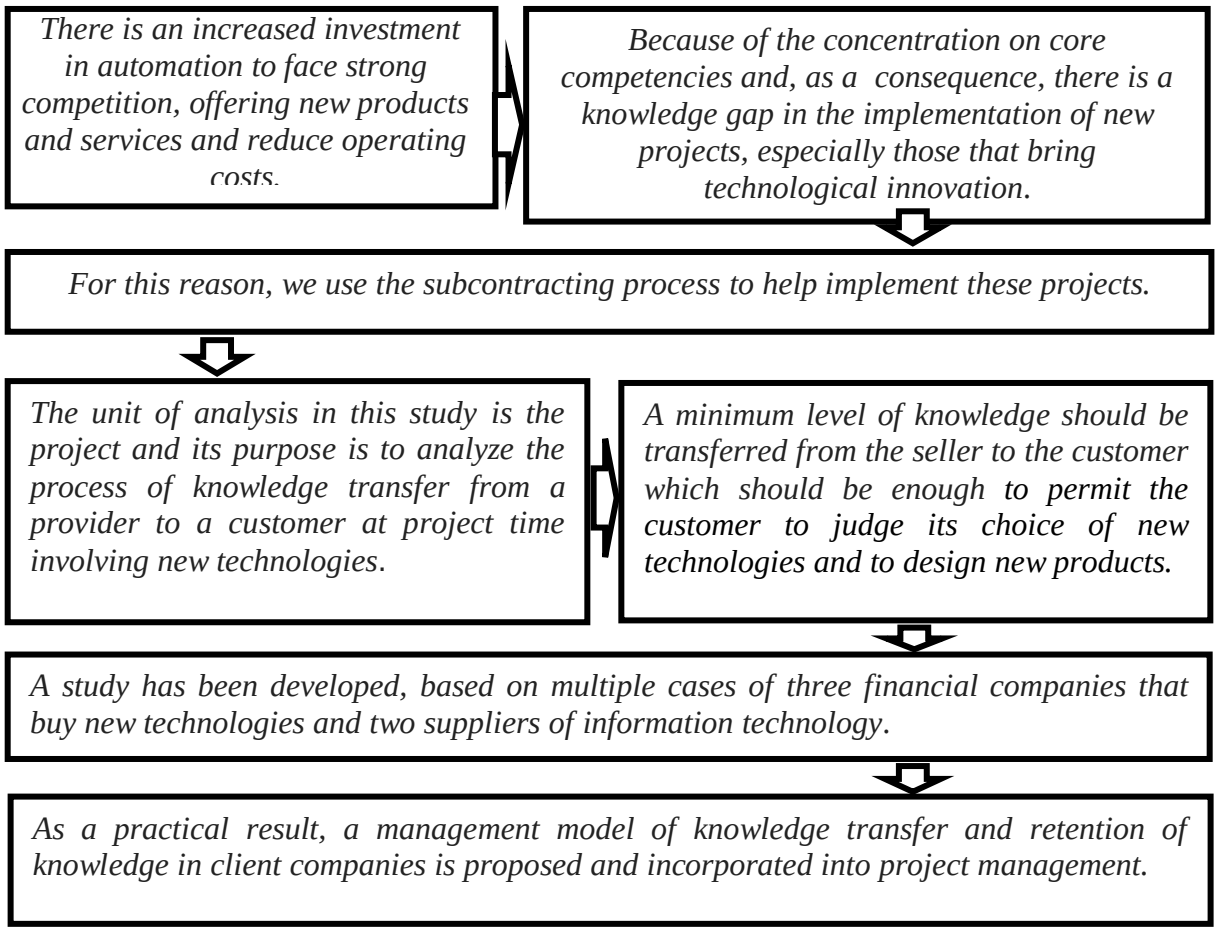

Figure 1 - Article summary
Source: Authors.

2. CONCEPTUAL ASPECTS

In this section, a literature review related to innovation, strategy, knowledge management and acquisition management is presented.

2.1. Technological innovation

Technological innovation can be performed on the product, service or process and can be performed either incrementally or through a radical transformation, (Tidd et al, 1997:7). Thus, technological innovation addresses matters that are not part of a company's operation that must be incorporated in an economically viable manner.

There is a need for a distinctive treatment of innovation projects and regular projects, Takeishi (2002:321-338). For regular projects, with known technology, the most important architectural knowledge has an overview of the components, whereas when a project involves new technologies, it is important that the organization either have a high level of knowledge of the specific component to solve unexplored engineering problems or acquire solutions using IT innovations (Ireland, 1999;

Takeishi, 2002) by subcontracting suppliers that have this knowledge domain, as shown in Table 1 (Kamel (2003); Steensma & Corley, 2000).

Type of project	**Division Effective model**	**Automakers should have**	**Providers should have**
Regular project (known technologies)	Clear division	Architectural knowledge	Specific knowledge of component
Project with Innovation (new technologies)	Superposition	Architectural knowledge and Specific knowledge of component	Architectural knowledge and Specific knowledge of component

Table 1 - Model suggested for an effective division of knowledge, Takeishi (2002)

The strategic aspect of IT is also analyzed in Table 2, which shows McFarlan's (1984) universe, a place that the same author, in partnership with Nolan (NOLAN,2005), recently revisited and where companies can be positioned in a strategic matrix. The horizontal axis of Table 2 shows the need to develop new applications, whether for reasons related to the market or to the rapid incorporation of new technologies or new features. The vertical axis shows the need to use a trusted IT organization, i.e., if an IT fails, the business is directly affected. This division leads to four quadrants, with the extreme right quadrant deemed Strategic, which shows the importance of IT to an organization's strategy. The Factory quadrant shows the companies for which IT must be reliable, but do not feel pressure to develop new applications. The quadrant of IT Support does not show a need for new applications or great reliability, i.e., it is fault tolerant in the absence of a direct injury to the business. The Transition quadrant is so called because it houses those organizations that require new applications, but it is expected that over time the organizations in that quadrant evolve to the Factory or Strategic quadrants.

Need for reliable IT (present)		***IT DEFENSIVE***	***IT OFFENSIVE***
	High	Factory	Strategic
	Low	Support	Transition
		Low	***High***
		Need for new applications (future)	

Table 2 - The Four Quadrants, NOLAN, McFarlan (2005)

In the case of banks—the research focus of this paper—the framework is the strategic quadrant related to the need to continually develop new applications and the need for highly reliable IT.

2.2 Knowledge Management

During the research on the meaning of knowledge, it was identified that there are difficulties in its conceptualization.As with knowledge itself, its concept is fluid and subjective and in this paper, the concept defined by Nonaka & Takeuchi (1997), Myburgh (2000), Bollinger (2001), Beijerse (1999) and Probst (2000) is used. Knowledge covers a scope with boundaries that are not well defined. It always has a goal, a target to be reached, an action and a meaning; it requires a base of information, which can be suppressed by skills and competencies, but it mainly depends on the beliefs and attitudes of the people who possess that information. Therefore, knowledge is always connected to human actions, which are based on and correlated with a set of information, giving them meaning so as to perform some actions. Knowledge is also compared to an iceberg, in which the visible part is the knowledge that can be made explicit and the submerged part is tacit knowledge, or those concepts present in the process of knowledge creation, which is called the SECI model, (Socialization, Externalization, Combination and Internalization).

Through the process of **socialization**, tacit knowledge is passed from one person to another. **Externalization**, i.e., the structure and organization of knowledge, makes it explicit that combining knowledge with knowledge leads to the **internalization** and consolidation of new tacit knowledge. That knowledge then goes back to the beginning of the cycle, where more knowledge can be generated (Marçula, 2001). Fagan (2001) is based on studies of IT adoption and implementation and identifies a large number of factors that may impact the process of transferring IT projects and associated knowledge. Twenty-three factors are identified and grouped into the following five categories: individual, organizational, innovation, task-related and environmental factors. Another proposal for transfer of knowledge is presented by Karhu (2002), using a framework based on the literature and case studies. The first case addresses the difficulty of explanation experienced by technical professionals, and the second case discusses a situation in which a company has a large amount of information that it does

not use properly in the decision-making process. In this case, the problem discussed relates to:

- Challenges in documenting technical information;
- Knowledge distributed in different countries; and
- Information that is critical to a company.

To address these problems, Karhu (2002) recommends the use of so-called professional knowledge administrators. These professionals describe others' experience and knowledge. A knowledge administrator also acquires information for a company, analyzes the information in detail, formulates it and documents it for use by knowledge seekers. The technique of "mentoring"[1] is a powerful method used in the knowledge transfer process, but it is only appropriate when knowledge is not distributed among many different individuals and localities. In this case, interviews and observation prove adequate for this type of knowledge transfer, with the help of knowledge administrators' tools. Trust and personal relationships are basic to achieving positive results in the acquisition of knowledge factors. Thus, the framework follows the following steps:

1. Interviews of technical professionals and observation of their work;
2. Documentation of knowledge gained from the analysis, descriptions and written instructions;
3. Feedback using a professional process to ensure content quality;
4. Documentation that provides the basis for reading and learning from other people, who may use those readings in their own experiences and then assemble their own mental models or tacit knowledge.

Another view of knowledge transfer that it is related to tactical knowledge and explicit in projects as demonstrated by Batra (2007), who has conducted a survey involving knowledge from one project applied to another project. Batra's argument is that knowledge management for development requires a mix between knowledge that is inside the company, which in large part is tacit, and external knowledge, which in large part is explicitly local knowledge. The author explains that the contextual knowledge of a problem is more deeply understood and captured before solutions to a development project may be implemented.

A survey of 46 closed projects shows that the body of project knowledge taken from the knowledge of other projects is associated with the performance of the surveyed projects. Despite the benefits of this knowledge transfer, research has shown that an increase in investments that account for this process. However, one suggestion to reduce this negative impact of a high level of effort for knowledge transfer is to assign a limited number of project members that effort. With respect to methods of knowledge transfer, it is recommended that project managers and project-based organizations use both formal methods (e.g., meetings, special teams, project reviews, mentoring, written messages, documents and observations of the results of other projects) and informal methods (e.g., interactions between project members with or without the use of multimedia resources, teleconferencing, emails and chats), Landaeta, (2008).

Although innovation outsourcing has become quite widespread in field research and development, project managers always want to know what PM practices are necessary for the development of new technologies that use suppliers (Zhijian&Loch, (2009). An analysis of 24 of Siemens's projects to develop embryonic technologies,

[1] "Mentoring" is defined as tracking procedures that provide support or training.

which used different sources of outsourcing, identifies five success factors common to such projects: reliability, communication, strong supplier competence, strong internal competence, a clearly defined problem, and an alignment of interests. These factors can be summarized by the importance of the level of relationship between the customer and its supplier.

One study shows that according to 73.9 % of workers at software companies, there is an incentive to share knowledge, even where there is a formal and structured knowledge management program (Souza et al, 2010).

To provide an example that focuses on business processes, knowledge sharing is also cited as a positive contribution by knowledge management in market-oriented companies, Ferraresi et al, (2012).

The results of another study reveal the need to facilitate the integration of human resource management into managing knowledge processes, a proposal that would address the formulation of policies and strategies to strengthen human resource departments' primary selection, training and development activities, along with their activities related to communication, design work performance evaluation and compensation, to encourage the creation, storage, sharing and application of knowledge, Gelabert et al, (2012).

Medina (2012) concludes that the process of knowledge transfer in knowledge-intensive business services (KIBS) firms is facilitated by the process of socialization among experts, using the mechanism of meetings in which people share stories involving issues, training, coaching, mentoring, shadowing, practice and virtual social networking communities.

The process of knowledge acquisition aims to gain knowledge from various sources internal and external to an organization. One of the fundamental principles of knowledge-transfer capacity is the location and acquisition of knowledge through collaboration between individuals and partners. The acquisition of knowledge by suppliers as a capacity for knowledge transfer is present in all of the reference models of the software process, Galvis-Lista & Sánchez-Torres (2013).

In summary, the process of knowledge transfer, as in Karhu (2002) Marçula (2001), Fagan (2001), Tsang (2002), Batra (2007), Landaeta (2008), Zhijian & Loch (2009), Souza et al, (2010), Medina (2012), Ferraresi (2012), Galvis-Lista & Sánchez-Torres (2013), may rely on various methods of transfer and acquisition of knowledge, but it always involves human interference. The complexity of transforming tacit knowledge into explicit knowledge—or even transforming tacit knowledge into tacit knowledge—is the major challenge.

2.3. Management Acquisition

The management of acquisition is a knowledge area of PM that includes goods and services that must be purchased from another business to complement the scope of a company's project processes. This management's job "is to plan, conduct, administer and close acquisitions," as in PMBOK (2008).

There are several levels of contemplated subcontracting, from subcontracting the project as a whole to demanding simple programming of previously defined components. This research focuses on complex projects in which the fundamental

knowledge belongs to the supplier(s). This focus is important because it is this context that characterizes both the problem addressed and the existence of a gap in technical knowledge on the part of a client company in relation to its supplier's knowledge. Thus, the scope of this study does not involve only cases of subcontracting at the project implementation stage. This phase should be part of the case, but we do not view it in isolation.

3. PROBLEM

In this section, the problem focus of the research is characterized and two models are presented: the problem's characteristics and knowledge transfer.

3.1. Characterization of the problem

This research aims to contribute to the processes of PM that incorporate aspects of knowledge management (KM), both during project execution and after project completion. PM processes should be complemented by KM, for example, through improved interaction with suppliers, knowledge transfer and the provision of an enabling environment for KM.

Therefore, the central problem is how to use the set of KM practices within the context of PM to improve the processes that develop IT projects at various stages. This process of integration among areas of knowledge, where new knowledge is based on knowledge gained in other areas, is cited by Lovejoy (1996:1-22), who shows how operations management depends on the relationship among various disciplines or areas of expertise.

Innovation projects that include at least partially new knowledge are considered strategic and, therefore, must be internalized by transferring a company's supplier(s) to the acquiring organization. This transfer is justified because a company needs this internal knowledge, at least to judge the competence of service providers and enable the development of new products or services, because the time periods between such releases have become increasingly smaller. Thus, it is critical to structure additional processes to address this knowledge transfer.

The acquisition of knowledge through a vendor also depends on a good customer-supplier relationship (Karlsson, 1998). The pursuit and implementation of IT solutions are not sufficient in themselves, without the transfer of knowledge from the supplier(s) to the client company. The process of the internalization of knowledge is essential as a basis for both the construction of new projects and the evaluation of suppliers (experts) (PMBOK, 2008; Probst, 2000; Byrd & Turner, 2001). The argument for internalization is particularly strong when a company is positioned in the strategic quadrant of the McFarlan model and there is a strategic impact on its application development portfolio (Nolan, 2005; Cordenonsi, 2001). An informal and sometimes conflicting relationship with suppliers can lead to failure to achieve project objectives and a consequent failure to absorb knowledge. Additionally, it is important to realize the importance and feasibility of internalizing internally nonexistent knowledge and transferring new knowledge.

From the above, the implementation of KM practices is very important because companies use their suppliers' expertise to cope with competitiveness and innovation (Lim et al, 1999).

3.2. Model of the problem

To better explain the context of the survey, the conceptual model presented in Figure 2 was developed.

New products and services often require the use of new technologies. The complexity of technology, urgency of implementation and demand for low-cost project financing are assumed. Projects to generate products and services with innovative components require new knowledge (see the right side of Figure 2), which must be internalized at a level that provides the power of judgment in relation to the suppliers of new technologies and the construction of new products and services. Acquisition is the area of PM that addresses this search for solutions. In this area, subcontracting and outsourcing are justified by a company's need to focus on its core competencies. Importantly, the term subcontracting is used as a way to describe hiring workers to develop custom IT applications in complex projects with a high degree of integration. Thus, when firms seek new knowledge through suppliers, they should be concerned about and alert to the proper transfer of knowledge. This model analyzes the difficulties and shortcomings of this process and investigates the following questions:

1. How is it possible to enhance the model of acquiring these solutions within the context of PM and knowledge transfer?

2. What is the best way to transfer knowledge at the time of the project?

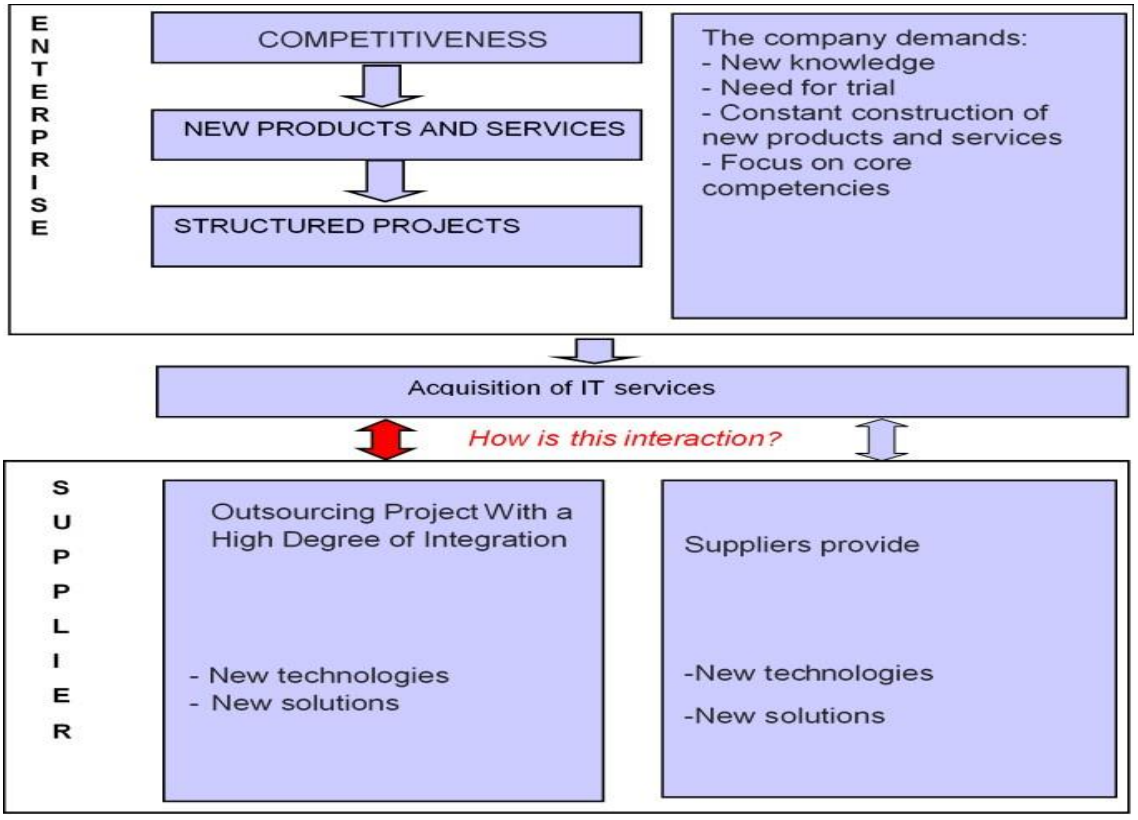

Figure 2 - Model of the problem to be analyzed

Source: Authors.

4. GROUPING HYPOTHESES

The explanation of the concept that underlies both this article and the problem to be treated, along with the questions to be answered, is organized following the grouping of our hypotheses.

Figure 3 summarizes the elements of this research with a description of the problem (P1), the main questions (Q1, Q2, Q3) and the hypotheses H1 to H6).

The hypotheses were developed through the literature review. The H1, H2, and H3 hypotheses were used to confirm the sample of the cases, and the H4, H5, and H6 hypotheses were used to analyze forms of knowledge transfer.

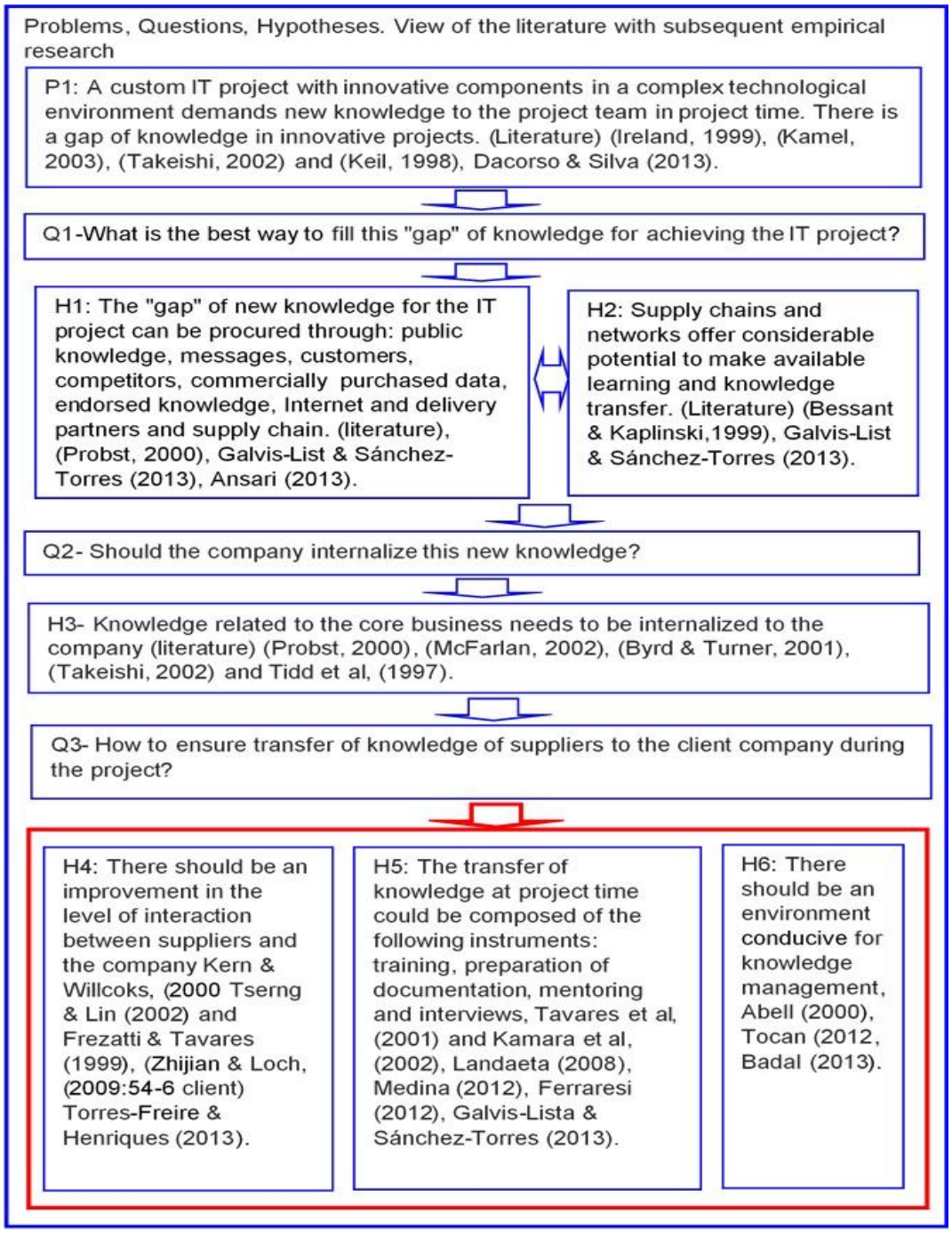

Figure 3 - Grouping of hypotheses. Source: Authors.

Once the problem to be solved and the points to be investigated are clearly understood, the model developed to represent the transfer of knowledge described in Figure 4 can be presented. So far, the study shows that the literature has provided no specific model that solves the problem posed in Figure 2 or specifically answers the questions proposed in this paper. Thus, we propose a model based on other models that partially respond to our proposal.

The above model has a core that is intended to guide the actions and interactions between a client company and its supplier. The client company engages in a number of internal activities, represented on the left. The client company has IT projects that incorporate technological innovation that remains focused on its "core business" and provides subcontracting suppliers with knowledge necessary for technological innovations. With regard to creating an environment that is conducive to KM, there is a need to create a capture process, an organization, access to and the use of new knowledge. The company should also seek to use IT tools for the storage and dissemination of new knowledge.

The PM process must contemplate the planning of this process. The supplier, represented on the right, possesses the technology, expertise and knowledge that are to be transferred.

Regarding interactions between firms, clear rules for the qualification and delivery of knowledge must be established. One should seek a higher degree of formalization and focus on the processes of transfer of new knowledge. At the core of the model is the process of knowledge transfer. This process consists of mapping activity related to gaps in knowledge, new knowledge documentation, previous training and mentoring process. At its core, this model basically consists of the model proposed by Kamara et al, (2002), which presents a framework for selecting a KM strategy that can be used as a basic model to identify knowledge needs, the target knowledge to be transferred and finally, the selection of the method of knowledge transfer. This model can also be complemented with the observations of Landaeta (2008), Medina (2012), Ferraresi (2012), Galvis-Lista & Sánchez-Torres (2013), which discuss the process of knowledge transfer.

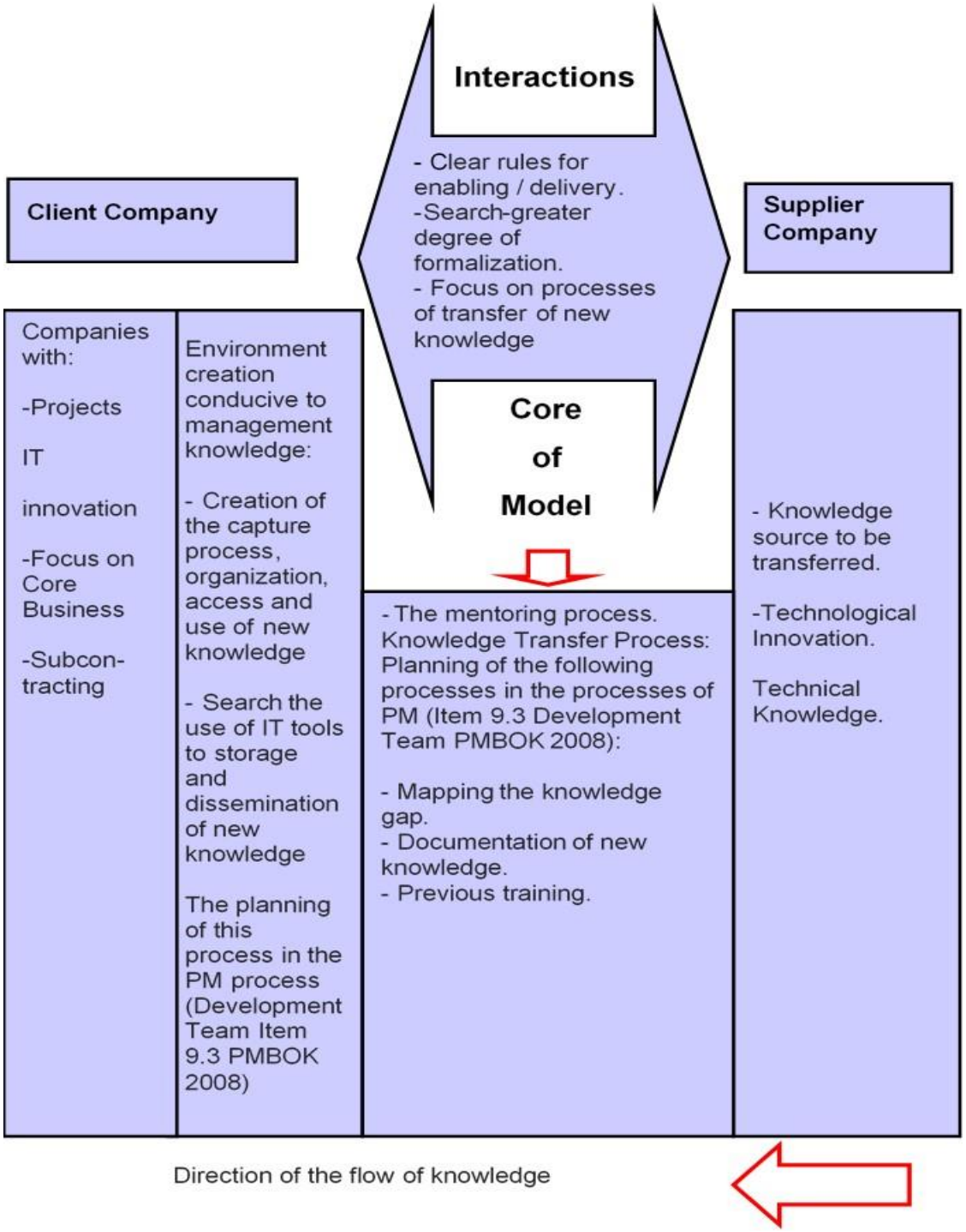

Figure 4 - Proposed model of knowledge transfer

Source: Authors.

It is also suggested that this transfer would not be effective without a good relationship between the client company and its suppliers, who are subcontractors for creating IT projects. This assertion is supported by Tserng & Lin (2002), Kern & Willcocks (2000), Zhijian & Loch (2009) and Torres-Freire & Henriques (2013), who claim that the improvement of relationships is a factor in the success of the subcontracting process. The process of interactions between a client company and its supplier is also critical in this model, more precisely at the moment of a company's

choice of supplier and/or technical solution. A client company that needs an innovation solution has not yet learned to judge the best or most appropriate solution for its business problem. In such a case, one can rely on a model of interaction among companies synthesized in the model as interactions (Frezatti & Tavares,1999). Finally, as Abell (2000), Tocan (2012) and Badal (2013) explain, it is essential to create or maintain an environment conducive to KM. Therefore, it is suggested here that some processes of PM are increasingly streamlined and effective, and it is also suggested that companies improve their relationships with suppliers and create a conducive environment for KM.

5. CASE STUDIES

5.1 Planning Research

To test the model shown in Figure 4, the case study research method was considered appropriate because it enabled the analysis of several companies, suppliers and customers with an appropriate degree of depth and a specific focus on new technologies, as described below and as recommended by Yin (2001).

Data collection was carried out through closed-question interviews, which provided the researcher with a more accurate picture of the environment to be searched, although there were also open-ended questions to complement the information obtained. This format was based on a questionnaire interview that previously prepared and was answered by "informants" and presented the interview as "structured" or as "a formal survey". A personal interview enabled the project managers to present their interpretations of certain events. Furthermore, the interviews relied on an important complementary factor: direct observation through a field visit. To facilitate the proper chain of evidence and to obtain a proper comparison between the respondents' information, or even comparing the cases together, we used the Likert scale process as a way to measure and quantify the results related to the blocks referenced in the questionnaire.

Because the object of the research is the flow of knowledge between suppliers and their customers, we selected three customer companies represented by three major banks characterized by their volume of assets and two major suppliers characterized by their volume of sales. For reasons of confidentiality, the names and identifying organizations where the case studies were conducted were omitted. Table 3 presents a summary table containing information about the main characteristics of the studied organizations.

Key Numbers	Bank A	Bank B	Bank C	Supplier A	Supplier B
Volume of Assets	**US$ 65.1 billion**	**US$ 109.5 billion**	**US$ 41.6 billion**		
Number of employees	**29,600**	**40,000**	**23,000**		
Annual revenues				**US$ 32 billion**	**US$ 86,4 billion**

Table 3: Numerical information about surveyed companies

Source: Surveyed companies.

The research procedure was as follows:

1. We pretested the questionnaire with project managers who did not participate in the final survey to ensure clarity of the questions and coverage of the items to be searched;

2. The questionnaires were usually administered to two managers in each company (i.e., the customer and the supplier) who had participated in projects with innovative components;

3. We received and analyzed the questionnaires;

4. We conducted a personal interview with each manager that responded; because two managers were interviewed at each company, we were able to check the similarity of business information;

5. We made sporadic phone calls and visits to clarify specific points that were not clear, or divergent points between two managers at the same company;

6. All of these steps together took approximately 2 months, reflecting 200 hours of total work, which shows the depth of our study in this research field.

5.2. Development of cases

The cases were developed through visits to the studied companies, where we conducted interviews with several people. The questionnaire organized support for the hypotheses through a series of questions to be answered by the respondents.

Figure 5 shows the organization of the survey and the case study process:

- Blocks 1 and 2 - Information about the company
- Block 3 - Characterization of the process of innovation
- Block 4 - Characterization of IT projects
- Block 5 - Level of interaction(s) with the supplier (s)
- Block 6 - Process of knowledge transfer
- Block 7 - Environment conducive to G.C.
- Block 8 - Numerical information to give the dimension of the importance of the cases

• Process analysis was used to consolidate the results in a comparable way, using the theoretical models as a parameter.

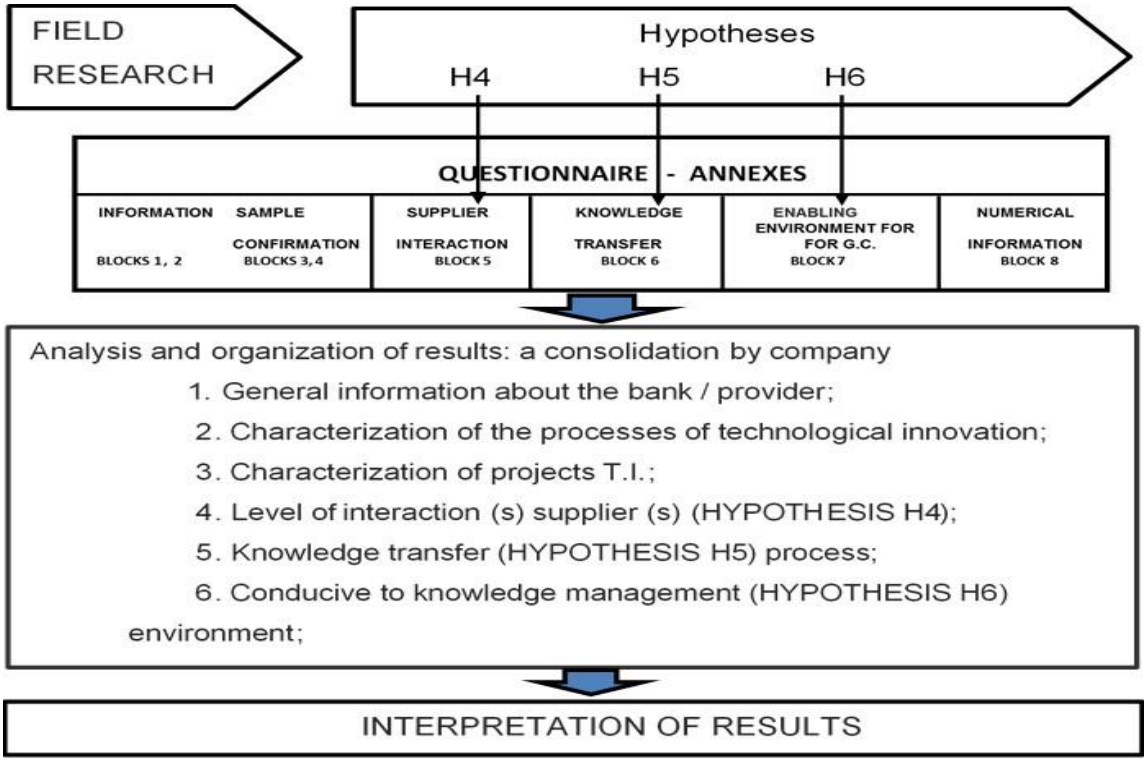

Figure 5 - Walkthrough of the study

Source: Authors.

The consolidation was performed by comparing the results with theory and the cases among themselves, i.e., for each row of the table, the results of each client's case were compared with B and C and with vendors A and B.

5.3. Research Limitations

Because the case study analyzes specific situations, such as the example in this study that analyzes the process of knowledge transfer over time from to a technology provider to its client (in the case of financial industry firms) during a project, adopting a degree of depth, one cannot generalize this study's results to other situations or companies. For replication to occur for other companies, it is critical to present similarities to the cases surveyed. The following presents the results obtained in each of the points mentioned in the analysis and organization of results as shown in Figure 5.

6. RESULTS

6.1 Consolidation of the results of the search

Blocks 3 and 4 (sample confirmation) check whether the cases made assumptions about IT projects with technological innovation, and blocks 5 through 7

relate to hypotheses H4, H5 and H6. The correlations among the hypotheses and the answers to the posed questions are described in the next subsection of item 6 results.

6.2 Analysis of adherence to the model using the score

Scoring the result of the closed questions, the analysis of the open questions, the interviewers' observations and the examination of other evidence during the interviews allowed for the general analysis of this item. However, it is also important to explain the numerical result of what is quantifiable, such as Table 4, in line with the assumptions presented in Figure 3. Analyzing the rows in Table 4, we observe that the only block that is integrally bonded to the model for all cases is the characterization of IT projects. For others, there are within-case variations. The remaining blocks vary in adherence according to the company searched. Observing the score for the event, the company that comes closest to the model, restricted to the quantitative view, is supplier B. The results of the research versus the assumptions of H4, H5 and H6 are detailed in sections 6.3 through 6.6 of this chapter.

Cases → / Blocks of Questionnaire ↓	% Maximum Score by Block Questio-nnaire	Client Company A	Client Company B	Client Company C	Supplier Company A	Supplier Company B
Innovation processes	10	7.7	8.5	4	6.5	10
IT projects	2	2	2	2	2	2
Customer interaction (H4)	8	4.7	7	8	1.5	8
Knowledge transfer (H5)	37	20.5	22.8	15,5	20	28
Environment conducive to G.C.(H6)	18	10	14	12	10.5	18
Total	75	44.9	54.25	41.5	40.5	66
% Adherence to the model: Each company's score versus the total score		60%	72%	55%	54%	88%

Table 4 - Score resulting from field research: cases of corporate customers and suppliers

Source: Authors.

6.3 Analysis of the level of interaction between customer and supplier versus hypothesis H4

The interpretations of this item are based on the premise that there must be an improvement in the level of interaction between suppliers and customers.

The research result shows that companies have a level of interaction with their suppliers and customers that evolves and does not fully adhere to the model, as in

Tserng & Lin (2002, p. 107-108), Kern & Willcocks (2000, p. 328-329), Zhijian & Loch (2009) and Torres-Freire & Henriques (2013), who claim an improvement in the relationship success factor benefits the subcontracting process. Although most managers interviewed stated that their level of interaction is appropriate, they also recognized that there were problems such as a lack of clear rules of engagement and informality in processes involving new suppliers or subcontracting. The client company that is closest to the model is Company C, and the supplier company that is closest to the model is Company B. The highlight of the findings related to client company C is that there are clear rules for approval and competition among providers and principles of social responsibility that influence the company's relationship and interaction with suppliers.

From a supplier's point of view, one respondent commented that there are situations in which customers were technically unprepared, that the relationships were not always good and often that problems with projects were blamed on suppliers, which in his view was incorrect. Another supplier took the position that clients should have an organizational focus on projects with innovative components, particularly with regard to planning for the time and resources necessary to absorb new knowledge. According to supplier companies' project managers, projects with innovative components cannot be managed in the same way as projects that use technologies known by the customers. The other highlight related to the supplier B, which showed total adherence in the search for appropriate interaction with its customers, using many of the processes of PM and the benefits of KM in projects for its clients. Although supplier B did not completely adhere to the model in the general context of all cases, as observed in the case of client company C, in the case of supplier B and the reports of managers from other companies, this need and trend in the model search is proposed as a success factor in subcontracting and achieving project objectives.

6.4 Analysis of the result of knowledge transfer versus the Hypothesis H5 process

The interpretations of this item were based on the premise that the transfer of knowledge at project time can be composed of the following instruments: training, preparation of documentation, interviews, and mentoring.

The first analysis was performed comparing the results with the proposed model and then comparing the cases, i.e., compliance and coincidence of these cases to one another. Other aspects considered in this interpretation were relevant evidence and the cases' most significant aspects. The trace model of knowledge transfer is based on the research of Nonaka&Takeuchi (1997, p. 68-69), Karhu (2002, p. 436), Fagan (2001, p. 5-26), Tsang (2002, p.835-854), Kamara et al, (2002, p. 205-211), Landaeta (2008), Medina (2013), Ferraresi (2012), and Galvis-Lista & Sánchez-Torres (2013). In general, these authors address the process of form and tools for knowledge transfer. The evidence considered relevant to the surveyed projects, along with the items that were the most significant to those projects involved technologies that were new to the client companies at the time they were developed. In the case that follows, **d** and **e** represented projects that were innovative to the suppliers' business customers. Companies where these projects were executed, given the "heavy reliance on technology" and development activities, are located in the strategic quadrant, according to Nolan & McFarlan (2005), of Table 2. These projects were analyzed based on Blechar (1998, p. 6) and involved changes in the installed and/or technical and/or application layer

architecture technology environments. To different degrees, these changes represented a technological breakthrough for the companies involved.

The model of knowledge transfer was observed in all cases studying corporate customers and suppliers, although to various degrees and shapes. The following points were observed when considering the items analyzed, i.e., mapping, conversion forms, instruments of transfer, storage forms, modalities and level of knowledge transferred within the project:

1. The process of knowledge transfer must evolve if search results are compared with the proposed model, especially regarding the process of making knowledge explicit. All of the project managers that were surveyed reported that after the process of knowledge transfer, the most consistent form of knowledge was tacit. This suggests the fragility of the KM process. Although projects were documented in many cases, it was often recognized that the documentation was "just for the record." The instrument of socialization is important, but only when it is used, the KM process becomes incomplete and businesses continue to rely solely on people to use and add to the knowledge gained.

2. Comparing the results—specifically, the model presented by Kamara et al, (2002)—it is observed that there is one group considered as a source of knowledge and another targeted to receive new knowledge. Each of these groups has three components: people, paper and software. By comparing this model with the results of the studied cases, it is observed that the major focus is the component of people who includes only isolated examples of papers and software, as in the case of supplier B.

3. Another aspect that shows the need for a development environment for KM is one not been found in the cases studied (except for vendor B): that of a formal function administrator or an integrator of knowledge, as set forth in Marçula (2001, p. 130-134) and Karhu (2002, p. 430-446).

4. Evolution can also be analyzed starting from knowledge "built by the people" and progressing to knowledge "embedded in capital" (Prahalad, 1998, p. 20). Using this vision, it can be stated, based on all of the evidence, that the knowledge of the analyzed cases tends to merge into group knowledge "embedded in people" rather than the group's "corporate capital" knowledge. This statement is also aligned with the statement of the item that includes KM, in which it is found that in all of the projects surveyed, the most consistent, existing, post-transfer knowledge is in the form of tacit knowledge.

5. In the cases studied, we also find that companies need to differentiate themselves by emphasizing certain PM processes in projects with innovative components versus those with known technology environments. This occurs to the extent that the project managers surveyed had a dual role, i.e., the mission to internalize new knowledge and the task of implementing the project itself, see Meredith & Mantel (1995) and Tavares & Pessôa (1999a). Adherence to the model is proven to the extent that all project managers acknowledged the importance of knowledge transfer from suppliers in projects involving new technologies. There is also overlap between the processes used in knowledge transfer. However, the transfer processes used, in most cases, focus only on people using the method of socialization for converting knowledge. The evolution of the proposed model is mirrored in the process used by supplier B, which involves KM processes in its PM.

6.5 Analysis of the result of the enabling environment for KM versus Hypothesis H6

The interpretations of this item were based on the premise that there must be an enabling environment for KM. The results show that for client companies A, B and C and for supplier A, although most of the items related to the processes that allow the creation of a KM environment are practiced, these companies do not have a process explicitly for this purpose. The processes that do exist are important but informal. The only exception is supplier B because that company practices all of the items related to the processes that allow the creation of a KM environment and the company also has an explicit process for this purpose. For supplier B, the processes that exist are both important and formal. In this company, beyond those cases deserving of mention, there are storage processes for new knowledge, as well as processes to spread knowledge using IT tools, making that new knowledge available to every business and in some cases, to customers.

6.6 Knowledge Transfer: the results of the issues that consolidate Hypotheses H4, H5 and H6

This item considers the issues presented in item 3.2, which concern the presentation of the problem model. Thus, it is possible to obtain guidance on how to resolve the two questions posed.

QUESTION 1: How is it possible to enhance the model for acquiring these solutions in the context of PM and knowledge transfer?

Improving the procurement model for outsourcing IT projects with components of technological innovation should occur primarily through the following measures:

1. There should be an improvement in the interaction between client companies and their suppliers through bidding and approval processes that have clear rules and opportunities for all suppliers. Although this reality is not quite the same for all, as set forth in the model outlined by Tserng & Lin (2002), Kern & Willcoks (2000), Zhijian & Loch (2009) and Torres-Freire & Henriques (2013), client companies do seek to improve this model, with the full support of their suppliers. Importantly, client organization C and supplier B use very similar processes to those used in the model mentioned above.

2. The planning and execution of some processes of KM at project time can help the success of an IT project with innovative components following the proposed process:

a. Companies should map the gap in new knowledge versus current internal knowledge during a project's planning phase (i.e., management skills, resource planning and acquisition of people).

b. Companies should train their internal project teams on new technologies during the processes of resource planning, and team development.

c. Companies should plan the transfer of new knowledge to internal staff during the process of team development and contract closing, thus indicating the importance of formalizing this activity with suppliers.

d. Companies should undertake a planning process for storing and spreading new knowledge during the process of team development.

e. A project with innovative components must be planned and executed with much greater focus than in other types of projects in which technology is known and dominated by members of the internal project team. This focus is critical because the project manager should be concerned with balancing knowledge-transfer activities with the actual execution and delivery of the project.

3. Improving interactions with suppliers and using KM processes at project time have an important complement in creating an environment conducive to KM.

4. This environment is not complete in all cases studied. Most cases show that there are processes that facilitate KM, but that those processes are neither complete nor informal. Again, the only exception is the case of supplier B, which features an adequate process of creation, use and dissemination of knowledge using inclusive processes and IT tools. The result in Table 5 shows that the process of storing knowledge for future dissemination should be part of the PM processes during HR team development.

QUESTION 2: What is the best way to transfer knowledge at project time?

According to the survey, which involved a field of three client organizations and two suppliers, a proper form of knowledge transfer requires the steps set forth below. Moreover, the provided instruments of knowledge transfer for the cases studied confirmed these steps:

1. Either before or during the planning and execution of the project, personnel must be trained.
2. The project, especially new knowledge, must be documented.
3. There must be a mentoring process in which the supplier company, through its employees, transfers knowledge at project time, showing how the project is accomplished and then watching the professionals at the client company implement the project activities.

Processes of KM / Processes of PM	Mapping the knowledge Gap	Training	Process of knowledge management	Storage process of knowledge: to further spread
Processes of KM should be provided in PM processes	Total adherence to the model	Total adherence to the model	Total adherence to the model	Total adherence to the model
Project time management: estimating activity resources		Partial adherence: client companies B and C, item 6.3PMBOK (2008)		
HR management: acquiring persons	Partial adherence: client companies B and C. , Item 9.2 PMBOK (2008)			
Development team		Partial adherence: client companies A and B, item 9.3 PMBOK (2008)	Total adherence to the model, Item 9.3 PMBOK (2008)	Total adherence to the model, Item 9.3 PMBOK (2008)
Management of acquisition	Partial adherence: client companies B and C, item 12.1 PMBOK (2008)		Partial adherence: client companies B and C, item 12.4 PMBOK (2008)	

Table 5 - Results of the vision of the use of the processes of KM processes in the PM

Source: Authors.

7. FUTURE RESEARCH

Here are other related research opportunities that could complement our work: 1. A detailed study and criteria for qualifying and selecting suppliers of new technologies could be undertaken;

2. The project manager's major challenge is to balance the concentration of efforts between a knowledge transfer of new technology and the implementation and delivery of the project itself, therefore, learning how to achieve an optimal balance between the two would be very interesting;

3. It would be interesting to search among companies of the same group (e.g., Matrix and subsidiaries) the transfer of technical knowledge in projects that have components of technological innovation.

8. FINAL THOUGHTS

This article studies projects that incorporate some type of technological innovation that will bring new information or practices into an organization's technology. This means that projects with this feature have a "hidden" objective: the transfer of knowledge from supplier to customer. A project's success can be jeopardized if the client company does not appropriate this knowledge. The contribution of this research is to create a process of knowledge transfer embedded into the acquisition process at project time. This process is summarized in Figure 4, and Table 5 shows its grip in the cases studied. Although these results cannot be generalized due to their application to only some cases studied, the model can be adopted in situations similar to those shown. The model has three pillars: good customer and supplier relationships, knowledge transfer and an environment conducive to KM.

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