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Knowledge transfer, Learning and Organizational Capabilities in an inter-organizational software project.

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Abstract

The aim of this work is to describe how learning and knowledge transfer mechanisms based on knowledge articulation and codification contribute to the development of organizational capabilities in software. The study focuses on client-specific and process capabilities. Results were obtained through a case study involving two partner companies in an inter-organizational project to develop an integrated information management and technology system. Evidence revealed investment and organizational efforts focused on knowledge articulation practices and activities to develop client-specific capabilities, as well as knowledge codification practices and activities to develop process capabilities. We also identified three factors that influenced software professionals' choice of the respective mechanisms (knowledge articulation and codification) namely: the sharing context, absorptive capacity and task complexity.

Key words: knowledge transfer, learning, organizational capabilities.

Transferência de conhecimento, Aprendizagem, e desenvolvimento de Capacitações Organizacionais em projeto interorganizacional de software.

Resumo

O objetivo deste trabalho é descrever como os mecanismos de aprendizagem e de transferência de conhecimento baseados em articulação e codificação de conhecimento contribuem para o desenvolvimento de capacitações organizacionais em *software*. As duas capacitações em estudo são: específicas do cliente e de processo. Os resultados obtidos por meio de um estudo de caso envolvendo duas empresas parceiras em um projeto interorganizacional de desenvolvimento de um sistema integrado de informações gerenciais e tecnológicas evidenciam investimentos e esforços organizacionais em práticas e atividades relacionadas à articulação de conhecimento para o desenvolvimento das capacitações específicas do cliente e em práticas e atividades relacionadas à codificação de conhecimento para o desenvolvimento das capacitações de processo. Também foi possível identificar três fatores que influenciam a escolha dos respectivos mecanismos (articulação e codificação do conhecimento) pelos profissionais de *software*, que são: o contexto de compartilhamento, a capacidade de absorção e a complexidade da tarefa.

Palavras-chave: transferência de conhecimento, aprendizagem, capacitações organizacionais.

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Introduction

When we analysed the development and renewal of organizational capabilities through learning and knowledge transfer mechanisms in a software products and services company, the results led to an appreciation of two focal issues. The first is that a relationship of inter-organizational partnership can stimulate continuous learning and knowledge exchange and, for this reason, may be an effective source for the development of organizational capabilities between companies. The second issue refers to the fact that inter-organizational knowledge transfer, which requires intense, continuous and joint efforts to align common interests and learning goals and share resources, skills and experiences, is always challenging and difficult for both people and organizations. It is therefore is necessary to identify which factors and/or conditions favour or hinder the professional's selection of acquisition and sharing strategies (knowledge articulation and codification) in order to understand which aspects lead to better conditions so that knowledge and information flow between people becomes more productive.

This work explores these two issues through a literature review and an analysis of data obtained from a case study between Information Technology (IT) companies, and makes both theoretical and empirical contributions. The theoretical contribution refers to the possibility of integrating three macro themes: organizational capabilities, knowledge management and organizational learning. We assume that learning through knowledge transfer is the force that links up and interacts between heterogeneous social agents, inside and outside organizational boundaries, enabling the development and renewal of the capabilities required for organizations to adapt to their environment. Our empirical contribution is the identification and proposal, to managers and other software professionals, of organizational practices and factors that enable and influence organizational learning and establish knowledge management strategies (knowledge articulation and codification) for the development and renewal of specific organizational routines for product and service development.

Capabilities result from an evolutionary organizational learning process requiring deliberate investments in financial, emotional and cognitive resources. They mainly originate from the integration of knowledge that emerges from and resides in a range of sources, inside and outside the company. In most cases, however, this knowledge is neither ready nor available for immediate acquisition and use (ZOLLO & WINTER, 2002).

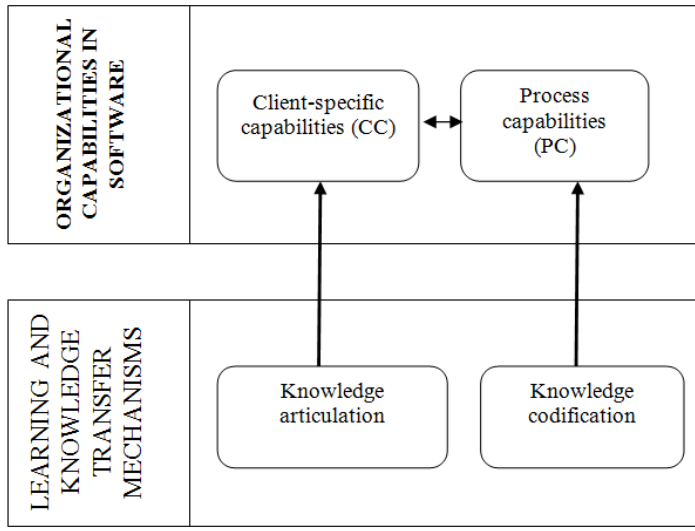
Organizational learning (OL) results from a complex combination of human (e.g. relationships between actors) and non-human (e.g. the structure, set of rules, artefacts and the environment) interaction and interdependence under constant negotiation and in joint efforts to reach a common understanding. We therefore need to identify and adopt knowledge transfer mechanisms or strategies that not only make information and knowledge available for acquisition, sharing and application in organizational routines, but are also able to explore and encourage interaction and socialization practices which continuously transform professionals, organizational structures and the various relationships between them (ANTONACOPOULOU; CHIVA, 2007).

In knowledge transfer and when learning during a partnership project to develop products and services, professionals adopt articulation and codification strategies for the acquisition and sharing of knowledge. The choice of strategies is influenced by certain organizational and individuals factors, namely: the sharing context, the professional's absorptive capacity, type of knowledge, cultural, structural and organizational differences and the goals of both the source and the recipient (AL-SATI; KACKNEY, 2011; COHEN; LEVINTHAL, NIU, 2010; SZULANSKI, 1996; TSAI; TSAI, 2005).

The aim of this paper is to answer the following research question: how do learning and knowledge transfer mechanisms contribute to the development of organizational capabilities? There are two organizational capabilities: client-specific and process. These are related to operations to develop software products and services. Figure 1 summarizes this study's conceptual analysis, relating learning and knowledge transfer mechanisms to specific organizational capabilities. We achieved our objective

through a case study, using interviews with four professionals from two companies, which we named Buyer-Seller, involved in a partnership project to develop software.

Figure 1 – Conceptual proposal for organizational capabilities, and learning and knowledge transfer mechanisms



Source: Compiled by the authors

Following this introduction, the paper is organized into a further four sections. The second describes the review of literature, the third the methodological procedures adopted in the fieldwork and the fourth the results. The fifth section presents the final considerations.

Review of literature

Our analysis of the research results was based on a theoretical foundation combining four macro themes: (1) the Resource-Based View (RBV), which provides an understanding and exploration of the strategic relationship between a company's internal resources, capabilities and competitive advantage; (2) Knowledge transfer and learning mechanisms based on knowledge articulation and codification, the factors that influence how professionals choose mechanisms, as well as organizational practices through which information and knowledge flow occurs; (3) Organizational Capabilities and software capabilities, which are organizational routines related to the development of products and services; and (4) the Buyer-Seller Relationship, which is the general business context in which the mechanisms and capabilities develop.

Resource-based View – RBV

The RBV posits that an organization's internal resources are the principal determinants of its competitiveness. Advantage in relation to competitors may be achieved through the coordination and exploitation of strategic resources, distributed heterogeneously in an industry (BARNEY, 1991; TEECE; PISANO; SHUEN, 1997; WERNERFELT, 1986). It involves knowing exceptional ways to deploy such resources, at the same time as developing resource bases and future capabilities (GRANT, 1996).

Under the RBV criteria, knowledge emerges as a significant strategic resource. In particular, tacit knowledge, since this is inherently indeterminate and dynamically reconfigured (TSOUKAS, 1996). Its transfer and sharing depend on repeated personal

interactions (KOGUT; ZANDER, 1992; LUBIT, 2001; NONAKA; TAKEUCHI, 1997; ZACK, 1999). Explicit knowledge is capable of being codified and stored accurately, but this does not guarantee that it will be readily assimilated by all, since its full understanding and apprehension may require prior skills and knowledge, specifically, absorptive capacity (COHEN; LEVINTHAL, 1990).

The transfer of these two types of knowledge, tacit and explicit, requires idiosyncratic organizational mechanisms which increase their value, such as the creation of a context of constructive communication and the use of different communication instruments that encourage and foster sharing, and propel the integration of a range of knowledge and other specialized resources fundamental to the development of organizational capabilities (GRANT, 1996; EISENHARDT; MARTIN, 2000).

To adjust to the demands of their environment, organizations often need to accelerate access to unavailable or insufficient resources and skills, which are difficult and/or time-consuming in their acquisition and internal absorption. Under these circumstances, the acquisition and renewal of skills through inter-organizational partnerships has been seen to be a viable strategic alternative, enabling companies to remain at the leading edge of technology (ULRICH; SMALLWOOD, 2004; TEIRLINCK; SPITHOVEN, 2013; FITJAR; GJELSVIK; RODRÍGUEZ-POSE, 2013), whilst at the same time stimulating theoretical investigations into this topic and other correlates for knowledge transfer and organizational learning.

Knowledge transfer and learning mechanisms, and influencing factors

Studies in software engineering have recommended approaches to knowledge management and organizational learning in the software development process for highly significant reasons (ALTHOFF; BOMARIUS; TAUTZ, 2000; DINGSOYR, 2002; KAUTZ; THAYSEN, 2001).

The first is that software engineering is considered to be a typical knowledge creation process in which tacit and explicit knowledge are recognized and converted over the entire product development lifecycle (LUCAS, 2006). The second is that software operations are highly dependent on tacit knowledge, where the individual is the expert and the principal holder of knowledge that can be systematically shared with an organization (RUS; LINDVALL, 2002). Finally, it is because software projects are under constant threat of discontinuation, due to the high mobility of human resources. This could only be alleviated by investment in infrastructure and the development of a work environment which promotes knowledge sharing inside and outside the company (RUS; LINDVALL, 2002).

Where information systems are outsourced, knowledge transfer must be understood as a set of individual and organizational activities assumed by the client to identify and acquire potentially useful knowledge, which is externally generated by the vendor (AL-SATI; KACKNEY, 2011) and vice-versa.

Some authors admit to a hierarchical relationship between data (a raw fact in the form of a number, image, text, symbol, etc.), information (data processed in a context and endowed with relevance and purpose) and knowledge (actionable information). There is some overlap and redundancy between the expressions knowledge transfer/sharing and information transfer/sharing (WILSON, 2002; SINGH, 2007; PAULIN; SUNESON, 2012).

There is also a tenuous line between what is transferred: whether it is information or knowledge, or both. Based on Singh's (2013) supposition that knowledge resides in the user and not in information collection, information becomes knowledge once it is processed in an individual's mind (tacit knowledge) and this returns to being information (explicit knowledge) through the practices of knowledge articulation and codification. This work therefore considers the distinctions asserted by Wilson (2002)[1], who admits

1 Knowledge which is shared with other people is inconsistent or incomplete, since it is never exactly the same as the knowledge generated by its creator or holder (tacit dimension).

that knowledge involves a combination of information and experience, reflected and interpreted within a context, integrating thought and feeling.

The knowledge transfer and learning mechanisms addressed here are, respectively, knowledge articulation and codification (ZOLLO; WINTER, 2002), which are the means by which individuals in an organization continuously acquire, share and accumulate the knowledge and experience required for the development and reconfiguration of organizational capabilities (HAKANSON, 2007). Such mechanisms may also be understood as knowledge management strategies (acquisition, dissemination and sharing) (HANSEN et al., 1999), and are therefore considered interchangeable in this work.

The codification strategy is the compression of knowledge and experience into a structure which involves the use of codes and models to translate rules and actions into procedures, guidelines, specifications and documents (WHITAKER; MITHAS; KRISHNAN, 2010). Through codification, knowledge is incorporated into transferable artefacts and may be moved over long distances (HAKANSON, 2007). The articulation strategy is the process through which tacit knowledge is explained, and this favours knowledge innovation and creation and promotes division of labour, thereby generating specialization advantages (economies of scale) (WHITAKER; MITHAS; KRISHNAN, 2010).

Knowledge transfer in organizations requires effort, since it depends on how easily knowledge (tacit) may be transmitted, interpreted and absorbed in a transaction between the source and the recipient. It is a distinct experience rather than a gradual process of dissemination, since it depends on the characteristics of all those involved in the transaction, which can itself generate causal ambiguity (BRESMAN; BIRKINSHAW; NOBEL, 2010; SZULANSKI, 1996), creating barriers which may be cognitive (absorptive capacity and content assimilation), social (trust between the source and recipient) and structural (configuration of the context in which the exchange and leaning takes place) (HANSEN; HASS; MARTINE, 2001), and which influence the choice of knowledge management strategies (codification and articulation).

Some of the barriers to knowledge acquisition and assimilation as well as to the best practices featured in the literature are, respectively: the nature or type of knowledge, absorptive capacity, context, task complexity and cultural differences, organizational structure and the goals of the source and recipient.

The type or nature of knowledge to be shared or acquired may be in tacit or explicit form. Tacit knowledge is not immediately available in written form, and its transference is far from trivial. Explicit knowledge may be simpler to transfer, since it does not depend on a strict social bond between transmitter and receiver. When initiating a process of knowledge conversion from tacit to explicit and vice-versa, organizations may therefore enhance the applicability of organizational knowledge (NIU, 2010) by replicating its capabilities (BERTA; BAKER, 2004; GIANNAKIS, 2008). This is particularly true in specific episodes of tacit knowledge transfer, which depend on the intensive use of communication for more prolonged periods of intense personal interaction between the source and the recipient (SZULANSKI, 1996).

According to Cohen and Levinthal (1990), absorptive capacity is related to the way in which an organization develops routines and strategic processes to internalize and apply external knowledge, and signifies the ability to recognize the value of new information, and assimilate and apply it for commercial purposes. Transfer effectiveness is conditioned by prior knowledge and skills, as well as the recipient's motivation to seek out and accept knowledge viewed by them as different or new. In this sense, a lack of motivation may engender in the recipient attitudes of procrastination, denial, sabotage, passivity or acceptance in their implementation and use of shared knowledge (SZULANSKI, 1996), due to the recipient's inability or failure to recognize and assimilate the knowledge made available for sharing and/or use (VAARA; et al., 2012).

Context is related to individuals who acquire knowledge because they are in a situation or task environment (TSAI; TSAI, 2005). This operational environment could be either sterile or fertile in terms of knowledge acquisition and sharing, as a result of the organizational structure (SZULANSKI, 1996). That is to say, when the

organization provides a favourable context (e.g. sources of coordination, culture, communication systems etc.) and collaborative mechanisms (e.g. teams, rules), knowledge transfer and the learning process tend to be facilitated (GOODERHAM; MINBAEVA; PEDERSEN, 2012).

Furthermore, cultural differences and the goals of the knowledge source and recipient may impede collaboration and, consequently, hamper knowledge transfer (AL-SATI; KACKNEY, 2011).

The factors described above may isolate or, at the same time, impact, positively or negatively, on the configuration and implementation of the articulation and codification strategies undertaken in the development and evolution of organizational capabilities.

Organizational capabilities

Organizational capabilities are the organizational skills required to repeatedly perform a production task, which directly or indirectly relates to the capacity to create value through the transformation of input and output recourses. These capabilities are based on the integration of created, existing and accumulated skills and knowledge within an organization (GRANT, 1996; WINTER, 2000; SPANOS; PRASTACOS, 2004).

Capabilities are rarely ready and available for immediate acquisition and use. They require development and improvement over time, through interactions between various tangible and intangible resources (TEECE, 2000). Their creation requires investment in continuous learning, through a sequence of coordinated and repeated activities by individuals undertaking organizational routines (DAGHFOUS, 2003). They can also be developed by inter-organizational teams, dedicated to commercial partnership projects (WAGNER, 2003).

According to Zollo and Winter (2002), learning processes are responsible for the evolution, over time, of two sets of organizational activities: i) those dedicated to the company's operational functioning (staff and line activities), that is, operational routines (or operational capabilities); and ii) those dedicated to the modification of these operational routines, that is, dynamic capabilities.

This study concentrates on analysing the development and renewal of software capabilities, in particular, process capabilities (PC) and client-specific capabilities (CC).

Software capabilities

Software development is made up of a series of activities and methods undertaken collaboratively by project teams and, for this reason, necessitates the mutual sharing of both tacit and explicit knowledge (RUS; LINDVALL, 2002). It requires organizational practices to exchange and integrate knowledge and information, which ensure the realization of interests and goals common to the two companies. It means progress in terms of product development, combining the current and distinct skills and abilities of professionals from each, enabling new skills and routines to be complemented and incorporated into both.

Software development is a tumultuous human process which involves rapidly changing technologies, highly skilled and mobile professionals, with distinct know-how, interests and views about a specific goal (PRIES-HEJE; BASKERVILLE; HANSEN, 2005). It is made up of a series of activities, methods and practices undertaken collaboratively by project teams. It is thus rich in tacit knowledge, which usually involves mutual knowledge sharing (RUS; LINDVALL, 2002).

Three main generic phases constitute a software development process (PRESSMAN, 1987): definition (focused on 'what?') – systems analysis, software design planning and requirements analysis; development (focused on 'how?') – software

design, codification and testing; and maintenance – concentrating on the changes associated with error correction and the necessary adaptations as the software environment evolves and new applications are produced in line with client requirements. In this latter phase, the steps of the previous phases are reapplied.

Previous studies conducted with global software service companies (ETHIRAJ et al., 2005; JARVENPAA; MAO, 2008) have identified and categorized two important capabilities for the industry: client-specific capabilities and process capabilities.

Client-specific capabilities (CC) are a function of repeated interactions with clients over time and in different projects, which reduce administration costs and improve the project. They focus on the routines and recourses that align provider activities with the goals and priorities of the client over the short and medium term. The service provider must develop an understanding and have sufficient knowledge of the client's business (e.g. banking), of their functional domain (e.g. share trading) and of the specificities and idiosyncrasies of the client's operational environment (ETHIRAJ et al., 2005; JARVENPAA; MAO, 2008). In large part, they therefore reflect a tacit knowledge of the client's business domain and operational routines, acquired through repeated interactions between the client and the seller.

Process capabilities refer to routines to deliver tasks and resources in order to achieve software design, development and execution. They reflect technical skills, abilities and recourses in software development systems and processes. They demonstrate the richness of the organization's software development process and reflect the consistency with which process outputs may be produced. They therefore also reflect knowledge domains (technical, managerial, product) which, for the most part, may be acquired explicitly, investing in infrastructure, information systems and formal training (ETHIRAJ et al., 2005; JARVENPAA; MAO, 2008).

Both software capabilities may be acquired and/or renewed through inter-organizational partnerships which stimulate learning and knowledge sharing and provide tangible benefits for the partners involved, in terms of cost reduction and improved efficiency (WAGNER, 2003; WHITAKER; MITHAS; KRISHNAN, 2010).

Buyer-Seller Relationships (B-S)

Economic factors are driving software development projects towards the outsourcing model (PRIES-HEJE; BASKERVILLE; HANSEN, 2005) whereby organizations hand over one or more of their business processes to an external seller (WHITAKER et al., 2010).

Beyond the need for companies to concentrate more fully on their core business, this practice has been justified by an immediate need to access unavailable or insufficient resources, which are hard and/or time-consuming to acquire as intellectual capital, knowledge, operational expertise or know-how (SUMPIKOVA et al., 2013).

Specifically, knowledge related to Information Technology (IT), enables an external provider to attain higher levels of efficiency for their clients' IT service delivery, while at the same time improving organizational performance through the implementation of improved systems. Learning and acquiring new knowledge may also generate productivity gains for companies that operate within a buyer-seller relationship (SUMPIKOVA et al., 2013).

According to Wagner (2003), one of the main benefits of a closer buyer-supplier relationship is the synergy resulting from two organizations working together and solving common problems in order to achieve common goals.

Outsourced information systems projects have been recognized as intensive knowledge undertakings, which often invoke interactions between people with different knowledge and skills, where the seller functions as the knowledge source and the client as the recipient (AL-SATY; HACKNEY, 2011). In this study, the buyer (client) and the supplier (seller) are both knowledge sources and recipients at the same time.

Methodological procedures

In order to investigate the phenomenon within its real life context, the empirical research was based on a case study (YIN, 2001) in an Information Technology (IT) company, known as the BUYER, which developed an integrated management information and technology system (IMITS) via a partnership contract with a specialized software service provider, known as the SELLER.

The IMITS project began to function as a partnership project in 2007, when the Buyer decided to migrate their system from a platform based on Microsoft technology to one based on Java technology, although they did not have readily available skills and abilities in-house to develop the integrated system for the new development platform. The Seller was then contracted to define the scope of the new version.

The IMITS is a property system (the Seller's intellectual property) in the form of an integrated management system. At the beginning of the contract, the Seller, who was not cognisant of the Buyer's business context, was required to form an inter-organizational team (project managers, developers, business analyst, infrastructure support and testing) in which each had to complement the capabilities required for the development and maintenance of the new version, which was then named IMITS-Web. One of the agreement requirements was that the companies should learn and exchange knowledge with each other. These factors made the project suitable for our case study.

The case study was chosen according to one of Gil's (2010) recommendations, that is by seeking out a typical case based on prior information. Thus, at the pre-testing stage for the software professional interview questions, we found out that that the IMITS project envisaged knowledge transfer and complementary skills with externally contracted partners and that, therefore, the parties involved (Buyer-Seller) would have to develop and maintain an interface to administer all the phases and the resulting products. This information, allied to the availability of the two companies to participate in the study, was decisive in making an intentional choice, which would lead to better understanding of the research question (CRESWELL, 2010).

Data was collected from two sources: semi-structured interviews and open-access documents provided by the respondents. The interviews were conducted with four professionals, including two project managers and two developers from both the Buyer and Seller. We chose these job profiles intentionally, since their functions assume an accumulation of skills and abilities that included knowledge inherent to the two capabilities under study (client-specific and process).

Each interview lasted approximately one hour and thirty minutes. All were recorded, with the respondents' prior authorization, and then transcribed. Data with ambiguous interpretations or inconsistent with the documents was reviewed and clarified with the respondents.

The data collection aimed to capture the project professionals' evaluations of the knowledge acquisition and exchange during the development of the IMITS-Web and how these contributed to the systematization, consolidation and maintenance of development routines (organizational capabilities), specifically, those routines and resources which aligned the Seller's activities with the Buyer's goals, needs and priorities over the short, medium and long term; and how learning and knowledge transfer occurred over time.

The research protocol included an interview script to obtain a minimum set of information in the field. Focusing on the complexity of developing capabilities, we gathered the following information: academic backgrounds of the Buyer and Seller technical teams; how team skills have changed over time; how the partnership contributed to skill development; where the ideas for changes to or improvements of the product came from; the possible benefits arising from improved skills; the possible barriers to knowledge acquisition; how they prefer to learn and/or acquire knowledge; what influences this preference. The respondents provided other information during data collection and this was highlighted and incorporated into the initial information set during the transcription phase.

We used content analysis techniques to interpret the interview data (BARDIN, 2011). These consist of a set of techniques to analyse communications, using systematic procedures and goal descriptions based on message content in order to overcome uncertainties and enrich our reading of the data (MOZZATO; GRZYBOVSKI, 2011). We operationalized these analysis techniques using certain *a priori* categories based on the literature review and complemented *a posterior* according to the repetition frequency of characteristics associated with the research topics, extracted from the interview content and summarized in a single chart.

As one of the strategies to increase the reliability of data in qualitative research, Creswell (2010) recommends the use of different sources of information. To this end, we also used documentary sources, based on the (physical and electronic) records made available by the respondents, including: the official bid for contracting the Seller, the project description including terms of amendment, project reports, databases of lessons learnt, and a use case template (UCT). These records were important for reviewing the interview responses and were used to cross-reference the two data collection instruments and as a source of additional data, enabling a more in-depth analysis, as recommended for case studies (GODOY, 1995; YIN, 2001).

Discussion

The empirical study took place in an Information Technology company which developed, in-house, the first version of an integrated management and technology information system using a Microsoft platform. The number of users increased and demands for new features emerged, leading them to migrate to a Java platform, that is, to redesign the system as a whole. Specific operational capabilities need to be developed in such companies.

The companies had complementary capabilities (the Buyer was more client-specific and the Seller more process oriented), providing an important justification for the partial outsourcing of the IMITS-Web, that is, the design team's need for knowledge, operational expertise and know-how.

Before proceeding to an analysis of the development of client-specific capabilities in these companies, we need to recognize a typical business approach to defining its clients through a mediated model. In other words, there is an agent between the product user and the producer (JARVENPAA; MAO, 2008, LEVINA; ROSS, 2003). The case we studied operates by way of a "partnership" between the two companies in the configuration: End User – Buyer – Seller. The End User is the one for whom the system is developed, and directly benefits from the features configured in the work. The Buyer is the company that outsources development services to the Seller and interacts with the End User in order to understand their needs and translate them into system features. The Seller is the one who interprets, alongside the Buyer, the End User's demands and develops the product.

Client-specific capabilities

The inter-organizational team works in the same physical environment in the Seller company's facilities, where a project office was set up to create physical proximity and facilitate interaction. The project managers of each company set up in the same office and jointly developed project activities. At the time of the interviews, the two managers stated it was not possible for others to discern the fact that they worked for separate companies, and this increased their sense of familiarity. At the time of renewal, the Buyer-Seller contract was extended and longer contracted periods were guaranteed through the mutual interests of both parties, as the Buyer's Project Manager stated:

> "It is in our interests to develop this current partnership because we had a number of previous problems, when the partnership was with a company in another state (BH) and everything had to be solved by telephone or e-mail, which put back project deadlines, while their professionals had difficulties understanding our needs. And the

> project manager only listened to complaints and resolved conflicts between the two teams, here and there, and no one was interested in exchanging anything, and their team had high staff turnover, so when the developer or tester started to dominate the project he would leave the company" (Buyer's Project Manager).

Since one of the Buyer's goals was to contract a company capable of developing a partnership that facilitated the transfer of basic knowledge about the Java platform and one whose team was able to assume the updating and maintenance of the IMITS-Web over the medium and long term, the requirements of the official contracting process had to be changed entirely. To this end, the total and exclusive commitment of the Seller's team (one project manager and four developers) to the project was included, as a means of guaranteeing that the professionals were able to learn and master the Buyer's business. The Seller's Project Manager confirmed that this demand was essential for the evolution of the initial project stages and to fine tune the common language to communicate between the teams.

Another activity undertaken by the Seller's team was the inclusion of the Use Case Template (UCT), which formalized the specification requirements for updating features (updating modules) and maintaining the system.

> "This document helped us a lot in mastering system features and consequently better understanding the business we were working for, which was very hard at the beginning. I think at some point all of us are going to learn about this business" (Seller's Developer).

The intention was to codify the design scope to facilitate communication between the teams and assess project performance. It required a great deal of team discipline to establish and continue using this design document. In this way, according to the Buyer's Project Manager, the need for personal interaction when dealing with design problems was greatly reduced.

By constructing and allocating a specific physical space for the project teams, in order to maintain proximity and interaction between them, the Buyer is evidencing deliberate and explicit investment in a mechanism that provides and fosters knowledge articulation. By including the UCT as a standard document for the project, that is, by ensuring that all IMITS-Web maintenance and updating is preceded by UCT use and authorization, the Seller is seeking to establish a common means of sharing knowledge and information, which guides the project team throughout the product development stages. This is, therefore, an explicit knowledge codification practice.

The End User, specifically its administrative team, encouraged the Buyer's developers to enrol in lectures and/or specific courses related to new work procedures which could require IMITS-Web updating. For example, the Buyer's developer made a comment about an asset depreciation course he participated in with the End User because he wanted to enhance this feature within the system.

The Buyer's team has their own expertise and know-how about these client-specific capabilities, and was able to transfer and impart knowledge to the Seller's professionals. After a three-year partnership, the Seller's more experienced developers already understood the End User's needs and suggested and/or triggered system updates. According to the Seller's Project Manager, it generally takes at least one year for a software engineer/developer to understand the system's administrative modules for themselves. The Seller's Project Manager and Developer have the same opinion about what each of the teams need to know regarding the business environment, since they incorporate the End User's vision and needs into the development project.

We asked the Buyer's developer about the importance of and need for prior experience and knowledge in order to perform the project tasks, and she said:

> I completed a basic post-graduate course in information systems twenty years ago, as well as mini courses in programming languages (SQL and Visual Basic), however I recognize that my greatest contribution to the project is my understanding of the purchasing and asset module, since I have worked in these areas here in the company. I think that when our knowledge about an activity/area is very basic, it can impede good understanding of what we do. Look, we have already taken courses on the Java platform and other more up-to-date technology, but I came out of these lectures not having understood anything, so then I talked to the project manager, who is trained in computer science and we complement each other, because she doesn't know anything about the administrative tasks and those system modules are my responsibility. Without the team of specialized contracted developers, we would not have the IMITS-Web version that we have today.

The Buyer's and Seller's Project Managers prefer to learn from books or contact with colleagues (the Seller's Project Manager is a highly experienced teacher of Java technology) because that way it is quicker and easier to learn. "Currently we don't need conventional courses, after all, there is material on the internet and I've got a book".

The Seller's Developer stated that it is not difficult these days to learn on your own, since a trained and experienced professional knows how to update his knowledge in a specific area. He also mentioned a knowledge articulation practice commonly used by software professionals today – that of joining the LinkedIn network. On this network, one can locate an expert in an area of application and book a meeting with them (e.g. lunch, evening drinks). According to the respondent, knowledge exchange is much more specialized and personalized and one can thus increase one's '*netknowledge'* (a term the respondent used meaning the network of software professionals' knowledge).

This report evidences large gaps in prior knowledge and experience (absorptive capacity) between the knowledge 'source and recipient', which could in itself compromise learning and knowledge transfer (COHEN; LEVINTHAL, 1990; SIMONIN, 1999; SZULANSKI, 1996), since the Buyer's professionals have neither 'training nor experience' in Java technology. This could impact on the development of software capabilities (both process and client-specific).

Process capabilities

The Seller's team is experienced in the use of software development methodology and the Project Manager is formally trained in project management, although this does not apply to the Buyer's team. The UCT document was one of the first documents that taught the Buyer's team how to work in development by adhering to a particular standard.

> "Before this document everything was haphazard, the end user requested something and we made the adjustment. However, neither the request nor the solution were recorded and this created repeated work for the team. Then they passed on this know--how to our team and the project" (Buyer's Developer).

Another activity that changed the team's working methods was the Seller's incorporation of a software tool named JIRA (a programme that organizes and manages software development projects), which manages modifications to the IMITS-Web in terms of complexity and criticality, records the timeline of alterations and is responsible for project development activities.

> "This greatly facilitated project management and meant the team was more up-to--date with project progress - who is taking care of what and who is specializing in which IMITS-Web modules, improving our project manager's distribution of tasks to the developers" (Seller's Developer).

The project had a common Buyer-Seller-approved project development monitoring system. This system contains a project knowledge database, records of requests, a history of programming coding modifications, lessons learnt (feature and specification errors and corrections), which the entire team had access to and was responsible for updating.

The Seller's team has expertise in development methodology and is transferring this to the Buyer's team, which (based on reports from the Buyer's Project Manager) had previously developed the system chaotically, without applying standards.

Learning and knowledge transfer mechanisms, organizational practices and factors that influence mechanism choice

Table 1 summarizes the organizational practices that the companies (Buyer-Seller) employed to develop organizational capabilities, adopting one and/or other learning and knowledge transfer mechanisms. The two companies used at least one of these organizational practices in each of the two training sessions provided during the project.

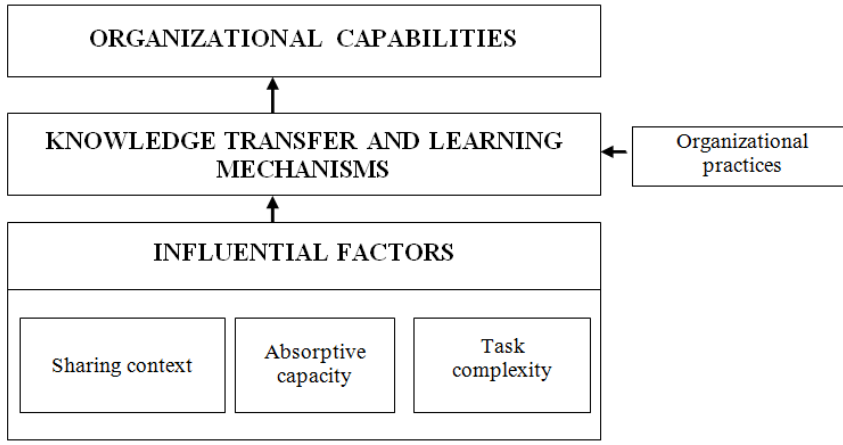
Table 1 – Learning and knowledge transfer mechanisms and organizational practices.

Learning and knowledge transfer mechanisms	Organizational practices
Knowledge articulation	• Project meetings • Personal interaction with the End User • Meetings via the LinkedIn network • Discussion forums.
Knowledge codification	• Electronic database (JIRA, project management and organization software) • Books and periodicals • Technical documents and reports from the internet.

On the one hand, client-specific capabilities require investments in time and team availability in order to share what is known between the teams and the end user, and to locate the right expert on discussion forums or LinkedIn in order to obtain a solution for the project problem or technical quandary. They therefore require knowledge articulation efforts. On the other hand, process capabilities are predominantly developed by practices that require explicit investment in training programmes, infrastructure and information systems, which enable information storage, project reports, use case templates etc. However, some practices, such as opting for books, periodicals and documents sourced on the internet, may require both explicit (funds to buy books and subscribe to specialized magazines) and implicit (learning by doing) investment in learning. They therefore depend on codification efforts, without discarding the need for knowledge articulation, principally during their acquisition and storage.

The relationship between elements from the theoretical framework and the fieldwork results are summarized in Figure 2. Both client-specific and process capabilities are acquired through learning and knowledge transfer mechanisms, which are, respectively, knowledge articulation and codification. These two strategies involve the utilization of organizational practices (Table 1) by the project team to convert tacit into explicit knowledge and vice versa across all software development stages. However, professional deliberations about one and/or other strategy are demonstrably influenced by certain factors, namely: the sharing context, absorptive capacity and task complexity. These factors function to facilitate or hinder knowledge transfer and consequently interfere in the capability learning process.

Figure 2 – Influential factors, knowledge transfer and learning mechanisms, and organizational capabilities.



Source: Compiled by the authors

Client-specific capabilities involve intense interactions and a close relationship with the client in order to understand their business specific domain, which more often than not requires tacit exchanges of knowledge. Process capabilities require learning about routines and the application of resources involved in the operations. These necessitate discipline, infrastructure, systems and training programmes and, therefore, explicit investment in knowledge codification.

In terms of the types of shared knowledge (tacit and explicit), the developers most involved in process capabilities made the following comments:

> "When the problem is new to me, hard to solve and requires a quick decision, I prefer to enter a discussion forum or call a friend to find the way out, because the priority is to move forward. When I have more time to solve the problem and time to think, I prefer to read internet material or project documents and then ask for someone's help" (Seller's Developer).

> "I prefer, above anything else, to ask my office partner, if he provides the solution, then I'm satisfied. When I see that my office partner has discovered a new solution or something interesting I seek to learn it right away". (Buyer's Project Manager).

In this case, relative ease of conversion between two types of knowledge is not the only important factor for knowledge transfer and learning. Task complexity also influences the adoption of knowledge articulation and/or codification. This is because the choice that the professional makes between one or other strategy is related to the characteristics of the knowledge he requires in order to undertake a specific task. That is, some tasks depend on routine, already codified, knowledge, and reading a report or technical procedure is sufficient to complete them. Others depend on non-routine, specific and complex knowledge and may require consultation of a network of experts in order to learn from accumulated experience.

Professionals have a greater propensity for the convenience of proximity to acquire the knowledge they require when the task needs to be performed quickly. When they work in close proximity, they feel they need to expend less effort to acquire knowledge if the environment encourages direct interaction with an office colleague. Then they tend to favour the knowledge articulation strategy.

The Buyer's team's lack of *a priori* knowledge about the Java platform led to a requirement for the Seller's professional team members to have at least three years' experience, so that these professionals could begin training the Buyer's team. A lack of prior knowledge and experience may therefore hinder or impede learning and knowledge transfer based on codified knowledge, so the preferred option was to outsource (Seller) professionals with expertise, in order to acquire the skills and abilities needed to develop the IMITS-Web.

As predicted in the literature review, *absorptive capacity* is a barrier to knowledge transfer and compromises the development of process capabilities, through the knowledge codification strategy. This means that the professional has neither the *a priori* knowledge nor the experience to autonomously acquire the knowledge required to migrate from one technology development platform to another (from Microsoft to Java, for example).

Constructing an office where the Buyer and Seller teams could work together promoted knowledge articulation. Training, implementation forms and a project monitoring system facilitated access to information and knowledge exchange, promoting codification. Other aspects that featured in the interviews included ensuring that the End User was not aware that the Seller team was outsourced, and physical proximity, which created more familiarity between team members. Increasing involvement between professionals thus creates friendships, fosters articulation and may more quickly alert the team to the need for knowledge codification.

The *sharing context* is another factor which may influence the choice of knowledge articulation and codification strategies. This means that the organizational environment (tangible and intangible resources, climate) favours the sharing of information, knowledge and abilities between people. This predisposes them to work collaboratively and learn continuously. It involves eliminating physical barriers (greater physical proximity between knowledge source and recipient) and making available technological resources that favour interaction between professionals. The fact that professionals work in the same physical environment creates integration and strengthens interdependence in tasks and professional experiences, as well as stimulating social bonds.

Task complexity involves the knowledge characteristics (routine/standardized and non-routine/non-standardized) that the professional requires to undertake specific tasks, i.e., it depends on how complex the task is from the professional's point of view. Degree of task complexity was seen to influence the professional's preference for adopting knowledge articulation or codification. When the task was more standardized, that is, the procedures were clearly demarcated and detailed analysis or judgement was not required in order to understand how to complete it, the tendency was for the professional to explore already available and explicit knowledge based on physical or electronic data (e.g. JIRA, books, virtual libraries, etc.) Typical process capability routines display these characteristics. In contrast, when the task is more specific and more complex, it might take more time to find a solution, which might not be available for access or use. In this case, the professional preferred to seek a solution from other professionals who have recognized and legitimized technical skills and experience in this subject.

This barrier to task complexity, identified in our field research data, is consonant with Simonin's (1999) considerations that the number of interdependent technologies, routines, individuals and resources associated with specific knowledge may complicate task completion. The complete spectrum of a skill may be distributed amongst several individuals, departments and contexts, so that knowledge is not easily integrated or understood in its entirety by many individuals, thus hindering transferability.

Final considerations

The results we obtained suggest that the development and renewal of software capabilities may occur via learning and knowledge transfer mechanisms based on knowledge articulation and codification (strategies for knowledge acquisition and sharing) and on inter-organizational partnerships (e.g. a buyer-seller relationship). However, professional choice of strategy is influenced by social, structural and cognitive factors.

In terms of the structural aspect, working in a team, in an environment which facilities and stimulates information exchange and knowledge, as well as analysis and solution of joint problems, the inexistence of team member subordination (Buyer-Seller),

all tend to promote communication and trust between people, and an interest in learning and sharing what they know. In terms of the social aspect, collective learning promotes a disposition for interaction and interdependence in the professional workspace, which becomes a connecting force between a variety of heterogonous social agents (e.g. software professionals and users). Regarding the cognitive aspect, the effectiveness of the practices adopted for the acquisition and sharing of knowledge is conditioned by absorptive capacity (the ready assimilation of the knowledge that is being shared) and distinct skills and experience in relation to the complexity of tasks undertaken.

Both of the capabilities we investigated require and are based on different types of knowledge. Client-specific capabilities require an exchange of tacit knowledge, which is acquired through personal User-Buyer-Seller interactions. They require access to, transit through and integration between Seller professionals in both the Buyer's and End User's environments, so as to better understand their needs and requirements. Client-specific capabilities may therefore require greater efforts and specific investment in certain organizational aspects, in order to strengthen culture, information and knowledge-sharing policies between and within organizations both individually and in groups. This increases the teams' interest and trust so they can learn and complement each other's skills and abilities though knowledge and experience, which is already available for use and has apparent economic value.

Process capabilities (PC) rely more heavily on autonomously acquired explicit knowledge (for example, through self-study from books, courses and learning by doing). Interpersonal interaction may therefore be less intensive than in CC. PCs require more experience, ability and absorptive capacity from individual professionals in terms of new knowledge. They could therefore necessitate strategic company activities in terms of contracting policies, recognizing and maintaining the best experts on the staff team, as well as permanent incentives for professional qualifications and training.

Theoretically, integrating organizational capability approaches to learning with organizational knowledge management demonstrates the dynamic potential (adjusting routines and resources to environmental contingencies) to (re) configure the skills required for software development (process capabilities) and align products/services to the client's needs and priorities (client-specific capabilities). We are therefore reasserting the strategic value of this relationship for studies regarding competitive organizational performance.

We empirically identified specific strategies for the acquisition and sharing of knowledge and the factors that influence these strategies. We found that one of the main obstacles to guaranteeing information and knowledge flow, while improving organizational capabilities and reducing cognitive distance between parties (who are involved in the acquisition and sharing of these resources), is the fact that the greater the disagreement and physical distance between these parties, the more likely it is that difficulties will arise in the acquisition, assimilation and use of organizational knowledge.

Finally, the study's main methodological limitations refer to the fact that it was based on a single buyer-seller transaction and a specific project, and we acknowledge that opting for the single case study technique restricts findings and conclusions to the companies investigated (YIN, 2001). In general terms, we have confirmed the supposition that knowledge is constructed from interaction between individuals within society and internalized through the learning process (TSAI; TSAI, 2005), and that the repetition of organizational practices (organizational routines) is an essential learning mechanism (EISENHARDT; MARTIN, 2000). We therefore propose the expansion of future investigations of training, particularly those that look at how to employ essential routines, to include: (i) identifying and selecting partners who have the resources and skills required to generate new knowledge (SCHILKE; GOERZEN, 2010); and (ii) building and maintaining trusting relationships (NIU, 2010) in order to stimulate the exchange of information, knowledge and experience between partners both inside and outside organizations.

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