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The project manager cannot be a hero anymore! Understanding critical competencies in project-based organizations from a multilevel approach

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Abstract

This paper focuses on improving the understanding of critical competencies in project-based organizations (PBOs) from a multilevel approach. To do so, we detail the types of "PBO competencies" (functional and integrative), and identify their links with the three levels of competencies in PBOs (individual, collective, and organizational). We perform case studies of four PBOs (IBM, Hewlett-Packard, Arkopharma, and Temex) operating in different sectors and reveal the relations that unite the three levels of critical competencies. The multilevel approach also highlights a new reading of the collective competence of a project team. Our study recommends that both practitioners and current academic researchers stop looking for the perfect, "ideal" project manager who would possess all of the necessary critical competencies for projects. Managers should consider sharing responsibility between the individual and organizational competencies and should not expect a project manager to possess all the required competencies.

Keywords: Critical competencies; Project-based organizations (PBOs); Project manager; Multilevel approach

1. Introduction

Since the recognition of projects as the major business endeavors for executing new business opportunities in a rapid changing market environments (Brady and Davies, 2004; Söderlund and Tell, 2011), project-based organization (PBO), defined as an organization where "the project is the primary business mechanism for coordinating and integrating all the main business functions of the firm (with) no formal functional coordination across project lines" (Hobday, 2000, p. 874), is becoming an increasing important mode of organization in knowledge-intensive industries (Bakker et al., 2013; Gann and Salter, 2000; Lindkvist, 2004; Söderlund and Tell, 2011). Nevertheless, as organizations define more of their activities as projects, projects continue to fail in large numbers, and organizations demand faster and cheaper solutions. Consequently, both the demand for project managers and the interest in project management competencies (PMCs) are increasing (Bredillet et al., 2015; Crawford, 2005). This evolution in theory and practice has placed the project manager and his/her competencies at the center of a project's, and an organization's, success.

Indeed, "smart" organizations place a significant focus on finding and hiring "strong" project managers—those who are able to deal with "soft" issues related to people and relationships, and who not only manage projects but also drive value (Gerush, 2009). Additionally, the number of required individual competencies in reference lists (such as the "Project Management Competency Development Framework" [Project Management Institute, 2013]) is continually increasing, and leads more and

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more toward evaluating project managers' competencies on the basis of extensive "shopping lists." Also, prior research mainly addresses individual PMCs held by project managers (Bredillet et al., 2015; Brière et al., 2015; Cheng et al., 2005; Crawford, 2005; El-Sabaa, 2001; Fisher, 2011; Medina and Medina, 2014; Morris et al., 2006; Stevenson and Starkweather, 2010; Suikki et al., 2006). As a result, the project manager is still seen as a "hero" who carries on his or her shoulders the heavy load of responsibility for a project's success or failure.

Faced with this problem, it appears necessary to improve and extend our understanding of critical competencies for managing in PBOs. By critical competencies, we mean competencies that must be implemented in a project context (Jha and Iyer, 2007; Ruuska and Teigland, 2009). The density of prior research has been mainly organized into three levels of analysis: individual, collective, and organizational. Although a few studies (Frame, 1999; Gareis and Huemann, 2000; Melkonian and Picq, 2011; Muffatto, 1998; Ruuska and Vartiainen, 2003) have considered that a simultaneous approach to the three levels of competencies appears fundamental to a relevant analysis of competencies implemented in PBOs, nothing is said about how to integrate the three levels (Thiry and Deguire, 2007). There is a lack of empirical studies that reveal how these three levels of competencies can be combined and coordinated.

Because these levels of competencies coexist and are interrelated in PBOs, it is necessary to consider the interplay dynamic between them. With such categorizations mostly taken separately, the literature runs the risk of missing important elements of competencies by overlooking interrelations between the levels (Thiry and Deguire, 2007) and/or emphasizing one aspect over another at the expense of ignoring phenomena that emerge through ongoing connecting operations undertaken by actors (Hernes, 2008). As a result, this gap in the existent research brings up the following questions: Is the project manager solely responsible for the emergence of the collective competence of the project team? How are distributed levels of competencies combined inside a project and how can we improve their development? Addressing questions such as these is important because in human resource management, the process of selecting a project manager on the basis of increasingly unwieldy lists of competencies becomes unrealistic. This situation led Napier et al. (2009) to state that a project manager needs to be a "magician manager" that possesses a remarkable range of competencies to build success and avoid failure.

We argue that to address this gap, we need to break out of this limited view and develop a multilevel approach that combines diverse elements into a whole (Aguinis et al., 2011; Hitt et al., 2007; Kozlowski and Klein, 2000; Mathieu and Chen, 2011; Ployhart and Moliterno, 2011)—that is, we need to combine the levels of critical competencies in PBOs. Accordingly, the purpose of our study is precisely to provide answers to a central question: *How can critical competencies in project-based organizations be understood from a multilevel approach*? In other words, we aim to understand how the different levels of competencies are combined and coordinated in PBOs. Responses to this question would give managers a deeper knowledge of the distribution of project competencies throughout their organization and among the individuals within it by breaking out compartmentalizations of the management field, levels, or types-specific mind-sets (Aguinis et al., 2011; Hitt et al., 2007; Mathieu and Chen, 2011).

Our research is based on a qualitative approach centered on a case study of four companies that are organized by projects and operate in different sectors: computer services, computer software, food supplements, and electronic components. The four PBOs are IBM, Hewlett-Packard, Arkopharma, and Temex. These PBOs are not "pure temporary organizations", such as defined by Söderlund (2005) as temporary ventures designed and implemented for a one-shot and non-repetitive operation. Instead, the four companies studied conduct the majority of their activities in project mode and/or privilege the project dimensions over functional dimensions in their structure and processes (Lindkvist, 2004). Here, even though project is the primary business mechanism for coordination and integrating all the main competencies of the firm, there is a need for some functional support and coordination (Melkonian and Picq, 2011). More specifically, in the four PBOs, our study focuses on the activities of new product development projects (NPD) and services. The products and services considered are new for the company that develops them, but they are not necessarily new to the market. The innovation lies mainly in the modification of a product or service already delivered by the company.

Our main contributions to the field of project management are threefold. First, our overarching contribution is a multilevel approach to critical competencies in PBOs that not only specifies and integrates levels of competencies to yield a more theoretically complete picture of the creation and content of competencies, but also challenges conventional thinking on critical competencies. Second, our study suggests a new reading of collective competence of a project team. Third, we give managers an understanding of how to find a project's strength by combining competencies in order to produce an outcome that could not have been achieved by any one competency alone.

2. Theoretical background

Some authors have insisted that various competencies are critical for managing in a PBO (Bredillet et al., 2015; Bredin, 2008; Brière et al., 2015; Crawford, 2005; Danneels, 2002; Frame, 1999; Gareis and Huemann, 2000; Medina and Medina, 2014; Melkonian and Picq, 2011; Muffatto, 1998; Ruuska and Teigland, 2009; Söderlund, 2005; Suikki et al., 2006; Verona, 1999). More generally, and basing our assumptions on the work of many authors (Drejer, 2001; Le Deist and Winterton, 2005; Nordhaug, 1998; Sanchez et al., 1996), we define "competence" as the ability of an individual, a team, or a company to mobilize and combine resources (i.e., knowledge, skills, and attitudes) in order to implement an activity in situation. Moreover, we understand competence management as the set of managerial actions taken by one or more organizations to identify, construct, and develop competencies. Inside PBOs, individuals work on a project team that is one of many interrelated projects that fulfill

the firm's overall organization and strategy. Thus, the three levels of competencies (i.e., individual, collective, and organizational) appear crucial in PBOs. Each of these three levels has been studied extensively, but few multilevel perspectives have been concretely developed. We propose to present each level of competencies before explaining the need to develop a multilevel approach.

2.1. Individual level of competencies

The majority of research on individual competencies deals with the competencies of project managers, who have been described by different attributes (Bredillet et al., 2015; Brière et al., 2015; Cheng et al., 2005; Crawford, 2005; Fisher, 2011; Medina and Medina, 2014; Morris et al., 2006; Stevenson and Starkweather, 2010; Suikki et al., 2006). More precisely, according to Crawford (2005), as organizations define more their activities as projects, the demand for project managers grows, and there is an increasing interest in project management competencies and in standards for assessment, development, and certification in these competencies. Indeed, various project management competency frameworks have been developed such as the "Guide to the Project Management Body of Knowledge" (PMBOK) developed by the Project Management Institute (PMI, 2013) or the International Project Management Association (IPMA) Competence Baseline. PMI (2013) organizes project management competencies into ten basic project management knowledge areas: integration, scope, time, cost, quality, human resources, communications, risk, procurement, and stakeholders. Along the same lines, the IPMA classifies 46 competency elements into three groups: contextual, behavioral, and technical competencies (Caupin et al., 1999). Each element is composed of a knowledge and experience component that can be evaluated to yield a competency assessment. In this context, Morris et al. (2006) have highlighted the role of formal Bodies of Knowledge (BOKs) and their associated certification programs in the development of project management profession.

For their part, Cheng et al. (2005) separated the critical competencies of project managers into two categories: generic competencies, which can be applied to all types of projects, and job-task competencies, which are specific to the sector in which a project manager operates. For Suikki et al. (2006), project management competence consists of understanding the project management knowledge areas, leadership skills, and business environment. Stevenson and Starkweather (2010) isolated six critical competencies for project managers: leadership, the ability to communicate at multiple levels, verbal skills, written skills, attitude, and the ability to deal with ambiguity and change. Recently, a set of "softer" project manager competencies has been identified as essential in dealing with project complexity. These competencies include "emotional intelligence" (Thomas and Mengel, 2008), "conflict management" (Fisher, 2011), "stress management" (Müller and Turner, 2007), and "ethics and ethical virtues – such as courage, temperance, friendship, … and prudence" (Bredillet et al., 2015).

Nevertheless, as Midler (1995) showed, the diversity and complexity of the competencies mobilized in the course of a project mean that it is not sufficient to adopt an approach that focuses solely on team members taken individually or on the project manager alone.

2.2. Collective level of competencies

The fundamental characteristic of a project is precisely its collective dimension anchored around project team. The notion of a collective competence can be defined as "a group's ability to perform together toward a common goal, which results in the creation of a collective outcome, an outcome that could not be accomplished by one member due to its complexity" (Ruuska and Teigland, 2009, p. 324). This competence is argued to be at the group level and as such it is a collective competence that integrates both practical and interpersonal competence. Practical competence refers to the project members' ability to integrate their individual competencies and solve problems together. It includes a combination of learned skills, working routines, and processes as well as thinking chains and reasoning. Interpersonal competence refers to the ability of project members to interact and collaborate with other members while accomplishing the project's tasks (Ruuska and Teigland, 2009).

Consequently on the team level, studies have reported the effects of team competence on projects' performance (Jha and Iyer, 2007; Melkonian and Picq, 2010, 2011; Ruuska and Teigland, 2009). Maznevski (1994) revealed that to improve project performance, it was necessary to go beyond individual competencies and combine them in a common endeavor. Recent work in the project management field has found that successful projects are those that are able to achieve collective competence (Ruuska and Teigland, 2009; Ruuska and Vartiainen, 2003). From this perspective, a project's strength lies in the ability to combine competencies in order to produce an outcome that could not have been achieved by any one of them deployed in isolation (Ruuska and Teigland, 2009). Nevertheless, although the notion of collective competence is increasingly being seen as a vital precondition for the success of project teams, we still know little about the ingredients of this collective competence. From a case study of one complex public–private partnership, Ruuska and Teigland (2009) highlighted four ingredients to ensure project success through collective competence: (1) co-developing a clear project charter; (2) recruiting a project leader with strong knowledge broker skills; (3) conducting joint problem-solving tasks using boundary objects; and (4) ensuring an understanding of the "big picture" through continuous open and balanced communication. For their part, Melkonian and Picq (2010) made use of the insights offered by the very particular world of the French Special Forces, which have been operating successfully for several decades in extreme environments. Based on an in-depth qualitative study of their project-based mode of operations, they detail the six main ingredients of the collective competence that underpins the activities of commando units in mission: (1) the high individual expertise; (2) the combination of different but

complementary forms of expertise; (3) the construction of a shared representation, based on common frames of reference and languages; (4) the capacity for collective improvization; (5) a collective memory; and (6) the personal and solidaristic commitment.

Accordingly, prior studies (Jha and Iyer, 2007; Melkonian and Picq, 2010, 2011; Ruuska and Teigland, 2009) have tackled the question of collective competence in project teams as the result of the combination of individual competencies involved. The aim is then to analyze how the collective competencies are built in project contexts in order to firstly, define one or more mechanisms (i.e., explanatory ingredients) of the emergence of collective competence from the individual competencies. Secondly, prior studies aim to understand how these mechanisms operate and thirdly, how the project team is constructed from the individuals. Nevertheless, such prior studies said little about the place and the role of the organizational context in which project teams evolve.

2.3. Organizational level of competencies

As Frame (1999) noted, if individuals and teams are to express their competencies in projects, they need the support of their company. Within the organization studies literature, the organizational level of competencies represents the company's strengths or capabilities. This organizational level has been described as the aggregated learning in an organization, including the coordination and integration of various production skills and numerous types of technology (Prahalad and Hamel, 1990). Specifically in PBOs, according to Melkonian and Picq (2011), this organizational level concerns the systems of selection and individual training or various routines and programs evolutions and changes. In other words, in the context of PBOs, the organizational level concerns competencies that are beyond one project's boundaries.

Anchored in the Resource and Competence Based View (RCBV) (Barney, 1991; Grant, 1991; Prahalad and Hamel, 1990; Teece et al., 1997; Wernerfelt, 1984), the literature suggests that PBOs must develop "project capabilities" (Brady and Davies, 2004; Bredin, 2008; Davies and Brady, 2000; Melkonian and Picq, 2011; Söderlund, 2005), defined as internal abilities of a PBO to create lasting performance based on multiple short-term projects (Davies and Brady, 2000). Those abilities are seen as two-way relationships wherein strategic and organizational frames drive, orient, and support multiple projects and are simultaneously constantly questioned and redefined through emergent and divergent practices brought by projects. For Melkonian and Picq (2011), project capabilities are organizational capabilities necessary to perform in a turbulent environment, and concern the systems of selection and individual training, or routines and programs evolutions and changes. For his part, Söderlund (2005) uses the term "project competence", defined as the firm's ability to generate/select and implement/execute projects skillfully. The author sees this organizational competence as one of three strategic competencies frequently observed in modern firms (with business and technological competencies as the other two). In PBOs, the routines, skills and coordination processes of projects constitute such distinctive capabilities (Söderlund, 2005).

In this paper, we prefer to use the term of "PBO competencies" to talk about these organizational competencies required in PBOs. Indeed, we consider that this term of "PBO competencies" provides a better understanding of the distinction between project and organizational levels of competencies. Furthermore, we are agree with Hitt et al. (2007) when they explain us that the distinction between individuals and collectives is relatively easy to make, but it can be more challenging to identify the precise boundary where one collective ends and another begins (e.g., groups), as well as the point at which one has moved beyond one level of analysis (e.g., collective) and into another (e.g., organization). Moreover, according to Hitt et al. (2007), such distinctions are even more difficult in the age of team-based organizations such as PBOs. To overcome this difficulty, we propose to consider the term of "PBO competencies" rather than "project capabilities/competencies".

More specifically, at this organizational level, the literature has identified the type of competencies to mobilize in PBOs. In particular, previous literature (Danneels, 2002; Verona, 1999) has highlighted two types of necessary competencies for innovative projects: "functional competencies" and "integrative competencies". These types of competencies are seen as responses to the inherent tensions within PBOs: projects by their very nature foster innovation, whereas organizational efforts concentrate on routinization and economy of repetition. This tension paradoxically refers to a traditional issue in organizational theory—the pressure between differentiation and integration (Lawrence and Lorsch, 1967).

Functional competencies are related to the need for differentiation in PBOs. Indeed, to be able to meet clients' needs and adapt to changing contexts, PBOs should behave like intra-organizational units with a high degree of autonomy and differentiation. Functional competencies concern the specialized technical knowledge developed within various functions of the company, such as research and development, marketing, production, and logistics (Grant, 1991; Henderson and Cockburn, 1994; Prahalad and Hamel, 1990). For instance, in new product development projects, which are the object of the present study, Danneels (2002) estimated that customer and technological competencies take priority. Customer competencies give the firm the ability to serve customers—for example, they provide knowledge of customer needs, preferences, and purchasing procedures, or provide communication channels for exchanging information between the firm and customers. Technological competencies give the firm the ability to design and manufacture a physical product with certain features—for example, design and engineering knowledge and ability, product and process design equipment, or manufacturing facilities.

Integrative competencies are related to the need for integration in PBOs. Organizations need coherence and a long-term perspective to create lasting performance. Integrative competencies make it possible to successfully combine and coordinate the various functional competencies deployed in the project (Grant, 1996; Henderson and Cockburn, 1994; Teece et al., 1997). More

precisely, for Teece et al. (1997), integrative competencies could be an important condition of the value of new product(s) developed. According to Grant (1996), these competencies may even be a source of competitive advantage for the company in a changing competitive environment and when the advantage is primarily the result of the effectiveness of integration of the company's specific competencies; in other words, the advantage depends on the company's ability to acquire and exploit specialized knowledge of the individuals. Thus, integrative competencies are considered as organizational competencies, that is, as organizational processes and means of coordination.

2.4. A multilevel approach

Although each level of competencies is essential to perform projects in PBOs, these three levels (i.e., individual, collective, and organizational) should not be seen as separated performance systems, isolated from each other. Indeed, in PBOs, the three levels of competencies coexist and are interrelated. Nevertheless, project management competencies' research faces one of the persistent issues in management studies: the single level of analysis. As reminded by Hitt et al. (2007), most management problems involve multilevel phenomena. Yet, most management research uses a single level of analysis. Nyberg et al. (2014) underlined that scholars in the management and strategic fields tend to focus on the individual level or the collective level and rarely consider both the different levels and the relations between them. As explained by various researchers (Aguinis et al., 2011; Hitt et al., 2007; Mathieu and Chen, 2011), this tendency is correlated with the compartmentalized evolution of the management field in either micro (e.g., organizational behavior, human resource management) or macro (e.g., business policy and strategy, organization and management theory) domains.

More specifically, in project management, a few studies (Frame, 1999; Gareis and Huemann, 2000; Melkonian and Picq, 2011; Muffatto, 1998; Ruuska and Vartiainen, 2003) have considered that a simultaneous approach to the three levels of competencies appears fundamental to a relevant analysis of competencies implemented in PBOs. But, few practices are observed to support this perspective and deeply explain how to integrate them. For instance, Melkonian and Picq (2011) have developed a multilevel approach to competencies in PBOs from the types of project capabilities defined by Brady and Davies (2004). The authors acknowledge that between individual competencies and organizational processes the collective level plays a key role, but nothing is said about how to integrate the three levels. Ruuska and Vartiainen (2003) revealed that competencies in projects must be seen as qualities of individuals, teams, and organizations. Yet, their study does not explain how to develop these kinds of competencies. Consequently, despite the richness of previous research, we still know little about how to combine these levels of competencies (Thiry and Deguire, 2007). Prior research does not deeply explain how to develop these kinds of competencies, and there is a lack of empirical studies that reveal how these three levels of competencies can be integrated.

In the line of these works, we propose to extend prior research by developing a multilevel approach that combines the three levels of competencies in PBOs (individual, collective, and organizational). To do so, we follow the methodology proposed by some work on multilevel approach (Aguinis et al., 2011; Hitt et al., 2007; Kozlowski and Klein, 2000; Mathieu and Chen, 2011; Ployhart and Moliterno, 2011). More precisely, after defining the levels of analysis of the phenomenon studied, scholars must articulate these levels between them. As noted by Hitt et al. (2007, p. 1387), "whenever research traverses levels of analysis, it becomes more complex, and scholars must be vigilant about carefully articulating the theoretical bases of their work". Then, they recommend to define clearly the level of theory and the level of measurement. Firstly, the level of theory refers to the focal level to which generalizations are meant to apply. More precisely, a key attribute of the level of theory is the notion of focal unit. Focal units are entities about which one wishes to make generalizations (e.g., individuals, groups, organizations, etc.). In our research, the focal unit is the level of organization—that is the PBO. Secondly, the level of measurement (or observation) refers to the unit to which the data are directly attached (Hitt et al., 2007). In our research, our unit of observation is the types of "PBO competencies". Accordingly, in our empirical study, we will observe and detail the types of "PBO competencies" [functional and integrative, as highlighted by Danneels (2002) and Verona (1999)], and identify their links with the three levels of competencies in PBOs (individual, collective, and organizational). In particular, the focus of our research on the PBO competencies' types highlights a new unit of observation of the main components of the three levels of critical competencies in PBOs. This unit of observation provides a more detailed analysis of companies' and actors' activities in PBOs. Therefore, the PBO competencies' types help to link levels of analysis and practical action. Moreover, in the same line of Melkonian and Picq (2011), we consider that an analysis through the prism of PBO competencies' types is an original way for finding the links between the three levels of competencies in PBOs, and so to develop a multilevel approach. According to us, this multilevel approach will improve the understanding of critical competencies to manage in PBOs.

3. Methodology

3.1. Research design and setting

We used an inductive, multiple-case research design for this study (Eisenhardt, 1989). According to Yin (2008), multiple cases permit a replication logic in which cases are treated as experiments, with each serving to confirm or disconfirm inferences drawn from the others. This process typically yields more robust, generalizable theory than single cases (Eisenhardt and Graebner, 2007). More precisely, with a multiple case study, we searched "empirical regularities", identifying surface patterns without specifically searching for underlying explanations of these patterns and differences between cases.

Table 1
Summary data on the four case studies.

Case characteristics	Case 1 IBM	Case 2 Hewlett-Packard (HP)	Case 3 Arkopharma	Case 4 Temex
Sectors	Computer technologies and services	Computer technologies and services	Pharmaceutical	Electronics
Types of projects studied	E-business solutions	Computer software	Food supplements	Electronic components
Unit/department	IBM global services	HP software (Open View and Open Call Units)	All company	All company
Total staff of the group in 2009	399,409	304,000	1202	1200
Turnover in 2009	$95.8bn	$114.06bn	€177.6 m	€100 m
Country	United States	United States	France	France
Maturity of project-based organization	Pioneer (installed in 1995)	Pioneer (date of installation not communicated)	Novice (installed in 2002)	Novice (installed in 2002)
Number of interviews	15	12	24	13
Number of observation days	16	11	14	10

The research setting is based on four companies that are organized by projects for the design and development of new products and/or services and operate in different sectors, including computer services, computer software, food supplements, and electronic components. These firms and their sector representation are attractive for our study because the firms are recognized as being innovative in the development of products and services, and because they have "think tanks" on competence management and project management. More precisely, after defining the type of organization that could be studied (i.e., a project-based organization for the design and development of new products and/or services),[1] we carried out an inventory of potential companies within this field; these companies were then contacted.

The case studies were selected using the theoretical sampling criteria recommended by Eisenhardt (1989). First, the cases present common features that ensure comparability and production of similar results (i.e., the theoretical representation criterion). For example, for each product or service developed, a project team was created that had a beginning and a predetermined end, and the team's work was extended over a long term (i.e., several months to several years). Second, the search for specificities allowed us to obtain variety to increase the understanding of the phenomenon. Our four selected cases were different in terms of industry sector, size, turnover, nationality of the company, and maturity of PBO. Table 1 presents an overview of the four case studies. This summary allows the reader to judge the similarities and differences among our cases.

3.2. Data collection and analysis

Given our goal of understanding how the three levels of competencies (i.e., individual, collective, and organizational) are combined and coordinated in PBOs, we mainly conducted one-on-one interviews. We used semi-structured interviews with internal informants. For the four companies studied, 64 interviews that lasted 90 min on average were conducted with operators in different functions and positions in product and service development projects. We met 5 people from the head office, 7 in the human resources department, 26 functional directors and managers, 12 project managers, and 14 project team-members (i.e., product managers, scientific or technical experts, and engineers). Appendix A shows the distribution of informants in the four companies. We based selection of internal informants on three criteria: (1) long tenure in their company, (2) direct involvement in the politics of project management competencies, and (3) functional and hierarchical variety. These criteria allowed us to obtain an overall and impartial view of the research topic. The interviews were based on an interview guide that covered a range of previously defined issues and enabled us to determine the research topic. This guide was created after our literature review and while identifying the cases. It was expanded and revised as the empirical study progressed. We summarized each interview on an index card after it was recorded and rapidly transcribed, in full, through computerized word processing. In total, 100 h of interviews was recorded, and 960 pages were transcribed.

The interviews were supplemented by documentation (e.g., technical, management procedures for projects to develop new products and/or services, files and personal notes from the operators), on-site observations (conducted on company premises while interviewing, and with 51 days of observation), and informal dialogues (including conversations with interviewees via e-mail, telephone, or conversations without any prior arrangement). The documents were annotated, sometimes summarized, and systematically listed under the themes they addressed. We also transcribed our observations in a daily journal. These four sources of data (i.e., interviews, documentation, observation, and informal dialogues) ensure richness of the findings and are useful for triangulation (Yin, 2008). Finally, a report of approximately 50 pages was written about each of the four companies and submitted to key actors identified in each case to obtain their agreement, validate our interpretations, and thus increase the construct validity and the internal research validity (Yin, 2008). The result of our research

[1] Based on our literature review on PBOs, we have defined three qualitative criteria that allow us to identify companies that structure their business development for new products and services through projects: (1) The constitution of team-building projects that cut across the company's business (in other words, a matrix organization by projects); (2) the existence of project managers, responsible for development of new products and/or services; and (3) the formalization of project management through the development of project management methods and tools.

design and data collection is a relatively complete and robust understanding of critical competencies in PBOs.

Following recommendations by Eisenhardt (1989), we began with an in-depth analysis of our cases through the lens of the research question: *How can critical competencies in PBOs be understood from a multilevel approach*? Our primary aim in choosing a multiple case study research method was not to develop theoretical propositions or test specific hypotheses, but rather to observe and detail the two types of "PBO competencies" (functional and integrative), and understand their links with the three levels of competencies in PBOs (individual, collective, and organizational). In other words, to understand how the different levels of competencies are combined in PBOs, our research design embeds two units of analysis: the two types of PBO competencies (functional and integrative) and the three levels of critical competencies in PBOs (individual, project team, and organization). The analytic strategy (Yin, 2008) consisted of two main techniques, including "thematic coding" (Miles and Huberman, 1994) and "open coding" (Strauss and Corbin, 1990). Thematic coding was used to identify the different functional and integrative PBO competencies. We used here two thematic codes: FUN-COMP and INT-COMP. Open coding was used to highlight the links between the two PBO competencies' types and the three levels of analysis. We used here three open codes: the individual level of competence (Level I), the collective level (Level C), and the organizational level (Level O). To define the different levels of competence corresponding to each PBO competence, we relied on the content analysis of interviews. To ensure the stability and reliability of our codes, we used the data analysis software ATLAS/Ti and based our data analysis on inter-coder agreement. To summarize, present, and analyze the multitude and variety of data collected, we used many tables to follow the recommendations of Miles and Huberman (1994). Finally, we used a cross-case analysis to compare the different companies and to identify consistent common points and themes (Eisenhardt and Graebner, 2007). Because of space constraints, this paper presents only the outcomes of the cross-case analysis.

4. Case studies findings

For the presentation of our findings, we detail the two types of "PBO competencies" (functional and integrative), and present their links with the three levels of critical competencies in PBOs (individual, collective, and organizational). In addition to the general findings described below, we also provide illustrations and quotes.

4.1. Functional competencies: the individual level

The four projects observed (i.e., computer services, computer software, food supplements, and electronic components) allow us to identify three distinct functional competencies: customer, technological, and project. We recall that according to Danneels (2002), customer competencies give the firm the ability to serve customers (i.e., knowledge of customer needs, preferences, or purchasing procedures), and technological competencies give the firm the ability to design and manufacture a physical product with desired features (i.e., design and engineering knowledge and ability, or product and process design equipment). Apart from Danneels's (2002) competencies, we consider that project management competencies give the firm the ability to serve projects (e.g., capabilities to manage the constraints of costs, delays, and quality; to evaluate the project's risks; to allocate and control resources). At IBM, HP, and Arkopharma, we observed that project management competencies are held exclusively by project managers. In the case of Temex, this functional competence is also held by the quality engineer and one person in the Project Office. Nevertheless, in an electronic component development project, the project manager remains solely responsible for the successful completion of a given project. Therefore, we consider that individual functional competencies in project management are the responsibility of project managers whose function is well recognized as a full profession.

The three functional competencies identified here are managed in the trades or functions within the company and are carried by the project actors and their individual competencies. These individual functional competencies that are required for the projects studied are synthesized in Table 2.

Accordingly, the individual level of competence is reflected by the functional type of competence insofar as in a given trade it is an individual who holds that functional competence. For example, it is the product manager or sales engineer who possesses and mobilizes the customer competencies required for the project. Therefore, expectations concerning this competence are at the level of the individual-actor, who must possess the necessary and adequate expertise to be a "worthy" representative of his or her trade or function in projects.

4.2. Integrative competencies: the organizational level

We asked informants the following question to identify the integrative competencies: "How are different functional actors coordinated in the different projects of the PBO?" The analysis of answers yielded three integrative competencies within PBOs: simultaneous development, project management process, and platform for inter-trades cooperation. Together, these three organizational competencies effectively help to integrate individual functional competencies within projects. We recall here that, in agreement with our theoretical background, these integrative competencies are considered to be organizational competencies. Indeed, they are organizational processes and means for the coordination. In the specific context of PBOs, where many interrelated projects fulfill the firm's overall organization and strategy, the organizational level concerns competencies that are beyond one project's boundaries. Table 3 provides a summary of the organizational integrative competencies and their managerial interests mentioned by informants.

4.2.1. Simultaneous development

In the four cases, the pattern of concurrent development (Clark and Fujimoto, 1991) was imposed because it was a response to

Table 2
Identity of actors holding functional competencies in projects.

Cases				
Functional competencies	IBM	HP	Arkopharma	Temex
	Competencies held by . . .			
Customer competencies	Business consultant	Product manager	Product manager	Sales engineer
Technological competencies	Architects and specialists	Architects, technical leaders, developers, and testers of software quality	Technological competencies are divided into: – Scientific competencies (carried by a pharmaceutical developer, a chemical analyst, a quality controller, a person in drug toxicology, one in clinical service, and one in regulatory service) – Industrial competencies (purchaser who is responsible for industrial methods and a logistician)	Technological competencies are divided into: – Technical competencies of Research and Development department (designer, test engineer) – Technical competencies of Program Management department (responsible for handling technical proposals and technician) – Operational competencies (production engineers who are responsible for industrial methods, a purchaser, and a logistician)
Project management competencies	Project manager	Project manager	Project manager	Three actors have competencies in project management: – Project manager – Quality engineer – Project Office

the demands of reducing delays in the development of companies' products and services. According to Midler (1995), concurrent or simultaneous development, originally known as "concurrent engineering,"[2] means that all of the company's functions work on the project simultaneously beginning with its initial phases. In the four companies studied, we observed that this working method is actually a real capacity for integration of individual functional competencies. Indeed, simultaneous development enables project participants to reduce problems downstream, promote inter-trades exchanges, and benefit from better understanding of constraints on other actors involved in any given project.

> In software development, we work into concurrent engineering. The only place where it is run sequentially, and that's what is wanted, is in the transition between development and test validation. (Research and Development Director, HP)
> Before, the working way was sequential. The project came and went from one department to another. This way of working way presented problems in coordinating competencies. . . . With the current organization, the project goes through the business, we add the competencies, and it is better. (Head of Chemical and Analytical Development, Arkopharma)
> We cannot say that we don't know the product when it comes into production. During product development, we intervene for the validation of the technologies used, the qualification of manufacturing processes (if new), we know the product by models, we participate in the project review process, etc. (Director of Operations, Temex)

[2] Given the nature of projects undertaken by the companies studied, the term "development" seemed more appropriate than "engineering."

4.2.2. Project management process (PMP)

This is a process of breaking down projects into phases which themselves are broken down into major tasks to achieve a future product or service. In the PMP, we find the major phases and tasks along with decision points in time called milestones. In the four companies, there is a PMP "type" that the project manager uses to build the management process of his or her project. The informants indicated that there are four main advantages of PMP: (1) It ensures joint decision making by consensus at formal meetings or project reviews, (2) it allows project actors to acquire a common language, (3) it develops common understandings and similar approaches in working methods, and (4) it allows functional actors to focus their efforts on issues of substance.

> At IBM, we have a strong culture in procedures. When the project management arrived, everyone, project manager or not, had to learn the basic concepts in order to have the same language, the same terminologies. (Project Manager, IBM)
> What is interesting in the project process is that the phase outputs are at cross trades. This allows us to see dependencies between different functions. (Manager of a Unit Development, HP)
> I think the project management process provides better knowledge and understanding of the constraints of other businesses and provides a similar methodology of work. (Industrial Manager, Arkopharma)
> Our process synchronizes our languages, terms, and definitions. (Head of Strategy and Corporate Director of Temex Microelectronics division)
> The formalization also allows the participants to focus on more technical and more specific project problem-solving. It allows us to put aside project monitoring, which becomes more systematic. (Project Manager Office, Temex)

Table 3
Synthesis of organizational integrative competencies.

Organizational integrative competencies	Managerial interests
Simultaneous development (observed in 4 companies)	Reduce problems downstream
	Promote inter-trade exchanges
	Benefit from better understanding of constraints of other actors involved in project
Project management process (observed in 4 companies)	Ensure joint decision making by consensus at formal meetings or project reviews
	Acquire common language
	Develop a common understanding and the same approach in working methods
	Focus efforts of functional actors on issues of substance
Platform for inter-trades cooperation (observed in 3 companies)	Encourage regular meetings and informal communications
	Enable functional actors to exchange and share their project experience with their colleagues, directly and on a regular basis

4.2.3. Platform for inter-trades cooperation

The sites of HP, Arkopharma, and Temex are platforms for inter-trades cooperation,[3] since all individual functional competencies required for every project development take place in the same location.[4] This physical proximity of project actors encourages regular meetings and informal communications within projects, but also between projects. On the one hand, within projects, the platform for inter-trades cooperation incites the coordination of actors through direct contact and reminds us of Mintzberg's (1979) notion of mutual adjustment as a means of work coordination. On the other hand, the physical proximity of actors has an important role in inter-project knowledge sharing, as it enables functional actors to exchange and share their project experience with their colleagues, directly and on a regular basis (and thus mainly synchronously, i.e. between ongoing projects). However, even if the interviewed actors recognize that the gathering of actors in one place is important, they know that it is not always possible to group people physically in the current environment characterized by economic globalization. This issue is most relevant for IBM and HP, insofar as the various participants in a project are at geographically distant sites. In the cases of Arkopharma and Temex, the question does not arise (or has not yet), since all individual functional competencies required for projects are grouped in the same area. Our data thus demonstrate that the traditional concept of a project team, physically assembled in one place at a given time, is gradually becoming only one form of organization, among others.

> With the team, we are all physically on the same place. . . . They come to see me all the time, so we communicate a lot. (Project Manager, HP)
>
> The fact that we are all together on the same site, from production to sales, through the R&D and other activities, is the company's strength. (Project Manager, Arkopharma)
>
> The best way to communicate is that people are side by side. It is the case here; everyone is on the same platform. (Research and Development Director, Temex)

[3] The "project center" model includes all members that contribute to the project in the same place and, if possible, around a common area. The "project center" must be distinguished from the platform for inter-trades cooperation, as we are doing here. Whereas the "project center" focuses on a single project, the platform for inter-trades cooperation applies to all projects.

[4] The notion of platform is not mentioned in the IBM case because of the firm's size and the geographic dispersion of project actors on different sites.

4.3. Collective competence: an emergent result of individual functional competencies, organizational integrative competencies, and collective mechanisms

The analysis of functional and integrative competencies is, respectively, individual and organizational. Collective competence appears, in the cases studied, to be the emergent result of individual functional competencies and organizational integrative competencies. Indeed, our multilevel approach allows light to be shed on the emerging dimension of collective competence.

In the four cases, projects systematically needed individual functional competencies (i.e., marketing, technological, and project management). These competencies are managed in the trades or functions within the companies and are carried by the project actors employing their individual competencies. These individual functional competencies will need to be coordinated through the deployment of the three organizational integrative competencies identified in our cases (i.e., simultaneous development, project management process, and platform for inter-trades cooperation). These three organizational integrative competencies exist for all projects in PBOs. Accordingly, it becomes possible to combine the functional competencies of the company within projects or, in other words, to coordinate individual competencies in collective operations thanks to organizational integrative competencies. Therefore, our analysis of the cases leads us to conclude that the coexistence of individual functional competencies and organizational integrative competencies is central to the project team's collective competence.

Moreover, each project team generates its own collective competence; it is of a different nature from the strict sum of individual competencies of business actors, as four interviewees noted.

> The success of a project depends on links, interconnections between functional actors. (Project Manager, IBM)
>
> It's the alchemy between individual competencies that will enable the team to become successful. (Human Resources Director, HP)
>
> Good trade specialists without coordination and management of the whole would not make a successful project. (Quality Director, Arkopharma)
>
> A project team is an integrated team from the start. The integration of individuals into a team is at the heart of a successful project. (Program Management Director, Temex)

In our case studies, we observe that the emergence of the collective competence of a project team also comes from its own collective mechanisms implemented during the project, and which allow functional actors to work together. In our four cases, the two major collective mechanisms underlying the integration of individual functional competencies into a project team are documentation and artifacts, and internal communication.

4.3.1. Documentation and artifacts

In the four companies studied, the projects produce a considerable amount of documentation (e.g., specifications, development plans, product data sheets, analysis files and reports, quality reviews, meeting reports). These documents are constantly evolving and are subject to intense revision; this allows project actors to share information on projects, see work done by other functional actors, and eventually adjust actions of each actor depending on project progress. Therefore, this regular production of artifacts acts as a support to inter-trade coordination within project teams. More precisely, the use of physical objects is likely to minimize transaction costs between business actors involved in projects because the artifacts allow them to compare their representations around a common document, discuss knowledge obtained, ask questions, and develop hypotheses. Accordingly, our empirical investigation revealed that these artifacts support mutual understanding of project participants and appear to play the role of "boundary objects" (Cacciatori, 2008; Carlile, 2002) between different individual functional competencies.

> Whenever I make a delivery, I write a document, which I then transfer to individual team members. (IT Architect, IBM)
> We have an archive of all our project documentation. Everything is stored on computer servers. People know where it is and where they can go to search it. (Project Manager, HP)
> Thanks to the documents, the project stakeholders know exactly what they have to do and when, how the project is going, etc. (Project Manager, Arkopharma)
> These documents are archived by computer, so that everyone in the project can access them. (Project Manager, Temex)

4.3.2. Internal communication

In our four case studies, the importance of establishing intensive internal networks of communication was very noticeable. Two major communication media outlets are used by project actors to promote the integration of individual functional competencies within projects: (1) information and communication technologies (ICT) such as e-mail or videoconferences and (2) face-to-face exchanges. Even if ICT tools are widely appreciated by informants who see them as powerful tools for rapid diffusion to all participants of information generated during the project, verbal and face-to-face exchanges are the preferred media of internal communication within projects. In particular, meetings and project reviews allow actors to review the progress of projects, keep abreast of activities of other team members, solve problems, and make decisions collegially. More precisely, meetings and project reviews allow team members to get to know each other, realize they are doing something together, understand the nature of their interdependencies, and combine each of their individual actions during the project. We agree with Frame (1999), who suggests that these meetings and project reviews make a team more tangible and remind its members that they are not solitary navigators but are part of a group.

> I always do regular items on the very widest fields, which means that I mix as many people as possible in the same conference call, so that even if the field is not directly in relationship with people who are in the conference, at least they hear about things beside their work, which allows them to own the project and feel somehow an element of the set. I have always preferred conferences, scheduled points, and reports. (Project Manager, IBM)
> From my perspective, meetings are the best way to be connected with the project stakeholders and oversee project progress. (Project Manager, Arkopharma)
> Communication is done primarily through working meetings. These meetings are important to inform people, but they are especially important to involve people so they understand the importance of things. (Project Manager Office, Temex)
> The inter-department communication within projects is mainly done at product reviews, from which each department will walk away with its action plan. (Director of Operations, Temex)

The multilevel approach that we advocate in this paper is shown in Fig. 1 and illustrates the relationships that unite the two types of "PBO competencies" (functional and integrative) and the three levels of critical competencies in PBOs (individual, collective, and organizational). Indeed, in all four cases, the competence of the project team is collective and is distributed between individual functional competencies, organizational integrative competencies, and collective mechanisms. In the context of a PBO, the collective competence of a project team does not exist at the beginning of the project; it is built progressively during the project. More precisely, at the beginning, the project team is composed of individual functional competencies and has the support of organizational integrative competencies. So, it is the coexistence of individual functional competencies and organizational integrative competencies, but also the development during the project of collective mechanisms that allow the collective competence of the project team to emerge.

To offer a deeper understanding of how the three levels of competencies are combined in PBOs, we focus on a particular case study: IBM. More precisely, we offer an illustration of this process combination from a project of an e-business solution at IBM. Indeed, the IBM case provides strong theoretical representativeness and the potential for real discovery. The company bases its strategy on a strong and clear commitment to manage competencies of the company on one hand and thorough know-how in project management on the other.

In a global and simplified manner, an e-business solution project follows the project management process defined by IBM. The process starts with a request from a customer. A business consultant, one who possesses customer competencies in the business of the customer, meets with the customer to

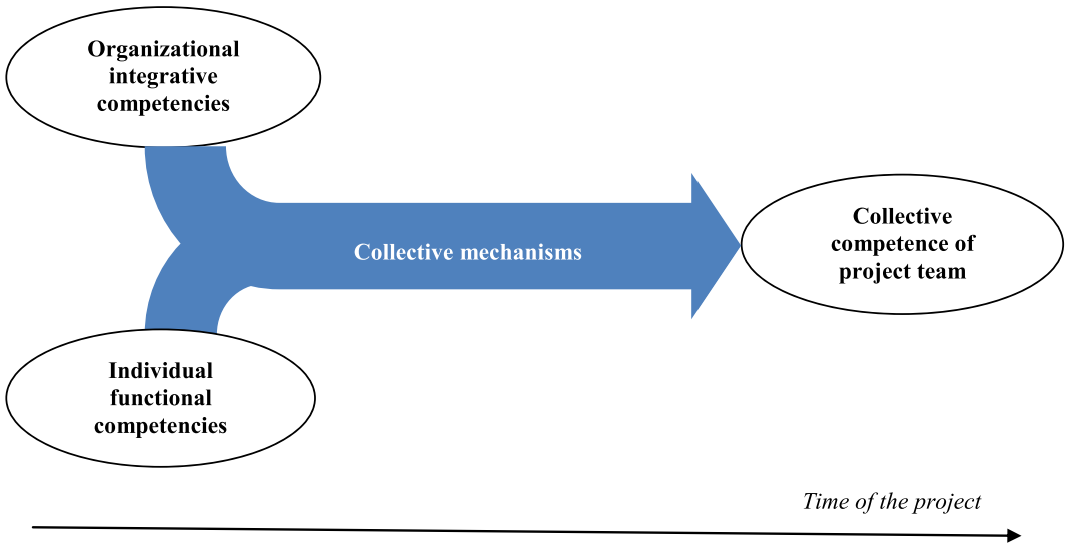

Fig. 1. The multilevel approach of competencies within a project.

identify his or her problems and to respond satisfactorily while seeking and using both individual competencies and organizational competencies of IBM. Based on identified needs of the customer, the business consultant establishes a business proposal and presents it to the customer; then the consultant participates in the negotiation of the solution's specifications in cooperation with the potential project manager and one or several architects. Once the contract is signed (i.e., the customer has accepted the business proposal), a project manager is appointed. His or her first task is then to work out the specifications of the project with the business consultant and to describe the content of the project, its financial arrangements, and the resources allocated to it. In general, from that time, the project team is in direct contact with the customer, and the project manager is in charge of the project's implementation.

At IBM, three individual functional competencies are required for an e-business solution project: (1) customer competencies, (2) technological competencies, and (3) project management competencies. These three functional competencies are held by different actors in the project.

(1) *Customer competencies* are owned by a business consultant, who is responsible for the business relationship between IBM and its customer. The business consultant becomes involved very early in the computer service development project. He or she must know the business values of the client, understand the client's problems, and be an expert in the technology solution developed by IBM. The business consultant also ensures the successful completion of the project and customer satisfaction. In addition, business consultants are specialized by activity sector (e.g., automotive, banking, health care, insurance, retail, telecommunications, electronics, and financial markets) in order to be able to understand clients' businesses, problems, and expectations. To help in managing the business relationship, the consultant is surrounded by a specialized technical team of one or more architects.

(2) *Technological competencies* (i.e., knowledge of design and engineering and mastery of computer languages such as Linux, Java, C++, HTML, and assembly) are held by architects and specialists. On one hand, the architect defines the design of the proposed technological solution to the customer and provides a complete technical solution to the client's problem through products (i.e., software or hardware). An architect very often accompanies the business consultant in meetings with the client and helps to convince the client to buy the solution and then to sign the contract. He or she is primarily a technical expert. On the other hand, a specialist focuses on the construction and implementation of what has been defined by the business consultant and architect as meeting the client's needs.

(3) *Project management competencies* are the responsibility of the project manager. He or she conducts the establishment of a technological solution to a customer. He or she ensures the availability of individual competencies, selects and controls the subcontractors, implements and manages schedules and their realization, establishes architectures, and assesses the technical risks of the project.

Fig. 2 presents the intervention of individual functional competencies required in an e-business solution project. The gray rectangles correspond to periods of active involvement in the project (as a decision maker or actor acting), and white rectangles represent periods of passive intervention (as a consultant or spectator).

To ensure that individual functional competencies are integrated toward a common goal, an e-business solution project at IBM relies on two organizational integrative competencies (simultaneous development and project management process). *Simultaneous development* works to coordinate and combine the three required individual functional competencies in the project. IBM has established a concurrent approach that involves all functional competencies in an iterative and interactive manner. In

Fig. 2, we see that the consultant, architect, specialist, and project manager work together at the early stages of the project (draft), develop parallel work, and promote inter-trade exchanges. In the *project management process*, this formalized knowledge serves as "a cue for action" and must be implemented by all actors in the project.

Moreover, as shown in Fig. 2, the collective competence of a project team emerges over time and as the result of interactions between individual functional competencies and organizational integrative competencies, but also as the result of the two collective mechanisms deployed during the project (documentation and artifacts, and internal communication). Regarding *documentation and artifacts*, an e-business solution project produces a considerable amount of documentation (e.g., technical specifications, development plans, analysis files and reports, meeting reports) that is written by the project manager and team members. This documentation is permanently available on the computer system of the project and constitutes its documentary memory. *Internal communication* is recognized by the informants at IBM as the main means of coordinating individual actions in a project. Many means of communication are used by project actors to promote the integration of individual functional competencies within projects: ITC (i.e., telephone, e-mail, instant messaging, telephone conferences, and videoconferencing) and meetings (i.e., face-to-face and distance). More precisely, for each project several meetings are used to allow for better coordination of individual functional competencies in the project: the kick-off meeting, weekly meetings to monitor the progress of the project (e.g., between project manager and team members), regular meetings with customers, informal meetings when problems arise, and the final review meeting for the project.

Finally, for IBM, a collective competence is viewed as the ability of a project team to perform together toward the common goal of the project—in this case, the development of an e-business solution—by controlling the quality, cost, and time. More precisely, according to informants at IBM, the collective competence results from the combination of individual functional competencies during the project. This combination is possible because IBM has developed two organizational integrative competencies and because each project team defines its own collective mechanisms. Accordingly, the collective competence is built by the team, but also is the place of confrontation between individual and organizational levels of competencies.

> The competencies of a project team are represented in the stage of resources' joining to start a project. It is at this point where we work with functional managers to have the staff needed for the projects, and it is at this point where we get awareness of these issues of competence management, availability of people. It is from this point that the competence of the group begins to build progressively. (Project Manager, IBM)

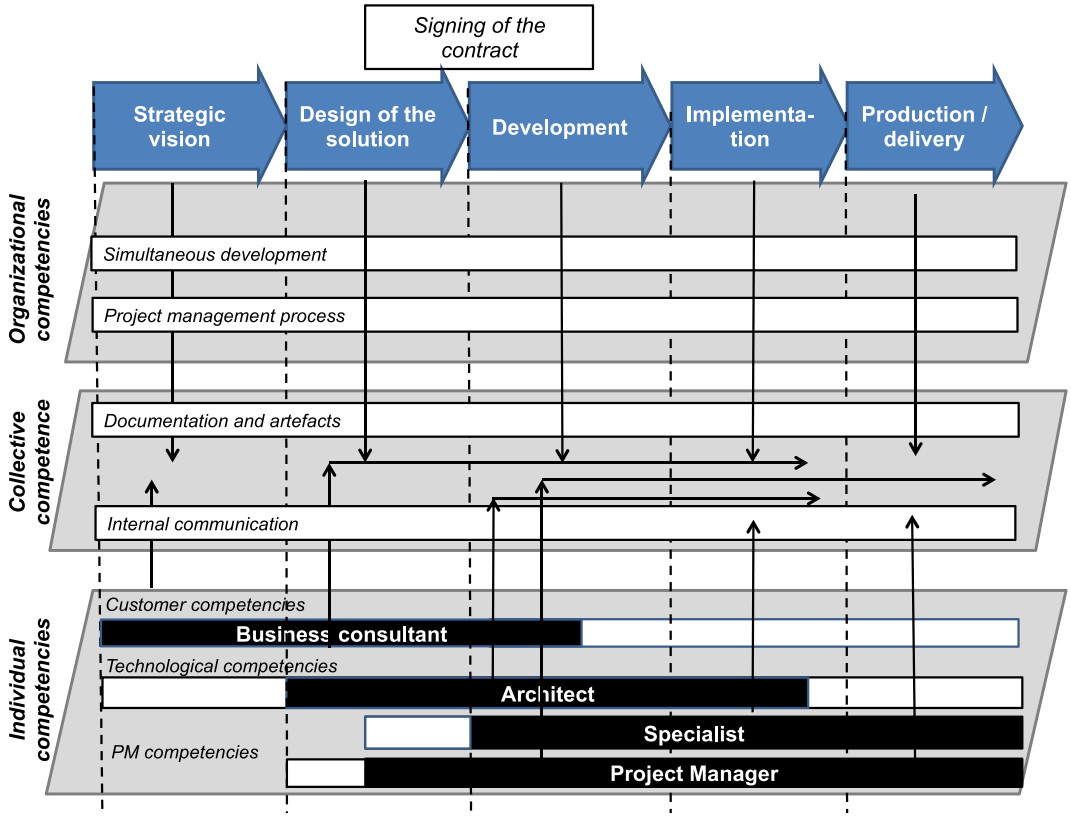

Fig. 2. The combination of critical competencies within an e-business solution project.

5. Discussion, managerial implications, and further research

The objective of this paper was to contribute to the discussion of how to understand critical competencies in PBOs from a multilevel approach. In other words, based on our four case studies, we aimed to understand how the different levels of competencies are combined and coordinated in PBOs. As explained before, the level of organization, that is the PBO, is the level of theory to which generalizations of our results are meant to apply (Hitt et al., 2007). We recall here that we have chosen to focus in this paper on PBOs as defined by Lindkvist (2004), where multiple temporary projects are embedded into a permanent organizational context, with internal core employees outnumbering outsiders.

5.1. Theoretical contributions

Our contributions to the literature regarding project management competencies are twofold. First, our study develops a multilevel approach that specifies and combines the three levels of competencies (i.e., individual, collective, and organizational) that operate within the same organizational territory—that is the PBO. By combining these levels, the multilevel approach developed here is important because it provides the literature and managers with a deeper understanding of critical competencies in PBOs. Despite the richness of the previous research on the different levels of competencies, our literature review revealed that we still know little about how to concretely combine these levels of competencies in PBOs. Prior research (Davies and Brady, 2000; Frame, 1999; Melkonian and Picq, 2011) fails to explain how to develop these kinds of competencies, and empirical studies that demonstrate how these three levels of competencies are concretely integrated are lacking. Our study develops and applies a multilevel approach of critical competencies in PBOs in four cases and improves the multilevel analysis of competencies by showing concretely the combination of the three classical levels of analysis: individual, collective, and organizational. Indeed, our findings reveal the relations that unite the levels of competencies, thanks to functional and integrative competencies. On the one hand, individual functional competencies held by actors in the project are managed in the trades or functions of the company; on the other hand, integrative competencies are organizational capabilities that allow combining and coordinating individual functional competencies within projects. Consequently, our research can help to overcome the traditional distinction between micro, meso, and macro levels of analysis. Indeed, research into project management competencies faces one of the persisting issues in management studies: the single level of analysis. As we are reminded by Hitt et al. (2007, p. 1385), "most management problems involve multilevel phenomena, yet most management research uses a single level of analysis". As explained by Ployhart and Moliterno (2011), multilevel theory is concerned with understanding how constructs and processes are related across levels of analysis (e.g., individual and firm). As Kozlowski and Klein (2000, p. 11) noted, "multilevel theory building presents a substantial challenge to organizational scholars trained, for the most part, to 'think micro' or to 'think macro' but not to 'think micro and macro'—not, that is, to 'think multilevel.'" The conceptual approach we advocate also reconciles an apparent "paradox" between micro-level and macro-level scholarship: micro scholars emphasize the importance of context-generic, whereas macro scholars emphasize the importance of context-specific (Ployhart and Moliterno, 2011). The multilevel approach reconciles this paradox by recognizing that the collective competence is an emergent phenomenon. Moreover, we advocate future research of multilevel analysis. We aim to extend analysis to a more relational perspective in which everything (i.e., levels, types, trades, and projects) is linked. Indeed, we are placed in a view of *becoming*, where competencies emerge from new combinations. As explained by Hernes (2008), the level treats entities as the starting point and ignores all the intricacies of how they were built up in the first place.

Second, this research suggests a new reading of collective competence and thus challenges prevailing understanding regarding collective competencies. We see the coexistence of individual functional competencies, organizational integrative competencies, and collective mechanisms as being central to the emergence of the collective competence of a project team. Conceiving collective competence as an emergent result of individual functional competencies, organizational integrative competencies, and collective mechanisms is original for two main reasons. First, it contrasts the traditional idea that the question of competence should be thought of collectively early in projects (Midler, 1995; Ruuska and Vartiainen, 2003). Instead, our interpretation of collected data indicates that, in the specific context of PBOs as studied in this paper, it is possible to address collective competencies within projects only from a combination of individual and organizational levels of competencies. This special status of emerging collective competence moves away from the perspective developed by the classical literature on the levels of competencies (Nordhaug, 1998; Sanchez et al., 1996), which considers collective competence as the union of—and not a result of—individual and organizational competencies. At the same time, findings from our multilevel approach revealed that instead of the collective level of competencies playing a key role between individual competencies and organizational processes as noted by Melkonian and Picq (2011), the collective competencies are the result of interactions between individual functional competencies, organizational integrative competencies and collective mechanisms. Second, this new reading of collective competence contributes to a new understanding of the emergence of the collective competence of a project team and thus reconsiders the major role of individuals and organizations in the construction of this level of competence. The collective competence does not exist at the beginning of the project; it is built during the project as a result of the interactions between individual and organizational competencies, and the development of collective mechanisms. In other words, collective competence is not simply built by gradual expansion of resource but instead emerges from within the system in a

process that varies according to different contexts. For instance, to reinforce the individual competencies of its employees, a company might choose to stimulate collective and organizational effects before investing in personal training devices.

5.2. Implications for practice

From a managerial point of view, our recommendations are that managers should consider that a project manager cannot be a hero anymore. Instead, managers should consider a shared responsibility between individual and organizational competencies and not only the responsibilities held by project managers. Accordingly, they should focus not only on the individual competencies of the project manager but also on organizational integrative competencies.

As project management continues to mature, there has been increasing interest in the individual competencies of project managers and in standards for assessment, development, and certification in PMCs (Bredillet et al., 2015; Cheng et al., 2005; Crawford, 2005; El-Sabaa, 2001; Fisher, 2011; Morris et al., 2006; Stevenson and Starkweather, 2010; Suikki et al., 2006). Nevertheless despite the richness of these works, competencies frameworks remain focused on project manager competencies and consequently only on the individual level of competence. Organizational and collective competencies are missing here, and thus their importance in project management is underestimated. With our multilevel understanding of competencies in PBOs, the different perceptions and expectations of PMCs between project managers and their supervisors (i.e., senior management), as noted by Crawford (2005), are very important and must be taken into account. Moreover, we consider that our multilevel perspective on critical competencies in PBOs would be a response to distress at work caused by project-based management (Asquin et al., 2010). In other words, from a managerial point of view, we see that the emergence of the collective competence of a project team would be a shared responsibility of individuals and organizations and not solely the responsibility of project managers. Therefore, we recommend that both practitioners and current academic researchers stop looking for the perfect, "ideal" project manager who would possess all of the necessary critical competencies for projects.

5.3. Limitations and suggestions for further research

Despite the theoretical and managerial contributions of our work, there are some (primarily methodological) limitations. The principal limitation concerns the external validity of the stated results: our sample size was too small to allow for generalization of the results. At this stage of our research, we cannot claim that our results are applicable in a broad way; however, the initial aim of our work was not to make statistical generalizations but to make analytical generalizations (Yin, 2008) with the aim of enriching the most recent work on critical competencies in PBOs by offering a multilevel approach combining the three levels of analysis (micro, meso, and macro).

To conclude, this work reveals some interesting avenues for future research. Drawing on a multilevel approach, an important and exciting area for research will be in conducting processual and longitudinal analyses of the emergence of critical competencies over projects in PBOs and in observing the dynamics of interactions between competencies over time. A second perspective would be to extend the procedure to new fields in other branches of industry or in other activities than new product development projects. The aim would be to test and enrich the results obtained by the inclusion of new contexts; this would help to improve the external validity and reliability of the results. A third promising research perspective would consist of improving understanding of the conditions of emergence of collective competence resulting from individual functional competencies, organizational integrative competencies, and collective mechanisms. In this paper, we focused analysis on the identification of critical competencies in PBOs, rather than on their construction and development. Thus, a third interesting avenue lies in the in-depth study of mechanisms that underlie the emergence of these competencies in PBOs as well as study of the actors and organizational units in charge of this emergence. Ultimately, we hope to have offered a better understanding of critical competencies in PBOs from a multilevel approach. More generally, this paper among others constitutes a step forward in the understanding of competencies in PBOs.

Conflict of interest

We have no conflict of interest.

Appendix A. Distribution of informants in the four case studies

Case	Case 1 IBM	Case 2 Hewlett-Packard (HP)	Case 3 Arkopharma	Case 4 Temex	Total
Number of interviews	15	12	24	13	**64**
Head office	1	1	1	2	**5**
Human resources department	3	1	2	1	**7**
Functional directors and managers	3	7	10	6	**26**
Project managers	6	2	3	1	**12**
Project team members	2	1	8	3	**14**

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