BUILDING DYNAMIC CAPABILITIES IN PRODUCT DEVELOPMENT: THE ROLE OF KNOWLEDGE MANAGEMENT

IE Business School Working Paper WP08-14 05-03-2008

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Abstract
This paper contributes to the clarification of the connections between knowledge management and dynamic capabilities in the context of product development to see how they explain product development competences. Building on the knowledge management and dynamic capabilities literatures, the paper argues that the social side of knowledge management has a role to play as enabler of dynamic capabilities in the context of product development. Further, dynamic capabilities shape product development competences. Empirical evidence is provided by performing survey research with data collected from 80 product development projects developed in Spain. The paper includes conclusions, limitations and future research potentials for those with an interest in supporting dynamic capabilities.

Keywords
Product development**,** dynamic capabilities, knowledge management, product development competences, organizational knowledge.

1. Introduction

The successful development of products may be used to explain the competitiveness of organizations in today's fast changing business environment (Danneels, 2002). Moreover, product development is a primary mean of organizational renewal by contributing to nurturing dynamic capabilities that enable the creation and reconfiguration of resources and competences (Leonard Barton, 1992; Iansiti and Clark, 1994; Danneels, 2002). While the nature of dynamic capabilities is still not completely understood, their visible outcome is the transformation of operational competences to better match environmental needs. For example, as explained by Verona and Ravasi (2003), dynamic capabilities in Oticon A/S, a leading company in the hearing-aid industry, enable the capacity to develop and launch a considerable number of high-quality products during the nineties. Dynamic capabilities thus propel product development activities in ways that build on and adapt product development competences for tomorrow's product development efforts and create platforms for future product development (Marsh and Stock, 2003; Winter, 2003).

Dynamic capabilities are considered to be grounded in knowledge (Iansity and Clark, 1994; Eisenhardt and Martin, 2000; Zollo and Winter, 2002), so that learning and knowledge processes guide their development, evolution, and use (Zollo and Winter, 2002; Cepeda and Vera, 2007). Several studies also highlight the knowledge-related processes that underlie continuous innovation. Indeed, new products rely on new ideas, concepts or technologies that embody knowledge of a different nature (Dougherty, 1992; Iansiti and Clark, 1994; Verona and Ravasi, 2003). While some studies tend to focus in one specific knowledge-related process, early conceptualizations of dynamic capabilities in product development rest on the simultaneous presence of three core knowledge processes: knowledge generation, knowledge integration, and knowledge reconfiguration (Teece et al., 1997; Verona and Ravasi, 2003; Dougherty, Barnard and Dunne, 2004). On behalf of developing the dynamic capabilities implicit in product development, identifying and managing the knowledge enablers that contribute to conduct these processes seems a critical task. Leonard Barton (1992), for example, identifies employee skills, technical systems, management systems, values and norms as the critical dimensions of the interrelated knowledge system to be managed for making up the capability base of the organization. Accordingly, dynamic capabilities and knowledge management must be closely intertwined, so that the management of knowledge generation, integration, and reconfiguration is behind the formation and evolution of dynamic capabilities (Verona and Ravasi, 2003; Cepeda and Vera, 2007). In this sense, a few empirical papers (Gold, Malhotra and Segards, 2001; Haas and Hansen 2005; Sher and Lee, 2004; Cepeda and Vera, 2007) have begun to examine the way in which dynamic capabilities are facilitated by knowledge management initiatives. While still in its infancy (Zahra, Sapienza and Davidsson, 2006; Mulders and Romme, 2007), these kind of studies show the relationship to be complex, which suggests there is a need to understand in greater depth the specific interplays between knowledge management and dynamic capabilities.

While the prevailing interest for knowledge management within firms has long been rooted in a "technology side" that stresses the control of information-seeking and IT solutions, the knowledge management literature has reached the point of acknowledging the importance of a "social side" of knowledge management. This social side recognizes

the key role of cultural and organizational enablers in the creation, sharing and configuration of knowledge that can produce hard-to-imitate capabilities (Pan and Scarbrough, 1999; Gloet and Berrell, 2003). Accordingly, this study focuses on the social side usually associated to knowledge management, and combines it with dynamic capabilities as determining to product development competences. Specifically, the paper describes product development competences in terms of the achieving of process competence and product competence. Process competence concerns the effectiveness of the product development process and the degree of collaborative behavior of product development team (Zirger and Maidique, 1990), and product competence concerns the characteristics associated with products and the product success in the market place (Clark and Wheelright, 1995).

The purpose of this study is thus to explore the logic link between knowledge management and dynamic capabilities in product development to see how they form a complete model to explain product development competences. This purpose is an attempt to make three essential contributions. First, while dynamic capabilities are usually described as an abstract concept using qualitative case studies, and the lack of measurement makes difficult to study how dynamic capabilities are amenable of managerial action, the context of product development as focal unit of analysis allows this research to measure them as multi-dimensional construct. Second, this study proposes a model of dynamic capabilities that incorporates their antecedents and their consequences and, though studied in product development, may be comprehensive for other contexts or units of analysis. Third, by focusing on the product development work, this article contributes to product development literature by examining specific influential enablers that may help to develop competitive new products beyond existing success factors.

The paper is organized as follows. The next section presents a research background on dynamic capabilities in the context of product development, and explains next the research model that links dynamic capabilities to knowledge management and operational competences in product development. The third and fourth sections respectively describe the research methodology used to test the model the analysis and results obtained. The last section includes the discussion of findings, limitations, and future research suggestions.

2. Literature review and hypotheses

2.1. Dynamic capabilities in product development

Dynamic capabilities provide effective perspective of the dynamic nature of capabilities, asking how firm's resources and capabilities evolve over time in changing competitive environments (Wernelfelt, 1984; Teece, Pisano and Shuen., 1997; Eisenhardt and Martin, 2000). They are defined as "the ability to integrate, build and reconfigure internal and external competences to address rapidly-changing environments" (Teece et al., 1997, p.519). Dynamic capabilities can reconfigure virtually any resource, but it is important to stress the role of knowledge as an essential resource (Pavlou and el Sawy, 2004). As stated by Iansiti and Clark, "dynamic capability links capacity for action to the evolution of the associated knowledge base through the effective execution of problem-solving processes" (1994, p. 563). Several authors make general linkages between dynamic capabilities and organizational

knowledge, suggesting that dynamic capabilities which underpin the long-term, continuous renewal of the firm rest on knowledge-based processes (Eisenhardt and Martin, 2000; Prieto and Easterby-Smith, 2006). For example, Zollo and Winter (2002) to identify a 'knowledge evolution cycle', including generative variation, internal selection, replication and retention behind the development of dynamic capabilities. Similarly, Verona and Ravasi, (2003) and Dougherty et al. (2004) describe dynamic capabilities as a set of specific knowledge processes that create, integrate and reconfigure internal and external organizational skills, resources, and competences to address rapidly changing environments (Teece et al., 1997; Eisenhardt and Martin, 2000; Verona and Ravasi, 2003). Empirical studies also reveal these processes as pertinent to dynamic capabilities (Wang and Ahmed, 2007).

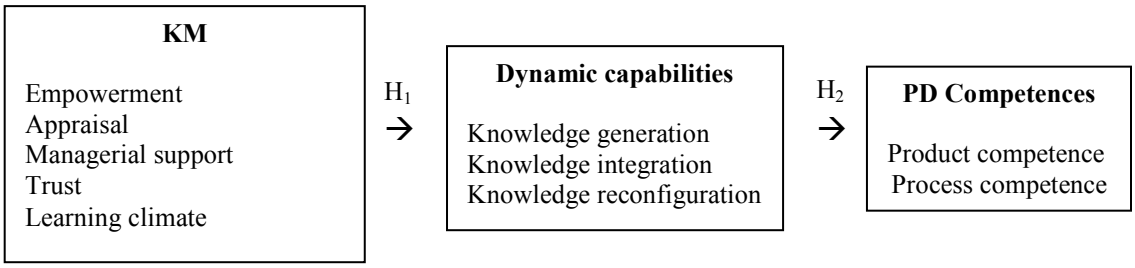
Accordingly, it is possible to delineate dynamic capabilities into a multi-dimensional construct embedded in three distinctive processes: knowledge generation, knowledge integration and knowledge reconfiguration. Knowledge generation is about the promotion, enhancing, and renewing of knowledge. It involves developing or replacing existing content within the existing tacit and explicit knowledge (Alavi and Leidner, 2001), and occurs through social and collaborative processes as well as through individual's cognitive processes. Knowledge integration describes the ability to asses the value of existing knowledge and integrate it to shape new knowledge and competences. Knowledge integration is traditionally associated to dynamic capabilities (Iansity and Clark, 1994) since it represents the capacity to merge new knowledge with deep accumulated knowledge of the complex existing capability base of the organization. Finally, knowledge reconfiguration is the ability to change the patterns of combined knowledge that forms the essence of processes, products, and strategies before it becomes a rigidity. In rapidly changing environments, it involves sensing the need to reorganize and recombine knowledge by accomplishing the necessary transformations and restructuring activities ahead of competition (Teece et al., 1997).

Recent articles pertinent to dynamic capabilities largely focus on product development as an internal enabler for firm change and renewal (Danneels, 2002; Dougherty, 1992). The product development process allows organizations to sense market opportunities and seize them by integrating dispersed knowledge (Henderson and Cockburn, 1994; Grant, 1996), reconfiguring it, and generating new effective knowledge (Iansiti and Clark, 1994) to improve the production, sale, and delivery of products. In the product development context, knowledge generation is based on the development of problem-solving activities that involve problem recognition, knowledge application to solve problems, and further generation of new knowledge for developing and launching new products (Iansiti and Clark, 1994). Knowledge integration involves that people belonging to different firm departments work together combining varied knowledge and skills in order to design and develop a specific product (Clark and Fujimoto, 1991). It is thus necessary a cross-functional knowledge integration perspective as a key aspect of product development. Accordingly, product development members should be able to interpret corresponding meanings on data and information and establish close relationships with others, in such a way that each member's specialized knowledge is disclosed, shared and legitimized in order to become a part of the product development process. To finish, knowledge reconfiguration in product development is at the basis of the potential to reorganize patterns of knowledge embodied in products and activities through the establishment of flexible relationships that are open to dispersed members, and thus through a loosely coupled structure with multiple and evolving patterns, and

open to informal relationships (Verona and Ravasi, 2003).

Product development is thus a function where organizations change by introducing new products, and it is thus an ideal framework to analyze dynamic capabilities (Eisenhardt and Martin, 2000; Pavlou and el Sawy, 2004; Marsh and Stock, 2003, 2006). Specifically, product development provides a specific context to contribute to the existing themes in the literature on dynamic capabilities around their potential antecedents (Zollo and Winter, 2002; Blyer and Coff, 2003; Verona and Ravasi, 2003) and their outcomes (Danneels, 2002; Winter, 2003; Zott, 2003; Cepeda and Vera, 2007; Mulders and Romme, 2007). In this sense, there is some kind of agreement on the fact that dynamic capabilities develop in response to a variety of antecedents and on the fact that their outcome are new operational competences and not firm performance (Eisenhardt and Martin, 2000; Pavlou and El Sawy, 2004). However, the empirical testing of these several linkages has not generated any unifying framework since it is hampered by a lack of consensus in the description, composition and operationalization of dynamic capabilities. Given these concerns, and considering product development as a knowledge intensive process likely facilitated by knowledge management (Cooper, 2003; Madhavan and Grover, 2003; Nambisan, 2003), this paper uses it as level of analysis to examine the influence of knowledge management on dynamic capabilities, and the resulting operational competences. Figure 1 details the research model and the relationships that this study intends to validate.

Figure 1. Predicted Relations



The model proposes that knowledge management enablers such as empowerment, appraisal, managerial support, trust, and learning climate directly influence dynamic capabilities (in terms of knowledge generation, knowledge integration and knowledge reconfiguration). The model also suggests that dynamic capabilities affect product development competences, which can be achieved by concurrently achieving process efficiency (e.g., efficient teamwork, fast time to market and low costs) (Kusunoki, Nonaka and Nagata, 1998) and product effectiveness (e.g. value to customers, product quality and innovativeness). Both competences have been linked to market success and profitability (Cordero, 1991; Pavlou and El Sawy, 2004).

2.2. Antecedents of dynamic capabilities: the role of knowledge management

Just as the research on dynamic capabilities recognizes that their nature and evolution can be described in terms of knowledge (Eisenhardt and Martin, 2000; Zollo and Winter, 2002), other scholars with a primary interest in knowledge management also

consider their potential link to dynamic capabilities (He and Wong, 2004; Sambamurthy and Subramani, 2005; Prieto and Easterby-Smith, 2006). From a dynamic capabilities perspective, Leonard (1992), Lawson and Samson (2001) and Verona and Ravasi (2003) identify personal skills and knowledge, physical technical systems, structural and managerial systems, and cultural values and norms as essential constituents for building dynamic capabilities. In the knowledge management literature there is convergence around social relationships, managerial practices and technological solutions as key knowledge management enablers that can support knowledge processes (Gold et al., 2001; Lee and Choi, 2003; Van der Brink, 2003; Chuang, 2004).

Contemporary knowledge management approaches often reflect the strong divide between those interested in the "technology side", and those emphasizing the "social side" of knowledge management (Alvesson and Karreman, 2001; Gloet and Berrell, 2003). However, research agrees on the fact that, although information technology may inspire knowledge management, it cannot deliver it alone since technology solutions cannot provide a full understanding of complex situations. Information technology is thus just a portion of what is necessary for effective knowledge management. Even the dynamic capabilities literature, while recognizing the use of information technology on facilitating dynamic capabilities (MacPherson, Oswald and Zhang, 2004; Sher and Lee, 2004), distrust this relationship. For example, Sambamurthy, Boudreau and Rose (2003) suggest that information technology is itself a dynamic capability.

Knowledge is usually developed by individuals on the basis of day-to-day work and, as such, knowledge is a continuing result of interactions between people, within and outside the organization. Accordingly, organizations must encourage knowledge-related processes by creating context that nourishes knowledge exchange, build, and transformation (Gold et al., 2001; Lee and Choi, 2003; Zárraga and Bonache, 2003; Chuang, 2004). Knowledge management enablers emphasizing people and social processes are accepted as a real pipeline to act as a medium to guide and motivate people to learn from colleagues with expertise, to be supportive and willing to help one another, to share information, and to watch out from one another (Janz and Prasarnphanich, 2003). These behaviors derive from the managerial practices, principles, norms and values that underpin the actions of an organization and its members, and are usually cultivated over a long period.

This study positions in this social side in order to handle the management of knowledge in product development. From this perspective, dynamic capabilities should be nurtured by enabling people to create, integrate and reconfigure knowledge and expertise as they work, which is possible by combining different enablers such that people can trust each other, work together, be motivated to share ideas, and engage in dialogue (Dougherty et al., 2004). Among these people-focused enablers, literature on knowledge management addresses the role of structural and organizational enablers (Gold et al., 2001; Hasanali, 2002; Lee and Choi, 2003; Zárraga and Bonache, 2003; Kulkarmy, Ravindron and Freeze, 2007) together with the organizational culture (shared values) and work climate (Gold et al., 2001; Hasanali, 2002; Lee and Choi, 2003; Van der Brink, 2003; Chuang, 2004) as important to implement a successful knowledge management program. To capture this thinking, but setting some limits to our research, this study focuses on five major enablers as significant in making up dynamic capabilities in product development. As previous studies have done (Gold et al., 2001; Van den Brink, 2003), this study distinguishes between two generic types of social enablers: (1) organizational

enablers and (2) cultural enablers. These enablers build up on the literature on knowledge management, as well as innovation frameworks as usable to encourage certain behaviors and repress others.

Organizational enablers comprise the procedures, systems and directives that facilitate a business's activities by stimulating people to coordinate, communicate and collaborate. This study examines two main organizational enablers: empowerment (Teece, 2000; Janz and Prasarnphanich, 2003) and performance appraisal (Zárraga and Bonache, 2003). *Empowerment,* equivalent to "autonomy" or "self-direction", refers to the extent to which an individual or group of individuals have the freedom, independence, and direction to determine what actions are required and how best to execute them (Janz and Prasarnphanich, 2003). It includes responsibility for such things such as the management of work methods, time scheduling, the assignment of people to tasks, and freedom to take reasonable risk. Empowerment is seen as a significant dimension of knowledge management that facilitates knowledge combination and exchange among individuals (Gold et al., 2001). Moreover, Nonaka (1991) and Garvin (1993) suggest that self-organizing teams and groups are considered a key success of a knowledge creating company. Empowerment thus encourages individuals (and teams) to self-organize their knowledge and communicate it to develop solutions to new or existing problems and to integrate and generate knowledge (Janz and Prasarnphanich, 2003). Findings relating to empowerment are also consistent on the idea of decentralization, which shows a strong and positive effect on knowledge sharing (Van den Brink, 2003) and knowledge creation (Lee and Choi, 2003). As a result, we might reasonably expect that dynamic capabilities are facilitated by high levels of empowerment. Thus,

Hypothesis 1: Empowerment positively influences dynamic capabilities in product development

Appraisal is an instrument to motivate knowledge exchange and integration by sending signals to individuals about the fact that are behaviors to be encouraged. Specially, appraisal is a part of performance management where the aim is to combine stretch and discipline to stimulate people to deliver high quality results and make them accountable of their actions (Gibson and Birkinshaw, 2004). Therefore, appraisal must establish a set of clear standards of performance and behavior, but also requires an acceptance and commitment to them. It must also establish a system of open, candid, and rapid feedback so that the members may know how the actions they have taken are related to the results they have produced, and carry out an evaluation activity. In this sense, appraisal is part of any adaptation aim since it may help to test the beliefs about what creates success and failure, and provide a shared awareness of the difference between the desired performance and actual performance. This performance gap stimulates people to engage in problem-solving activities in order to improve and, considering that performance gaps result from knowledge gaps, appraisal opens the door to dynamic capabilities by providing the awareness that new knowledge is needed or that something needs to be changed. Otherwise, lack of information can hide problems and reduce opportunities for change, specially, change that contributes to organizational progress.

Hypothesis 2: Appraisal positively influences dynamic capabilities in product development

Cultural enablers comprise drivers such as values, feelings and attitudes, which trigger

people to do what they do. Within these enablers, this study analyzes the role of managerial support (Hasanali, 2002; Zárraga and Bonache, 2003; Gibson and Birkinshaw, 2004; Kulkarmy et al., 2007), trust (Lee and Choi, 2003; Zárraga and Bonache, 2003; Gibson and Birkinshaw, 2004), and learning climate (Gold et al., 2001; Thomset and Hoest, 2001; Janz and Prasarnphanich, 2003). *Managerial support* is a measure of the organization's interest on employees' welfare, so it may also nurture knowledge behaviors by creating a positive work environment that gets the knowledge generation and transformation processes going (Gold et al., 2001; Janz and Prasarnphanich, 2003). Specially, team leaders may exert considerable influence over the work climate and knowledge behaviors within teams (Madhavan and Grover, 1998; Edmonson, 2003; Sarin and Mcdermott, 2003). By definition, product development teams bring together individuals with different experience and background. As Sarin and Mcdermmott (2003) argue, the interaction between the product development manager and these individuals would stand to have a direct effect on the successful generation, integration and reconfiguration of knowledge to current and future product development efforts. Also Edmondson (2003) suggest that team managers play a key role in supporting their team members frame and reframe knowledge and experience. Individuals in the team directly observe the team leader's management style and the extent to which this style provide help rather than exercise authority (Gibson and Birkinshaw, 2004). A supportive leadership is the one that provides help and attention when needed, is open to discuss an individual's ideas and suggestions, or is involved in the task as a team member. A supportive leader also makes the members safe in the team environment and encourages them to think freely and explore non-routine alternatives (Edmondson, 1999). Thus, it encourages dynamic capabilities since it encourages knowledge creation, exchange, and use.

Hypothesis 3: Managerial support positively influences dynamic capabilities in product development

Trust involves the maintaining of reciprocal faith in each other in terms of intentions and behaviors. Some scholars define trust as one party's confidence in its partner's reliability and integrity (Morgan and Hunt, 1994). Team members who trust each other are more willing to share relevant ideas and comprehensive information, clarify problems, and share long-term goals. In this line, Dyer (1997) suggests that trust is required to maximize the use of knowledge in effective collaboration. As such, team members tend to be more willing to participate in knowledge exchange and creation (Lee and Choi, 2003). The information, know-how, and capabilities shared at work can be valuable assets that could be used asymmetrically to gain advantages for some team members. When trust is embedded in the relationship among team members, opportunistic behavior is unlikely to occur because product development members ignore short-term individual gains in favor of the long-term interest of product development. Trust-based interchanges rely on mutual interest between team members and acts as an important restraint to opportunistic behavior (Morgan and Hunt, 1994). In the light of these considerations, trust should facilitate dynamic capabilities.

Hypothesis 4: Trust positively influences dynamic capabilities in product development

Learning climate involves the existence of a collective conviction of the importance of knowledge and learning, which supports the routine of communicating and achieving a common language and methodology at work (Dougherty et al., 2004). Effective

knowledge sharing and generation occurs in companies that are characterized by greater openness, an overall access to information and resources, dialogue, and frequent contacts. A learning climate also gives support to innovation since climates with several controls, little freedom, and risk intolerance can inhibit creativity and innovation (McLean, 2005), which are sources of success in product development. One major reason for failure in product development is the attitude of protecting individual functions rather than securing participation across functions. A participative learning climate incentive processes to gain firsthand knowledge from other team members (Song, Thieme and Xie, 1998). Only the different backgrounds of each member can produce friction or conflicts that erode trust, so that a climate properly channeled to learning and collaboration should focus on the communalities among members rather than their differences. Hence,

Hypothesis 5: A learning climate positively influences dynamic capabilities in product development

2. 3. The impact on product development competences

Dynamic capabilities are criticized by being tautologically linked to firm performance. Although the argument that dynamic capabilities cannot be themselves a source of sustainable competitive advantage (Eisenhardt and Martin, 2000), there is a reasonable conformity in their contribution to performance as a result of renewing and improving operational competences. Operational competences are the way the firm does things and earns a living by using resources (Zollo and Winter, 2002; Winter, 2003; Cepeda and Vera, 2007). They are zero-order capabilities shaped and improved by first-order dynamic capabilities in order to better match the changing environment and lead to better performance (Teece et al., 1997). Therefore, the impact of dynamic capabilities in creating firm value is fully mediated by the operational competences they support, change and improve (Eisenhardt and Martin, 2000; Zollo and Winter, 2002; Zahra et al., 2006).

This study refers to 'product development competences' as the visible outcome of dynamic capabilities in product development. These competences involve the ability to develop and put on the market superior new products rapidly and effectively through a set of complementary resources, specially knowledge resources, and they can affect performance measures and lead to above-average returns. As suggested by Danneels (2002), product development competences must include both the competence to physically make the new product (which is possible when technological competence is present) and the competence to sell the product in the marketplace (which is enabled by the presence of customer competence). In fact, successful firms are those able to match their new developments goals to customer requirements and to their internal technological competences (Schilling and Hill, 1998). Capturing this thinking, product development competence can be considered a bidimensional concept achieved by concurrently realizing *process competence* (e.g., fast time to market and efficient teamwork) and *product competence* (e.g. product quality and value to customer). Process competence gives the firm the capacity to design and manufacture products with certain attributes, such as the effectiveness of the product development process and the degree of collaborative behavior in the process development team (Zirger and Maidique, 1990). When cooperation and shared knowledge exist, the members of product development get work done quickly, reduced cost, and also reduce design and engineering hours, and have a general sense of productivity and timely conflict

resolution, creativity, and effective decision implementation and communication. Product competence concerns the characteristics associated with products and their potential to provide value to customers, thus succeeding in the market place (Clark and Wheelright, 1995). It includes the value of the new products in meeting the customer needs and expectations in the market place (Clark and Fujimoto, 1991) together with distribution and sales access to customers (Danneels, 2002). It also reflects the product success in the market place and its creation of value to customer in terms of highly perceived product quality (Clark and Wheelright, 1995).

The transformation and exploitation capabilities that dynamic capabilities comprise are likely to influence these process and product competences in product development. In example, Iansity and Clark (1994) empirically show that the ability to integrate knowledge resources influences product quality and cycle time. Also Dougherty et al. (2004) sustain that it is the integration, recombination and building of knowledge about technological possibilities and market understandings which allows firms to create new streams of products over time. Zott (2003) shows that the timing and the cost of resource deployment are attributes of dynamic capabilities conductive to performance differences. Therefore, product development with good capacities for knowledge generation, integration and reconfiguration are likely to be more adept at continually revamping knowledge and overcome competence traps and rigidities (Leonard, 1992) by matching customer demands and transforming them into technically viable products.

Hypotheses 6: Dynamic capabilities positively influence superior process competence in product development.

Hypotheses 7: Dynamic capabilities positively influence superior product competence in product development

3. Research methodology

3.1. Sample characteristics and data collection

In order to test the model, this study uses the key informant method to collect survey data from product development projects developed in Spain. First, an in depth literature review allows the design of the questionnaire. In a second step, we validate the questionnaire by means of a pre-test carried out through several personal interviews with product development executives. These interviews allow purifying and rectifying any potential deficiency in survey items, where minor adjustments are made on the basis of specific suggestions. After the pilot study, a mailing list is obtained from Madri+d (which is a society that groups firms and public research organizations aimed of improving of competitiveness through encouraging research, development, innovation and knowledge transfer). Respondents are product development managers, selected according to a representative population approach, and contacted by telephone or mail. Those who agree to participate in the study, receive the questionnaire by e-mail or by accessing a web page where it is possible to find the questionnaire. Respondents answer to questions related with a specific product development, but a researcher involved in the study is accessible to personally help product development managers to solve the question related to the survey. This point implies that sample characteristics are not significantly different from the corresponding population parameters of the original sample provided by Madri+d. As a result, 80 product development managers

provide responses. In term of industry type, the study covers a wide number of industries. Table 1 summarizes respondent characteristics in terms of total number of employees.

Table 1. Respondents by firm's size

Firms by size	
Up to 499	65,80%
500-999	9,60%
1000-4999	12,30%
5000-9999	6,80%
Over 10.000	5,50%

Having in mind that all data are collected from the same respondent, using the same perceptual measurement technique, the study tests the presence of common method bias following one of the procedures described in Podsakoff, MacKenzie and Podsakoff (2003, p. 890). More precisely, the study applies Harman's single factor procedure, in which all the items from the four constructors are included into an exploratory factor analysis to determine whether the majority of the variance could be accounted for one general factor. In the analysis, any single factor emerges and one general factor do not account for the majority of the covariance among the measures, so that common method bias is not a problem in the study.

3.2. Measures description

The measurement of the analysis variables has been built on a multiple-items method, which enhances confidence about the accuracy and consistency of the assessment. Each item was based on a five point Likert scale and all of them are perceptual variables. Table 2 displays items used in the study.

The study measures cultural and organizational enablers of knowledge management with 20 items corresponding to empowerment, appraisal, managerial support, trust, and learning climate, as indicated in Table 2. Most of these items have been adapted from Lee and Choi (2003), Gold et al. (2001), Thomset and Hoest (2001) and Zárraga and Bonache (2003).

Following the proposed conceptualization, the measurement of dynamic capabilities considers three distinctive processes: knowledge generation, knowledge integration, and knowledge reconfiguration. Each of these three dimensions is measured by 4 items mostly based on the suggestions of Lee and Choi (2003), Mohrman et al. (2003) and Katila and Ahuja (2002), about the measurement of knowledge processes.

In the case of product development competences, the study includes both process competence and product competence. To capture process competence, product development managers indicate the extent to which the product development team worked well together, coordinated activities well, implemented decisions effectively, was productive, used financial resources sensibly, used all product developments resources rationally and used product engineering hours efficiently. To capture product competences, respondents reflect customer value by indicating the degree to which the new product met the customer needs and expectations in the market place (Clark and

Fujimoto, 1991; Clark and Wheelright, 1995). These items were all based in the work by Hong et al. (2004).

Since the importance of dynamic capabilities is considered to be dependent on environmental characteristics, the study includes as control variables two classic environmental variables of product development: environmental dynamisms and complexity. Environmental dynamisms, or the rate of change of the environment, are assessed using 4 items based on Gupta and Wilemon (1990), Iansity (1995) and Soulder et al. (1998). Complexity, or the diversity of factors and issues in the environment, reflects the level of complex knowledge that the environment requires to be understood. Based on Germain et al. (2001) Clark and Fujimoto (1991) and Clark and Wheelwright (1995), our final measure of complexity integrates 3 items. Additionally, organizational size, in terms of the number of employees, is the third control variable.

Table 2. Description of Items and Constructors and Factorial Analysis Results

Construct		Measurement items	Factor Loading	% variance explained	Reliability
		Rate of technology change that the firm currently experiences	0.85		
		Large of number of new product ideas has been made possible through technological breakthroughs in the industry	0.87		
		Technological changes provided big opportunities in the industry	0.83		
		Customers' preferences changed quite a bit over the time	0.67		
		Firm's product complexity	0.87		
		Knowledge intensity in product development process	0.67		
		Firm's process complexity	0.82		
		Project produces many new novel and useful ideas.	0.62		
		Project does an outstanding job uncovering product problem areas with which customer were dissatisfied.	0.81		
		Project does an outstanding job correcting product problem areas with which customer were dissatisfied.	0.82		
		Project incorporates new knowledge, methods and inventions	0.65		
		Project integrates new and existing ways of doing things without stifling their efficiency	0.72		
		Project puts in operation lessons learned in other areas of the organization.	0.69		
		Project makes use of existing (technical and market) competences related to products/services that are currently being offered.	0.43		
		Project is able to identify valuable knowledge elements, connect and combine them.	0.52		
		Project introduces perceptible changes that lie outside the existing features of existing products/services.	0.42		
		Project reconfigures the networks of relations and communication relationships both within and outside the firm.	0.69		
		Project transfers knowledge from the product development team to the whole organization.	0.65		
		Project is able to replace outdated knowledge.	0.52		
		Project members have enough autonomy to do their work well.	0.82		
		Project members feel free to allocate their time and skills among their daily tasks	0.82		
		Project members do not need to ask to their supervisor before taking action or make decisions about their task.	0.79		
		Project members continually obtain and use any kind of appraisal feedback to improve its performance and the performance of its members	-0.83		
		Project members are rewarded or punished on the basis or a rigorous measurement of their performance against goals	0.83		
		Project members obtain support and help to do their work (when they need it).	0.63		
		Project members are encouraged to ask others for assistance when they need it.	0.80		
		Project managers are open to individual proposals and	0.59		

		individual creativity			
		Projects managers are usually open to take (prudent) risk.	0.56		
		Projects managers are involved in the task as a member of the team.	0.83		
		Projects members are encouraged to ask others for assistance when they need it.	0.70		
		Project members are generally trustworthy.	0.86		
		Project members have reciprocal faith in other's abilities, intentions and behaviors.	0.83		
		Project members have relationships based on reciprocal faith and trust.	0.86		
		Project members understand the importance of knowledge to success.	0.81		
		Projects managers clearly support the role of knowledge in the firm's success.	0.77		
		Projects managers make efforts to improve the employees' knowledge and skills.	0.85		
		The product had a high quality.	0.70		
		The product exceeded customer expectations.	0.85		
		The product created a high customer value.	0.84		
		The product was successful in the marketplace.	0.67		
		Project members worked well together	0.68		
		Project members coordinated their activity well	0.77		
		Project members implemented decisions effectively	0.81		
		Project members were productive	0.73		
		Project members used financial resources sensibly	0.73		
		Project members used al product development resources rationally	0.79		
		Project members used product engineering hours effectively	0.81		

4. Results

Data analysis involves several steps. First, to verify that items tapped into their stipulated construct, we conduct five factorial analyses (principal component and varimax rotation, retaining factors with eigenvalues greater than 1), one for each type of measurement variables: control, dynamic capabilities, cultural and organizational knowledge management enablers, and product development competences. Results are factors that condense the original nominal variable information while providing continuous variables for each group of variables. Table 2 summarizes the results, including the internal consistency measures (Cronbach's alpha) to assess the reliability of the measurement instruments. All items load on their appropriate scales, and the internal consistency measures of multi-item scales (Crobach's alpha) also meet the statistical threshold in exploratory research. In order to make simpler the following analysis, we decide to combine the three distinctive processes of dynamic capabilities in product development in a single multidimensional variable where the mean of the three dimensions -knowledge generation, knowledge integration and knowledge reconfiguration- constitutes the variable labeled dynamic capabilities in the study.

In a second step, the analysis includes the testing of the proposed hypotheses by using ordinary least square (OLS) regressions. For more detail, correlations among variables are presented in Table 3, where dynamic capabilities appear to correlate significantly to the five knowledge management enablers, although correlation with trust is only significant at a 0.1 level. Product and process competences show significant correlations with dynamic capabilities in product development, and also with some cultural and organizational knowledge management enablers. Colinearity between these variables proves that dynamic capabilities positively affects product development competences, but shows the interest of analyzing dynamic capabilities as a missing link between

knowledge management and product development competence (Cepeda and Vera, 2007).

Table 3. Zero-order Correlation Matrix

	Dynamic C.	Size	Dynamism	Complexity	Product C.	Process C.	Empower.	Appraisal	M. support	L. climate	Trust
Dynamic capabilities	1										
Size	0.08	1									
Dynamism	0.13	0.01	1								
Complexity	1.41***	-0.23**	0.00	1							
Product competence	0.33***	-0.08	0.01	0.22**	1						
Process competence	0.35***	-0.03	0.11	0.21**	0.00	1					
Empowerm.	0.40***	0.11	0.21**	0.05	0.12	0.19*	1				
Appraisal	-0.34***	-0.13	-0.19*	-0.03	-0.12	-0.06	0.00	1			
Managerial support	0.34***	0.17*	0.20	-0.06	0.28***	0.15	0.32***	-0.06	1		
Learning climate	0.38***	0.03	0.00	0.11	0.39***	0.31***	0.22***	-0.24***	0.00	1	
Trust	0.19*	-0.02	0.13	0.18*	0.16	0.32***	0.02	0.21***	0.00	0.00	1

***p<0.01; **p<0.05; *p<0.1

Given that the main interest of the study focuses on the nature of relationships in a multi-variate context, Table 4 presents the results of the regression analysis (standardized beta coefficients). Three models are estimated: Model 1 relates dynamic capabilities with knowledge management enablers and control variables. Model 2 and 3 explain process and product competences in terms of control variables and dynamic capabilities in product development. The exclusion of knowledge management variables in Models 2 and 3 responds to the aim of avoiding results distortions due to multi-colinearity but, in fact, the analysis of any mediation effect could be an extension of the model.

Table 4. Regression Analysis Results (standardized beta coefficients)

Variable	Model 1: Dependent Variable, Dynamic capabilities	Model 2: Dependent Variable, Process competence	Model 3: Dependent Variable, Product competence
Size	0.08	-0.08	-0.10
Dynamism	0.01	0.11	-0.08
Complexity	0.36***	0.06	0.09
Empowerment	0.21**		
Appraisal	-0.23**		
Managerial support	0.27***		
Learning climate	0.25**		
Trust	0.12		
Dynamic capabilities		0.26**	0.26**
R^2	0.51	0.11	0.11
Adjusted R^2	0.45	0.06	0.05
ANOVA F	8.12***	2.11*	2.02*

***p<0.01; **p<0.05; *p<0.1 All regressions include a constant. Beta coefficient displayed

Results of Model 1 clearly show that empowerment, managerial support, and learning climate act as significant and positive enablers of dynamic capabilities, giving support

to our hypotheses 1, 3 and 5. Results also show that appraisal significantly but negatively influence dynamic capabilities, so there is no support to hypothesis 2. Finally, trust is shown as non significant, so there is neither support to hypothesis 5. Estimation of Model 2 and Model 3 also provide significant evidence of the positive influence of dynamic capabilities in product development competences. In both models, the coefficient is statistically different from zero, so there is support to hypotheses 6 and 7. Nevertheless, the low value of the adjusted R^2 indicates that there are some missing factors in both equations.

5. Discussion and implications

Recent research on dynamic capabilities (Zahra et al., 2006; Cepeda and Vera, 2007) suggests that the conceptualization of dynamic capabilities needs to incorporate the explicit role of management in enacting and directing such capabilities. In example, Prieto and Easterby-Smith (2006) note the importance of exploring the role of knowledge management in contributing to dynamic capabilities for different types of business and at different stages of the organizational growth process. Therefore, the management of these capabilities is critical in order to gain their performance related benefits. Accordingly, the purpose of this study is to explore the link between knowledge management and dynamic capabilities in product development to see how they explain product development competences. The study has several key findings: first, it quantifies the concept of dynamic capabilities into a multidimensional construct including knowledge generation, knowledge integration and knowledge reconfiguration. Second, the results confirm the role of some social knowledge management enablers as enablers of dynamic capabilities in product development. Finally, dynamic capabilities are shown to impact product development competences.
These findings suggest that, as product development managers seeks to achieve success, their knowledge management efforts need to contribute to dynamic capabilities resulting in unique ways of doing things, that is, in unique product development competences. By focusing in the product development work as the focal unit of analysis, this study specifically contributes to the product development literature by examining specific influential enablers that can help to develop competitive new products beyond existing success factors. Together, we also help to diminish the relative lack of comment and guidance within existing models about how knowledge management and dynamic capabilities may stick together.

Dynamic capabilities are criticized for their lack of empirical grounding and measurement, and most studies on dynamic capabilities use qualitative research with no operationalization and measurement of them (Pavlou and El Sawy, 2004). Based on the propositions of the knowledge-based nature of dynamic capabilities, this study empirically measures dynamic capabilities as three specific core knowledge processes. Specifically, as suggested by Teece et al. (1997) and Verona and Ravasi (2003), the study argues that dynamic capabilities are formed by the simultaneous achieving of knowledge generation, knowledge integration and knowledge reconfiguration. Although distinct, the three proposed processes are interrelated so it can be deduced that they jointly produce the outcomes of dynamic capabilities, in such a way that is not easily imitated by competitors. This measurement of dynamic capabilities opens new avenues for empirical, quantitative, and analytical research.

The consideration of dynamic capabilities as a set of core knowledge processes makes possible to analyze the links to knowledge management. Specially, this study identifies several social knowledge management enablers that may support dynamic capabilities. Results confirm that dynamic capabilities in product development are associated with organizational enablers, such as empowerment, and cultural enablers, such as managerial support and learning climate. These enablers encourage product development members for taking initiative, cooperate, and keep consciousness about what the others know, so building, sharing and applying expertise competently. For instance, the significant path between empowerment and dynamic capabilities is consistent of the idea that when individuals are allowed to use their own judgment as to how to divide their time and energies between exploring new opportunities and searching for alignment in current activities, as required by dynamic capabilities (Teece et al., 1997; Gibson and Birkinshaw, 2004). The path between managerial support and dynamic capabilities shows that behind dynamic capabilities there are managers able to improve how people feel about themselves. Managers must serve as a model, coordinate and focalize the different viewpoints in a work team, provide guidelines, and put themselves in other's shoes to create a work environment that shapes individual's freedom to pursue action and affects how people interact. Similarly, dynamic capabilities occur in a learning climate where individuals learn and develop new skills as well as share existing knowledge, both of which are crucial for product development. Interaction, dialogue, and frequent contacts must be promoted within a learning climate in order to create new ideas, share them, transmit tacit knowledge, and facilitate solutions to novel or existing problems.

Contrary to what we might expect, the analysis shows that appraisal negatively affects dynamic capabilities. One potential explanation to this unexpected result could be the fact that appraisal has the risk to be perceived as a mechanism for compliance and detection of errors instead as a mechanism for discipline and recognition of efforts that is based on individual's commitment with clear defined standards. The perception of appraisal as the existence of rules and control would push product development members towards order and away from knowledge generation and reconfiguration. Together with, it is also true that appraisal work best when it is related to the type of personnel. Specially, in the context of product development, appraisal could work best when it is related to recognizing and rewarding, not individual performance (the traditional way), but the results of the product development team.

In examining the effect of trust on dynamic capabilities in product development, the study hypothesizes that a positive relationship is likely to exist. However, results show no significant relationship between trust and knowledge-based dynamic capabilities. This non-significant finding means product development does not consider trust an important factor driving higher level of dynamic capabilities. This finding is intriguing as main stream thinking states that trust is a facilitator of effective collaboration. Trust involves the maintaining of reciprocal faith in each other in terms of intentions and behaviors, so product development team members who trust each other are more willing to share relevant ideas and comprehensive information, clarify problems and share long-term goals. As such, team members will act in the common interest by being keen on participating in knowledge exchange and creation (Lee and Choi, 2003). That being so the construct is valid and reliable, but other factors might explain the non significant finding. In fact, together with its virtues trust may reduce the cognitive distance between individuals and the relationship may run out of innovative steam. Too much trust may

also hamper the generation of diversity of views and potential criticisms that compel to high quality new products. Another potential explanation is that trust is more effective at reducing uncertainty in the early phases of product development, but less effective over time as team members consolidate interaction history and deepen their knowledge of each other. The construct of trust definitely deserves to be examined further in future research using a different set of sample frame. More knowledge is needed about the role of trust on dynamic capabilities under different relationship conditions.

Last but not least, results also attest to the important role of dynamic capabilities to product development competences. Specifically, the study verifies that dynamic capabilities generate both process and product competences, which respectively differentiate a firm's product development efforts from competitors (i.e. efficient teamwork) and provide product-market advantages to customers (i.e. value to customer). These results are not surprising if we have in mind that the literature assumes that performance results do not come from dynamic capabilities themselves but from intermediate outcomes (i.e. operational capabilities) that transform knowledge into business value (Eisenhardt and Martin, 2000; Zahra et al., 2006). Although we do not analyze this mediating role nor any link to financial performance, the results confirm that being able of renewing and leveraging both process and product competence in product development means that the firm is able to extract value out of its competences.

Interestingly, results also show that the control variables such dynamism have no significant effect on dynamic capabilities neither on their outcomes. Complexity on the other hand is positively related to dynamic capabilities. Together with our previous findings, these results come to confirm that dynamic capabilities develop in response to a variety of enablers, not just environmental dynamism. It is thus necessary to emphasize the dynamism of the capabilities themselves, not the environment (Zahra et al., 2006). Possibly, future research should explore if the potential outcomes of dynamic capabilities are moderated by environmental dynamics.

The results of the study must be viewed in the light of some limitations. First, we must mention that the study has tried to define their constructs as precisely as possible by drawing on relevant literature and to closely link our measures to the theoretical underpinnings through a careful process of item generation and refinement. Evidently, this measurement effort represents an advance for research but, nonetheless, the research items are far for being perfect as long as they measure facts that are neither fully nor easily measurable. A second limitation concerns the fact that sample is not large and, what is more, all data were collected from the same respondent using the same perceptual measurement technique. Although the findings may help to explain certain relationships between variables, replies from multiple respondents would have ruled out potential drawbacks. Third, future research should consider that both the external environment and other internal characteristics naturally interfere with product development efforts, therefore sustaining (or hindering) dynamic capabilities. This article has integrated disparate literatures as a preliminary step towards a better understanding the connection between knowledge management and dynamic capabilities. On the basis of previous limitations, it naturally points out avenues for future research, especially if we have in mind that, even if the product development process is the empirical context of this study, we have no reason to believe that our construct of dynamic capabilities is not generalizable to other levels.

References

Alavi M, Leidner DE. Review: knowledge management and knowledge management systems: conceptual foundations and research issues. MIS Quarterly 2001; 25(1): 107-136.

Alvesson M, Karreman D. Odd couple: making sense of the curious concept of knowledge management. Journal of Management Studies 2001; 38 (7): 995-1018.

Blyer M, Coff RW. Dynamic capabilities, social capital and rent appropriation: ties that split pies. Strategic Management Journal 2003; 24: 677-686.

Cepeda G, Vera D. Dynamic capabilities and operational capabilities: a knowledge management perspective. Journal of Business Research 2007; 60: 426-437.

Chuang S. A resource-based perspective on knowledge management capability and competitive advantage: an empirical investigation 2004; Expert Systems with Applications, 27: 459-465.

Clark KB, Fujimoto T. Product development performance: strategy, organization, and management in the world auto industry. Boston, MA: Harvard Business School, 1991.

Clark KB, Wheelwright SC. Leading product development. The Free Press, New York, 1995.

Cooper LP. A research agenda to reduce risk in new product development through knowledge management: a practitioner perspective. Journal of Engineering of Technology Management 2003; 20: 117-140.

Danneels E. The dynamics of product innovation and firm competences. Strategic Management Journal 2002; 23(12): 1095-1121.

Dougherty D. Interpretative barriers to successful product innovation in large firms. Organization Science 1992; 3: 179-202.

Dougherty D, Barnard H, Dunne D. Exploring the everyday dynamics of dynamic capabilities. 3rd Annual MIT/UCI Knowledge and Organizations Conference, Laguna Beach, California, 2004.

Eisenhardt KM, Martin JK. Dynamic capabilities: what are they?. Strategic Management Journal 2000; 21: 1105-1121.

Edmondson A. Psychological safety and learning behavior in work teams. Administrative Science Quarterly 1999; 44: 350-383.

Edmondson A. Framing for learning: lessons in successful technology implementation. California Management Review 2003; 45 (2): 34-54.

Ettlie J, Pavlou, PA. Technology-based new product development partnerships, Decision Sciences 2006; 37(2): 117-148.

Garvin DA. Building a learning organization. Harvard Business Review 1993; 71 (4): 78-91.

Germain R, Droege C, Christensen W. The mediating role of operations knowledge in the relationship of context with performance. *Journal of Operations Management 2001;* 19 (4): 453-69.

Gibson CB, Birkinshaw J. The antecedents, consequences, and mediating role of organizational ambidexterity. Academy of Management Journal 2004; 47 (2): 209-226.

Gloet M, Berrel M. The dual paradigm nature of knowledge management: implications for achieving quality outcomes in human resource management. Journal of Knowledge Management 2003; 7 (1): 78-89.

Gold AH, Malhotra A., Segars AH. Knowledge management: an organizational capabilities perspective. Journal of Management Information Systems 2001; 18 (1): 185-214.

Grant R. Toward a knowledge-based theory of the firm. strategic management Journal 1996; 17 (Winter special Issue): 199-122.

Gupta AK, Wilemon DL. Accelerating the development of technology-based new products. California Management Review 1990; 32 (2): 24-44.

Haas MR, Hansen MT. When using knowledge can hurt performance: the value of organizational capabilities in a management consulting company. Strategic Management Journal 2005; 26(1): 1-24.

Hasanali F. Critical success factors of knowledge management, available at: www.kmadvantage.com/docs/KM_articles/Critical_Success_Factors_of_KM.pdf (accessed 9 April 2007), 2002.

He Z, Wong P. Exploration vs. exploitation: an empirical test of the ambidexterity hypothesis. Organization Science 2004; 15(4): 481- 494.

Henderson R, Cockburn I. Measuring competence? exploring firm effects in pharmaceutical research. Strategic Management Journal 1994; 15 (special issue): 63-84.

Hong P, Nahm A, Doll W. J. The role of project target clarity in an uncertain project environment, International journal of Operations & Production Management 2004; 24 (12): 1269-1291.

Iansity M. Shooting the rapids: managing product development in turbulent environments. California Management Review 1995; 38 (1): 37-58.

Iansiti M, Clark KB. Integration and dynamic capability: evidence from product development in automobiles and mainframe computers. Industrial and Corporate Change 1994; 3(3): 557-605.

Janz BD, Prasarnphanich P. Understanding the antecedents of effective knowledge management: the importance of a knowledge-centered culture. Decision Sciences 2003; 34 (2): 351-384.

Kulkarmy U, Ravindron S, Freeze R. A Knowledge management success model: theoretical development and empirical validation. Journal of Management Information Systems 2007; 23 (3): 309-347.

Kusunoki K, Nonaka I, Nagata A. Organizational capabilities in product development of japanese firms: a conceptual framework and empirical findings. Organization Science 1998; 9(6): 699-718.

Lawson B, Samson D. Developing innovation capability in organisations: a dynamic capabilities approach. International Journal of Innovation Management 2001; 5 (3): 377-400.

Lee H, Choi B. Knowledge management enablers, processes, and organizational performance: an integrative view and empirical examination. Journal of Management Information Systems 2003; 20(1): 179-228.

Leonard Barton D. Core capabilities and core rigidities: a paradox in managing new product development. Strategic Management Journal 1992; 13 (8): 111-125.

Macpherson A, Oswald J, Zhang M. Evolution or revolution? Dynamic capabilities in a knowledge-dependent firm. R & D Management 2004; 34 (2): 161-177.

Madhavan R, Grover R. From embedded knowledge to embodied knowledge: new product development as knowledge management. Journal of Marketing 1998; 62 (4): 1-12.

Marsh SJ, Stock GN. Building dynamic capabilities in new product development through intertemporal integration. Journal of Product Innovation Management 2003; 20: 36-148.

Marsh SJ, Stock G.N. Creating dynamic capability: the role of intertemporal integration, knowledge retention, and interpretation. Journal of Product Innovation Management 2006; 23: 422-436.

McLean LD. Organizational Culture's Influence on Creativity and Innovation: A Review of the Literature and Implications for Human Resource Development. Advances in Developing Human Resources 2005; 7 (2): 226-246.

Mohrman SA, Finegold D, Mohrman AM. An empirical model of the organization knowledge system in new product development firms. Journal of Engineering and Technology Management 2003; 20: 7-38.

Morgan RM, Hunt SD. The Commitment-Trust Theory of Relationship Marketing Journal of Marketing 1994; 58 (3): 20-38.

Mulders D, Romme G. Operationalizing dynamic capability: a systematic literature review. 23rd Egos Colloquium, Vienna, Austria, 5-7 July, 2007.

Nambisan S. Information systems as a reference discipline for new product development. MIS Quarterly 2003; 27(1): 1-18.

Nonaka I. The Knowledge creating company. Harvard Business Review 1991; 69 (6): 96-104.

Pan SL, Scarbrough H. Knowledge management in practice: an exploratory case study. Technology Analysis & Strategic Management 1999; 11(3): 359-374.

Pavlou PA, El Sawy OA. Understanding the 'black-box' of dynamic capabilities: a missing link to the strategic role of it in turbulent environments?. Working Paper, 2004.

Podsakoff PM, MacKenzie B, Lee J-Y, Podsakoff NP. Common method biases in behavioural research: a critical review of the literature and recommended remedies. Journal of Applied Psychology 2003; 88 (5): 879-903.

Prieto I, Easterby-Smith M. Dynamic capabilities and the role of organizational knowledge: an exploration. European Journal of Information Systems 2006; 15 (5): 500-510.

Sambamurthy V, Subramani M. Special issue on information technology and knowledge management. MIS Quarterly 2005; 29(1): 1-7.

Sambamurthy V, Bharadwaj A, Grover V. Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms. MIS Quarterly 2003; 27(2), 237-263.

Sarin S, McDermott C. The Effect of team leader characteristics on learning, knowledge application, and performance of cross-functional new product development teams. Decision Sciences 2003; 34 (4): 707-739.,

Sher PJ, Lee VC. Information technology as a facilitator for enhancing dynamic capabilities through knowledge management. Information & Management 2004; 41: 933-945.

Song XM, Thieme JR, Xiu J. The impact of cross-functional joint involvement across product development stages: An exploratory study. Journal of Product Innovation Management 1998; 15 (4): 289-304.

Soulder WE, Sherman JD, Davies-Cooper R. Environmental uncertainty, organizational integration, and new product development effectiveness: a test of contingency theory. Journal of Product Innovation Management 1998; 15 (6): 520-33.

Teece DJ. Strategies for managing knowledge assets: the role of the firm structure and industrial context. Long Range Planning 2000; 33 (4): 35-54.

Teece DJ, Pisano G, Shuen A. Dynamic capabilities and strategic management. Strategic Management Journal 1997; 17 (Winter Special Issue): 509-533.

Thomsen HK, Hoest V. Employees' perception of the learning organization. Management Learning 2001; 32 (4): 469-491.

Van den Brink P. Social, organizational and technological conditions that enable knowledge sharing. Doctoral thesis, Technische Universiteit Delft, Amsterdam, 2003.

Verona G, Ravasi D. Unbundling dynamic capabilities: an exploratory study of continuous product innovation. Industrial and Corporate Change 2003; 12(3): 577-606.

Wang CL, Ahmed PK. Dynamic capabilities: a review and research agenda. International Journal of Management Reviews 2007, 9 (1): 31-51.

Wernerfelt B. A resource-based view of the firm. Strategic Management Journal 1984; 5(2): 171-180.

Winter SG. Understanding dynamic capabilities. Strategic Management Journal 2003; 24**:** 991-995.

Zahra SA, Sapienza HJ, Davidsson P. Entrepreneurship and dynamic capabilities: a review, model, and research agenda. Journal of Management Studies 2006; 43(4): 917-955.

Zirger BJ, Maidique M. A model of new product development: an empirical test. Management Science 1990; 36: 867-883.

Zollo M, Winter SG. Deliberate learning and the evolution of dynamic capabilities. Organization Science 2002; 13 (3): 339-351.

Zott C. Dynamic capabilities and the emergence of intra-industry differential firm performance: insights from a simulation study. Strategic Management Journal 2003; 24: 97-125.

Zárraga C, Bonache J. Assessing the team environment for knowledge sharing: an empirical analysis. International Journal of Human Resource Management 2003; 14 (7): 1227-1245.

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