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Knowledge creation and absorptive capacity: The effect of intra-district shared competences

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Summary This paper takes a cross-level approach in contributing to defining the competences accumulated and shared in an industrial district, and to explaining how they differ from firm-specific, knowledge-based capacities. From a dataset of 952 Spanish firms and 35 industrial districts, we provide empirical evidence that industrial districts are spaces with dense networks of information and knowledge transfer, inter-personnel relationships and a strong specialised stock of human capital, which are accessible and shared by all firms embedded in such a district. However, we explain the complementarity between district and firm-specific capacities in order to develop the notion of absorptive capacity, by indicating that the diffusion of shared competences is neither easy nor direct and that it requires a firm's internal learning effort to better absorb localised knowledge spillovers. Results enable us to shed new light on how firms' knowledge creation and diffusion processes benefit from these external knowledge flows.

Introduction

From the open innovation approach, Chesbrough (2003) identifies winner firms as those making the best use of internal and external ideas simultaneously. It is generally accepted that no firm can entirely rely on its own internal knowledge capacities and sources to create competitive advantages through innovation, and it needs to both develop its capacity (Cohen & Levinthal, 1990; Volberda, Foss, & Lyles, 2010; Zahra & George, 2002) to absorb new external knowledge, and to combine inflows and outflows of knowledge (Prahalad & Hamel, 1990; Teece, Pisano, & Shuen, 1997). An extensive body of literature argues that innovation must be regarded as resulting from distributed inter-organisational networks, rather than from single firms (Coombs, Harvey, & Tether, 2003; Douglas & Ryman, 2003; Dyer & Singh, 1998; Powell, Koput, & Smith-Doerr, 1996). Other research lines have focused on how knowledge creation and diffusion processes might benefit from localised knowledge spillovers between firms in the same industry (e.g., Verspagen & Schoenmakers, 2004; West, Vanhaverbeke, & Chesborough, 2006). The most interesting case of firms' spatial co-location is that of industrial districts. However, as Volberda et al. (2010) point out in their bibliometric analysis, the inter-organisational antecedents have been relatively neglected in absorptive capacity literature and the emergence of absorptive capacity from the interactions of its distinct level antecedents remains unclear. This paper enables us to shed new light on how intra-district firms' knowledge creation and diffusion processes benefit from the knowledge flows within a

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cluster, and how they differ from firm-specific, knowledge-based capacities, by adopting a cross-level approach to this end.

The canonical approach (e.g., Becattini, 1979) defines industrial districts as ideal environments with rich, localised knowledge spillovers, within which firms can access knowledge exchanges that flow more smoothly (Malipiero et al., 2005) or free of charge (Boari & Lipparini, 1999). This view neglects the coexistence of cooperation and competition relations within the cluster (Dei Ottati, 1994; You & Wilkinson, 1994), the empirical evidence of strong intra-district heterogeneity in knowledge-based capabilities and performance (Camisón, 2004; DeCarolis & Deeds, 1999Lazerson & Lorenzoni, 1999; McEvily & Zaheer, 1999), and the uncertainty over whether intra-district knowledge flows are so free and straightforward (e.g., Ferreira & Serra, 2009). The relationship between intra-district shared competences and firms' internal knowledge creation remains equally controversial, with positions which predict that location in a cluster could reduce intra-district firm R&D investment (Bernstein & Nadiri, 1989; Henderson & Cockburn, 1996) in contrast to other scholars who anticipate a stimulating effect (Harabi, 1995; Maskell & Malmberg, 1999; Veugelers, 1997). Thus, the understanding of the dynamics of the knowledge creation and diffusion flows within industrial districts and their relationships with firms' internal processes (substitution versus complementary effect) still remains unclear (e.g., Arikan, 2008; Camisón, 2004; Pouder & John, 1996; Tallman, Jenkins, Henry, & Pinch, 2004). Therefore, there is an ongoing debate on how firms inside an industrial district absorb the knowledge that may be flowing freely within its boundaries, and how they benefit from this cluster-based knowledge to create advantages in their internal knowledge stock.

Among other reasons, advancement on the concept and drivers of knowledge-based capabilities has been halted by the lack of a specified level of analysis (e.g., Glick, 1988; Glick & Roberts, 1984; Rousseau, 1985). Failing to specify a theory level can cause problems because the researcher does not describe the target for which theoretical generalisations are made, or the methodological and/or statistical analyses are incongruent with the level of theory and thus the results may misrepresent the theoretical relationship the research would have uncovered (Klein, Dansereau, & Hall, 1994, p. 199). The relevance and meaning of the level-of-analysis issue within the industrial districts literature have not been explored, despite its value for a better understanding of the different theoretical approaches to the topic and their explanatory mechanisms. A given construct — firm-specific, knowledge-based capabilities in our case — may be explicitly or implicitly conceptualised with alternative assumptions, predicting that members located in an industrial district are homogeneous, independent or heterogeneous; and consequently, the relationships between different categories of capabilities (firm-specific versus shared competences) are a consequence of differences among clusters, among independent firms located in clusters, or among firms within clusters. We try to explain the firm's stock of knowledge-based capabilities by using suprafirm-level variables in our theoretical discussion, as proposed by the Scandinavian Approach (Foss, 1996; Foss & Eriksen, 1995). This new research line predicts competitive asymmetries between firms within the same industrial district derived from their different patterns of appropriation of shared competences (Arikan, 2008; Camisón, 2004; Foss, 1996; Lorenzen, 2007, 1998; Lorenzen & Foss, 2003; Lawson, 1999; Maskell & Malmberg, 1999; Maskell et al., 1998), which are in turn connected with their heterogeneous firm-specific capacities.

The concept of shared competences is still extremely ambiguous. Our first contribution is to provide a theoretically based concept of shared competences accumulated in an industrial district, differentiated from firm-specific, knowledge-based capacities, together with valid measurement instruments to capture the conceptual frontiers existing among these constructs. Shared competences are a collective concept dealing with factors shared by all firms located in an industrial district, and therefore it is a higher level concept (Foss, 1996; Foss & Eriksen, 1995; Lorenzen, 1998). This theoretical approach to the topic entails the development of a multi-level study (Klein et al., 1994; Mossholder & Bedeian, 1983). This cross-level approach can make an interesting contribution to the understanding of knowledge creation and diffusion flows by firms located within an industrial district, and to the multi-level nature of the capabilities concept (Peteraf, 2005). Second, this article also extends previous research by offering new empirical evidence to show that industrial districts are pools of shared competences to which intra-district firms have common access. A third contribution is empirical evidence on the complementarity between cluster-based and firm-specific knowledge capacities aimed to develop the firm's external knowledge absorptive capacity (Volberda et al., 2010; Zahra & George, 2002; Cohen & Levinthal, 1990). The results are interesting in that they raise certain questions about the definition of intra-district shared competences as free and public goods, and they add value to the existing literature on absorptive capacity from a cross-level perspective.

In order to obtain accurate, significant empirical evidence of the relationship between the variables studied, we first conceptualise firms' absorptive capacity, their internal knowledge creation capacity, and intra-district shared competences. Having determined this theoretical framework, we then construct our theoretical model and propose the research hypotheses. In the following section, the general guidelines are established for the design of the empirical study. We test the hypotheses proposed in the theoretical model using structural equations models. This is followed by a statistical analysis of the results. The final part of the paper discusses the study's conclusions, academic and managerial implications, together with its limitations and suggestions for future research.

Theoretical framework

Understanding on how intra-district firms absorb the knowledge that may be flowing within its boundaries, and how the competences accumulated and shared in a cluster differ from firm-specific, knowledge-based capacities has been halted by the lack of specified levels of analysis. In the literature on levels, this problem is defined as committing a fallacy of the wrong level (e.g., Glick, 1988; Rousseau, 1985; Glick & Roberts, 1984). Following Klein et al. (1994, p. 198), a level issue refers to a specific organisational context described as ''individuals within groups''. The term ''group'' is used

broadly and can be interpreted to mean any higher level organisational entity, the industrial district in our case. Similarly, the term "individuals" may be interpreted to refer to members of higher level entities, in our case, firms located within or outside an industrial district. New theoretical developments about the knowledge process in firms and industrial districts have highlighted this level-of-analysis issue, leading to confusion and controversy regarding the appropriate level of analysis.

Klein et al. (1994, p. 196) highlight the primacy of theory in addressing the levels issue. Therefore, the first step in approaching the issue is to specify the level of one's theory, which describes the target (e.g., individual, group, firm, inter-organisational network, industry, industrial district) the researcher aims to explain, from which generalisations are made. Specifying a theory level has significant implications because, by making this decision, the researcher (implicitly or explicitly) predicts that members of a group are homogeneous, independent or heterogeneous in relation to the constructs of the theory; and also the relationships among theoretical constructs are a consequence of differences among groups, differences among independent members of groups, or differences within groups. In particular, beyond the study of the two classical alternatives (homogeneity versus independence, e.g., Glick, 1985), the recognition of a third alternative of heterogeneity (Klein et al., 1994; Glick & Roberts, 1984) has been relevant, since in discussing the meaning and implications of heterogeneity, we discover a fruitful avenue for building theory about knowledge-based capabilities.

In specifying that the level of a theory is a group, a researcher predicts that group members are homogeneous with respect to a theoretical construct, these individuals' values are identical and they may be characterised as a whole, and consequently the proposed relationships should focus on variation between groups. The canonical approach to industrial districts (Brusco, 1982; Becattini, 1979) is a good example of this view. This theoretical approach considers the industrial district as a homogeneous space with a rich stock of resources and capabilities that firms can access. This definition comes close to that of Porter (2000, p. 16), who conceptualises the cluster as a "geographically proximate group of interconnected companies and associated institutions in a particular field linked by commonalities and complementarities". This common space is a factor that should favour internal district homogeneity. The intense interdependence among people and firms derived from stable, long-term, direct relationships between the agents in the local environment, within a relatively homogeneous community with a shared value system, should also play a key role in supporting intra-district symmetry. Knowledge circulating within an industrial district is thus viewed as a public good bounded in space (Krugman, 1999), in which knowledge flows more smoothly within the cluster boundaries (Malipiero et al., 2005), available knowledge is "in the air" (Audretsch and Feldman, 1996), circulates freely and spontaneously (Boari & Lipparini, 1999; Breschi & Lissoni, 2001), and whose exchange is informal in nature (Grilliches, 1979). The concept of "localised knowledge spillovers" has been widely accepted to describe the spatial boundaries of knowledge flows, which could be particularly strong when firms cluster in order to take advantage of the available knowledge within certain boundaries encompassing strong agglomeration economies. Spillover effects are externalities of economic activity or processes affecting those who are not directly involved in it. Knowledge spillover is a non-rival knowledge market externality that has the effect of exchanging ideas and stimulates technological improvements in a neighbourhood through a firm's own innovation. The transmission of knowledge and the model of reference within the specific industrial atmosphere of the district also act as a force to foster shared behaviours. Thus, the canonical approach studies industrial districts as a homogeneous group, the target unit is conceptualised as a single whole unit, and is described by a single value.

At the opposite extreme, much organisational and strategy literature has adopted an independent approach to study firms in relation to a group such as the potential cluster they are located within. From this perspective, researchers have specified the level of theory as the independent firm, and they predict that individual firms (even when located in a cluster) will be independent of that group's influence. Because cluster membership would be irrelevant to the theory's constructs, the distinction of within-cluster and between-cluster variation is viewed as irrelevant. Variation in the constructs is conceptualised only as between-firm variation. The main line of this level of theory is the Resource-Based View (RBV), a plural approach with different and complementary perspectives to analyse the firm's resources and capabilities. Within the RBV dynamic perspectives (Eisenhardt & Martin, 2000; Teece et al., 1997; Zollo & Winter, 2002), the Competence-Based View (CBV) is of particular interest (Foss, 1997, 1993; Foss & Knudsen, 1996; Grant, 1996; Kogut & Zander, 1992); this perspective considers tacit knowledge and intangible assets as the basic source of competitive advantage. CBV is a firm-level theory that explains the firm's knowledge process as a consequence of between-firm variability in the learning process that leads to the reconfiguration and transformation of existing capabilities and innovation in products, processes and activities. Organisational learning requires both the exploration of new paths and the exploitation of what is already known (Benner & Tushman, 2003; Bontis, Crossan, & Hulland, 2002; Gupta, Smith, & Shalley, 2006; He & Wong, 2004). Therefore, learning and generation of new knowledge exist in exploration activities related to searching, experimentation and risk taking, as well as in exploitation processes consisting of the leveraging and expansion of existing competences and technologies and also focused on gaining efficiency (March, 1991).

The analysis of the knowledge development process must also pay attention to two sub-processes: internal knowledge creation and external knowledge absorption (Chakravarthy, McEvily, Doz, & Devaki, 2003). Although different in nature, these two components are interrelated: innovative assets are considered to be a consequence of the complementarity between the creation of internal knowledge and the assimilation of external knowledge (Cohen & Levinthal, 1990; Teece et al., 1997; Zahra & George, 2002).

We understand firms' *internal knowledge creation capacity* to mean all the competences associated with the creation of an internal system of continuous learning in the firm. Firms' internal knowledge creation is, fundamentally, generated by R&D investment and internal problem solving

(Prieto, Revilla, & Rodríguez-Prado, 2009; Grant, 2000). Other antecedents of firms' internal knowledge creation are employees' abilities, level of education, experience, training and the skills they acquire in the workplace through their interaction with other agents with different knowledge bases (Nonaka & Takeuchi, 1995). For this reason authors such as Mahnke, Pedersen, & Venzin (2005) highlight the formation of self-management teams and informal social networks. The firm's directors can also collaborate by developing an appropriate structure (Nonaka & Takeuchi, 1995; Tsai, 2002), an organisational culture and leadership focused on knowledge and learning objectives (Nonaka, 1991). Lloyd (1998) notes that greater autonomy allows employees to adopt more complex learning by creating new ideas and mental models.

The way firms reach a balance between exploration and exploitation activities is complex, since as March (1991), March (1996) has indicated, the two processes can require routines of a very different nature to develop. A balance between the exploration and the exploitation processes requires an organisational design that comes close to the ambidexterity model (Benner & Tushman, 2003; Tushman & O'Reilly, 1996).

External knowledge flows also provide opportunities for firms to broaden their knowledge base, make up the internal shortages common to all firms today (Grant & Baden-Fuller, 2004), develop useful knowledge more quickly than their rivals (Prahalad & Hamel, 1990; Teece et al., 1997), and increase their flexibility (Grant, 1996; Almeida, Phene, & Grant, 2003). A firm's *external knowledge absorptive capacity* involves the usage of mechanisms through which knowledge outside the firm is identified, acquired, assimilated, transformed and applied. This definition by Zahra and George (2002) reformulates the traditional three-dimensional model introduced by Cohen and Levinthal (1989, 1990), as it identifies four different, complementary dimensions: acquisition, assimilation, transformation and application. The concept of each of these processes is described in Table 1. Zahra and George (2002) suggest that these dimensions can be integrated within two complementary components: (a) potential absorptive capacity, which comprises external knowledge acquisition and assimilation capacities; and (b) realised absorptive capacity, which includes both knowledge transformation capacity and the capacity to exploit newly developed knowledge. Furthermore, external knowledge absorptive capacity relies on firms' internal capacities and on how they structure their relationships with the environment. Firms need internal effort and R&D investment (Leahy & Neary, 2007; Cohen & Levinthal, 1990) and must adjust their internal structures to support the formation and sustenance of other capacities (Zahra, Filatotchev, & Wright, 2009; Fosfuri & Tribó, 2008; Vanhaverbeke & Peeters, 2005; Caloghirou, Kastelli, & Tsakanikas, 2004) in order to absorb new external knowledge.

It should be recognised that many of the studies included in the canonical approach and CBV have noted that the research into the behaviours and performance of firms located within an industrial district is a cross-level study; and logically higher level district properties should homogeneously influence lower level organisational properties. However, they continue to conceptualise industrial districts as a single, whole unit, although the level of these theories differs and can be placed in the industrial district (as a group) or firms (as individuals).

Table 1 Dimensions of firms' absorptive capacity by Zahra and George (2002).

- Acquisition capacity is defined as the firm's ability to locate, identify, value and acquire external knowledge that is critical to its operations (Lane & Lubatkin, 1998; Zahra & George, 2002).
- Assimilation capacity refers to the firm's capacity to absorb external knowledge. This capacity can also be defined as the processes and routines that allow the new information or knowledge acquired to be analysed, processed, interpreted, understood, internalised and classified (Szulanski, 1996; Zahra & George, 2002).
- Transformation capacity is the firm's capacity to develop and refine the internal routines that facilitate the transfer and combination of previous knowledge with the newly acquired or assimilated knowledge. Its main objective is to establish how to adapt the new knowledge to the reality and needs of the organisation (Zahra & George, 2002).
- Finally, application or exploitation capacity refers to the firm's ability to use new knowledge, for commercial ends, to achieve its objectives (Lane & Lubatkin, 1998). This capacity can also be defined as the organisational capacity based on routines that enable firms to incorporate acquired, assimilated and transformed knowledge into their operations and routines not only to refine, perfect, expand and leverage existing routines, processes, competences and knowledge, but also to create new operations, competences and routines (Zahra & George, 2002).

A significant change is observed when the researcher adopts a cross-level theory approach: the focus is no longer just on the firm (individuals) or the cluster (group), but the firms in the cluster (individuals within the group). In this case, firms located in an industrial district (group members) are regarded as neither homogeneous nor independent of the cluster, but heterogeneous and varying at an intra-district level with respect to the construct of interest. The assumption of heterogeneity forces the level of analysis to be placed in the firms within an industrial district, and therefore the study of the individual attributes of intra-district firms and the cluster average for this attribute must be combined. Previous works have pointed out the specificities of knowledge flows within industrial districts and subsequent heterogeneity of intra-district firms (Camisón, 2004; DeCarolis & Deeds, 1999; McEvily & Zaheer, 1999; Lazerson & Lorenzoni, 1999; Rabellotti & Schmitz, 1999). The new theoretical developments on the knowledge process in firms and industrial districts that have highlighted this level-of-analysis issue come from the Social Capital Approach and the Scandinavian Approach.

Firms are increasingly using different sources of external knowledge to complement their internal knowledge creation activities (Escribano, Fosfuri, & Tribó, 2009; Chen, Lin, & Chang, 2009; Fosfuri & Tribó, 2008; Koka & Prescott, 2002; Zahra & George, 2002), which leads to the coexistence of cooperation and competition relations within the cluster (You & Wilkinson, 1994; Dei Ottati, 1994). These external relationships represent social capital because they are channels through which a variety of capital, information and knowl-

edge is exchanged (e.g., Koka & Prescott, 2002; Tsai, 2000; Tsai & Ghoshal, 1998), by creating learning opportunities for firms and fostering obligations and expectations that are based on norms of reciprocity and equity. Social capital regards firms as social actors, and can be defined as "the sum of resources that accrue to a firm by virtue of possessing a durable network of inter-firm relationships" (Bourdieu & Wacquant, 1992, p. 199). The depth, extent and efficiency of the mutual exchange of knowledge is determined by the use the firm makes of its external relationships in acquiring and exploiting knowledge, and it is regulated by the amount of social capital embedded in these networks. The social capital approach is consistent with the Relational-Based View (Lane & Lubatkin, 1998), which suggests that a firm's competitive advantages derive both from the resources the firm itself owns and from the resources embedded in the dyadic and network relationships with the environment. Knowledge that is accessible through the firm's social network can be viewed as a strategic asset in itself, because the network is path-dependent and, as a result, it is idiosyncratic and difficult to imitate and substitute. Social capital is a matrix of various social relations, combined with particular normative and cognitive social institutions that facilitate cooperation and reciprocity, in which the density of matrices increases with proximity (Lorenzen, 2007). Therefore, this concept can be applied to the cases of firms with knowledge resulting from the spillovers that circulate in industrial district in which they are located.

CBV can also provide a suitable approach from which to take a theoretical assumption of heterogeneity of intra-district firms within a higher level unit, the cluster, in studying the effects on knowledge creation and absorption processes of a firm's integration in an industrial district (Grant, 1991, p. 548). This extension stems from the suggestion by Peteraf (2005) that the RBV is a useful approach with which to explore multi-level linkages and the multi-level nature of capabilities. A competence-based view of competitive advantage naturally links the firm to its market environment and the other players in that environment. The CBV extension to industrial districts is mainly grounded on the Scandinavian Approach. The first works to take this approach were those by Foss and Eriksen (1995) and Foss (1996), which engendered a stream of fruitful literature (e.g., Lorenzen, 1998, 2003, 2007; Maskell et al., 1998; Lawson, 1999; Lawson & Lorenz, 1999; Maskell & Malmberg, 1999; Malmberg, Malmberg, & Lundequist, 2000; Karlsson & Klaesson, 2000; Maskell, 2001a,b; Malmberg & Maskell, 2002; Lorenzen & Foss, 2003; Maskell & Lorenzen, 2004; Lorenzen & Maskell, 2004). From this view, although is assumed that intra-district firms vary with respect to the theory's construct, knowledge-based capabilities, the cluster is deemed to be a meaningful level. Knowledge of cluster context is necessary to interpret an individual firm's position in the district. This literature also highlights the cluster dependence of the firm's knowledge process. A knowledge-based competitive advantage is a function of firm-specific capabilities relative to its competitors. Capability heterogeneity implies that some firms have capabilities that can generate more economic value than others (Peteraf & Barney, 2003a, 2003b). In this vein, for example, a single firm may be a superior performer relative to its extra-cluster competitors, and an inferior performer relative to its intra-district competitors.

Theoretical model and hypotheses

District embeddedness and intra-district shared competences

Shared competences

Shared competences are understood by Foss (1996) as "all intangible, higher-order resources and capacities", as a context of opportunities and restrictions generating superior order capacities by Foss and Eriksen (1995), and by Lorenzen (ed., 1998, p. 143) as a higher-order knowledge base shared by firms located in an industrial district. Intra-district shared competences are a measure of the structural attractiveness of the knowledge spillovers accessible to intra-district firms. Shared competences are common assets inside the district which are not exclusive to one single intra-district firm, so they are a higher level concept than firm-specific capabilities. In addition, Arikan (2008) has developed the concept of a cluster's knowledge creation capacity, which is also based on the stimulating conditions of inter-firm knowledge exchanges within industrial districts. By integrating the Social Capital Approach and the Scandinavian Approach, we define shared competences as consisting of social capital that stimulates the wealth of intra-district knowledge flows, and complementary assets as an institutional framework facilitating support services to organisations. From this theoretical definition, we define intra-district shared competences in industrial districts in terms of two dimensions: external capacity of knowledge creation and transfer, and coordination of collective effort.

External capacity of knowledge creation and transfer

This dimension integrates the knowledge spillovers emerging from a collective, localised learning curve (Lorenzen, 2007, 2003, 1998; Lawson & Lorenz, 1999), and the benchmarking processes with which companies access the knowledge and successful experiences of their neighbours (Camisón, 2004). The first driver is the availability of a rich pool of local qualified human capital, which has acquired the specialised education and experience in institutions and firms located in the territory. Second, knowledge spillovers result from dynamism in the information and knowledge flows about products, processes, technologies, consumers and markets, which circulate informally within the system (Lorenzen & Maskell, 2004). The diffusion of knowledge, essentially tacit, is also intensified by both the strength of non-production-related cooperation relationships, personal contacts between people employed in local organisations (Audretsch & Feldman, 1996; Maskell & Malmberg, 1999; Dahl & Pedersen, 2004), and processes of "cross-pollination" favoured by both the high mobility of local labour among intra-district companies, and local spin-offs. Rich, local diffusion of knowledge is not a simple consequence of geographical proximity. The literature on open innovation concludes that the relevance of inter-personal and inter-organisational networks for knowledge diffusion processes is rooted in the nature of knowledge creation and transfer as a socially embedded process. Therefore the intra-district collaboration model is only possible where a community of people (Grandori, 1999) with strong social links and widely agreed standards of desired behaviour (Lazerson & Lorenzoni, 1999; Becattini, 1979) is deeply

embedded in local traditions (Malmberg & Maskell, 2002; Granovetter, 1985), by way of a cognitive community (Lorenzen & Foss, 2003). This highly permeable and flexible social structure enables firms to extend their skills in exchanging quality knowledge, particularly knowledge with a certain tacit component.

Coordination of collective effort

This dimension reflects the presence of local institutions that provide a host of collective support mechanisms for intra-district firms (McEvily & Zaheer, 1999; You & Wilkinson, 1994). Local institutions such as technological sector institutes can act as intermediaries that play a relevant role in providing intra-district firms with new information and knowledge, and in supporting business innovation (Camisón, 2004; Breschi & Lissoni, 2001). Local institutions like chambers of commerce or universities also provide training and services to coordinate cooperation relationships (Newlands, 2003). The existence of local institutions is especially valuable, as they collaborate in the creation and maintenance of an environment in which constructive types of cooperation and competence — particularly innovative competence — predominate over destructive ways of operating based on price competition (Dei Ottati, 1994; Mistri & Solari, 2001). Collective strategy also includes public institutions (Henry & Pinch, 2001) like regional or industrial development agencies that coordinate the agents located within the industrial district, support business development, and promote the design of a local strategic orientation in the cluster. Finally, there is a process of institutional creation of collective reputation based on communication activities carried out cooperatively by groups of competitors, business associations or public institutions, which can be clearly differentiated from those of competitors outside the agglomeration.

Shared competences include explicit knowledge about customers or suppliers available through extra-nets, business-to-business webs, or sector webs, alongside tacit knowledge about R&D projects developed by intra-district firms in cooperation with technological institutes or universities; human capital turnover among intra-district firms; experience in technologies and processes by consultants, subcontractors or equipment manufacturers; and collective learning process driven by sector leaders or business networks. All this knowledge accumulated in a district is accessible to the intra-district firms, but not available to outsider firms located beyond its boundaries. The literature (e.g., Hall, 1993) has repeatedly emphasised the special value of intangible assets as a source of sustainable competitive advantages, due to the barriers raised to duplication (Rumelt, 1991; Barney, 1991) and to substitution by similar strategic assets (Peteraf, 1993). Barriers to the imitation, appropriation or substitution of shared competences are even greater because they are largely district-specific, idiosyncratic, complex and based on tacit knowledge (Belussi, 1999; Enright, 1998) and unique institutions and multiple links between actors that cannot be reproduced outside the area and greatly restrict their mobility (Porter & Sölvell, 1998). The social mechanisms that govern the relationships inside the district thus allow control of the threat of opportunism from its component parts (Dei Ottati, 1994; Foss & Koch, 1996), by producing savings in surveillance mechanisms, thus freeing up resources that can be used for more extensive communication, and by limiting district-specific knowledge transfer outside its boundaries. In addition, Sölvell and Zander (1998) use the concept of the isolating mechanism in local innovation systems to underline the strategic nature of these collective capacities. In sum, the agents that coordinate the collective effort will offer more opportunities to access that knowledge to firms located inside the district than to competitors located outside. Our first hypothesis is therefore:

Hypothesis 1 (*H1*). There is a positive relationship between a firm's embeddedness in an industrial district and the shared competences accessible within it.

Intra-district shared competences and firms' absorptive capacity

Explicit knowledge may be relatively easy for the firm to absorb through passive efforts such as attending conferences or more active methods such as benchmarking (Lane & Lubatkin, 1998). However, a large proportion of knowledge spillovers might consist of district-specific tacit knowledge flows, which are difficult to codify and to transfer. The existence within an industrial district of a large number of face-to-face links (Tsai & Ghoshal, 1998), their strength or degree of closeness (Brown & Konrad, 2001), and the repetition of the interactions (Triglia, 2001; Maskell and Malmberg, 1999; Kogut & Zander, 1996) increase intra-cluster firms' abilities to evaluate, acquire and assimilate those tacit knowledge spillovers (Cohen & Levinthal, 1990; Dyer & Singh, 1998; Lane & Lubatkin, 1998). The existence of a series of intermediary agents or gatekeepers, such as local institutions that are specialists in acquiring information and knowledge (Brusco, 1982), connected by diverse external networks and knowledge communities, allow the intra-district firms to obtain a reduction in the costs of search and access to these capabilities (Maskell, 2001a; McEvily & Zaheer, 1999). These low costs are translated into a greater capability to value, acquire, interpret and assimilate not only intra-district information and knowledge, but also that deriving from external networks.

In light of the above insights, we put forward the following hypothesis:

Hypothesis 2 (*H2*). Ceteris paribus, the greater the amount of shared competences in an industrial district, the higher the firm's capacity to absorb external knowledge will be.

Intra-district shared competences and firms' internal knowledge creation capacity

The existence of shared competences will stimulate rather than substitute or diminish investment in intra-district firms' own knowledge creation (Harabi, 1995; Veugelers, 1997). Of course, the possibility of a firm's internally generated knowledge being exploited by its closest competitors in the immediate environment may lead it to reduce its investment in R&D and training (Bernstein & Nadiri, 1989) and be detrimental to its internal knowledge generation efforts (Henderson & Cockburn, 1996). But when an intra-district firm cuts back on its efforts to create knowledge internally and concentrates on exploiting the knowledge spillovers that circulate within cluster, it is ignoring the need to supplement this

exploitation with the exploration of new sources of knowledge. The relationships of competition and fierce rivalry between firms, explained by their physical proximity and the similarity of the goods and products they offer, stimulate the continuous internal generation of knowledge and new technologies in firms striving to hold onto their competitive advantage in the market. Thus, firms that do not want to lose their competitive position in the district and hope to take maximum advantage of the knowledge opportunities in their environment must also work to broaden the scope of their knowledge background and develop new routines and structures and a culture that fosters internal knowledge generation (Caloghirou et al., 2004).

The literature on creativity (Milliken & Martins, 1996; Paulus, 2000; Sethi & Park, 2001; Woodman, Sawyer, & Griffin, 1993) postulates that diversity in skills, knowledge and experience among individuals within a context is what matters to innovation, because a heterogeneous population will draw on more varied information sources, and may lead to a wider variety of interpretations, a greater number of alternatives and a superior capacity to solve disparate problems. The assumption of homogeneity prevailing in the canonical view could lead to the belief that within the cluster there is less variety of shared ideas and approaches, fewer opportunities to learn about different perspectives and therefore reduced probability to find more innovative solutions. But this interpretation ignores the fact that intra-district firms are social actors, with a heterogeneous network of inter-firm relationships. The variety of social capital embedded in the networks in which every intra-district firm is involved is other factor explaining the positive effect of cluster location on a firm's internal knowledge creation. The assumption of homogeneity also ignores the fact that the industrial district acts as a "cognitive laboratory" (Bellandi, 1989) or a collective R&D laboratory, open to the development of the new shared mental and organisational models, to learning and experimentation (Maskell & Malmberg, 1999), in which innovation continuously flourishes (Camisón, 2004).

Our third hypothesis is therefore:

Hypothesis 3 (*H3*). Ceteris paribus, the higher the amount of shared competences in an industrial district, the higher the firm's internal knowledge creation capacity will be.

Firms' internal knowledge creation capacity and absorptive capacity

The existence of a set of shared competences in the firm's cluster environment will not be sufficient to ensure that it internalises them satisfactorily. Although the knowledge that firms generate inside industrial districts is not easily protected, this does not mean that knowledge will be automatically acquired by other firms. The identification, acquisition, and above all, implementation of external knowledge are by no means simple processes (Veugelers, 1997), nor are they cost free (Harabi, 1995). The existence of social interaction and supportive local institutions plays a key role in knowledge transfer, especially tacit knowledge, but does not guarantee that the recipient firm will be able to internalise that external knowledge. If external knowledge is to be acquired and assimilated, organisations have to invest time and effort in developing their capabilities for combining it with certain firm-specific capacities and practices to absorb those external competences (Leahy & Neary, 2007;). The cumulative and path dependent process of capacity accumulation is therefore highly specific to each firm, so that even if firms operate in the same macro environment and industry over the same period of time, they may end up with different levels of technological capacities. As absorptive capacity is path dependent (Cohen & Levinthal, 1990), firms should have an internal critical mass of knowledge that allows this new external knowledge to be valued, understood, related to their previous knowledge base, and finally applied (Fabrizio, 2009; Nieto & Quevedo, 2005). Without this previous related knowledge base, intra-district firms will not be able to identify the innovativeness potential of external knowledge for creating competitive advantages, and may even be unaware of the existence of the cooperative knowledge networks. But an intra-district firm's knowledge base is constrained to certain scientific and technological domains (Lane & Lubatkin, 1998). Therefore, it is logical to assume that the effect of shared competences on the development of a firm's absorptive capacity will also be limited and mediated by its knowledge stock.

Specifically, following De Clercq and Dimov (2008), we suggest a variety of mechanisms that explain why a firm's internal knowledge creation capacity in a particular domain will lead it to develop domain-specific absorptive capacity. First, the diversity and depth of the firm's internal knowledge base provide it with different frames of reference, standards, languages and codes, and greater operational flexibility. These advantages give the firm a more comprehensive understanding of the new information it receives, increasing its ability to scan and discover more and better ideas and valuable tacit knowledge in the environment (Chesbrough, 2003), and to access and select external opportunities more efficiently and faster (Cohen & Levinthal, 1990). Second, a larger prior knowledge base facilitates more abstract mapping of the domain of the firm's activity and allows for a higher level of articulation and codification of its knowledge base. These abstract representations lead to improved assimilation and integration of new information into the existing knowledge base (Zollo & Winter, 2002). Third, according to Cohen and Levinthal (1990) knowledge base diversity will augment the organisation's capacity for making new linkages and associations between new external knowledge and pre-existing concepts. Knowledge developed internally therefore enhances the firm's ability to incorporate additional knowledge into its internal processes and apply it for commercial ends through its incorporation into the firm's operations (Zahra & George, 2002).

In light of the above, we can state that firm's internal knowledge creation capacity is required to acquire, assimilate, transform knowledge from outside the boundaries of a firm and apply it to innovation. Therefore, our hypothesis is as follows:

Hypothesis 4 (*H4*). The greater the firm's internal knowledge creation capacity, the higher its capacity to absorb external knowledge will be.

As in Chen (2004), we introduced as control variables two internal factors, organisational size and firm age, and one external factor, the industry to which the firm belongs.

Organisational size has been used as a control variable in many studies on absorptive capacity. Some of these studies (e.g. Cohen & Levinthal, 1989) consider that larger firms acquire less external knowledge than smaller firms because they have more resources with which to develop knowledge internally. Furthermore, larger firms tend to be more bureaucratic, which is also an obstacle to the external acquisition of knowledge (Liao, Welsch, & Stoica, 2003). However, authors such as Autio, Sapienza, & Almeida (2000) find that larger firms have more resources to devote to the acquisition and use of external knowledge. Firm age is also a variable that has been extensively studied in the literature. Some researchers report that older firms tend to be more autonomous, and less reliant on external knowledge (Foss & Pedersen, 2002). Authors such as Tushman and Romanelli (1985) suggest that over time, decision-making processes become routine and behaviour patterns more rigid, resulting in a drop in the diversity of information that the firm acquires. But as in the case of size, some empirical studies indicate that older firms have a larger experience base (Rao & Drazin, 2002), and a greater reputation (Zaheer & Bell, 2005) with which to improve routines, systems and structures to acquire new knowledge (Sorensen & Stuart, 2000). Because knowledge acquisition processes vary from one sector to another (Lane & Lubatkin, 1998), we introduced the industry variable to control for its effects. Fig. 1 presents the complete model.

Data, measurement and methods

Data set

The fallacy of the wrong level also can produce problems when methodological and/or statistical analyses are incongruent with the level of theory (Klein et al., 1994; Rousseau, 1985).

The level of measurement describes the unit to which data are attached. It is important that data collection ensures the conformity of the data with our theory level specification (Klein et al., 1994, p. 209). Because we wish to test theory in a cross level that predicts individuals' within-group heterogeneity (which can also be heterogeneous), we collect data across a number of clusters (groups) and samples of firms (individuals) that belong to and are outside these industrial districts. The heterogeneity of the data within groups and among groups is thus ensured. We also use measures for the constructs of interest that (like the theory) highlight both the position of each firm relative to the cluster (by evaluating their firm-specific capabilities relative to competitors), and a single score representing each cluster as a whole. Our survey instrument and sample enable data collection across heterogeneous organisations within and outside different clusters.

The population selected to test the hypothesis from our theoretical model covered all Spanish industrial firms. The Spanish industry continues to specialise in sectors with medium-low technological content and manufacture of final consumer goods. The dominant market structure is characterised by a reduced mean size of plants and a significant proportion of small and medium size firms. The capital structure reveals a high participation of family-owned firms and the frequent coincidence of ownership and management. Production organization typically has a low degree of integration and a high use of subcontracting. The notable production decentralisation is related to the pattern of geographical location concentrated in few regions. Spanish industrial firms have a marked trend towards location in environments with a production system specialised in the same activity or in a technologically connected activity, which have largely arisen spontaneously from the industrial development processes in each region. This decentralisation

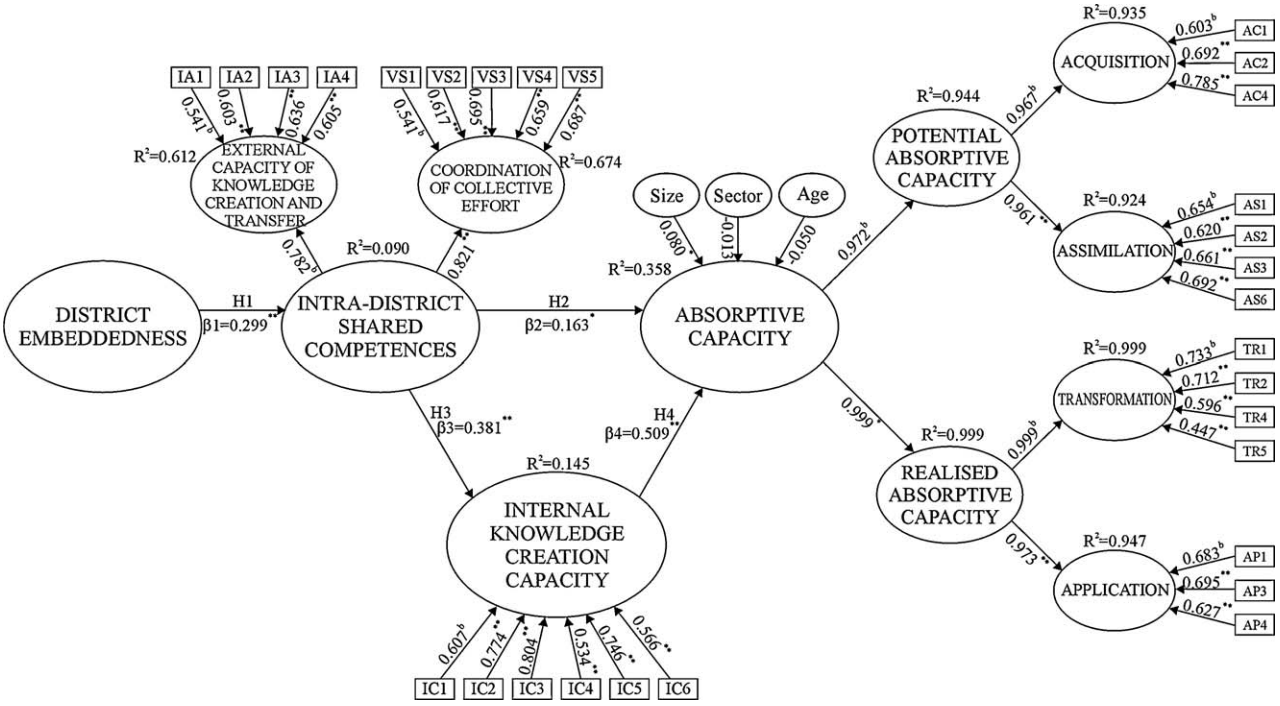

Fig. 1 Theoretical Model[a]. χ^2 = 517,486; d.f. = 477; BB-NNFI = 0.986; CFI = 0.988; IFI = 0.988; NC = 1.085; RMSEA = 0.015. [a]See annexes for a full description of the items. [b]Parameter equal to one to determine the scale of the latent construct. $^{*}p < .05$; $^{**}p < .01$.

has led to a location pattern organised on the basis of local production systems, with strong specialisation and complementarity among the firms. Costa (1993) identified 23 local productive systems with these characteristics. A decade later, Camisón (2004) delimited 35 Spanish industrial districts across the whole country, although with a greater weight in the Valencian Community, Catalonia and to a lesser extent, Andalusia and Madrid.

To observe differences between clusters, we adopted the list of 35 industrial districts delimited by Camisón (2004) to identify Spanish industrial districts. The sample includes cases from seven Spanish regions (Valencian Community, Balearic Islands, Andalusia, Murcia, Galicia, Catalonia and Madrid). The principal activity of these industrial districts includes footwear, leather products, toys, food, clothing and textiles, knitwear, furniture, machine tools and machinery, tiles, software, aeronautical and car components, ship components, metal carpentry, marble, glass, carpets and ceramics. A total of 735 firms from the sample (77.2%) are located within an industrial district, with an average number of firms for each cluster of 21.

To measure the differences between firms inside and outside these industrial districts, we use a data set covering the whole of Spain that includes the complete set of Spanish industrial firms registered in the Spanish National Statistics Institute's Central Company Directory. We set the initial sample size at 2,000 firms to guarantee a maximum margin of error of ± 2.2 with a confidence interval of 95.5%. We selected units on the basis of stratified random sampling, focusing on industry and firm size. The population was classified into 14 industries according to 3-digit SIC codes, and into four size groups according to the European Union's definition of micro, small, medium and large firms (the number of employees <10, 10—49, 50—249, and ≥ 250, respectively). We used the optimal sample allocation procedure in each group, and simple random sampling to select cases until the allocated size was reached. We also ensured a minimum sample of 20 observations for every industrial district, by substituting extra-cluster firms for other intra-cluster companies with similar industry and size characteristics. The average size of the companies surveyed was 301 workers, with average sales of €22.87 million. Microfirms made up 15.8% of the sample, while 47.3% were small firms, 22.6% medium firms and 14.4% large companies. The final sample included firms from all industries, with the exception of the energy sector.

The information was gathered through self-administered electronic questionnaires, following a set of procedures for the electronic survey technique from Simsek and Veiga (2000). We used a webpage-based instrument for data collection, following Stanton and Rogelberg's (2001) recommendations to avoid technological pitfalls; data collection took place between February and May 2007. The questionnaire was sent by e-mail to the sample firms' President, Chairperson, or CEO, in line with common practice in the research on the topic (e.g., García-Morales, Ruiz-Moreno, & Llorens-Montes, 2007), taking necessary measures to ensure respondent anonymity and data security. The questionnaire was sent out twice, and was followed up with a phone call to non-respondents. A total of 952 firms returned usable and fully completed responses, giving a response rate of 47.6%. The questionnaire consisted of six sections and 127 questions. All the information refers to December 2006.

The possible existence of non-response bias was explored with a time trend extrapolation test (Armstrong & Overton, 1977). This test operates under the assumption that "early" and "late" respondents are not significantly different. No significant differences in explanatory or dependent variables were detected from the t tests ($p > .05$), suggesting an absence of non-response bias in terms of firm characteristics.

To test the validity of both the research findings and the measurement instruments included in the questionnaire, we performed a methodological triangulation exercise by combining different methods (Creswell, 2003). The triangulation method enhances the credibility of results (Brewer & Hunter, 1989) while reducing the risk of observations that reflect some artefact or bias inherent in any single method. We combined elements from qualitative study and quantitative survey methods. Qualitative inquiry prior to the distribution of surveys (Jick, 1979) was administrated through a pre-test of the questionnaire in 14 firms randomly selected from the survey sample. The purpose of the pre-test was to ensure that the statements were unambiguous and to collect suggestions about their design.

Following the quantitative survey, a qualitative inquiry was undertaken through a personal interview with 36 chairpersons or CEOs, in which the answers initially included in the questionnaire were tested, and were also supported through direct observation and an analysis of the firms' internal documents. These case studies demonstrated the validity of the responses to the quantitative survey, and showed that the questionnaires had been answered by the person to whom they were addressed.

We also ensured the fit between the theory level specification and the level of statistical analysis. With this purpose, we examined the conformity of the data to the theory's prediction of heterogeneity, by controlling for between-cluster differences and between intra-cluster firms.

Statistical techniques

We used a two-stage structural equation model (SEM) to test the theoretical model (Anderson & Gerbing, 1982; Hair, Andersson, Tatham, & Black, 1998). In the first stage, we developed a measurement model and performed confirmatory factor analyses (CFA) to demonstrate the model's psychometric properties of reliability, validity and dimensionality (Bagozzi, 1981). In the second stage, we tested the hypotheses through covariance structure models. We used the EQS 6.1 (Bentler, 1995) to estimate structural models, and the maximum likelihood method with robust estimators to estimate the parameters to alleviate the requirements of normality.

Measurement of the variables

The Appendix presents the description of the items for measuring both the exogenous and endogenous variables of the theoretical model. The exogenous variable *district embeddedness* was measured as a dichotomous variable according to whether or not the firm was located in an industrial district. To measure the firm's embeddedness in an industrial district, we first defined the potential clusters in which a firm can be located. In the field work, the sample firms were provided with this list to determine which industrial district they belong to.

The three endogenous variables are latent constructs that were measured by 5-point Likert-type self-evaluation scales, reflecting managers' perception of the endowment of shared competences in their industrial district (1—"very low", 3—"average", and 5 "very high"), and the firm's strength as compared to its industry competitors (1—"much worse than our competitors", 3—"on a par with our competitors", and 5—"much better than our competitors") for each of the attributes of the firm's internal knowledge creation capacity and its absorptive capacity. To avoid the risk that respondents' answers might not be independent if all questions for the same dimension of a construct were presented in related sections, we randomised question presentation in the questionnaire by mixing the items. The "robot effect" in responses was avoided by a control process that consisted of formulating certain items inversely (see Appendix A).

We opted to use management self-assessment, which permits the transfer of judgment, knowledge, and experience of key individuals to a linguistic multi-item scale. Managerial self-evaluations have precedence in measuring firms' resources and capacities (e.g., Camisón & Forés, 2009; Prieto et al., 2009), and the structural characteristics of the environment in which they are located (e.g. Camisón, 2004), since various studies have found that they are convergent measures with equivalent objective indicators (e.g. Camisón, 2005). Furthermore, in order to reduce the potential problem of autocorrelation we placed dependent variables after independent variables in the questionnaire (Williams, Cote, & Buckley, 1989). We also verified the convergent validity of the subjective measures from self-evaluation with objective measures both internal and exogenous to the firm (details in Section 5).

Intra-district shared competences

From the theoretical definition given above, we define *intra-district shared competences* as a second-order latent construct, made up of two dimensions or first-order factors: external capacity of knowledge creation and transfer, and coordination of collective effort. The final scale to measure shared competences in industrial districts includes 11 items from Camisón's (2004) scale, and is presented in Appendix A, Section I. The variable was evaluated from managers' perception of the endowment of shared competences in the industrial district in which the firm is located.

Firms' internal knowledge creation capacity

In spite of the extensive literature on firms' internal knowledge creation capacity, the lack of consensus surrounding this construct has not spawned sufficient debate about its measurement (Easterby-Smith, Crossan, & Nicolini, 2000). Most of these studies measure firms' internal learning capacity through R&D spending. The excessive focus on the analysis of R&D makes it impossible to move forward in the study of this capacity for the internal development of knowledge in firms where R&D is less evident (as in the case of SMEs) or less intensive (as in low-tech industrial sectors). Following the theoretical definition included previously in this paper, we define firms' *internal knowledge creation capacity* as a unidimensional multi-item scale, following García-Morales et al. (2007). The six items comprising the scale are the result of a thorough review of the literature (e.g. Camisón, 2005, 2004; Templeton, Lewis, & Snyder, 2002; Lähteenmäki, Toivonen, & Mattila, 1999; Goh & Richards, 1997), in which additional efforts were made to select aspects related to the learning and creation of knowledge, and the discovery of new solutions within the firm. Specifically, these attributes gather managers' and employees' commitment to change and learning, firms' abilities to develop an innovation culture, an organisational design open to learning, and investment in R&D (Appendix A, Section II).

Firms' absorptive capacity

In their respective reviews of the absorptive capacity concept, Volberda et al. (2010) and Lane, Koka, and Pathak (2006) state that empirical research on absorptive capacity has been hindered by the lack of a clear definition and operationalisation of the construct, which in turn has resulted in inconsistent findings (Matusik & Heeley, 2005). Whereas some studies have employed multiple-indicator scales to measure this construct (Szulanski, 1996; Lane & Lubatkin, 1998; Lane, Salk, & Lyles, 2001), most research uses proxy variables related to firms' R&D activity that do not fully capture the richness and multidimensional nature of the construct. We start by conceptualising the construct in line with Zahra and George's (2002) theoretical definition, and develop a scale to capture the richness of the construct by considering *absorptive capacity* as a third-order latent construct formed by two dimensions of potential absorptive capacity and realised absorptive capacity, which in turn are second-order factors consisting of two sub-dimensions. The final scale to measure firms' *absorptive capacity* includes 19 items from the Camisón and Forés (2009) scale, and is presented in Appendix A, Section III.

Control variables

Size was measured by a continuous scale using the number of employees in the firm. *Industry* was measured by the Standard Industry Classification (SIC) codes, identified from 18 industrial sectors with SIC 2 digits. *Age* was measured by the number of years since the firm's creation and computed by the difference between the year the data is based on, 2006, and the year the firm first entered the industry.

Table 2 presents the descriptive statistics and correlations of the study variables.

Results

Measurement model

To develop the measurement model, we ran a joint confirmatory factor analysis for all latent factors (see Table 3). This analysis resulted in certain modifications to the initial model in order to achieve a good fit; namely, items EC5 and CC6 from the initial scale of intra-district shared competences and AC3, AS4, AS5, TR3 and AP2 from the initial scale of absorptive capacity were eliminated following LMTEST recommendations.

To test the dimensionality of the constructs, we studied the goodness of fit of the factor measurement model on the basis of the estimation technique proposed by Hair et al. (1998). Table 3 summarises results, including the internal consistency or reliability measures (conjoint reliability index). All index fits show good statistics. Moreover, the

Table 2 Means, standard deviations and correlations among study variables.

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1	District embeddedness	0.772	0.294	1.00											
2	Intra-district Shared competences	2.928	0.574	0.251**	1.00										
3	Industrial atmosphere	2.912	0.631	0.227**	0.842**	1.00									
4	Value system	2.943	0.705	0.205**	0.876**	0.476**	1.00								
5	Internal knowledge creation capacity	3.489	0.561	0.101*	0.368**	0.287**	0.342**	1.00							
6	Absorptive capacity	3.216	0.603	0.141**	0.283**	0.157**	0.320**	0.565**	1.00						
7	Potential absorptive capacity	3.186	0.637	0.148**	0.255**	0.129**	0.300**	0.526**	0.945**	1.00					
8	Realised absorptive capacity	3.246	0.639	0.119*	0.280**	0.168**	0.305**	0.542**	0.945**	0.786**	1.00				
9	Acquisition capacity	3.142	0.712	0.137**	0.302**	0.158**	0.351**	0.438**	0.866**	0.908**	0.729**	1.00			
10	Assimilation capacity	3.231	0.695	0.132**	0.158**	0.075	0.190**	0.516**	0.845**	0.903**	0.694**	0.641**	1.00		
11	Transformation capacity	3.256	0.660	0.118*	0.295**	0.173**	0.325**	0.590**	0.866**	0.730**	0.906**	0.655**	0.667**	1.00	
12	Application capacity	3.236	0.736	0.100*	0.222**	0.137**	0.239**	0.412**	0.866**	0.710**	0.925**	0.678**	0.608**	0.676**	1.00

* $p < 0.05$.
** $p < 0.01$.

standardised factor loadings of each indicator are positive in the factor to which they have been theoretically assigned (with null weightings in other factors), and exceed the minimum value of 0.50 (Hair et al., 1998) for all except one item (TR5 = 0.434, Table 3), which came very close to the minimum level; we therefore decided not to eliminate it so as not to weaken the definition of the construct domain, and their measurement errors are not correlated. The values of the estimated parameters are also statistically significant ($t \geq 1.96$; $\alpha = 0.05$) (Anderson & Gerbing, 1982). The reliability measures of latent constructs (conjoint reliability index) also meet the statistical threshold of 0.60 in exploratory research (Churchill, 1979) (see Table 3). We used the R^2 statistic (Hair et al., 1998) to estimate the reliability of the individual items.

We evaluated discriminant validity from the correlations matrix between each dimension of the model. The correlations between the dimensions of the same construct were greater than the correlations with the dimensions of other constructs, confirming the discriminant validity of the model (see Table 2). We also performed a complementary assessment of discriminant validity with chi-square difference tests on the values obtained to an unconstrained model (i.e. a model where the factor correlations are not constrained to unity) and a constrained model (Anderson & Gerbing, 1988). The results, presented in Table 4, show significant differences between the chi-square values obtained for the dimensions of intra-district shared competences and the dimensions and sub-dimensions of absorptive capacity constructs, indicating that these constructs are not perfectly correlated and, while they do measure some commonalities, each dimension measures a unique aspect on its own.

Finally, we evaluated both concurrent and predictive criterion validities (Bollen, 1989). Concurrent validity was tested by verifying whether the measurement of capacities based on managers' perceptions was convergent with the objective measurement based on quantitative data. The comparison was made for four items: (1) AP4, which was correlated with the number of patents; (2) TR2, correlated with the number of information technology-based innovations introduced by the firm; (3) AC2, correlated with the number of technological cooperation agreements established by the firm; and (4) AS5, correlated with the percentage of firm personnel involved in external knowledge-based activities. The Pearson's correlation coefficients were positive (0.45, 0.34, 0.37, and 0.30, respectively) and statistically significant ($p < 0.01$). The predictive validity, following the CBV's identification of capacities as basic sources of economic rents, was tested by the correlation between the absorptive capacity scale and organisational performance. We measured performance by ROA from the 2007 annual accounts compiled in the Iberian Balance Sheet Analysis System (SABI) database. The results indicated positive correlations ($p < 0.001$) between ROA and both PACAP ($r = 0.55$) and RACAP ($r = 0.49$).

Structural model

The hypotheses were jointly assessed by the structural model (Fig. 1). The model was correctly identified and can be properly estimated. It is over-identified (degrees of freedom > 0) and has adequate fit indexes (BB-NNFI = 0.986,

Table 3 Confirmatory Factor Analysis of the construct measurement model[a].

Factors	Standardised factor loadings	*t*-values[c]	R^2	Conjoint reliability
Intra-district shared competences				0.683
External capacity of knowledge creation and transfer	0.832[b]		0.692	0.640
EC1	0.550[b]		0.302	
EC2	0.591	7.715	0.350	
EC3	0.647	7.834	0.418	
EC4	0.593	6.515	0.352	
Coordination of collective effort	0.769	5.596	0.591	0.728
CC1	0.535[b]		0.286	
CC	0.613	7.773	0.376	
CC	0.698	8.073	0.487	
CC4	0.659	8.280	0.434	
CC5	0.684	8.310	0.468	
Internal knowledge creation capacity				0.789
IK1	0.588[b]		0.346	
IK2	0.792	21.858	0.627	
IK3	0.825	21.281	0.681	
IK4	0.519	10.177	0.270	
IK5	0.750	24.474	0.563	
IK6	0.521	10.521	0.272	
Absorptive capacity				0.943
Potential absorptive capacity	0.972[b]		0.944	0.875
Realised absorptive capacity	0.999	3.513	0.998	0.944
Acquisition capacity	0.970[b]		0.941	0.669
AC1	0.600[b]		0.360	
AC2	0.696	29.870	0.485	
AC4	0.791	24.104	0.625	
Assimilation capacity	0.958	4.838	0.917	0.740
AS1	0.656[b]		0.431	
AS2	0.623	14.206	0.388	
AS3	0.665	17.720	0.442	
AS6	0.694	22.143	0.482	
Transformation capacity	0.999[b]		0.999	0.668
TR1	0.736[b]		0.542	
TR2	0.721	11.844	0.520	
TR4	0.582	8.803	0.339	
TR5	0.434	7.541	0.188	
Application capacity	0.986	15.953	0.972	0.643
AP1	0.687[b]		0.472	
AP3	0.695	11.090	0.483	
AP4	0.632	12.160	0.399	

Goodness of fit indexes[d]

RMSEA	Below 0.08	0.026
IFI Fit Index	Up to 0.9	0.972
CFI Fit Index	Up to 0.9	0.972
BB-NNFI Fit Index	Close to 0.9	0.968
Normed Chi Square	Between 1 and 5	1.242

[a] See annexes for a full description of the items.
[b] Parameter equal to one to determine the scale of the latent construct.
[c] The *t* values over 1.645 are significant at a level of 5% (one tail).
[d] RMSEA: Root Mean Square Error of Approximation index; IFI: Incremental Fit Index; CFI: Comparative Fit Index; BB-NNFI: Bentler-Bonnett Non Normed Fit Index; NC: Normed Chi-Squared.

CFI = 0.988, IFI = 0.988, NC = 1.085, RMSEA = 0.015). All the parameters were significant at the 0.05 level, the factor loadings were greater than 0.50 for all except one item (TR5 = 0.447, Fig. 1), and the composite reliabilities exceeded 0.60. The measurement model therefore fits the data with reliable and valid measurement indicators. The hypothesised model explained 36% of the variance in firms' absorptive capacity (R^2 = 0.358).

Our first hypothesis predicted that district embeddedness would be positively associated with intra-district shared

Table 4 Discriminant validity of the constructs.

Variable	Model	X^2	df	$\Delta\chi^2$
Shared competences	1. Unconstrained model	47.114	24	–
	2. External capacity of knowledge creation and transfer – coordination of collective effort	93.148	25	46.034**
Potential absorptive capacity	1. Unconstrained model	18.441	13	–
	2. Acquisition - assimilation	91.313	14	72.872**
Realised absorptive capacity	1. Unconstrained model	18.734	13	–
	2. Transformation - application	87.733	14	68.999**
Absorptive capacity	1. Unconstrained model	106.267	72	–
	2. Potential absorptive capacity – realised absorptive capacity	163.161	73	56.894**

Notes: $\Delta\chi^2 = \chi^2$ (unconstrained model) $- \chi^2$ (constrained model).
** *p-value* < 0.01 level. A-B implies that constructs A and B are set to be completely correlated.

competences. The structural model confirms the existence of a direct, positive and statistically significant relationship between the two constructs ($\beta_1 = 0.299$, $p < 0.01$) (Hypothesis 1).

The second hypothesis, which predicted a positive, direct relationship between the shared competences in an industrial district and firms' external knowledge absorptive capacity, was also shown to be positive. In the structural equation of the relationship model we obtained a positive and statistically significant coefficient ($\beta = 0.163$, $p < 0.05$) (Hypothesis 2).

Our third hypothesis suggested that the greater the amount of shared competences in an industrial district, the higher the firm's capacity to develop knowledge internally would be. The structural model confirms the existence of a direct, positive and statistically significant relationship between the two constructs ($\beta = 0.381$, $p < 0.01$) (Hypothesis 3).

Focusing on the internal aspects of the company, the fourth hypothesis suggested that firms with a greater capacity for internal knowledge creation would have a higher capacity to absorb external knowledge. The results confirm this hypothesis, as they indicate a direct, positive and statistically significant relationship between the two constructs ($\beta = 0.509$, $p < 0.01$) (Hypothesis 4).

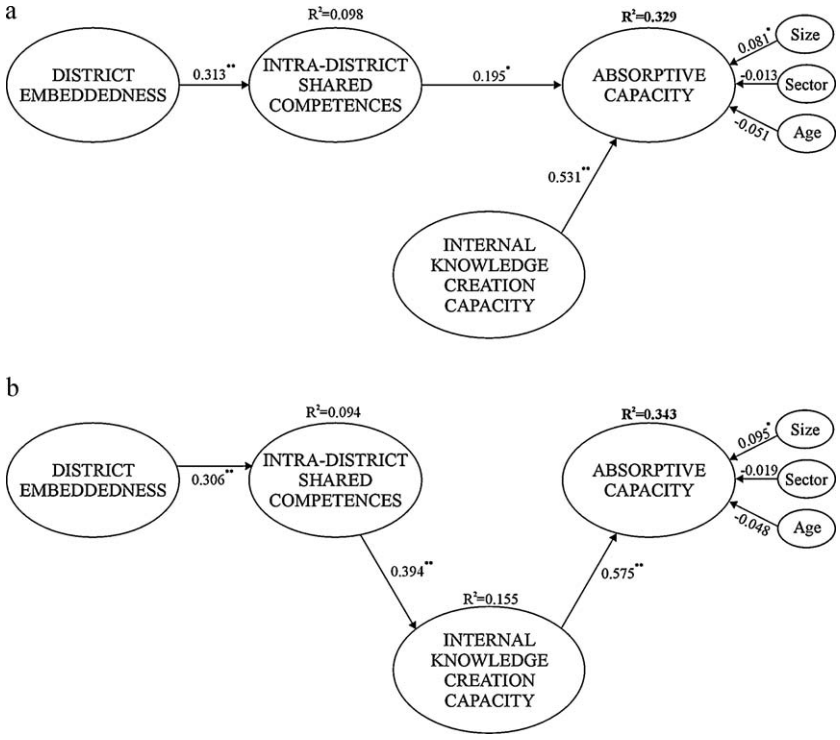

Fig. 2 Alternative Models. Model 1: No relationship between intra-district shared competences and firms' internal knowledge creation capacity. $\chi^2 = 538.393$; d.f. = 478; BB-NNFI = 0.980; CFI = 0.982; IFI = 0.982; NC = 1.126; RMSEA = 0.019. $^{*}p < .05$; $^{**}p < .01$. Model 2: No relationship between intra-district shared competences and firms' absorptive capacity. $\chi^2 = 528.552$; d.f. = 478; BB-NNFI = 0.983; CFI = 0.985; IFI = 0.985; NC = 1.106; RMSEA = 0.017. $^{*}p < .05$; $^{**}p < .01$.

The control variables age and industry did not significantly affect absorptive capacity ($p > 0.05$), but size had a positive effect, albeit with a relatively low path coefficient (0.080, $p < 0.05$). Our results support the view that larger firms are likely to have greater absorptive capacity, as previous studies indicate (e.g., Autio et al., 2000), since they have more resources with which to develop their knowledge bases and to more quickly recognise the value of novel external knowledge and pursue productive opportunities in-house (Cohen & Levinthal, 1990). We controlled for industry because exchange processes, knowledge acquisition, and relationship outcomes are expected to vary by industry (Lane & Lubatkin, 1998). However, our finding that industry does not have a significant influence on absorptive capacity is not without precedence (e.g. Chen, 2004). Like industry, the finding on age may reflect an inconclusive relationship with absorptive capacity (Sorensen & Stuart, 2000).

Alternative model evaluation

The hypothesised model (Fig. 1) is a fully mediated model. Following the recommendations for the evaluation of causal models in management research, we conducted additional analyses to test the validity of a non-mediated model (Model 1, Fig. 2) and a partially mediated model (Model 2, Fig. 2).

Both Model 1, Fig. 2 (NNFI = 0.980; CFI = 0.982, IFI = 0.982, NC = 1.126, RMSEA = 0.019) and Model 2, Fig. 2 (NNFI = 0.983; CFI = 0.985, IFI = 0.985, NC = 1.106, RMSEA = 0.017) fit the data well. Further chi-squares in Model 1, Fig. 2 ($\Delta\chi^2 = 20.907$, $p < .001$) and Model 2, Fig. 2 ($\Delta\chi^2 = 11.066$, $p < .001$) increased with respect to Model 1, Fig. 1, and differences are significant at the 0.001 level, confirming that the hypothesised model represented a better fit than the alternative models.

Discussion

Research on the effect of location in an industrial district and the stock of shared competences as triggers of the intra-district firms' knowledge accumulation process is scarce. This paper contributes to the discussion of absorptive capacity from a cross-level approach by developing an integrative model that identifies two multilevel antecedents of absorptive capacity: shared competences, as inter-organisational flows of learning embedded in the specific context of industrial districts, and firms' internal capacity to develop a continuous learning system. Our research extends the previous theoretical framework by studying in depth the relationships between district-level and firm-level capacities that have not been sufficiently explored in the literature.

This study follows the line established by Camisón (2004), by distinguishing two levels of strategic assets: corporate competences and shared competences. Our first contribution is to provide a theoretically based concept of shared competences accumulated in an industrial district, differentiated from firm-specific, knowledge-based capacities, which has been successfully tested through confirmatory factor analysis. Shared competences are defined as a dense matrix of social relationships, combined with local institutions that facilitate cooperation and reciprocity, stimulating the wealth of intra-district knowledge flows.

Industrial districts are environments defined by localised knowledge spillovers to which intra-cluster firms can access. The strong, stable, long-term inter-personnel and inter-organisational relationships, the density in networks of information and knowledge exchange, the support role of local institutions, the stock of human capital with a high inter-firm turnover, and a social structure that shares a value system, create a common space with a great force towards homogeneity. However, this canonical definition of industrial district does not fit with previous empirical evidence, which reveals a strong heterogeneity of intra-district firms (e.g., Camisón, 2004; DeCarolis & Deeds, 1999; McEvily & Zaheer, 1999; Lazerson & Lorenzoni, 1999; Rabellotti & Schmitz, 1999). Our research reconfirms intra-district heterogeneity, and also highlights an indirect relationship between embeddedness in an industrial district and the firm's absorptive capacity, through the mediating effect of intra-district shared competences. The absence of a direct effect of a firm's embeddedness in an industrial district on its absorptive capacity appears to belie the strong belief rooted in canonical literature (e.g., Boari & Lipparini, 1999; Harabi, 1995) which perceives that the knowledge flows circulating within a cluster can be automatically acquired and applied by all firms embedded in it. An organisation will not benefit from localised knowledge spillovers if it is not embedded in the inter-personnel and inter-organisational networks that enhance access to the pool of shared competences. In other words, firms located in an industrial district should be active players in the system dynamic if they want to access the collective assets that the local community possesses.

Neither does the traditional definition fit with the Scandinavian Approach notion of the industrial district, based on the assumption of heterogeneity. This perspective continues to see the cluster as a context that must be considered when interpreting an individual firm's position in the district and vis-à-vis competitors. But the Scandinavian Approach also highlights the cluster dependence of the firm's knowledge process, because the intra-district shared competences do not secure the firm's competitive advantage deriving from location within the district. The shared competences and the localised learning and knowledge transfer processes are accessible only to firms embedded in the industrial district. The sustainability of knowledge-based competitive advantages, insistently repeated by the CBV in terms of individual firms, can now be extended to the ambit of the district. The barriers to the imitation, appropriation or substitution of idiosyncratic shared competences are based on a pattern of human capital development, learning and knowledge flows, traditional routines, business practices, unique institutions and multiple links between actors, which cannot be reproduced outside the area and greatly restrict their mobility. Therefore, shared competences can be the basis for a cluster-based competitive advantage over other clusters and other firms located outside the cluster. But shared competences are embedded in the intra-district processes, networks and institutions, and they are not the legal property of any particular firm. Consequently, the generation of firm-specific competitive advantages requires complementarity between cluster-based and firm-specific capabilities. The acquisition and subsequent use of external knowledge is neither easy nor free of charge, and only when firms develop a critical mass

of know-how internally will they be able to take advantage of the pool of external technological opportunities and spillovers. Intra-district firms must also develop their capacity for internal learning by making use of the advantages for innovation that industrial districts offer.

Competitive asymmetries between firms within the district will derive more from their different patterns of appropriation of shared competences, which are connected with their heterogeneous firm-specific capacities, as some previous papers have predicted but without providing empirical evidence (e.g., Camisón, 2004; Malmberg & Maskell, 2002; Lawson, 1999; Foss, 1996). The endowment of shared competences in industrial districts has a direct influence on the intra-district firms' capacity to absorb external knowledge, but this direct effect is lower than the indirect effect mediated by firms' internal knowledge creation capacity. This finding coincides with the notion of absorptive capacity introduced by Cohen and Levinthal (1990), highlighting the importance of a previous knowledge base to enable the effective absorption and use of external knowledge spillovers.

Our research also shows that the relationships of collaboration, together with the flows of tacit, codified knowledge and the support of local institutions that integrate the shared competences of an industrial district, stimulate the capacity to create internal knowledge among the firms located inside it. This empirical evidence sheds light on the question of whether flows of external knowledge substitute rather than complement those generated internally, reducing support for the hypothesis that shared competences may be detrimental to firms' internal knowledge and instead, strengthening the argument that they help intra-district firms to develop their internal learning capability (Maskell & Malmberg, 1999). The absence of a direct effect of the firm's embeddedness in an industrial district on its internal knowledge creation capacity reinforces this argument by showing that the richer a district is in knowledge spillovers, the greater the benefit firms obtain through internal learning in the intra-district firm.

Our research results make an interesting contribution to the discussion opened up by scholars who claim that the industrial district model is a dated concept in the global interconnected world, or who have doubts about the strength of intra-district knowledge flows (e.g., Ferreira & Serra, 2009). The clusters we have studied are local learning and collective knowledge creation laboratories, and these learning processes and intra-district knowledge flows determine the endowment of higher-order capacities shared by firms located in an industrial district (Arikan, 2008; Lorenzen, 1998; Foss, 1996). These localised knowledge spillovers can offer a good basis for intra-district firms' competitive advantages derived from knowledge-based capabilities. The pressure derived from some environmental changes has stimulated ways of conceptualising innovation based on external knowledge absorptive capacity (Cohen & Levinthal, 1990) or open innovation schemes (Chesbrough, 2003), which fit better with the cluster model than with the Chandlerian model, for which successful innovation requires control and firms must be highly self-reliant in internal knowledge development.

The results of the study also have interesting implications for managers. Simply being located inside an industrial district, however rich its knowledge flows or dense its network of contacts and support institutions, might not help to assimilate this shared knowledge. Firms must strive to reinforce their internal learning capacity by taking advantage of the opportunities that this common space offers on an exclusive basis. Only when this critical mass of knowledge has been accumulated will an intra-district firm take maximum advantage of the acquisition, internalisation and application of the external knowledge circulating inside the district. In other words, firms' capacity for internal knowledge creation and their capacity to absorb external knowledge are complementary, and an exceptional wealth of potential for assimilating external knowledge should not detract firms from investing internally in R&D and in striving to build a culture that favours change and innovation.

This study has a number of limitations that might also constitute opportunities for future research. First, the responses are based on self-evaluation from a single respondent, in this case the firm's managers, which may cause problems of internal validity, although we have tried to minimise the risk of bias. Second, the research was conducted using a sample of Spanish firms, and as such, we should be cautious about generalising from the results. The specific features of the Spanish industrial context could affect the usability of our findings in future research in other societal contexts. These particular characteristics include an historical tradition of clustered industries, a strong territorial dependence and embeddedness of industrial districts that has led to close involvement of public organisations and other regional institutions (e.g., universities, technological institutes) in collective efforts to develop cluster competitiveness, and a specialisation pattern of clusters in low/medium technology-based manufacturing, Only by extending this research to other countries could we learn whether the results are biased and the findings generalisable. Finally, the data used in this study are cross-sectional. Considering the dynamism of the proposed model, an interesting avenue for further research would be to test the stability of the empirical evidence obtained by working with longitudinal data. Although the approach used reduces this problem by means of measurement scales with items that reflect dynamic characteristics, our results should be interpreted as an association between variables and not in terms of causality. Moreover, the division of organisational learning into different external and internal processes is more pedagogic than structural. With longitudinal data we can study the possible recursive relationship between firms' organisational knowledge creation and absorptive capacity (Autio et al., 2000; Cohen & Levinthal, 1990; Veugelers, 1997). Thus, through longitudinal research we can make a systematic study of the determinants, processes and outcomes of a firm's knowledge creation and absorptive capacity (Volberda et al., 2010).

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Appendix A

A.1. Section I. Intra-district shared competences

When responding to the following items, consider the endowment of shared competences present in the industrial district in which your firm is located (see attached list of Spanish industrial districts). Evaluate each item on a scale from 1 to 5 where 1 is very low, 3 average, and 5 is very high.

Item	Description
External capacity of knowledge creation and transfer	
EC1	The firm's human capital has acquired its statutory and / or continuing education in local educational institutions or companies located in the industrial district (local education and experience of human capital)
EC2	Availability of a rich pool of qualified and specialised human capital in the industrial district (local pool of human capital)
EC3	There is a model or pattern of relationships for the informal transmission of innovations and knowledge within the local territorial environment that cannot be reproduced outside the area (local diffusion of innovations)
EC4	When designing its strategy and internal organisational relationships, the firm benefits from the successful experiences of neighbouring firms in the industrial district (permeability of the economic and social structure)
EC5	The firm can easily establish nonproduction-related cooperation agreements within the district with suppliers, competitors, and customers that are difficult to reproduce outside it (easily of local cooperation) †
Coordination of collective effort	
CC1	Availability of support services to obtain information and knowledge for firms located within the industrial district in which the firm is based (collective information and knowledge services)
CC2	Availability of support services for R&D (technological institutes or universities, R&D centres, etc.) and employee training in new products, processes and technologies for firms located within the industrial district (collective support services for R&D and training)
CC3	The physical environment is coordinated by public institutions (public coordination of territory)
CC4	Existence and importance of an overall business strategic orientation for all the firms in the industrial district (strategic local orientation)
CC5	Public administration support the business development in the industrial district (public administration support)
CC6	Firms benefit from the collective reputation developed by the external communication activities carried out cooperatively by groups of competitors or business associations in the industrial district (institutional creation of collective reputation)[a]

[a] Item dropped from the final scale.

A.2. Section II. Firms' internal knowledge creation capacity

When responding to the following items, consider the firm's capacity to develop new knowledge through its internal resources, capacities and systems. Evaluate the strength of the firm's competitive position for each item in relation to the direct industry competitors' average on a scale of 1 to 5 where 1 is ''much worse than our competitors'', 3 is ''on a par with our competitors'', and 5 is ''much better than our competitors''.

Item	Description
Internal knowledge creation capacity	
11	Firm's efficiency in the development of a culture and organisational systems designed to attract, develop and retain talent (innovative culture and systems)
12	Firm's capacity to integrate the employees with the organisational objectives of knowledge creation and learning (employees' fit with firm's learning objectives)
13	Degree of employees' motivation and commitment to quality and innovation at a personal level (employee's commitment to innovation)
14	Degree to which managers consider change as natural and desirable, encourage employees to learn, experiment, constantly question the way things are done to improve them, solve problems and offer suggestions (managerial support to learning)
15	Degree to which the organisation stimulates the development of competencies and the knowledge sharing among employees by encouraging horizontal and vertical communication, and the development of work teams and discussion forums (organisational design for learning)
16	Firm's capacity to efficiently assign resources to the R&D department (R&D investment)

A.3. Section III. Firms' absorptive capacity

When responding to the following items, consider the firm's capacity to absorb external knowledge. Evaluate the strength of the firm's competitive position for each item in relation to the direct industry competitors' average on a scale of 1 to 5 where 1 is ''much worse than our competitors'', 3 is ''on a par with our competitors'', and 5 is ''much better than our competitors''.

Item	Description
I. Potential absorptive capacity (PACAP)	
(A) Acquisition capacity	
AC1	Degree of management orientation of waiting to see what happens, instead of concern and orientation towards the environment to monitor a wide-range of trends continuously and to discover new opportunities to be exploited proactively (management's orientation towards external learning)[a]
AC2	Frequency and importance of firm's co-operation with R&D organisations - universities, business schools, technological institutes, etc.—as a member or sponsor to create knowledge and innovations (R&D cooperation)
AC3	Firm's capacity to capture relevant, continuous and up-to-date information and knowledge on current and potential competitors (knowledge of the competition)[b]
AC4	Firm's effectiveness in establishing programmes oriented towards the internal development of technological acquisition of competencies from R&D centres, suppliers or customers (technological competences acquisition capacity)
(B) Assimilation capacity	
AS1	Firm's ability to use employees' knowledge, experience and competency in the assimilation and interpretation of new knowledge (knowledge assimilation capacity by human resources)
AS2	Firm's capacity to assimilate new technologies and innovations that are useful or have proven potential (technology assimilation capacity)
AS3	Firm benefits when it comes to assimilating the basic, key business knowledge and technologies from the successful experiences of enterprises in the same industry (industrial benchmarking)
AS4	Degree to which company employees attend and present papers at scientific conferences and lecturer at universities, and other companies' employees visit the company on research assignments (involvement in knowledge diffusion flows)[b]
AS5	Firm's employees attendance at training courses, trade fairs, exhibitions and meetings (knowledge absorption from formal and informal professional sources)[b]
AS6	Firm's ability to develop knowledge management programmes guaranteeing employee's capacity to understand and carefully analyse knowledge and technology from other organisations (external knowledge management)
II. Realised absorptive capacity (RACAP)	
(A) Transformation capacity	
TR1	Awareness by the firm of its competencies in innovation, especially with respect to key technologies, and capability to eliminate obsolete internal knowledge, stimulating in exchange the search for alternative innovations and their adaptation (knowledge renewal capability)
TR2	Firm's capacity to use information technologies in order to improve information flow, develop the effective sharing of knowledge and foster communication between members of the firm, including virtual meetings between professionals who are physically separated via Internet B2E portals, e-mail, teleworking, etc. (transmission of IT- based knowledge)
TR3	Firm's capacity to adapt technologies designed by others to its particular needs (knowledge adaptation capacity)[b]
TR4	Degree to which firm prevents all employees voluntarily transmit acquired scientific and technological information to each other (exchange of scientific and technological information)[a]
TR5	Firm's capability to co-ordinate and integrate all phases of the R&D process and its inter-relationships with the functional tasks of engineering, production and marketing (integration of R&D)
(B) Application capacity	
API	Degree of application of knowledge and experience acquired in the technological and business fields to the firm's strategy that enables it to stay at the technological leading edge in the business (knowledge application capacity)
AP2	Organisation's capacity to use and exploit new knowledge in the workplace to respond quickly to environment changes (new knowledge exploitation capacity)[a]
AP3	Firm's ability to respond to the requirements of market demand or competitive pressure, rather than innovating to gain competitiveness by broadening the portfolio of new products, capabilities and technology ideas (response to market)[a]
AP4	Firm's capacity to put technological knowledge into product and process patents (patents development capacity)

[a] Items are reverse scored.
[b] Item dropped from the final scale.

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