Loving Outside the Neighborhood: The Conflicting Effects of External Linkages on Incremental Innovation in Clusters
by José-Vicente Tomás-Miquel, F. Xavier Molina-Morales, and Manuel Expósito-Langa

The present study assesses the explanatory capacity of three levels of factors, namely, internal to the company, and internal and external to the cluster, in predicting firms’ incremental innovative performance in cluster contexts. The empirical research conducted here focuses on a sample of 92 companies from the Spanish textile industrial cluster in Valencia. Findings reveal that the significant role played by firms’ interorganizational ties as a moderating factor between absorptive capacity and their incremental innovative performance. Additionally, results reflect the differentiated roles developed by intra- and extra-cluster linkages in these interaction processes.

Introduction
Over the last decades industrial clusters have received great attention both from academy and practitioners. We understand a cluster to be a localized network within a production context inside a bounded area (Boschma and ter Wal 2007; Parrilli and Sacchetti 2008). In these spatial agglomerations, the predominance of small and medium-sized enterprises (SMEs) is a characteristic feature, especially in traditional medium and low-tech industries such as textiles, footwear, furniture, leather, or clothing. Furthermore, the particular characteristics of these environments make it easier for their companies to have greater access to external sources of knowledge, thus enabling a richer and fuller analysis of innovation processes.

The identification of the cluster as an interorganizational network (Antonelli 2000) allows addressing some new and unexplored issues, particularly, those related to knowledge exchanges, innovation processes, and performance of these firms. In this paper, the incremental innovation, as the most characteristic innovation form in clusters, has been analyzed. To develop our analysis, we have combined internal and external factors, as well, direct and indirect effects, overcoming past partial or unsatisfactory approaches.

For a long time, the innovation literature made an important distinction by categorizing innovation as being either radical or incremental, depending on how much change was associated with it (Dewar and Dutton 1986). Recent contributions have begun to examine in greater depth the benefits that a firm’s internal and external factors may have on its incremental and radical innovative performance (see e.g., Cantner, Joel, and Schmidt 2011; Ritala and Hurmelinna-Laukkanen 2013; Soosay, Hyland,
and Ferrer 2008; Subramaniam and Youndt 2005; Tödtling, Lehner, and Kaufmann 2009).

With regard to incremental innovation, despite the significant competitive advantages and benefits that arise from its adoption (Bhaskaran 2006; Puga and Trefler 2010; Vara-darajan 2009), it has not been a major area of research or policy interest in comparison with other types of innovations of a more radical nature or high technology involvement (Bhaskaran 2006; Elche-Hortelano, Martín-Pérez, and García-Villaverde 2015). In fact, the previous literature notes that customer involvement often accepts incremental innovations better (Van der Panne, Van Beers, and Kleinknecht 2003), whereas radical or advanced innovations may encounter a certain amount of resistance from consumers (Christensen 1997). Additionally, incremental innovations play an important role in mature low- and medium-tech industries on which our research has focused. Finally, this type of innovation is based on contextual knowledge, mostly tacit in nature, which is characteristic of cluster networks (Becattini 2001).

The internal endowment of resources and capacities has been widely considered as a source of firm outcomes, as argued by the so-called resource-based view (Barney 1991; Grant 1991), since they are needed to capture, combine, and exploit all types of resources, particularly those related to innovation. Among these resources, absorptive capacity is one of the most significant notions to emerge in organizational research in recent decades (Lane, Koka, and Pathak 2006). According to Cohen and Levinthal (1990), it is critical to be able to use and benefit from externally acquired knowledge—particularly new knowledge (Zahra and George 2002).

On the other hand, scholars have also supported the notion that interorganizational networks are a key factor for firms' innovation in clusters (Bathelt, Malmberg, and Maskell 2004; Expósito-Langa, Tomás-Miquel, and Molina-Morales 2015; Giuliani 2007). However, existing empirical evidence suggests that although networks can enhance innovation processes, not all network ties or structures do so equally (Peng and Luo 2000; Stam and Elfring 2008). In this context, the influence of knowledge ties on the innovation outcomes may be different depending on the knowledge source, namely, whether it comes from inside or outside the cluster (Bathelt, Malmberg, and Maskell 2004; Giuliani 2005). Few attempts have been made to analyze what influence the different knowledge ties have on innovation (Stam and Elfring 2008), and this is even more the case when various categories of innovation, according to the intensity of change, are addressed in cluster contexts. Thus, a more complete view of cluster innovation processes is required.

Bearing in mind the theoretical premises outlined above, the aim of this paper is to explore the presence of multilevel effects on incremental innovation for clustered firms. To be more specific, based on nonlinear relationships, we assess the explanatory capacity of three different levels of factors, namely, internal to the company, and internal and external to the cluster, as well as the interactions between them in predicting a firm's incremental innovation in industrial cluster contexts.

In our opinion, our research offers a complete frame of interactions between diverse level factors enabling to a better understanding of the key factors of the innovation in clusters. In addition, the paper participates in the debate, still not satisfactorily resolved, on the conceptual distinction between incremental and radical innovation.

The analysis was conducted based on data gleaned from a survey conducted on a sample of 92 companies in the Valencian textile industrial cluster in eastern Spain. According to other studies that have stressed the role of internal and external factors on incremental innovation (Ritala and Hurmelinna-Laukkanen 2013; Soosay, Hyland, and Ferrer 2008; Subramaniam and Youndt 2005; Tödtling, Lehner, and Kaufmann 2009), this study confirms the significance of the role played by companies' ties as a factor that moderates between absorptive capacity and incremental innovation performance. Additionally, results also confirm the differentiated role developed by intra-cluster linkages (ICLs) and extra-cluster linkages (ECLs) on these interaction processes, thus showing that not all of a firm's ties are beneficial for incremental innovation outcomes.

This paper has been structured in four parts. After the introduction, the second section presents the theoretical framework on which the research is grounded. Research questions and hypotheses are also defined in that same section. The research setting and the results of the empirical study are then described. Finally, both theoretical and managerially significant conclusions are reported in the Discussion section, along with the limitations of the work and recommendations.
Clusters are networks of highly interconnected organizations where proximity and a sense of belonging facilitate trust and reciprocity, along with other common values (Antonelli 2000). Specific conditions in clusters are associated to a number of capacities shared among companies. Indeed, to some extent, certain capacities are not exclusive to a single company. Shared capacities allow the entire cluster to create particular mechanisms with which to identify and monitor external changes, as well as to gain access to new ideas and opportunities. For instance, local supporting organizations such as local universities, technological institutes, and so forth can act as bridging agents between extra-cluster sources and clustered firms (McEvily and Zaheer 1999).

Regarding innovation, firms within a cluster seem to be far better adapted for incremental or contextual innovation than for the radical type. Incremental innovations involve minor changes and modifications introduced to refine or reinforce existing products and technologies, whereas radical innovations represent important transformations of existing products or technologies that frequently make the current product designs and technologies obsolete (Chandy and Tellis 2000).

Becattini (2001) used the notion of contextual knowledge to explain the learning process in territorial agglomerations. This knowledge is embedded in the activity where knowledge is created; in fact, it increases together with activity and can be considered as being temporally, socially, and spatially contextualized. Contextual knowledge is usually not easy to describe even for the actors involved because it is mostly tacit in nature and based on experience, and is therefore difficult to reproduce at a distance, beyond the original context. Since this knowledge is more valuable within the specific activity but, conversely, it depreciates with alternative uses (Parra-Requena, Molina-Morales, and García-Villaverde 2010), it can be more oriented toward the development of incremental innovations.

In spite of their limitations, incremental innovations are an important strategic tool for the success of small and medium-sized enterprises that operate in highly competitive markets (Bhaskaran 2006). In fact, the development of incremental innovations in micro and small enterprises is far more frequent than the development of radical innovations (Forsman and Annala 2011). This situation is also valid for many cluster contexts, generally populated by numerous small companies (Elche-Hortelano, Martínez-Pérez, and Garcia-Villaverde 2015). In fact, Bellandi (1996) suggested that these environments are characterized by an experience-based gradual learning process. In conclusion, without renouncing the development of more advanced innovations, incremental innovations in these contexts have been frequently considered as a key factor of success.

The development and adoption of new products and processes can be described as a combination of specific firms and industry capabilities (Dosi 1988). On the other hand, to keep continuous innovation flows with other organizations, the ability to disseminate basic knowledge to organization is required, for example, interacting in research development and production activities.

A firm’s internal endowment of resources and capacities has been widely considered as a source of firm outcomes. Among these resources, we center our attention on absorptive capacity, which is one of the most significant notions to emerge in organizational research in recent decades (Lane, Koka, and Pathak 2006).

According to Cohen and Levinthal (1990), absorptive capacity is the ability a company has to identify, assimilate, and apply knowledge gained from external sources to commercial purposes. The authors argued that this capacity is essential to the innovation of a firm, and is linked to organizational learning and to the commercial application of external knowledge. Since product development is a knowledge-intensive process, the higher the firm’s absorptive capacity is, the higher the effective product outcomes are (Stock, Greis, and Fischer 2001). R&D investment is associated to the firm’s knowledge-base and absorptive capacity, and as a result there is a significant association between R&D intensity and innovation (see Kamien and Schwarz, 1982, for a review). All companies inside clusters can take advantage of this to develop added-value products, since the individual knowledge-base contributes to the cluster’s total absorptive capacity. In consequence, a positive relationship would be
expected between absorptive capacity and innovation.

The effect of absorptive capacity on innovation processes has been considered by previous literature independently of the novelty of that innovation or the underlying technology. Consequently, the introduction of incremental innovations also requires R&D activities (Tödtling, Lehner, and Kaufmann 2009). As Cohen and Levinthal (1990) argued, some absorptive capacity of the firm is also required for any category of innovation. This argument has already been analyzed and confirmed empirically in different contributions, such as Tödtling, Lehner, and Kaufmann (2009), Cantner, Joel, and Schmidt (2011), or Ritala and Hurmelinna-Laukkanen (2013).

In addition to these arguments and going a step further, it is also possible to develop a theory that posits the existence of a curvilinear relationship between absorptive capacity and innovation. Absorptive capacity is costly and could generate additional unwanted effects, so it can be argued that at certain level could produce diminishing returns. That is, the total return on investment as a proportion of the total investment decreases (Berman, Down, and Hill 2002). The benefits of the internal R&D activities may increase only as far as a turning point, beyond which they become negative. This theory acknowledges that more R&D activities are not necessarily associated in turn with increases in results across the entire relevant continuum. In general, economies of scale frequently become diseconomies at a certain degree of infrastructure and resource development. For example, bureaucracy, information loss, or employee incentive problems are usually stated as constraints hindering the growth of the organizational structure. It is also relevant that the learning curve reaches a saturation level, beyond which increases are not significant. There are some precedents confirming the existence of a curvilinear relationship between absorptive capacity and firm innovation or new product development (Stock, Greis, and Fischer 2001) and in addition, we collected several ideas and insights from different theoretical perspectives that allow us to contextualize this curvilinear relationship. Particularly, studies conducted on trust proposed a curvilinear relationship with firm innovation (Langfred 2004).

Absorptive capacity has been analyzed in the literature in different contexts and results showing that it does indeed have an influence on the development of new products. However, the cluster network presents distinct characteristics (intense relationships, shared capacities, and so on), which claim for a specific formulation (Molina-Morales and Martínez-Fernández 2009). According to some authors, organizations in clusters share resources and capabilities, resulting in distinct effects of internal factors on the outcomes of the clustered organizations. In particular, some overlapping effects between the potential absorptive capacity and external activities occur. Consequently, the absorptive capacity can be at some point partially substituted or complemented by external activities, depending on the degree of overlapping. In our opinion, these interactions between internal and external levels of capacities only happen under the cluster conditions, and thus rarely can be applied to different contexts (Molina-Morales and Expósito-Langa 2012).

In conclusion, a nonlinear inverted U-shaped relationship is the one that best captures expectations based on the theoretical description outlined above.

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H1: \text{The absorptive capacity of a cluster firm has a quadratic (inverted U-shaped) relation with incremental innovation.}
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Cluster-Level Factors for Innovation

As stated earlier, absorptive capacity benefits firms particularly by enhancing incremental innovation. In addition, belonging to a cluster, as we have already discussed, provides firms with shared values and capacities. Consequently, the benefits of absorptive capacity are likely to vary according to the firm's level of intra-cluster connectedness.

The cluster literature emphasizes the existence of externalities arising from local labor pooling, specialized suppliers, and knowledge spillovers, which underpin most research conducted on agglomeration economics (Krugman 1991; Marshall 1920). However, more recently, researchers have focused on local knowledge spillovers to examine the effects of agglomeration on innovation (Audretsch & Lehmann 2005; Bell 2005; Deeds, Decarolis, and Goombs 1999).

In fact, search costs are reduced, since knowledge resources flow easily in the cluster (Maskell 2001), thereby configuring a situation where the dynamics of knowledge exploration and exploitation are distinct compared to other contexts, which in turn facilitates the internal
learning process and is beneficial for all the clustered firms.

In this regard, several authors have proposed a direct positive association between cluster connectedness and innovation (Bell 2005; Coombs, Deeds, and Ireland 2009; Schilling and Phelps 2007). Interactions can be seen as channels through which resources circulate, thereby allowing stakeholders to gain access to the resources of other stakeholders (Lane and Lubatkin 1998; Tsai and Ghoshal 1998). Furthermore, the internal cluster knowledge resources, mostly of a tacit nature, seem to be far more appropriate for incremental innovations than for radical ones (Elche-Hortelano, Martínez-Pérez, and García-Villaverde 2015).

Previous researches are not conclusive on the effect of the interactions between absorptive capacity and relational activities. According to some authors, the effect of absorptive capacity shows a high degree of complementarity with external firm relations. The joint effect increases valuable information and knowledge and, consequently, value creation and innovation (i.e., Escribano, Fosfuri, and Tribó 2009). However, some recent research argued a possible partial substitution effect between internal R&D efforts and external knowledge sources such as relational activities. In fact, it is argued that collaborative relationships are costly, since some internal resources are required to develop and maintain them (Lam 1998). In parallel with increases in investments in R&D increases the pressure in capitalizing the efforts. In addition, in the same vein Chesbrough (2003) argued that strong orientations to internal R&D activities may lead to closed innovative processes.

Following this reasoning, we go further in considering the interactive effect of the ICLs on the relationship between absorptive capacity and incremental innovation. We then propose that firms that are strongly connected within the cluster network expand the effect of absorptive capacity on incremental innovation. Thus, the cluster flows of innovation-related resources would have an additive and complementary effect on internal absorptive capacity, positively affecting its relation with incremental innovation. Firms with high levels of absorptive capacity can be expected to be affected to a different degree—far more positively—due to the existence of high ICLs.

In addition, a saturation effect of R&D efforts on incremental innovation outcomes can also be proposed, following the same reasoning stated in Hypothesis 1. Thus, although the existence of ICLs can improve the relationship between absorptive capacity and incremental innovation, at high levels of absorptive capacity, a reduction in incremental innovation performance can be produced because of the effects of an excessive oversizing of R&D resources.

We expect the effect of absorptive capacity on incremental innovation can be moderated by ICLs. This moderation, following the majority of the literature on the topic, is expected to be positive, assuming the complementarity between external activities and absorptive capacity. We can express these arguments in a more formal way by defining the following hypothesis:

**H2: Intra-cluster linkages positively moderate the inverted U-shaped relation between absorptive capacity and incremental innovation.**

**Extra-Cluster Factors for Innovation**

A number of scholars have already suggested that many sources of innovation may, however, be located outside the cluster (Asheim and Belussi 2007; Boschma and ter Wal 2007; Maskell, Bathelt, and Malmberg 2006). Extra-cluster sources generally provide novel knowledge that is different from what usually circulates inside the cluster, thus enabling cluster firms to renew ideas and to break with pre-established concepts (Cattani and Ferriani 2008; Schilling 2005). In fact, these external interactions can prevent clusters from declining (De Martino, Mc Hardy Reid, and Zygliodopoulos 2006). Hence, the capacity to identify and adapt to external changes and developments is critical for the cluster (Robertson, Jacobson, and Langlois 2009).

Previous literature has suggested that contacts with organizations located outside the cluster boundaries (e.g., customers, suppliers, competitors, institutions, universities, consulting firms, and so on) will support innovation for clustered firms (McEvily and Zaheer 1999; Beugelsdijk and Smulders 2003; Williams 2006 or Ellison, Steinfield, and Lampe 2007). But since the knowledge acquired from extra-cluster sources is generally novel and groundbreaking, it may promote more advanced innovations, that is, those of a more radical and differential nature (Chapain et al. 2010). In fact, Cattani and Ferriani (2008) stressed the importance of external connections as a means of fostering creative performance through contact with diverse
sources of inspiration and stimuli. These external links can be identified as weak ties as defined in the seminal work by Granovetter (1973). According to this author, these bridges between actors provide newer and more exclusive knowledge resources, in contrast with strong ties (internal cluster) more frequent and intimate relationships. In consequence, external linkages seem to be more adequate for radical innovation than incremental one.

However, access to extra-cluster sources of knowledge and the consequent higher possibility for cluster firms to develop radical innovations may also seriously jeopardize current innovation strategies. In fact, the development of breakthrough innovations can reduce the firm’s performance in other innovations of a more incremental nature due to three main reasons: (1) the new radical innovation-based strategies may not comply with the rules and practices prevailing in the cluster (DiMaggio and Powell 1983). Thus, these companies may be considered opportunistic by other cluster firms, thereby reducing the confidence and productivity of internal ties; (2) the reassignment of a firm’s resources—both human and economic—from continuous improvement processes to radical innovation development processes; and (3) the loss of interest within the firm in minor product and process improvements as compared to more radical, profitable, and discontinuous innovations and changes.

On this basis, external factors present an alternative and conflicting effect. On the one hand, being connected to external networks provides firms with fresh and relevant knowledge, in turn furthering the development of more advanced innovations. On the other hand, the internal effect of external knowledge sources may alter the internal mechanisms that generate the incremental innovation outcomes.

Again, here we consider the interactive effect of ECLs on the relationship between absorptive capacity and incremental innovation. In the case of extra-cluster relations, we suggest that the effect of these ties on the relationship between absorptive capacity and incremental innovation runs in the opposite direction to those developed within the cluster. In consequence, we can expect firms with high levels of absorptive capacity to be affected to a different degree—negatively—by the existence of high ECLs. Firms with high and intense linkages with external networks can probably suffer from a reduction in the confidence and productivity of internal ties. On the other hand, they can also devote less effort to continuous improvement processes, thus reassigning their resources to R&D processes oriented toward the development of more advanced innovations.

Additionally, and in the same way as our previous hypotheses, we can propose the presence of an inverted U-shaped saturation effect between absorptive capacity and incremental innovation performance. Thus, as well as the negative effects of ECLs on the relationship between absorptive capacity and incremental innovation, we should expect a reduction of the incremental innovation performance at high levels of absorptive capacity because of the effects of an excessive oversizing of R&D resources.

We can summarize all these previous arguments more formally through the following hypothesis:

H3: Extra-cluster linkages negatively moderate the inverted U-shaped relation between absorptive capacity and incremental innovation.

### Joint Effect of Intra- and Extra-Cluster Factors

Finally, considering the previous hypotheses, we propose to study the joint effect of ICLs and ECLs on the relationship between absorptive capacity and incremental innovation. Theoretically, in terms of the levels of linkages, there are four possible combinations (Table 1): (1) low ICLs and ECLs, (2) low ICLs and high ECLs, (3) high ICLs and low ECLs, and (4) high ICLs and ECLs. These possible combinations of cluster firms’ relationships will have different effects on the way in which absorptive capacity influences incremental innovation performance.

In spite of the potential partial effects of the intra and extra-cluster linkages, when we consider the interactive effect of ECLs on the relationship between absorptive capacity and incremental innovation. In the case of extra-cluster relations, we suggest that the effect of these ties on the relationship between absorptive capacity and incremental innovation runs in the opposite direction to those developed within the cluster. In consequence, we can expect firms with high levels of absorptive capacity to be affected to a different degree—negatively—by the existence of high ECLs. Firms with high and intense linkages with external networks can probably suffer from a reduction in the confidence and productivity of internal ties. On the other hand, they can also devote less effort to continuous improvement processes, thus reassigning their resources to R&D processes oriented toward the development of more advanced innovations.

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### Table 1

**Combinations of Intra- and Extra-Cluster Linkages**

| ECLs            | ICLs       | Extra-Cluster Linkages |
|-----------------|------------|------------------------|
|                 | High–high  | High–low               |
|                 | Low–high   | Low–low                |

ECL, extra-cluster linkages; ICL, intra-cluster linkage.
considered combination of them, diverse effects occur as a consequence of the interaction between both levels.

More precisely, when both ICLs and ECLs are low for the cluster firm, the relationship between the level of absorptive capacity and incremental innovation performance will be poor, because the low level of connections will lead firms to obtain very little value for high levels of absorptive capacity.

Furthermore, when ICLs are low for the cluster firm, but ECLs are high, again the effect of absorptive capacity will be weakly related to incremental innovation performance, largely because the prevailing information that the company will have available will be related to novel and cutting-edge knowledge, thus paving the way for the development of more advanced innovations.

However, when intra-cluster ties are high for the cluster firm and extra-cluster ties are low, the firm will be deeply embedded in the cluster network, thus fostering the generation of trust with other cluster firms and the transmission of contextual knowledge, which is a precursor of incremental innovation processes, especially when levels of absorptive capacity are high. In addition, the limited existence of external links will reduce the amount of novel and groundbreaking knowledge obtained, thereby allowing the firm to concentrate its R&D efforts on innovations of a more incremental nature. We therefore propose that the relationship between absorptive capacity and incremental innovation will be strengthened when cluster firms develop a combination of high ICLs and low ECLs.

Finally, for cluster firms high in both linkages, we expect the high level of ECLs to mitigate the benefits provided by the high level of ICLs to the development of incremental innovations. As we commented before, the lack of trust toward the other cluster firms, the reallocation of the firm's resources from incremental to radical innovation processes, or the lack of interest of the firm in minor product and process improvements can be some of the factors triggering the loss of performance in the incremental innovation outcomes. Therefore, we can propose that the relationship between absorptive capacity and incremental innovation will be weaker for cluster firms that are high in both types of linkages.

In addition, and as in the previous hypotheses, we propose to consider that absorptive capacity has an inverted U-shaped saturation effect on the incremental innovation outcomes.

All these arguments lead to the following hypothesis:

**H4:** Companies’ ties moderate the inverted U-shaped relationship between absorptive capacity and incremental innovation in such a way that for firms developing high intra-cluster linkages and low extra-cluster linkages this relationship is stronger than for firms developing high intra- and extra-cluster linkages.

### Methodology

#### Research Setting

Our empirical study focuses on the textile cluster located in the Spanish region of Valencia. The textile industry is a challenging manufacturing industry encompassing a broad range of processes, from yarn to clothing production. Traditionally, it has played a significant role in the evolution of pattern of industrial specialization in Spain, and is considered one of the most important territorial agglomerations in the country. Indeed, this industry presents the highest level of geographical concentration here.

In general, we can differentiate between two main traditional market segments in the textile industry: clothing and home textiles. Nevertheless, another new segment is flourishing, the so-called technical textiles market. This specialized area centers on technical aspects, with higher R&D requirements (rather than esthetic and décor needs) compared to household textiles or clothing. The destinations for technical textiles are markets other than the traditional ones, such as the car, construction, or health-care industries.

#### Data Collection

The empirical research focuses on the population of active manufacturing companies that are part of the Valencian textile industrial cluster. According to the Spanish Information Center for Textiles and Clothing (CITYC), in 2015 the cluster employed about 22,452 workers, generating a turnover of 1,950 million Euros and representing 19 percent of the whole textile sector in Spain. The most important products are home textiles, even though, as mentioned above, over the last few years the production of technical textiles has increased significantly.
According to SABI (Iberian Balance Analysis System)\textsuperscript{1} database and ATEVAL (Valencian Business Textile Association), the textile cluster of Valencia is composed of around 300 companies, most of which are SMEs and micro businesses. A significant part of the cluster companies are commercial firms only dedicated to the purchase and sale of home textiles, thus largely lacking both productive and R&D activities. On the other hand, from the rest of manufacturing companies, about 30 are auxiliary suppliers of basic textile products such as fabric linings, embroidery, etc., which although they are fundamental in the composition of the products, bring little or no added value to it.

On this basis, a sample of 100 textile manufacturing companies was considered in this research since they concentrated most of the knowledge flows of the cluster. To verify that the sample selected included the most significant companies in the Valencian textile cluster according to criteria such as total sales, number of employees, or R&D investment, we used an expert panel. This panel was made up of technicians and managers from the most representative organizations and institutions of the cluster, namely, ATEVAL (Valencian Business Textile Association), AETA (Business Textile Association from Alcoy), Textile Department of the Universitat Politècnica de Valencia and AITEX (Textile Research Institute). The experts confirmed that the sample defined was representative of the whole cluster and that we had not omitted any company relevant to the study.

The interviews to firms’ managers and owners of the sample were the main data sources of this research. Given the large amount of data to be collected from them and the time required for this, it could generate certain errors in data collection during interviews, due to fatigue of the firm’s manager, time available, etc. Therefore, we decided to carry out the whole process in two phases separated by a few weeks. In the first stage, we employed the roster-recall technique (Wasserman and Faust 1994) to analyze network relationships between cluster firms, as it has often been applied in this research area (Boschma and ter Wal 2007; Giuliani and Bell 2005; Maggioni and Uberti 2011). More specifically, with this technique each firm in the sample is first provided with a complete list of the companies addressed in the study. Then, the participants are asked to indicate the firms from this list with which they have established relationships. In this research, we have followed the process described in Giuliani (2007) to study knowledge exchanges. The analysis satisfactorily concluded with 92 valid responses collected.

Finally, in a second stage, we returned to visit the manager or owner of each of the 92 companies with a twofold objective. On the one hand, through a structured questionnaire, to collect the data related to the other variables necessary for the study, such as firms’ incremental innovation, external relations, absorptive capacity, as well as other general variables such as their age or size; and, on the other hand, through semi-structured interviews, to obtain additional information to gain a more thorough understanding of the processes, product portfolio, business strategies, and the focus on incremental innovation developed by cluster firms.

**Variables**

**Dependent Variable.** Incremental Innovation. This variable seeks to represent the firm’s ability to improve processes in its existing products and services. We measured this variable by adapting the scale of Jansen, Van Den Bosch, and Volberda (2006) to the specific characteristics of our research. A seven-point Likert scale with seven different items was used. Table 2 summarizes the items defined.

We ran a factor analysis with varimax rotation to determine the multi-item scale of the incremental innovation variable. The Cronbach’s alpha value was 0.905 and the value of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was above 0.6 (KMO = 0.892). Bartlett’s Test of Sphericity was tested through chi-square, which was found to have a value of 324.834 significant at the 0 percent level of significance, thus denoting that the inter-item correlation matrix was not an identity matrix and, therefore, the data collected on this measure were suitable for factor analysis (Coakes and Steed 2001). The analysis revealed a one-factor solution that accounted for 62 percent of the total variance.

**Independent Variables.** Absorptive capacity. Based on several studies, such as Zahra and George (2002), Giuliani (2007), Jansen, Van

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\textsuperscript{1}The SABI Bureau Van Dijk data set is a tool that provides information in general and from balance sheets about over 2 million Spanish firms.
Den Bosch, and Volberda (2005), or Tu et al. (2006), absorptive capacity was operationalized by using a set of items to proxy the degree of intensity of the company toward R&D activities. Table 3 summarizes the items defined.

A factor analysis was run to obtain a factor score for the absorptive capacity construct. The resulting Cronbach's alpha value was 0.921 and Bartlett's Test of Sphericity was run ($\chi^2 = 17.661; p < .001$). Likewise, the KMO value was above 0.6 ($KMO = 0.799$). In consequence, data collected on this construct were suitable for a factor analysis. Finally, a one-factor solution was obtained with 67.1 percent of the overall variance.

Intra-Cluster Linkages. This variable is intended to represent the level of connectedness of cluster firms within the cluster boundaries. We operationalized this variable by measuring each firm's network centrality, that is, the proximity of each firm to all the other companies in the cluster's knowledge network. Specifically, we used closeness centrality as an indicator of the intensity of ICLs. It is calculated for each company as the inverse of the sum of the shortest path distances of the firm to every other firm in the cluster network (Borgatti 2005; Freeman 1979). Thus, the higher the closeness centrality of a firm, the lower its total distance to other firms.

From the knowledge relationship data matrix previously obtained from the roster-recall method, we calculated each firm’s closeness centrality through social network analysis and with the UCINET software program (Borgatti, Everett, and Freeman 2002).

Extra-Cluster Linkages. To be able to measure this variable, we developed a six-item scale building on an extensive body of previous literature, such as McEvily and Zaheer (1999), Beugelsdijk and Smulders (2003), Williams (2006), and Ellison, Steinfield, and Lampe (2007). We presented the company managers and executives with a list of six different types of organizations (one per item) located outside the cluster boundaries, namely, customers, suppliers, competitors, institutions, universities, and consulting firms. The types of organizations were proposed by different experts and were expected to be important sources of both resources and legitimacy for cluster firms. Particularly, respondents were asked to assess, using a seven-point Likert scale, the extent to which their company's managers and executives obtained relevant technical knowledge or collaborated in research projects with each category of extra-cluster organization (1: no contact, 7: very frequent contact). Responses were combined into a composite measure of ECLs (Cronbach's alpha = 0.762).

### Table 3

| Item | Description |
|------|-------------|
| 1. | The managers of the company are concerned about R&D. |
| 2. | Your firm considers cooperation of importance for knowledge acquisition. |
| 3. | Your company has participated in R&D projects (at regional, national or European levels) during the last three years. |
| 4. | Number of technically qualified personnel in the firm. |
| 5. | Percentage spent on R&D in relation to total sales (innovation effort). |
Controls (Firm Size and Firm Age). Finally, our model was completed by including some control variables. These new variables allowed us to isolate the effects of the independent and moderating variables in the models.

Size is a common control variable, which has been extensively studied in Kamien and Schwarz (1982) or Acs and Audretsch (1991), among others, where the authors associate size and innovation. Therefore, larger companies are expected to be likely to invest more in R&D activities. Firm size was calculated through the total number of employees so as to avoid the appearance of a high correlation between revenues and R&D intensity.

In addition, the firm’s age was included as a control variable, because several authors have pointed out that temporary evolution influences performance in industrial districts (Glasmeier 1991; Pouder and St. John 1996).

Finally, it should be noted that both variables were measured on a logarithmic scale to smooth them.

**Empirical Results**

**Regression Models**

Table 4 summarizes that the basic descriptive statistics and Pearson’s correlations between the independent and moderating variables utilized in the regression models. The firms in the sample have been active for an average of 35 years, and employ about 43 people. The CEOs and executives of a typical textile firm developed on average six ties to other cluster companies (maximum degree was 32). Nonsignificant correlations were observed between the independent and the moderating variables, although it is worth noticing that apparently, on average, larger firms show higher levels of absorptive capacity.

Following Dawson (2014), we used a stepwise hierarchical regression approach to test the hypotheses, and to examine the explanatory power of the set of variables and especially the effect size for the interactions. In addition, to deal with multicollinearity, independent and moderator variables were z-standardized before they were entered into the regression equations. In any event, to ensure that multicollinearity was not a problem in the models, we computed variance inflation factors (VIFs) for all the variables included in the models. All VIF levels were below the critical threshold of 10, thus indicating that the results were not contaminated by multicollinearity (O’Brien 2007).

Table 5 summarizes that the results from the hierarchical regression analyses. In the first step, we entered the control variables and the independent and moderating variables, which together explained a significant share of the variance in incremental innovation performance (Adjusted $R^2 = 0.246$, $p < .01$). ICLs displayed a statistically significant positive relationship with incremental innovation (ICL: $\beta = 0.276$, $p < .05$). Additionally, none of the control variables showed a significant direct relationship with the dependent variable (firm size: $\beta = 0.160$, n.s.; firm age: $\beta = -0.069$, n.s.).

In the second step, we introduced the two-way and three-way interaction terms to study possible linear moderating effects. None of the

| Variables      | Mean  | S.D.  | 1    | 2    | 3    | 4    | 5    |
|----------------|-------|-------|------|------|------|------|------|
| (1) ACap       | 0.094 | 1.088 | 1    |      |      |      |      |
| (2) ICL        | 3.078 | 0.425 | 0.275*| 1    |      |      |      |
| (3) ECL        | 0.684 | 1.588 | -0.024| -0.009| 1    |      |      |
| (4) Firm size  | 43.350| 54.118| 0.662***| 0.405**| 0.124| 1    |      |
| (5) Firm age   | 35.000| 20.014| 0.262*| 0.235| 0.100| 0.324**| 1    |

ACap, absorptive capacity; S.D., standard deviation.

$N = 92$.

* $p < .05$.

** $p < .01$.
linear moderating terms were statistically significant. Furthermore, the explanatory capacity of the model was not significantly increased ($\Delta R^2 = 0.019$, n.s.).

In the third step, we entered the absorptive capacity curvilinear effect to test the first hypothesis. This hypothesis posits an inverted U-shaped relationship between absorptive capacity and incremental innovation. As can be seen in Model 3 in Table 5, the absorptive capacity curvilinear effect is negative and statistically significant ($\beta = -0.723$, $p < .01$). This result indicates that increasing values of absorptive capacity run parallel with increasing values for incremental innovation; at a certain point, however, additional increases become negatively associated with performance. Hence, excessive absorptive capacity erodes the positive effect of obtaining and leveraging external knowledge. In consequence, Hypothesis 1 is supported. With a view to gaining a deeper insight into this effect, we plot the relationship in Figure 1.

Additionally, it should also be noted that the explanatory capacity of the model increased significantly after the introduction of the curvilinear effect of absorptive capacity ($\Delta R^2 = 0.130$, $p < .01$). Regressors explained a significant amount of the variance in incremental innovation (Adjusted $R^2 = 0.395$, $p < .01$).

In the next step, we entered the curvilinear moderating effects to test Hypotheses 2 and 3. On the one hand, we hypothesized that ICLs would have a positive moderating effect on the
U-shaped relationship between absorptive capacity and incremental innovation (Hypothesis 2). We tested this hypothesis by introducing the quadratic-by-linear interaction (absorptive capacity² × ICLs) into the regression equation. Model 4 in Table 5 summarizes that the coefficient associated with this interaction term was positive and statistically significant ($\beta = 0.337$, $p < .1$). Therefore, Hypothesis 2 was supported. The interaction effect between absorptive capacity and ICLs for incremental innovation is shown in Figure 2.

In contrast to Hypothesis 2, Hypothesis 3 posited that ECLs would negatively moderate the U-shaped relationship between absorptive capacity and incremental innovation. We also tested this new hypothesis by introducing the quadratic-by-linear interaction (absorptive capacity² × ECLs) into the regression equation. As summarized in Model 4 in Table 5, the coefficient associated with this interaction term was negative and statistically significant ($\beta = -0.651$, $p < .105$). Therefore, Hypothesis 3 was also supported. However, important insights can be derived from these results, which will be commented on later in the Discussion section. Figure 3 shows the interaction effect between absorptive capacity and ECLs on incremental innovation.

The explanatory capacity of the model increased significantly after the introduction of the two quadratic-by-linear terms in Model 4 ($\Delta R^2 = 0.058$, $p < .05$) with a relevant variance in incremental innovation explained by regressors (Adjusted $R^2 = 0.453$, $p < .01$).

Finally, in the fifth step, we entered the three-way quadratic-by-linear effect to contrast Hypothesis 4. This hypothesis proposed that the inverted U-shaped relationship between absorptive capacity and incremental innovation would be stronger for firms with high ICLs and low ECLs than for firms high in both linkages. We tested the hypothesis by introducing the three-way quadratic-by-linear interaction (absorptive capacity² × ICLs × ECLs) into the regression equation. Model 5 in Table 5 summarizes that the coefficient associated with this interaction term was negative and statistically significant.

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**Figure 1**
Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

![Curvilinear Relationship between Absorptive Capacity and Incremental Innovation](image)

**Figure 2**
Moderating Effect of ICLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

![Moderating Effect of ICLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation](image)
Thus, Hypothesis 4 was supported. Figure 4 shows the joint moderating effect of ICLs and ECLs on the relationship between absorptive capacity and incremental innovation.

To conclude, the introduction of the three-way quadratic-by-linear term in Model 5 also gave rise to a significant increase in the explanatory capacity of the model (ΔR² = 0.039, p < .1) and the variance explained in incremental innovation (Adjusted R² = 0.492, p < .01).

**Discussion**

This research has focused on the expected complex linkages among absorptive capacity, social ties, and incremental innovation in an industrial cluster. We have proposed that the

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**Figure 3**

Moderating Effect of ECLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

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**Figure 4**

Moderating Effect of ICLs and ECLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation
relationship between absorptive capacity and incremental innovation follows an inverted U-shape. In addition, we have assumed that the influence of intra- and extra-cluster ties on the relationship between absorptive capacity and incremental innovation runs in the opposite direction. Specifically, the influence of ICLs has a positive effect on this relationship and, conversely, the effect of ECLs is negative. Finally, we have hypothesized that the combination of high ICLs and low ECLs provides the best incremental innovation performance for cluster firms. The results show that all our hypotheses are supported by the empirical exercise.

A deeper analysis of the results can offer important insights. As Figure 2 shows, the presence of high intra-cluster connectedness has a positive influence on the relationship between absorptive capacity and incremental innovation, and reduces, but does not eliminate, the appearance of a saturation effect. Nevertheless, and unexpectedly, it is the low presence of ECLs, which regulates and prevents the existing saturation problems at high levels of absorptive capacity, as depicted in Figure 3. Thus, we suggest that it is the origin of the knowledge sources that generates this saturation effect and not just the oversizing of the R&D resources and infrastructure, as we had initially argued.

In our opinion, these initial results evidence important relevant theoretical implications. However, their contribution and understanding improve significantly when we address the influence of ICLs and ECLs jointly. More particularly, as we can observe in Figure 4, at high levels of both ICLs and ECLs, the growth of the firm's absorptive capacity produces a saturation effect in the incremental innovation outcomes. However, this effect does not occur with any other combination of links. In this regard, at high levels of ICLs, the low presence of external ones means that as the absorptive capacity grows, the incremental innovative performance increases exponentially at medium and high levels of absorptive capacity. In contrast, in a low presence of ICLs, increases in absorptive capacity do not significantly lead to increases in the incremental innovative performance, as we had initially expected.

These results allow some important conclusions to be drawn. First, the presence of ICLs is required for the development of incremental innovations and not only the possession of high levels of absorptive capacity. This highlights the critical importance that external knowledge acquisition processes have, especially those of a contextual nature, in R&D processes to achieve relevant incremental innovation outcomes. These results are in line with those authors who have proposed a direct positive association between cluster connectedness and innovation (Bell 2005; Coombs, Deeds, and Ireland 2009; Schilling and Phelps 2007).

Second, the development of a large number of ECLs in the presence of strong intra-cluster connectedness limits incremental innovation growth at high levels of absorptive capacity. In other words, the relationship between absorptive capacity and incremental innovation has an inverted U-shape. This result can be mainly explained by the fact that the availability of cluster internal and external knowledge for cluster firms may be useful for incremental innovations at low and medium levels of absorptive capacity. At this point, the R&D efforts and processes are limited and sometimes cluster firms are unable to take full advantage of the cutting-edge knowledge obtained from external sources. However, at high levels of absorptive capacity, incremental innovations may be neglected in favor of more radical innovations.

Results can also be related to some studies on the life cycle of clusters and the drivers that affects creation and development of clusters (Belussi and Sedita 2009). Martin and Sunley (2006) argued, the initial phases of the cluster development stimulate and benefit from emergent external economies, but in mature phases, they eventually tend to lose their former growth dynamics and enter a phase of and relative economic decline. Cluster dynamics are based on the technological heterogeneity of firms (Menzel and Fornahl 2009), that leads to technological convergence when learning takes place within the cluster, and technological divergence when learning takes place outside the cluster. According to Hervas-Oliver et al. (2012), there are technological gatekeepers across cluster life cycles, which assume the (temporary) role of leaders when it is a question of bringing in disruptive knowledge.

In our view, this research contributes to the cluster literature in several different ways. It provides a comprehensive vision of the incremental innovation process in clustered companies. In fact, our results allow us to weight the relevance of each type of knowledge resource. So, while ICLs are relevant for incremental innovation processes, the development of ECLs may hamper performance in these continuous innovation processes in favor of other more advanced types of innovation, thus showing
that not all of the firm’s ties are beneficial for incremental innovation outcomes. In this sense, its embeddedness in cluster networks allows the firm to get the most out of cluster sources of information, and as a result improve its performance in the incremental innovation outcomes. Therefore, our results corroborate previous contributions that have evidenced the significant role of social ties for incremental innovation (Soosay, Hyland, and Ferrer 2008; Subramaniam and Youndt 2005; Tödtling, Lehner, and Kaufmann 2009). However, we go beyond this by differentiating social ties in clusters as being either internal or external, and analyzing their effects on incremental innovation both individually and jointly.

Complementing the theoretical contribution, this research also provides diverse managerial implications for managers, entrepreneurs, and policymakers about how to conduct innovation inside the firm, inside the cluster, and outside the cluster. On the one hand, besides the development of internal resources such as absorptive capacity, our paper also remarks the need for the cluster firm to develop external resources with other companies in the form of knowledge ties to achieve relevant innovation outcomes. On the other hand, the nature of these linkages should not be random and unstructured, but organized depending on their origin and the dimension of the firm’s innovation objectives. Thus, ICLs will provide the cluster firm with new contextual knowledge, which will be a precursor of incremental innovations. In contrast, extra-cluster links will limit incremental innovation outcomes at high levels of R&D effort. Despite these results, the intention of this research is not to offer a negative view of ECLs for the cluster firm. In fact, this typology of linkages based on previous research is more related to innovations of a radical nature (Chapain et al. 2010). Furthermore, numerous contributions stress the need to promote ECLs to ensure the survival of the firm in today’s competitive context, since the absence of any outside relationships may in turn cause firms to become locked in and hence find it difficult to respond to changes that have their origin outside the cluster (Knoben 2009; Narula 2002). Therefore, and conversely, we propose that they will have a different influence on innovation performance according to the nature of the linkages.

Finally, our paper has some limitations that must be taken into consideration. First, we have addressed only a single industry. Therefore, we must be cautious when generalizing its results and main conclusions. In this sense, further analyses are required in other contexts. Second, although our study included different level factors, the analysis of the influence of other internal and external variables on incremental innovation could enrich the contribution. In this respect, it would be interesting to study possible organizational capabilities that could provide new skills to reduce the limiting effects produced by ECLs at high levels of absorptive capacity. Third, it would also be interesting to study the influence of firm internal, cluster internal, and cluster external level factors and their interactions on the performance of innovations of a more radical and differential nature. Despite the fact that the Valencian textile sector is characterized by a medium-low technological level, and that the main innovations are incremental in nature, it is worth noticing the presence in recent years of products that incorporate more radical innovations, for example, with the inclusion of electronic components or special properties in fabrics. Thus, we consider that there is a group of companies in the cluster whose innovative portfolio is, to a greater or lesser extent, oriented toward the development of innovations closer to radical innovation. Their analysis would enable us to define a more complete picture of the determinants of cluster firms’ innovation. Finally, and complementary to the previous idea, it would be worth exploring how cluster firms should combine ICLs and ECLs to optimize incremental and radical innovation performance at the same time. In this research area, some concepts such as ambidexterity (Gibson and Birkinshaw 2004; Gupta, Smith, and Shalley 2006) or network competence (Ritter 1999; Ritter, Wilkinson, and Johnston 2002) should emerge and complement these new analyses. However, we must leave these limitations for future research.

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