LOVING OUTSIDE THE NEIGHBOURHOOD: THE CONFLICTING EFFECTS OF EXTERNAL LINKAGES ON INCREMENTAL INNOVATION IN CLUSTERS

José-Vicente Tomás-Miquel[a]

(Corresponding author)

Universitat Politècnica de València, Business Administration Department

Plaza Ferrándiz y Carbonell 2, 03801. Alcoy (Alicante), Spain

Tel: +34 96 652 84 66

Fax: +34 96 652 85 85

jotomi@doe.upv.es

Francesc-Xavier Molina-Morales[b]

Universitat Jaume I, Business Administration and Marketing Department

Avda. Vicent Sos Baynat, 12071. Castellón de la Plana, Spain

xavier.molina@emp.uji.es

Manuel Expósito-Langa[c]

Universitat Politècnica de València, Business Administration Department

Plaza Ferrándiz y Carbonell 2, 03801. Alcoy (Alicante), Spain

maexlan@doe.upv.es

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[a] José-Vicente Tomás-Miquel is Assistant Professor of Business Management at the Universitat Politècnica de València (Spain).

[b] Francesc-Xavier Molina-Morales is Professor of Business Management at the Universitat Jaume I of Castellón (Spain).

[c] Manuel Expósito-Langa is Associate Professor of Business Management at the Universitat Politècnica de València (Spain).

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Abstract:

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 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.

Keywords: Cluster, incremental innovation, knowledge network

Introduction

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 for example, Subramaniam and Youndt 2005; Soosay, Hyland, and Ferrer 2008; Tödtling, Lehner, and Kaufmann 2009; Cantner, Joel, and Schmidt 2011; Ritala and Hurmelinna-Laukkanen 2013).

From this basis, we would like to go further by extending previous literature mainly in three different ways. First, we explore the territorial dimension of these influencing processes, adopting the concept of cluster as our framework of analysis. 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 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. Therefore, we believe that industrial clusters are contexts that are well suited to the purposes of our research, since they represent paradigmatic configurations in which multiple territorialized networks both coexist and interact.

Second, we focus on so-called incremental innovation. Despite the significant competitive advantages and benefits that arise from its adoption (Bhaskaran 2006; Varadarajan 2009; Puga and Trefler 2010) 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, Martínez-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), while 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).

Third, scholars have supported the notion that interorganizational networks are a key factor for firms' innovation in clusters (Bathelt, Malmberg, and Maskell 2004; Giuliani 2007; Expósito-Langa, Tomás-Miquel, and Molina-Morales 2015). 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 non-linear 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.

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 (Subramaniam and Youndt 2005; Soosay, Hyland, and Ferrer 2008; Tödtling, Lehner, and Kaufmann 2009; Ritala and Hurmelinna-Laukkanen 2013), 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 and extra-cluster linkages 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 for future research.

Theoretical Background and Hypotheses

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).

Innovation in clusters

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 in order 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 García-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.

Firm-level factors for innovation: absorptive capacity

A firm’s 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). 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.

Absorptive capacity has been analyzed in the literature in different contexts and results show that it does indeed have an influence on the development of new products. 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 Humerlinna-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. 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; Molina-Morales and Expósito-Langa 2012), 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; Molina-Morales and Martínez-Fernández 2009).

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

H1. *The absorptive capacity of a cluster firm has a quadratic (inverted U-shaped) relation with incremental innovation.*

Cluster-level factors for innovation

As stated earlier, absorptive capacity benefits firms particularly by enhancing incremental innovation. Moreover, 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 (Marshall 1920; Krugman 1991). However, more recently, researchers have focused on local knowledge spillovers to examine the effects of agglomeration on innovation (Deeds, Decarolis, and Coombs 1999; Audretsch and Lehmann 2005; Bell 2005). 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; Schilling and Phelps 2007; Coombs, Deeds, and Ireland 2009). 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).

Following this reasoning, we go further in considering the interactive effect of the intra-cluster linkages 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 intra-cluster linkages.

Moreover, 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 intra-cluster linkages 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 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 (Maskell, Bathelt, and Malmberg 2006; Asheim and Belussi 2007; Boschma and ter Wal 2007). 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 (Schilling 2005; Cattani and Ferriani 2008). 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 (for example, 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.

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 extra-cluster linkages 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 extra-cluster linkages. 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 towards 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 extra-cluster linkages 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 intra- and extra-cluster linkages on the relationship between absorptive capacity and incremental innovation. Theoretically, in terms of the levels of linkages, there are four possible combinations: (1) low intra- and extra-cluster linkages, (2) low intra-cluster linkages and high extra-cluster linkages, (3) high intra-cluster linkages and low extra-cluster linkages, and (4) high intra- and extra-cluster linkages. These possible combinations of cluster firms' relationships will have different effects on the way in which absorptive capacity influences incremental innovation performance.

More precisely, when both intra- and extra-cluster linkages 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 intra-cluster linkages are low for the cluster firm, but extra-cluster linkages 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 intra-cluster linkages and low extra-cluster linkages.

Finally, for cluster firms high in both linkages, we expect the high level of extra-cluster linkages to mitigate the benefits provided by the high level of intra-cluster linkages to the development of incremental innovations. As we commented before, the lack of trust toward the other cluster firms, the reassignment 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 aesthetic 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 healthcare industries.

Data collection

The empirical research focuses on the population of active 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.

The empirical study was conducted in two main phases. 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 (Giuliani and Bell 2005; Boschma and ter Wal 2007; Maggioni and Uberti 2011). First, an initial list of textile companies was obtained from the SABI[d] database. As commented earlier, the textile industry involves a broad range of auxiliary and manufacturing activities. Consequently, the overall number of cluster firms was relatively high, around 300, most of which were SMEs and micro businesses. However, the roster-recall method does not allow such a large number of firms to be processed.

Therefore, to refine the sample, from the preliminary roster we chose the most representative firms, based on an expert panel's opinion, from different cluster organizations and according to criteria

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[d] The SABI Bureau Van Dijk dataset is a tool that provides information in general and from balance sheets about over two million Spanish firms.

such as total sales, number of employees, or R&D investment. This resulted in a final sample made up of one hundred firms, thus enabling us to continue our study with a representative panel of companies from the total number of firms in the cluster.

With this sample, we then continue with the roster-recall method. 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 order to complement our study, we performed a second analysis in the empirical research aimed at examining in greater detail – through personal interviews – the firms that participated in the first stage of the study. We conducted semi-structured, in-depth interviews with firms' managers and owners, and this enabled us to gain a more thorough understanding of the processes, product portfolio, business strategies, and the focus on incremental innovation developed by cluster firms.

Variables

<u>*Dependent Variable*</u>

- *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 1 shows the items defined.

INTRODUCE TABLE 1 ABOUT HERE

We ran a factor analysis with varimax rotation to determine the multi-item scale of the incremental innovation variable. The Cronbach's α value was .905 and the value of the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was above 0.6 (*KMO* = .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.

<u>*Independent variables*</u>

- *Absorptive capacity (ACap)*

Based on several studies, such as Zahra and George (2002), Giuliani (2007), Jansen, Van 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 2 shows the items defined.

INTRODUCE TABLE 2 ABOUT HERE

A factor analysis was run to obtain a factor score for the absorptive capacity construct. The resulting Cronbach's α value was .921 and Bartlett's Test of Sphericity was run (Chi-square = 17.661; $p < .001$). Likewise, the Kaiser-Meyer-Olkin value was above 0.6 ($KMO = .799$). 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 (ICL)*

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 intra-cluster linkages. 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 (Freeman 1979; Borgatti 2005). 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 (ECL)*

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 CEOs 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 CEOs 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 extra-cluster linkages (Cronbach's α = .762).

- *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 also 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 in order to smooth them.

Empirical Results

Regression models

Table 3 shows 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). Non-significant 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.

INTRODUCE TABLE 3 ABOUT HERE

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. Moreover, 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 (VIF) 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 4 shows 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* $R^2 = .246$, $p < .01$). Intra-cluster linkages displayed a statistically significant positive relationship with incremental innovation (ICL: $\beta = .276$, $p < .05$). Additionally, none of the control variables showed a significant direct relationship with the dependent variable (Firm size: $\beta = .160$, n.s.; Firm age: $\beta = -.069$, n.s.).

INTRODUCE TABLE 4 ABOUT HERE

In the second step, we introduced the two-way and three-way interaction terms in order to study possible linear moderating effects. None of the linear moderating terms were statistically significant. Furthermore, the explanatory capacity of the model was not significantly increased ($\Delta R^2 = .019$, n.s.).

In step 3, 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 4, the absorptive capacity curvilinear effect is negative and statistically significant ($\beta = -.723$, $p < .01$). 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. So, 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.

INTRODUCE FIGURE 1 ABOUT HERE

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 ($\Delta R^2 = .130$, $p < .01$). Regressors explained a significant amount of the variance in incremental innovation (*Adjusted* $R^2 = .395$, $p < .01$).

In the next step we entered the curvilinear moderating effects to test Hypotheses 2 and 3. On the one hand, we hypothesized that intra-cluster linkages 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 capacity^2 x intra-cluster linkages) into the regression equation. Model 4 in Table 4 shows that the coefficient associated with this interaction term was positive and statistically significant ($\beta = .337$, $p < .1$). Therefore, Hypothesis 2 was supported. The interaction effect between absorptive capacity and intra-cluster linkages for incremental innovation is depicted in Figure 2.

INTRODUCE FIGURE 2 ABOUT HERE

In contrast to Hypothesis 2, Hypothesis 3 posited that extra-cluster linkages 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 capacity^2 x extra-cluster linkages) into the regression equation. As shown in model 4 in Table 4, the coefficient associated with this interaction term was negative and statistically significant ($\beta = -.651$, $p < .105$. 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 depicts the interaction effect between absorptive capacity and extra-cluster linkages on incremental innovation.

INTRODUCE FIGURE 3 ABOUT HERE

The explanatory capacity of the model increased significantly after the introduction of the two quadratic-by-linear terms in model 4 ($\Delta R^2 = .058$, $p < .05$) with a relevant variance in incremental innovation explained by regressors (*Adjusted* $R^2 = .453$, $p < .01$).

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 intra-cluster linkages and low extra-cluster linkages than for firms high in both linkages. We tested the hypothesis by introducing the three-way quadratic-by-linear interaction (absorptive capacity^2 x intra-cluster linkages x extra-cluster linkages) into the regression equation. Model 5 in Table 4 shows that the coefficient associated with this interaction term was negative and statistically significant ($\beta = -.579$, $p < .1$). Thus, Hypothesis 4 was supported. Figure 4 illustrates the joint moderating effect of intra- and extra-cluster linkages on the relationship between absorptive capacity and incremental innovation.

INTRODUCE FIGURE 4 ABOUT HERE

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 ($\Delta R^2 = .039$, $p < .1$) and the variance explained in incremental innovation (*Adjusted* $R^2 = .492$, $p < .01$).

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 relationship between absorptive capacity and incremental innovation follows an inverted U-shape. Moreover, we have also 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 intra-cluster linkages has a positive effect on this relationship and, conversely, the effect of extra-cluster linkages is negative. Finally, we have hypothesized that the combination of high intra-cluster linkages and low extra-cluster linkages 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 extra-cluster linkages 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 intra- and extra-cluster linkages jointly. More particularly, as we can observe in Figure 4, at high levels of both intra- and extra-cluster linkages, 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 intra-cluster linkages, 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 intra-cluster linkages, 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. Firstly, the presence of intra-cluster linkages 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 in order 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; Schilling and Phelps 2007; Coombs, Deeds, and Ireland 2009).

Secondly, the development of a large number of extra-cluster linkages 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.

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 intra-cluster linkages are relevant for incremental innovation processes, the development of extra-cluster linkages 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 (Subramaniam and Youndt 2005; Soosay, Hyland, and Ferrer 2008; 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 in order 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, intra-cluster linkages 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 extra-cluster linkages 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 extra-cluster linkages 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 (Narula 2002; Knoben 2009). 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. Firstly, 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. Secondly, 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 in order to reduce the limiting effects produced by extra-cluster linkages at high levels of absorptive capacity. Thirdly, 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. This 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 intra- and extra-cluster linkages 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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Table 1
Incremental innovation scale items

Item	Description
1	Your company frequently improves the existing range of products and services
2	Your firm regularly applies small adaptations to the existing products and services
3	Improvements in existing products and services are introduced in the local market by your company
4	Your firm improves the efficiency of your supplies of products and services
5	Your company increases economies of scale in existing markets
6	Your firm provides services to the existing customers
7	Reducing the costs of internal business processes is a major goal in your company

Table 2
Absorptive capacity items

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)

Table 3
Descriptive statistics and correlations of the measurements

Variables	Mean	S.D.	1	2	3	4	5
(1) ACap	.094	1.088	1				
(2) ICL	3.078	.425	.275*	1			
(3) ECL	.684	1.588	-.024	-.009	1		
(4) Firm size	43.350	54.118	.662**	.405**	.124	1	
(5) Firm age	35.000	20.014	.262*	.235	.100	.324**	1

N= 92; ** $p< .01$; * $p< .05$

Table 4
Results of Hierarchical Regression Analysis

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**
Controls					
Firm size	.160	.004	-.103	-.198	-.218
Firm age	-.069	-.075	.027	.043	.025
Independent and moderating variables					
Absorptive capacity (ACap)	.168	.290*	.923***	.988***	1.027***
Intra-cluster linkages (ICL)	.276**	.350**	.212	.174	.220*
Extra-cluster linkages (ECL)	.171	.168	.053	.847**	.860**
Linear moderating effect					
ACap x ICL		-.266	-.173	-.316	-.333
ACap x ECL		-.119	-.230	.335	.286
ICL x ECL		-.111	-.143	-.179	-.021
ACap x ICL x ECL		.024	.026	-.112	.122
Curvilinear effect					
$ACap^2$			-.723***	-1.027***	-1.195***
Curvilinear moderating effect					
$ACap^2$ x ICL				.337*	.379*
$ACap^2$ x ECL				-.651**	-.860***
Three-Way quadratic-by-linear effect					
$ACap^2$ x ICL x ECL					-.579*
Model *F*	5.236***	3.601***	5.248***	5.659***	5.845***
Adjusted R^2	.246	.265	.395	.453	.492
ΔR^2	-	.019	.130***	.058**	.039*

N= 92; ****p*< .01; ***p*< .05; **p*< .1
Standardized regression estimates

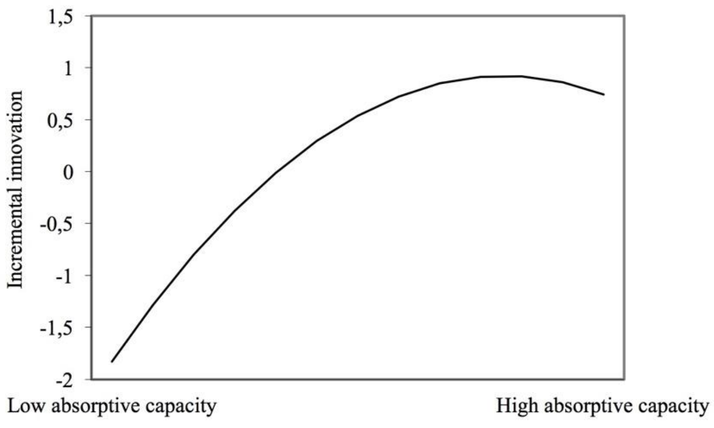

Figure 1. Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

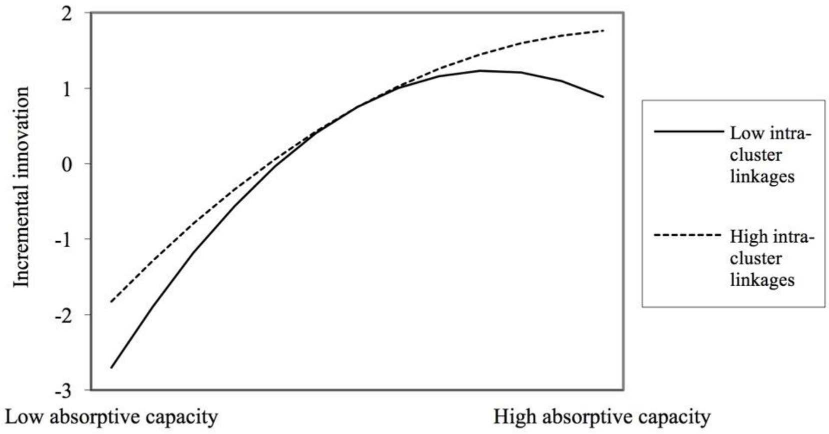

Figure 2. Moderating Effect of ICLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

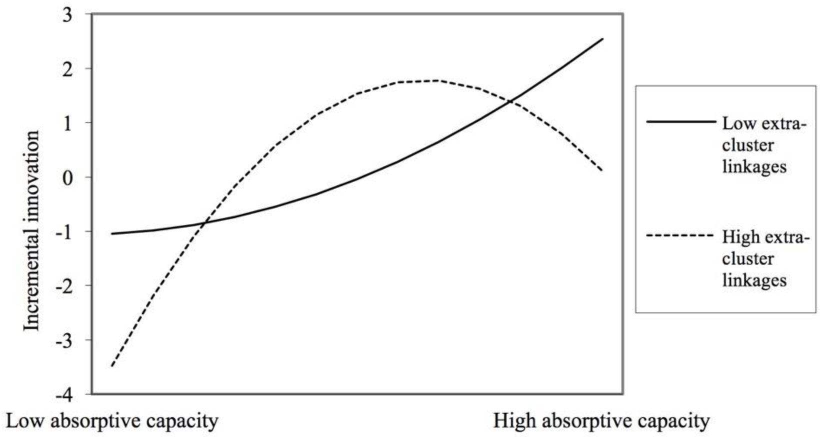

Figure 3. Moderating Effect of ECLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation

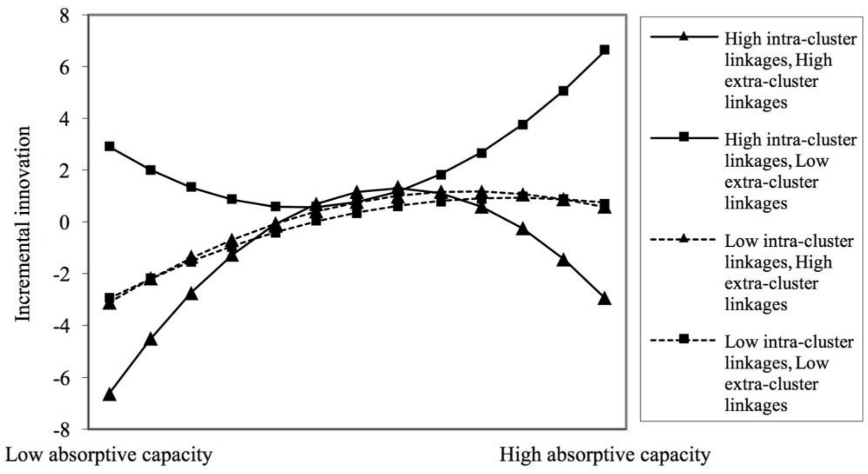

Figure 4. Moderating Effect of ICLs and ECLs on the Curvilinear Relationship between Absorptive Capacity and Incremental Innovation