

# A Literature Review on the Effect of Industrial Clusters and the Absorptive Capacity on Innovation

Enrique Claver Cortés, Bartolomé Marco Lajara, Eduardo Sánchez García, Pedro Seva Larrosa, Encarnación Manresa Marhuenda, Lorena Ruiz Fernández, Esther Poveda Pareja

## I. INTRODUCTION

**Abstract**—In recent decades, the analysis of the effects of clustering as an essential factor for the development of innovations and the competitiveness of enterprises has raised great interest in different areas. Nowadays, companies have access to almost all tangible and intangible resources located and/or developed in any country in the world. However, despite the obvious advantages that this situation entails for companies, their geographical location has shown itself, increasingly clearly, to be a fundamental factor that positively influences their innovative performance and competitiveness. Industrial clusters could represent a unique level of analysis, positioned between the individual company and the industry, which makes them an ideal unit of analysis to determine the effects derived from company membership of a cluster. Also, the absorptive capacity (hereinafter 'AC') can mediate the process of innovation development by companies located in a cluster. The transformation and exploitation of knowledge could have a mediating effect between knowledge acquisition and innovative performance. The main objective of this work is to determine the key factors that affect the degree of generation and use of knowledge from the environment by companies and, consequently, their innovative performance and competitiveness. The elements analyzed are the companies' membership of a cluster and the AC. To this end, 30 most relevant papers published on this subject in the "Web of Science" database have been reviewed. Our findings show that, within a cluster, the knowledge coming from the companies' environment can significantly influence their innovative performance and competitiveness, although in this relationship, the degree of access and exploitation of the companies to this knowledge plays a fundamental role, which depends on a series of elements both internal and external to the company.

**Keywords**—Absorptive capacity, clusters, innovation, knowledge.

Enrique Claver Cortés is with the Department of Business Organization, Alicante, Postal Code 03690 Spain (phone: 0034 965 903 605; fax: 0034 965903606; e-mail: enrique.claver@ua.es).

Bartolomé Marco Lajara is with the Department of Business Organization, Alicante, Postal Code 03690 Spain (phone: 0034 965 903 400 Ext. 2538; fax: 0034 965909789; e-mail: bartolome.marco@ua.es).

Eduardo Sánchez García is with the Department of Business Organization, Alicante, Postal Code 03690 Spain (phone: 0034 965 903 400 Ext. 3153, fax: 0034 965909789; e-mail: eduardo.sanchez@ua.es).

Pedro Seva Larrosa and Lorena Ruiz Fernandez are with the Department of Business Organization, Alicante, Postal Code 03690 Spain (phone: 0034 965 903 400 Ext. 3156, fax: 0034 965909789; e-mail: pedro.seva@ua.es, lorena.fernandez@ua.es).

Encarnación Manresa Marhuenda and Esther Poveda Pareja are with the Department of Business Organization, Alicante, Postal Code 03690 Spain (phone: 0034 965 903 400 Ext. 3274, fax: 0034 965903606; e-mail: encarnacion.manresa@ua.es, esther.poveda@ua.es).

IN today's global markets, where the degree of dynamism and competition is very high, companies must make constant efforts in innovation to try to maintain or improve their relative competitive position. Thus, the innovation reaches a transcendental character to achieve a high degree of competitiveness in the organizations. An appropriate innovation strategy is essential for companies to maintain or improve their competitive position in the industry to which they belong. Therefore, it is a differentiating factor that directly influences the degree of value creation for the company's customers and, consequently, its performance.

Since the 1960s, researchers have gradually deepened their analysis of the effects of the geographical environment in which companies are located on their innovative performance and competitiveness, in an attempt to identify the main elements that influence this relationship. Despite the fact that globalization, ICT and new transport infrastructures have facilitated access to world markets, localization has proved to be an essential factor for the maintenance and development of competitiveness in companies in today's global economy. According to [57], industrial clusters represent a unique level of analysis, halfway between the individual company and the industry. Likewise, due to the growing importance of knowledge as a fundamental factor of competitiveness, the analysis of the internal factors of companies that favor the use of this valuable knowledge from external sources has also acquired relevance. In this way, the ability of companies to take advantage of new knowledge obtained from sources outside the company and combine it with previous knowledge could lead to an improvement in the innovative performance of companies and an increase in their competitiveness. Thus, the main objective of this work is to try to determine the main factors that affect the degree of generation and use of knowledge from the company's environment and, consequently, the innovative performance of companies, particularly the membership of companies in a cluster and the AC.

The work is structured as follows. After this introduction, the second section will include a brief bibliographical review of studies on clustering and their effects on innovation and competitiveness of enterprises. In the third section, the most influential work on the AC of companies and its effects on knowledge acquisition and innovation performance will be briefly examined. In the fourth section, 30 most cited works present in the subject, in the "Web of Science" database, in the time period from 2000 to 2018, will be analyzed. The fifth

section sets out the conclusions derived from the results obtained and proposes a construct that relates the companies' membership of a cluster, the AC and the results in innovation.

## II. CLUSTERS, INNOVATION AND COMPETITIVENESS

The analysis of the effects of the territorial agglomeration of companies goes back to the works of the British economist Alfred Marshall, developed at the end of the 19<sup>th</sup> century and beginning of the 20<sup>th</sup> century, who was critical of the factory system, and developed the theory of territorial agglomeration of SMEs in specific socio-economic contexts, specialized in the different phases of the productive process of their main industry ("Marshall industrial district") [65].

Since then, and especially in the last decades, localization as a fundamental factor for the industrial and socio-economic development of regions has been analyzed by several relevant authors, who have developed different models and theories regarding the territorial agglomeration of companies and regional development, establishing different concepts in this respect. Some of the most important are "Milieu Innovateurs" [1], "Cluster" [55], "Local productive system" [67] and "Hot Spots" [59], although the most widely accepted concept, and which encompasses practically all the different types of territorial agglomerations, is the "Cluster". The concept of a cluster is defined by [56] as follows:

"Geographical concentration of interconnected companies and institutions belonging to a certain field of activity, that covers a wide range of linked sectors and other entities that are important for competitiveness. These include specialized suppliers of components, machinery, services and infrastructure".

The industrial district (hereinafter "ID") is conceived as a particular type of cluster, in which the social factor, productive disintegration and the presence of networks of small and medium enterprises take on a high degree of relevance. ID is defined by [5] as follows:

"A socio-territorial entity which is characterized by the interactive presence of a community of people and a population of companies within a limited area both, historically and naturally".

According to [13], the social nature of ID, and its link with the economic sphere, is a highly relevant comparative advantage over other production models, which places ID in a favorable position to compete successfully in the markets. The social character includes, among other aspects, a close link between the inhabitants of the territory participating in the productive process and the main activity of the ID. Coordination is achieved through balanced relations of competition and cooperation between the participating companies.

IDs are made up of a group of SMEs that carry out different activities in the value chain of a given industry, companies that offer complementary products and services, public and private institutions of different kinds and other interconnected agents, all located in a given socio-economic environment. In this context, an environment conducive to interaction, cooperation and confidence-building is generated, which

favors the exchange of information and knowledge and has a positive effect on the competitiveness of enterprises [41], [57]. Although competition in ID is greater than in other geographical areas, due to the presence of a large number of direct competitors, this situation keeps companies alert, and requires them to make constant efforts in innovation to maintain their relative competitive position in the market. Likewise, there are other factors derived from the structural and relational context of ID that favor the competitiveness of companies, such as the development of a high degree of productive specialization and adaptability, so that efficient, effective and flexible productive processes are developed to face the dynamism of current global competition. Thus, despite offering different perspectives, according to [58], the ID and cluster concepts can be exchanged, starting from a common root.

According to [17], the effect of these favorable production conditions derived from the location and integration of companies in a ID, which result in sustainable and measurable competitive advantages, was first coined as a "district effect" by [65]; although, due to subsequent contributions, the concept has been evolving ("cluster effect" [6], "district external economies" [29], "proximity effect" [60], among others). These effects are the result of the so-called "district economies", which are generated externally to companies, but internally with respect to ID. Reference [23] defines them as, "the set of competitive advantages derived from a strongly interconnected set of economies external to the individual firms, but internal to the district... ..these economies depend not only on the territorial concentration of productive activities (agglomeration economies), but also on the social environment in which these activities are integrated". However, although analyses related to the district effect have traditionally focused on measuring productivity to determine the competitiveness of companies located and integrated in an ID, according to [17], the capacity of companies to innovate takes on a relevant role as a determining factor of their competitiveness.

The systematic practice of innovation is born through the analysis of the environment in search of opportunities and requires a constant flow of new knowledge [25]. The location of companies in an ID is a benefit for them in terms of access to strategic resources, organizational routines and knowledge [66]. The complex relational network derived from the characteristic distribution of ID, in turn favored by geographical proximity, encourages the exchange of valuable information and knowledge, especially of a tacit nature (which is transmitted fundamentally through processes of socialization between individuals), allowing companies to learn from each other, and to maintain processes of continuous improvement. According to [30], socialization is essential for the exchange and combination of knowledge, especially tacit knowledge, within all informal learning processes.

Through the combination of explicit knowledge (fundamentally scientific-technical) and tacit knowledge derived from practice and the social context (essentially based on the experience of local society with respect to a given

productive activity), the generation and development of innovations takes place [21]. Thus, through the efforts of companies and their willingness to cooperate with other companies, agents and public and private organizations, collective learning dynamics are generated, from which innovations are developed [28]. In line with the above, [9] and [10] showed empirical evidence of the so-called "I-district effect", which refers to the dynamic efficiency of ID in terms of the greater number of innovations developed with respect to the average of the economy, based on the number of patents made. However, in addition to the internal linkages generated in the cluster, the ability of firms to integrate the value chain, both vertically and horizontally, through external linkages to the cluster, is critical to the innovative performance of firms in the context of the cluster [76].

Innovation has acquired a great prominence in recent decades as a key factor to achieve competitiveness of companies, in parallel with the gradual increase in competition in the markets, technological obsolescence, the speed of changes in the environment, risk and uncertainty arising from an increasingly globalized economy. As a result, the number and depth of works which analyze the elements that can drive the generation and development of innovations, as well as their effect on the performance of companies, have gradually increased. In this respect, there is a fundamental element related to the learning process that is essential to analyze: the AC of companies in the context of a cluster.

### III. AC, INNOVATION AND COMPETITIVENESS

The term "AC" was introduced by [18] and [19], who defined it as the ability of the company to identify (recognize the value of new knowledge), assimilate (understand and add new knowledge to the processes and routines of the organization) and exploit (apply it in obtaining new products) the knowledge of the environment, applying it to processes related to innovation and competitiveness, and emphasizing its collective character, the result of a set of individual capabilities. The company's prior knowledge base has a vital influence on the amount of external knowledge that the company is able to access and the time required to do so. In addition, increases in the company's AC allow it to anticipate market trends [20]. In line with the above, and in accordance with [38], experience in processes of acquisition and integration of internal and external knowledge, and the development of inventions improve the capacity to undertake such actions in a recursive manner. This experience, associated with the storage, recovery and application of knowledge, could be analyzed at different levels (individual, group and organizational), so that the AC of a company depends, in addition to the set of capabilities of the individuals who make up the company, on their individual motivations, the organizational culture of the company, its strategies and structure, as well as the relations with the environment and the different procedures established within it [43]. Thus, the AC is an essential element in the processes of creation of knowledge of the companies [27].

AC would later be considered a fundamental element of the

so-called "Dynamic Capabilities" [35], [46], [73], which provide a dynamic approach to the existing theory of resources and capabilities and, according to [70], allow the company to integrate, build and reconfigure resources and capabilities to generate solutions to changing environments. In this way, AC allows companies to efficiently and effectively carry out processes of acquisition, assimilation, transformation and exploitation of external knowledge, which have a dynamic character and contribute to the increase, organization and direction of knowledge towards the achievement of company objectives in turbulent environments, and favor the generation of sustainable competitive advantages [42], [72], [78]. Thus, AC is a fundamental pillar when it comes to generating and promoting the set of dynamic capabilities [16].

Reference [78] brings a new approach to the concept of AC, and defines it as "a set of organizational routines and processes that allow the company to acquire, assimilate, transform and exploit external knowledge". In reference to the detailed process, these authors group the four dimensions into two categories: "potential AC (PACAP)" and "realized AC (RACAP)". The first refers to "acquisition" and "assimilation", while the second refers to "transformation" and "exploitation" processes. To this end, they rely on the argument that "the organization can acquire and assimilate knowledge, but does not necessarily have the capacity to transform and exploit it to generate profits". They emphasize that knowledge can travel several times the distance between assimilation and transformation processes, prior to its exploitation and/or successful application, and they link the initial concept of AC with the set of strategic processes developed with the aim of generating dynamic capabilities. Thus, gradually, AC began to be conceived as an essential dynamic capacity of companies, which can influence the innovative performance of the company and be a source of sustainable competitive advantages [63].

In recent years, several authors have contributed with their research to deepen the analysis about the factors that determine the degree of AC in companies. Reference [72] determines that the appropriate valuation of new knowledge from the environment is essential, since the company's capacity to absorb and assimilate it depends to a great extent on this. Reference [37] distinguishes between internal determinants, such as prior knowledge and its management, organizational learning, culture, age and size of the company, and external determinants, such as the degree of dynamism of the environment, geographic proximity and the type of technological opportunities available to the organization. Reference [75] establishes the degree of organizational knowledge resulting from experience in the application of the AC, the formalization of the knowledge acquisition process and the social integration mechanisms associated with the internal functioning of companies. In addition, the company's human capital, investment in R&D and an appropriate design of the organizational structure, which facilitates the dissemination of knowledge, are relevant elements that influence the degree of AC [40], [61], [64], [74]. Reference [2] differentiates between the determinants of "PACAP" and

"RACAP". Thus, PACAP draws on the main external sources of knowledge available to companies (other companies both horizontally and vertically, and institutions of various kinds, among others). For RACAP, the effort made in the different phases of the innovation, knowledge management and technological processes is essential. Reference [26] argues that the flexibility of companies with respect to deviations from established rules is fundamental to the increase of AC, as it gives participants a certain margin to shape organizational processes according to their attitudes and priorities.

Based on the previous works, it can be determined that three of the main determinants of AC are cognitive factors, organizational factors and those related to the environment. Thus, belonging to a cluster could favor the generation and/or increase of its AC, as a result of the effects derived from geographical proximity and belonging to a certain socio-economic environment, in which the actors share certain cognitive characteristics, especially the vision about the way of understanding business, behaving and interacting.

#### IV. CLUSTERS, AC, INNOVATION AND COMPETITIVENESS

According to the literature analyzed, the companies' membership in a cluster and their degree of AC are two fundamental factors for companies to achieve adequate innovative performance and be competitive in today's markets. Based on the above, we will now go deeper into the analysis of these factors.

##### A. Methodology

The following search equation has been introduced in the "Web of Science" platform: "absorptive capacity" AND "Innovation" AND "cluster\*" OR "industrial district\*" present in the topic, establishing the temporal period from 2000 to 2018, selecting all the categories, and the type of document "article". As a result, 292 articles have been obtained. They have been ordered by number of citations in descending order, and the 30 most relevant papers have been selected, using as a criterion of relevance the number of citations obtained by each of them in the Web of Science database. With regard to the search, only articles were selected as, according to [14], they are considered documents whose knowledge has been certified through critical review by experienced reviewers.

Once the work obtained as a result of the search equation was analyzed, it was grouped according to its main objectives, and the conclusions obtained were examined to try to determine the main factors that affect the degree of use of knowledge from the company's environment.

##### B. Results

In a first block, four papers have been compiled that address the analysis of social capital and social networks in the context of a cluster, corresponding to [15], [48], [51] and [52]. Its main objective is to analyze the effects on innovation arising from the establishment of social networks in the context of a cluster, joint technological learning and appropriate use of ICTs to encourage and improve communication. In this way, they try to improve the understanding of the process of

creation of social capital in the company, as well as to analyze the impact on its innovative performance derived from certain elements that make up its social capital, such as social interactions, trust, the existence of a shared vision and the involvement of institutions, all in the context of a cluster. Two of them carried out an empirical analysis, in which innovation was established as an independent variable, and the other two carried out a literature review and a case study, respectively. The conclusions coincide in highlighting the positive influence that social capital has on the innovative performance of companies, as well as its multiplier effect, since sharing knowledge capital generates a greater amount of knowledge. They also highlight the positive effect of geographical and cognitive proximity on the degree of interaction, cooperation, trust and the establishment of social, economic and professional networks, both between companies and between companies and institutions of various kinds. They indicate that enterprises need access to the intellectual property of other enterprises, and competition and cooperation can and should coexist, emphasizing the importance of synergies arising from cooperation between actors with complementary resources and capabilities. To this end, the effective use of ICTs is beneficial to all economic operators. However, they explain that generally, from a certain point onwards, the degree of interaction may lose effectiveness, so that each company will have to determine the degree of development of its social capital factors, according to its needs over time. Finally, they stress the importance of social capital as a key factor in the development of the regions, its uniqueness and extreme difficulty in imitating it, its participation in the collective personality of the regions, where innovation takes place and the importance of non-local links on innovation performance. In general terms, the knowledge society and economy depend on knowledge stocks and flows to function, prosper and grow.

The 10 papers that make up the second block, corresponding to [3], [4], [22], [24], [34], [39], [45], [47], [49] and [54], address objectives focused on the analysis of cooperative-competitive interactions, examining the means through which companies and other agents communicate, with the aim of generating and/or obtaining new knowledge from both external sources ("pipelines") and internal ("buzz") to the cluster that will favor local learning and the dissemination of innovations. They also try to examine the main factors that influence the generation of new communication channels between companies and agents, and the intermediary role that various agents can play in this relationship. Regarding the methodology, seven of them carried out an empirical analysis, and the remaining three developed their study from a literature review. With reference to the conclusions obtained at the overall level, they highlight the importance of geographical and cognitive proximity, as well as the role of institutions, in the access of companies located in a cluster to a wide and diverse network of external knowledge sources ("pipelines"). This is one of the most important localization capabilities and it has a positive influence on the acquisition of new knowledge, as well as on the quality and diversity of the local "buzz", understood as those learning processes that take place

as a result of the interaction derived from the relational links of the agents integrated in a community. In reference to the nature of the connectivity of internal cluster resources with the global economy, they determine that more decentralized relational structures (*ceteris paribus*), where each cluster participant has independent access to certain global links, offer better opportunities for entrepreneurship and innovation development. However, although the dissemination of innovations is greater among geographically close links (both in terms of cooperation and rivalry), the AC of companies plays a key role in the dissemination of knowledge derived from social interaction and collective learning processes, especially that of the tacit type. In this sense, although geographic and cognitive proximity plays an essential role in fostering the relationship between university and industry, and previous experience in this type of collaboration increases the probability of occurrence, geographic proximity to technologically complementary companies diminishes the importance of this collaboration between university and industry. In line with the above, the role of business associations as intermediaries in this relationship, which depends largely on the AC of its members, is noteworthy. In this sense, the R&D efforts made by companies, in addition to having a positive impact on their innovative performance, increase their knowledge base, as well as their AC. In this way, it should be noted that the geographic economy, in addition to analyzing relations at the inter-business level, should focus on the inter-personal level.

In the third block there are three works corresponding to [11], [62], and [69]. These studies analyze the determining factors of the degree of inter-enterprise cooperation in the context of a cluster, although they approach this task from different perspectives. They thus explore the effect of geographical and technological proximity on the efficient access of companies to the flow of knowledge from other agents, the elements that influence the attractiveness of new companies to established ones when it comes to establishing cooperation agreements, the carrying out of R&D activities between companies belonging to different industries, which have complementary skills and a convergence in their innovation objectives. (The relevance of this last element for companies when it comes to successfully undertaking R&D projects is highlighted, given the limited nature of the Autonomous Community). The methodology used in the three papers is empirical analysis. In reference to the conclusions, it is determined that physical proximity increases the probability of exchanging knowledge, promoting cooperation through the development of social networks that enhance the joint implementation of technological and innovation programs. When establishing an R&D cooperation agreement, the initial phases of the decision process are essential, as well as the detailed definition of the project to be carried out, so that the partner can contribute its knowledge and exploit its AC. As for the attractiveness of new companies to be selected as alliance partners by established ones, the main factors that influence are, in order of relevance, their degree of public ownership, the development of new products, economies of scope, and

their geographical location within the cluster. In this cooperative relationship, while both large established companies and new entrants benefit, the former do so to a greater extent. In those companies that do not belong to a cluster, reputation in innovation is a relevant substitute to attract the attention of other sources of knowledge, both between clusters and between countries.

The fourth block is constituted by three publications: [33], [44], and [53]. Its main objective is to analyze the role played by "gatekeepers" in relation to knowledge dissemination in the context of a cluster, the definition of their relevant characteristics and the interaction patterns that take place between them and the different actors that make up a cluster. In terms of methodology, these works employ a case analysis and two empirical analyses, respectively. The conclusions obtained show the importance of reducing the cognitive distance between the different actors that make up the cluster, in order to favor potential combinations of knowledge resources that can create value, exploiting the same technological path. When it comes to absorbing new knowledge, public research organizations act as "gatekeepers" to a greater extent than private actors, although the leading companies in the cluster play a key role as knowledge "gatekeepers". As for the process of combining the new knowledge acquired and the previous one by the companies, it requires specific organizational mechanisms. In the context of a cluster, knowledge codification can generate externalities from the creation of new opportunities to combine and absorb knowledge (concept of "knowledge management platform" that proposes new dynamics of interaction, both at a cognitive and political level). In the case of leading private companies, interaction with agents outside the cluster is essentially developed and maintained by specific departments within the cluster, which simplify, codify and/or transmit a large flow of information and knowledge, acting as a filter that guarantees, as far as possible, the quality of the information and knowledge that is incorporated into the local knowledge system. However, an excess of power on the part of the leading companies can have detrimental effects on the degree of cohesion of the relational network, since knowledge is not widely disseminated from the "gatekeepers" to the companies in the cluster, but tends to reach a small number of companies. According to this, the effectiveness of the companies' AC, which is more relevant than size in terms of the use of regional social capital, would require additional efforts regarding knowledge transfer within the cluster. In this line, the regions should present a balance between internal "buzz" relational networks and external "pipelines". To this end, one of the main barriers to be overcome to encourage interaction between companies is the fear of leaks of specific knowledge from the company itself.

The fifth block includes three papers: [31], [68] and [77]. Thus, its objective is to analyze the degree of acquisition, assimilation, transformation and exploitation of knowledge from sources outside the company, from the perspective of internal resources and capabilities, in the context of a cluster. As for the methodology, two empirical analyses and a

theoretical development based on a review of the literature are developed. In reference to the conclusions obtained, the AC of the companies influences the learning dynamics within the cluster. Consequently, knowledge is not uniformly dispersed within the cluster, but rather it is concentrated and flows within a certain "cognitive" core of companies with a high degree of AC. From the perspective of organizational learning, in which knowledge is measured in terms of the number of existing knowledge nodes and the links generated between them, it is determined that, in order to learn, in addition to adding new nodes to the structure, organizations can vary the links that their current knowledge nodes have. Likewise, in order to try to explain the different levels of access to knowledge that result in sustainable competitive advantages, a distinction is made between two fundamental types of knowledge:

- Component knowledge: Specific knowledge (resources, skills and technologies) related to identifiable parts of the organizational system of a company linked to a given industry.
- Architectural knowledge: The set of structures and routines developed by a company to coordinate and integrate its "component knowledge" into patterns for productive use and to develop new knowledge, which is specific to each company and, due to its endogenous nature, evolves with it, as an inseparable part of the organization.

In this respect, they conclude that cluster members develop a competitive advantage over non-clusters in so far as they have common access to component knowledge, although this situation does not allow them to develop individual competitive advantages over other cluster members. However, these companies may develop a particular "architectural knowledge", depending on their capacity to absorb the "component knowledge" of the cluster, with the aim of generating a competitive advantage with which to achieve a higher performance than the rest of the companies in the cluster. In addition, they propose the possibility of the cluster as a unit developing its own "architectural knowledge", the assimilation of which will depend on the AC that the companies located in it have. In summary, in the context of a cluster, the internal resources and capabilities developed by companies, especially the AC, influence the acquisition and exploitation of external knowledge, as well as the achievement of sustainable competitive advantages.

The five papers that make up the sixth block deal with the analysis of the internal resources and capabilities of companies, but in relation to their explanatory effect on the innovative performance of companies in the context of a cluster: [7], [8], [12], [32], and [36]. The common objective of the work is to explore the combinations of internal and relational resources and their importance on the management and results of learning processes, innovation, and value creation of companies in the context of a cluster. In terms of methodology, they all conducted an empirical analysis. The findings show that company strategies shaped by internal and relational resources influence innovative performance and

partially shape the dynamics of clusters, so that the more intense their joint exploitation, the better the result on company performance. The external resources of the clusters are combined and exploited in different ways depending on the internal resources available to the companies and, although geographical proximity and the degree of integration in the cluster act as factors that drive the dissemination of knowledge and positively affect the companies' innovation processes, internal resources play a crucial role in companies' access to them, requiring a certain degree of AC among them in particular. In this line, the internal knowledge of companies, and the link between their internal competencies, determines their capacity to acquire knowledge from external sources and combine it to create an innovation. A greater variety of external interactions require a greater effort in the internal management of innovation. However, it is not only a matter of increasing the number of external sources of knowledge linked to a high intensity of innovation management internally, but each set of innovation management practices is linked to a particular search strategy. With regard to value creation, in order to develop the capacity to create new value for the client, companies must build three types of competencies: AC of external knowledge, general organizational competencies and relational competencies. The AC is crucial for the effective exploitation of external know-how, as well as to benefit from complementarities between internal and external resources. It can be enhanced by an innovative, proactive, risk-taking organizational culture and multidisciplinary coordination, and must be aligned with organizational processes and relational capabilities.

Finally, the last two works, developed by [50] and [71], present the main objective of analyzing the dynamics and evolution of clusters with respect to their main industry, as well as the characteristics of companies and the knowledge network. The methodology applied by both is a literature review. The conclusions obtained show that the clusters go through different levels of development, which differ from those of the main industry. These can be described, in addition to the number of companies and employees, with respect to the diversity and heterogeneity of the knowledge they possess. Thus, the pattern of geographic concentration in an industry co-evolves along with three entities: the firm, the industry and its technological qualities, and the patterns of interaction that describe the relational networks among firms in the industry. Thus, each stage of the life cycle of a cluster presents different combinations in terms of variety and number of companies, characteristics of the technological regime, density of relational networks and efficiency of the clustering effect. They determine that, despite its relevance, the literature on clusters does not give much importance to the heterogeneity of internal capabilities presented by companies located in a cluster, tends to overestimate the proximity effect, to underestimate the role of relational networks, and barely addresses the origin and evolution of clusters. Companies located in clusters with a high degree of heterogeneity show a better performance over time than companies located in permanent and relatively homogeneous clusters. Clusters can

increase their heterogeneity and self-renew by expanding their boundaries.

By way of summary, the most important factors that, according to the literature reviewed, influence the degree of

use of knowledge from the environment by companies and their innovative performance in the context of a cluster are indicated in Table I.

TABLE I  
 FACTORS THAT INFLUENCE THE DEGREE OF USE OF KNOWLEDGE FROM THE ENVIRONMENT BY COMPANIES

Geographic, cognitive and technological proximity	Positive effect on the degree of interaction, cooperation, trust, social capital and development and diffusion of innovations, as well as on entrepreneurial opportunities. It favors the combination of knowledge resources related to the same technological path and, with it, the creation of value and the generation of sustainable competitive advantages.
AC	It is essential for the effective exploitation of external knowledge, to take advantage of the complementarities between internal and external resources, in the processes of social interaction and collective learning from which knowledge is disseminated. It is more relevant than the size of the companies when taking advantage of the regional social capital, since knowledge is concentrated and flows among a certain cognitive core of companies with a high degree of AC. The larger their previous knowledge base, the greater the link between their internal skills and good practices in terms of innovation management. It favors the generation of sustainable competitive advantages.
Share capital	For each company there is a degree of development of the social capital in which its utility is maximized, and from which it loses effectiveness.
Pipelines	Geographically dispersed sources of knowledge is one of the most important localization capabilities, and positively influences the acquisition of new knowledge, as well as the local "buzz" learning processes and the development of innovations. Regions should have a balance between internal "buzz" networks and external "pipelines".
Previous collaborative experience	It increases the possibilities of collaboration between university and industry.
R&D efforts	They have a positive impact on the innovative performance of companies, increase their knowledge base and their AC (given the limited nature of AC, these are a good complement to it, which contributes to the success of R&D projects). Its detailed definition facilitates the use of AC, in those joint R+D projects.
ICT	Its effective use results in a benefit for all economic operators.
Business Associations	Their effectiveness is largely due to the AC of their members, and they play a mediating role in university-industry cooperation.
Degree of attractiveness of companies	When selecting alliance partners, companies established in a cluster assess new entrants, in order of relevance, their degree of public ownership, new product development, economies of scope and geographic location. It should be stressed that the degree of attractiveness will have a decisive influence on the establishment of cooperation agreements. In the case of those not established, the reputation in innovation is fundamental.
"Gatekeepers"	Public research organizations act as "knowledge gatekeepers" to a greater extent than private ones, although within the latter, leading companies play an essential role. They act as a filter that guarantees the quality of information and knowledge that is incorporated into the local knowledge system. An excess of power on the part of these leaders can have negative effects on the degree of cohesion of the relational network.
Knowledge coding	It allows the generation of externalities by creating new opportunities to combine and absorb knowledge.
Fear of knowledge leaks	Companies need to understand that the potential benefits of cooperation are, in most cases, greater than the costs, in order to overcome the fear of information and knowledge leakage from the company itself.
Knowledge nodes	To learn, in addition to increasing the number of knowledge nodes, companies can vary the links between them.
Relationship between internal and relational resources.	The more intense their joint exploitation, the better the result on the innovative performance of the company.
Degree of integration of the company in the cluster	It favors the acquisition of knowledge, as well as cooperative relations with companies and agents of various kinds belonging to the cluster.
Ability to create new value for the customer	It will depend on three types of skills: The AC of external knowledge; The organizational competencies of the company; Relational competencies. The combination of the company's internal competencies will determine its ability to acquire knowledge from external sources and combine it to generate innovations.
Organizational culture	An organizational culture that is innovative, proactive, that rewards risk taking, promotes multidisciplinary coordination and aligns with organizational and relational processes, enhances the company's AC.
Origin and evolution of clusters	Each stage of the life cycle of a cluster presents different combinations in terms of variety and number of companies, characteristics of the technological regime, density of relational networks and efficiency of the clustering effect. Companies located in clusters with a high degree of heterogeneity show a better performance over time than companies located in permanent and relatively homogeneous clusters.

## V. CONCLUSIONS

The current market dynamics force companies to continuously improve their performance, through the generation of innovations that favor the creation of value at different levels. In line with the above, the geographical proximity of companies, institutions and other agents of various kinds, linked to a main industry, generate a series of positive externalities available to companies. One of the main ones is the access of the companies to new useful knowledge, generated both internally and as a result of the interaction between the actors located within the cluster, as well as

between these and other external agents, and which is the fuel that feeds the machinery of innovation. As determined in the theoretical development, innovation is an essential element for companies when it comes to maintaining or improving their competitiveness, since it directly influences the degree of value creation for customers.

In determining the factors that favor the development of innovations, there is a certain consensus on the part of the scientific community regarding the role played by the socio-economic environment in which companies are located. Geographical and cognitive proximity allows the generation of

links between companies and other agents, from which certain cooperative-competitive relationships are generated. As a result, a series of synergies arise from the complementarities of resources and capabilities available to the participants, and the flow of valuable information and knowledge, from which innovations of various kinds can be generated, increases as confidence among the actors increase. However, in addition to the analysis of the environment as a relevant factor in the competitiveness of companies, it is necessary to explore the internal factors of companies. As we have mentioned, knowledge is a key element in the process of generating innovations. Although various environmental factors affect the quantity and quality of external knowledge available to companies, it is the internal characteristics of the latter that will allow it to be absorbed and applied to different processes. In this way, the AC could lead to an increase in its innovative potential which, in turn, would have effects on its degree of competitiveness. As a result of the exploration of several works focused on the analysis of AC, it has been determined that three of the main determinants of it are, at an internal level, the organizational ones, at an external level, the characteristics of the factors of the environment, and at both levels, the cognitive factors. In this way, through the combination of external knowledge, coming from the environment and internal to the company, both tacit and explicit, the potential of the company to generate innovations and the creation of value for the client would be increased, with the consequent effects for the competitiveness of the company.

From the main published works on the subject, obtained from the "Web of Science" database, it has been possible to determine the essential factors analyzed by their authors in relation to the concepts "cluster" and "AC". Thus, they address the analysis, in the context of a cluster, of social capital and the establishment of social networks, the communication channels between companies and the various sources at their disposal, the factors that influence the degree of inter-company cooperation, the characteristics and functions of the "gatekeepers" in relation to the dissemination of knowledge, knowledge management from the perspective of internal resources and capabilities, the explanatory effect of internal resources and capabilities on the innovative performance of enterprises, as well as the dynamics of the operation and evolution of clusters with respect to the main industry, the characteristics of enterprises and the knowledge network. We conclude that there is a compendium of factors affecting the degree of use of knowledge from the business environment in the context of a cluster, and it is possible to determine the relevance of the knowledge on the innovative performance and competitiveness of the companies, as well as for the growth and prosperity of the society.

On the basis of the above, a simple construct is proposed, which establishes the possible relationship between the companies' membership of a cluster and innovation, as well as the mediating effect that the AC can have on this relationship.

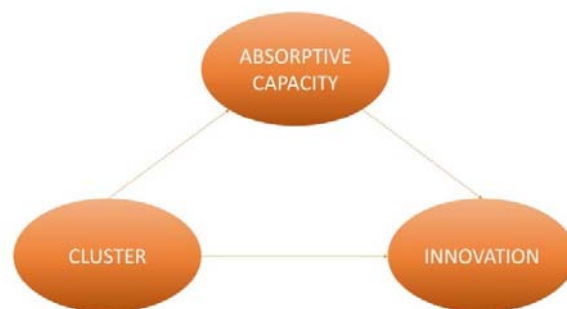


Fig. 1 Proposal of research model

This work aims to establish a basis for study to be confirmed in future projects. Thus, in subsequent works, the analysis of the proposed relationship will be deepened and an attempt will be made to empirically contrast the proposals made.

With regard to the limitations of the work, the analysis has been carried out on a small sample of 30 articles obtained from a given search equation, and a single database. This is why the nature of the study lacks the necessary breadth to draw determining conclusions, although it does shed light on the subject under study, and helps to clarify, as far as possible, the relationship between cluster membership, AC and innovation results, as well as the influence of other determining factors on the explanatory capacity of each of the constructs.

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