

The management of knowledge and the learning process in SMEs clusters: a study case

La gestión del conocimiento y el proceso de aprendizaje en los aglomerados productivos integrados por Pymes: un caso de estudio

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Abstract

Learning is a process of production and appropriation of knowledge that occurs in interaction with others. In this interaction, several studies consider the critical role developed by territory. However, the mere proximity and complementariness in the value chain is not sufficient for associativity among SMEs: the involvement of other actors (government, universities, institutions, chambers, among other) is also required. The process of interaction between them led to the development of different concepts: innovation systems, industrial districts and clusters. This paper presents guidelines and results of an investigation carried out in a metallurgical cluster integrated by ten SMEs in the Olavarría Partido in Argentina. The enquiring is focused on the processes of knowledge management in the cluster. Through an exhaustive review of the literature concerning the concepts of organizational learning and clusters, we designed a methodology analyzing the learning ability of the group.

Keywords: clusters, knowledge, nonparametric statistics, small and medium enterprises (SMEs).

Resumen

La proximidad territorial es decisiva en el proceso de producción y apropiación del conocimiento. Sin embargo, la mera proximidad y complementariedad en la cadena de valor no es suficiente para la asociatividad entre las Pymes. Se requiere la participación de otros actores (gobierno, universidades, instituciones, cámaras, entre otras) para el desarrollo de diferentes estructuras: sistemas de innovación, distritos industriales y aglomerados productivos. En este trabajo se presentan los lineamientos y resultados de una investigación realizada en un conglomerado de la localidad de Olavarría, en Argentina. El propósito fue estudiar los procesos de gestión del conocimiento del grupo. Para ello se diseñó una metodología y se utilizaron técnicas de estadística no paramétrica, con el objetivo de validar estadísticamente las conclusiones del estudio.

Palabras clave: conglomerados productivos, conocimiento, estadística no paramétrica, Pymes.

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† 27 de julio de 2012.

Introduction

As reckoned, learning is a process of production and appropriation of knowledge that occurs in interaction with others. In this interaction, various studies (Albuquerque, 2006; Becattini, 2006; Dini, *et al.*, 2007, among others) point out that territory has a decisive role: companies located in the same region often share a territorial identity that facilitates the transmission of knowledge between them. Closeness between the actors involved may enhance the social nature that characterizes the learning and innovation process. Innovation occurs in companies of all sizes, sectors and regions. However small and medium enterprises (SMEs) are those facing the greatest difficulties when trying to identify new ideas, products and practices in order to increase productivity and obtain an economic utility. They are able to overcome some of the mayor constraints they usually face: lack of specialized skills, difficult access to technology, inputs, market, information, credit, external services.

As a result, in decades there has been a significant growth of clustering of SMEs. The collaboration between these firms and different types of institutions became an element that enabled technology innovation, as it involves many actors who cooperate in the manufacture of goods or services that individually they could not carry out.

In this sense, if we look at the more common relations, where SMEs are included, we notice they usually involve actors of their own value chain (suppliers, customers, subcontractors, etc.) as well as other agents and operators in their same industrial sector. However, in Argentina the relation of cooperation between these companies does not arise *naturally*. In general, SMEs employers are quite reluctant to join partnerships with other firms. Their resistance comes from fears such as being harassed by larger partners, being replaced in their intellectual property or losing control of their company, among other reasons. This resistance to commit to perform joint operations has a high competitive cost nevertheless, especially in a market increasingly characterized by associations, in such manner that *the whole is greater than the sum of its parts*. In this sense, Porter (1998) discovered a *paradox of localization* since in a *triple w* world, ICTs (information and communication technologies) have not overcome the performance of personal knowledge.

For these reasons, the mere proximity and complementariness in the value chain is not enough to develop associativity between firms. It requires the involvement of stakeholders such as government, universities, financial institutions and institutions of association and chambers located nearby and interrelated.

The interaction between these agents led to the development of different concepts: innovation systems (Lundvall *et al.*, 2000), industrial districts (Becattini, 2006) and clusters (Porter, 1998). In particular, in this research we will analyze the joint learning ability of the companies that are part of a cluster. The literature on clusters is vast and there are many definitions provided by numerous scholars in various disciplines and regions of the world who have contributed to this debate.

However, the firms that compose a cluster keep legal independence and their administrative and managerial autonomy as well (features that reduce fears listed on the association between SMEs). Then, the different actors decide to participate in a joint effort to achieve a common goal. There are goals of different types: cost reduction, development of a new product, new links to address generation of R&D, among others. Thus, the associativity of SMEs in clusters is presented as an organizational structure that promotes the generation, acquisition and dissemination of knowledge and innovations.

The companies associated in clusters have a competitive advantage over isolated firms because of their higher collective efficiency (namely, external economies and joint actions): these enterprises compete and cooperate at the same time. Competition favors the division of labor between firms because each firm specializes itself in the development of a given productive capacity, i.e., each one concentrates its resources on the production of that in which it is more efficient. When cooperation occurs, it is possible to detect an increment in the capacity of joint response of companies to changes in demand or production. In this context, this research will focus on studying the processes of knowledge management in a metallurgical cluster integrated by ten SMEs in the City of Olavarria in Argentina, in order to discover how they learn together. To do so, we designed a methodology that both defines and measures several variables associated with the notions of organizational learning and clusters, such as externalities, joint action, governance, upgrading, cluster strategy and culture, learning styles and learning disabilities.

We are not aware of any study in Argentina that addresses this problem in clusters integrated by SMEs. Hence, the potential of this research lies in its foundation on an empirical basis and the use of nonparametric statistical techniques, which validate the conclusions obtained.

Furthermore, this work is the starting point of a larger investigation that aims at understanding the nature of knowledge of other SMEs clusters in Argentina. In this respect, this initial paper has contributed significantly to a deeper comprehension of the nature of complex processes of research that foresees certain exploratory characteristics. In the following lines, we will start by developing the limits of our theoretical frame. In

the first place, we present the characteristics of the analyzed firms and the peculiarities of the productive chain that concerns our research, and in which the cluster is inserted. Then, we explain the designed methodology and the analysis of the information we obtained about the opinion of the owners of each firm on their activity and their roll in the cluster. Finally, we will expose the conclusions and the future research lines.

1. Theoretical framework to study the relations between the actors that compose a cluster

The experience of many countries highlighted the leading role SMEs have on economic growth.

Escorsa and Maspons (2001) define macro-level competitiveness as the ability of a firm to compete, gain market share, increase profits and grow. Several studies on the topic mention that in order to make a company competitive it is necessary, on the one hand, to develop their human resources and skills; and on the other, to get external labor force through cooperation with other companies.

The closeness between the actors involved might enhance the social nature that characterizes the learning and innovation process. This fact would favor major interaction between them. Companies located in the same region often share a territorial identity that simplifies the learning process while stimulating the transfer of tacit knowledge between them.

These ideas were developed by authors such as Michael Porter (1998), who defines clusters as geographic concentrations of interconnected companies and institutions in a particular field. Roughly, clusters represent a new way of thinking about location, challenging much of the conventional wisdom on how companies should be configured, how institutions such as universities can contribute to competitive success and how governments can promote economic development and prosperity. Porter (1998) sees clusters as including:

- Linked industries and other entities, such as suppliers of specialized inputs, machinery services, and specialized infrastructure.
- Distribution channels and customers, manufacturers of complementary products, as well as companies related by skills, technologies, or common inputs.
- Related institutions such as research organizations, universities, standard-setting organizations, training entities and others.

Porter is widely credited with popularizing the term *cluster*, if not inventing it. Then, many other have offered their own variations and his definition was enriched with new concepts.

Pietrobelli and Rabellotti (2004) indicate that clustering is a major facilitating factor for a number of subsequent potential developments, including division of labor and specialization. Clustering can also facilitate the emergence of a wide network of suppliers; agents who sell to distant national and international markets, producers of specialized services, a pool of specialized and skilled workers, as well as the formation of business associations.

In views of capturing the positive impacts of these factors on the competitiveness of firms located in clusters, these authors introduced the concept of collective efficiency, which is defined as the competitive advantage derived from local external economies and joint action. Clustering offers opportunities for powerful externalities that may be grasped by SMEs located in clusters. Moreover, clustering may facilitate the development of joint actions among local actors.

Meanwhile, Gómez (2005) defines cluster as a sector or geographical concentration of companies involved in the same activities or closely related activities, which establishes cooperative and competitive links between the different actors. For him the notion of SMEs clusters refers to small and medium enterprises that are located geographically close and involved in the development of similar or complementary products. This author identified two theoretical currents: the Anglo-Saxon approach and the approach of industrial districts based on the Italian experience of the 70's and 80's decades.

After reviewing national and international literature, there is no evidence of any national statistics regarding the characteristics, forms of organization and knowledge management of SMEs clusters established in Argentina.

However, national studies based on quantitative techniques have been conducted; namely, input-output matrixes and location ratios. These studies have tried to identify relative concentrations of industries in a region, as well as to learn the relations of buying and selling in different sectors, *i.e.*, studies whose aim has been to distinguish companies whose production is geographically close, similar or complementary in order to create the cluster.

The developed models take into account quantitative techniques, but do not consider other elements that influence the formation of clusters. Within these elements, we can find the characteristics and the type of relations between the companies, the benefits of the pool, the collaboration and information flows, the conformation of solid links and, particu-

larly, the knowledge management set that is generated because of the interaction between firms.

However, the study of clusters has been addressed in depth by other countries that have been driving its formation and development for several decades. These studies led to the development of different models, such as the collective efficiency model and the model of global value chains. They are described in the following section.

1.1. The collective efficiency model

By *collective efficiency*, Pietrobelli and Rabellotti (2004) mean the combination of incidental external economies from the effects of joint actions, which helps to explain the efficiency gains of firms located in clusters, and their increased capability to upgrade and grow. This concept defines the competitive advantages enjoyed by firms located in clusters. These advantages stem from local external economies and joint action.

External economies or externalities: can be defined as positive or negative unpaid, out of the market rules, side-effects of the activity of one economic agent on other agents. Alfred Marshall first introduced the notion of external economies in his book *Principles of Economics*. He drew his insight from observations of the pattern of economic activity in the industrial districts of England. Marshall identified three reasons why groups of firms in a particular trade located near one another would be more productive than they would be separately. These reasons form the Marshallian Trinity: labor market pooling, supplier specialization, and knowledge spillovers (Cortright, 2006).

Marshall observed that a concentration of similar firms would attract, develop, and benefit from a pool of labor with a common set of skills. Individual workers could minimize their economic risk by being located in a place with many possible employers of their specialized skills. He also noticed that a concentration of similar firms created a good market for suppliers and provided the scale needed for suppliers to refine and specialize their expertise. This, in turn, worked to the productive advantage of their customers. Finally, Marshall found that in industrial districts, ideas moved easily from firm to firm as if knowledge was *in the air*. Marshall's description of industrial districts identified what economists today call *external economies*, productive benefits that are not captured by the individual firms that create them.

According to Pietrobelli and Rabellotti (2004), the most common external economies in clusters are the creation of a market for specialized skilled labor; the creation of a market for inputs, machinery and specialized inputs (increased availability, competition on price, quality and

service). This fact allows for a finer division of labor, improved market access and easy access to specialized knowledge on technologies and market and rapid dissemination of information.

Joint action: the authors indicate that joint action can take three different forms:

- Joint action within vertical linkages, including backward ties with suppliers, as well as subcontractors and forward ties with traders and buyers.
- Joint action within bilateral horizontal linkages between two or more local producers; this can include joint marketing of products, joint purchase of inputs, order sharing, common use of specialized equipment, joint product development and exchange of know-how and market information.
- Joint action within multilateral horizontal linkages among a large number of local producers, particularly through cluster-wide institutions; this includes cooperation in business associations and business development service centers.

1.2. The model of global value chains

Local external economies are important, however not sufficient to explain the growth and the competitiveness of firms located in clusters: the deliberate action by companies and other actors such as governments, cooperation organizations, research institutions, etc., is required. In this respect, the global value chain (GVC) approach helps to take into account activities occurring outside the cluster and, in particular, to understand the significance of the relationships with key external actors. The concepts or elements that form the basis of the GVC model are the following:

Value chains: it refers to each of the stages of a production process, from the transformation of raw material until the final product is obtained. Individual companies rarely undertake alone the full range of activities that are required to bring a product or service from inception to market. The design, production and marketing of products involve a chain of activities divided between different enterprises often located in different places, sometimes in different countries. The focus of value chain research is on the nature of relations between the different actors involved in the chain, and on their implications for development. For small firms in developing countries, participation in value chains is a way to obtain information about the upgrading necessary to gain access to the global market. The concept of governance is central for the analysis of these relationships.

Governance: it is linked to the organization of the cluster and it refers to the way they govern the relationships between the actors and production sectors involved in the chain of value. This concept refers to a more pluralistic notion of the State, in which the very State appears as an actor in this horizontal relation in order to promote and contribute to the interdependence and complementariness of relations inside the cluster. At any point on the chain, some degree of governance or coordination is required so as to make decisions regarding what will be produced (product design), how it will be produced (production process, technology, quality standards), and how much it will be produced. Coordination may occur through arm's-length market relations or non-market relations. In the latter case, we distinguish between three possible types of governance: networks, quasi-hierarchical and hierarchical. The first type means cooperation between firms with similar power, which share their competences within the chain. The second one is the relation between legally independent firms in which one company is subordinated to the other, and where a leader establishes the rules for all firms to follow. The third type refers to what occurs when a firm is owned by another external firm.

In contrast, in the arm's-length market relations it is the market that who governs the interactions and decision processes: the buyer and the supplier need to collaborate in the product, because it is a standard product, or because the supplier defined without taking into account the preferences of final consumers. Other authors do not consider this type of string as a form of governance.

Upgrading: that is, making better products, making them more efficiently, or moving into more-skilled activities. Upgrading and innovation are intertwined, particularly because we define upgrading as innovating to increase added value. Enterprises can achieve this in various ways, as for example by entering higher unit value market niches, entering new sectors, or undertaking new productive (or service) functions. In addition, in this context, innovation is clearly not defined only as a breakthrough into a product or a process that is new to the world. It is, rather, a matter of marginal, evolutionary improvements in products and processes, novel for the firm, and that enable it to keep up with an international standard. This involves a shifting in the activities, products and sectors that have a higher added value and higher barriers to market entry. Enterprises working in a value chain have four types of upgrading options: process, product, functional and intersectoral upgrading. Process upgrading refers to transforming inputs into outputs more efficiently by reorganizing the production system or introducing superior technology. Product upgrading means moving into more sophisticated product lines in terms of increased unit values. Functional upgrading refers to acquiring new, superior functions

in the chain, such as design or marketing, or abandoning existing functions that have low added value to focus on higher added value activities. Inter-sectoral upgrading denotes applying the competence acquired in a particular function to move into a new sector.

Likewise, Marco Dini *et al.* (2007), as a result of a research carried out with several productive integration projects driven by the Multilateral Investment Fund, adds a new type of upgrading called *mind innovation*. This new category includes the significant changes that may occur in vision, speech, opinion or attitude of the actors, as a result of their shares in the project. Certainly, the formation of clusters represents a way for SMEs to face challenges of upgrading and, in turn, its analysis seems a key for the cluster innovative performance.

Tacit knowledge: refers to the knowledge that is embedded in people. Linking the different actors of a cluster, favors the transfer for its transformation into explicit knowledge.

2. Theoretical framework to investigate learning among enterprises in a cluster

As we see, knowledge and learning are closely related concepts. The innovativeness of organizations depends largely on their ability to learn, i.e. their ability to acquire new knowledge and incorporate it into productive practices; a process that takes place in the interaction between explicit and tacit knowledge.

The process of learning and knowledge development do not occur equally in all organizations: organizations (like people) learn in different ways. These ideas led to authors such as Yeung *et al.* (1999) to conduct empirical research in order to study how organizations deal with the learning process. The theoretical concepts of Mach, Argyris, Huber and Garvin, among others, are recovered (Yeung *et al.*, 1999). This research takes many international companies into account, trying to identify factors that influence organizational learning: learning ability and the context of the organization. We discuss each of them below.

2.1. Components involved in the ability of learning

This capability includes, according to Yeung *et al.* (1999), both learning styles and learning disabilities in an organization. He identifies four learning styles. Experimentation: organizations learn through controlled experiments testing new ideas. Acquiring skills: encourage people to acquire new skills either through the recruitment of specialists or investing on training. Reference brands: companies learn by finding out how other

do it in order to adopt and adapt this knowledge in their organizations. Finally, continuous improvement: there are firms that are constantly improving what they already have done before and mastered each step before moving to the next). These styles are based upon two basic sources of organizational learning: direct experience and the experience of other. Through direct experience, organizations acquire knowledge and develop their knowledge by means of their own actions and thoughts. Using the experience of other, organizations gain knowledge without having to perform certain tasks or operations on their own (a learning style that characterizes companies such as Samsung Electronics).

Fruit of their empirical research, this author identified three pillars on which learning is based in an organization (this differentiation in types of learning made the difference between their work and that of other researchers). The first relates to the potential of a company to generate ideas: to acquire, discover, invent and substantiate ideas. This capability is directly related to the way of learning of the organization, i.e. with the dominant learning style. The second foundation is to generalize, implying shared ideas through the organization. According to the findings of Yeung *et al.* (1999), generally there are fewer companies that generate innovative ideas than those who generalize them. This occurs because generalization requires applying what has been learned, and learning occurs not only with the design of an innovative idea. The learning capacity is created not only developing ideas, but also when these ideas are shared inside the company or even outside it.

Identify disability is the third pillar mentioned by Yeung *et al.* (1999). Not all organizations have the same capacity to learn and this is because there are disabilities that hinder the generation and dissemination of ideas. These disabilities can be of different kind; Yeung *et al.* (1999) appointed seven. Blindness denotes inability to evaluate correctly the opportunities and threats in the environment. Candidness accounts for deficiencies in the analysis and generation of solutions. Homogeneity refers to lack of variety of skills, information, ideas and values. Close coupling denotes excessive coordination between the different units of the organization. Paralysis refers to the inability to implement new policies or processes. Superstition learning accounts for the inability to interpret correctly the meaning of the experience. Finally, deficiency in disseminating is related to limitations to share ideas with all the relevant parts of the organization.

The first four disabilities affect the generation of ideas, while the last three prevent their generalization.

Thus, Yeung *et al.* (1999) concluded that there are basic elements in learning, beyond the fact that organizations learn in different ways. As a

result, to investigate the learning capacity of the cluster in question we will use the theoretical foundations proposed by their research.

2.2. Factors that shape the context

The learning capacity of an organization (in this case, of a cluster) not only depends on the generation and dissemination of innovative ideas, but also on the detection of disabilities. Surely, factors such as strategy and culture have indeed an impact on this capacity.

Based on the work of Porter (1991, 1998) and Yeung *et al.* (1999), we identified fifteen business strategies, which are then grouped into the generic classification of *cost leadership* and *differentiation*. These strategies provide the focus to the quality of products or services, the provision of specialized services, the creation of employee commitment and control of distribution channels, among others.

For the diagnosis of culture, we decided to use the model designed by Cameron and Quinn (1999) as the Competing Values Framework. This model aims to identify the dominant culture of an organization based on four generic types of cultures: clan (valued human commitment, morale, participation and openness), adhocratic (attach importance to adaptability, growth and innovation), hierarchical (focus on stability, control and management of the existing bureaucracy) and market (emphasize the product, production, efficiency and clarity of goals).

In general, when we talk about organizational culture we are referring to the dominant culture. This concept expresses the values and main standards shared by the majority of the members of an organization. However, many companies have a dominant culture and a number of subcultures within it. These small subgroups have different sub-cultures.

The nature of clusters transforms these subcultures into elements of the utmost importance at the time of diagnosing their culture, since the companies that integrate these sectoral concentrations may have cultures that differ not only from one another, but also from the dominant culture of the whole.

3. Clusters as a source of knowledge and innovations

Gómez Minujín (2005) conceives clusters as a conceptual and operational unit that produces positive effects of *spillover* on the institutional and technological development: the clusters are formed not only by physical flows of goods and services but also by an intense exchange of information, knowledge and know-how. To this, Dini and Gasaly (2007: 36) adds that clusters allow the generation of quasi-public collective goods that interest

a larger number of companies, but their effects are verified only when public goods are incorporated into the competitive strategy of the beneficiary companies.

Following Hayek (1997), one would think that a cluster acts as a system of market prices, since its formation leads to identify and combine information on each company that so far was scattered and fragmented among its members. However, trust is a key aspect of cooperation and interaction between actors in the cluster, as it enables firms to improve their innovational capacity, lower transaction costs and reduce asymmetric information; such a situation could not be guaranteed by market relations. So, paraphrasing Hayek (1997) and Nonaka and Takeuchi (1999), clustering would be a way to use the partial knowledge of businesses to produce a joint organizational capacity to generate new knowledge specific to the agglomerate and dispersed, *spilling* among members and perform them in product/service innovation.

Nonaka and Takeuchi (1999), and Hayek (1997) point out that in a *knowledge-creating* company, the whole business hinges on continuous innovation. It is therefore possible to consider a production complex as a source of generation, transmission and utilization of knowledge. With the creation of a cluster, companies with different cultures, structures, learning styles, different procedures and skills, begin to cooperate and work together, and inter-organizational knowledge appears because of that cooperation. The way they handle this knowledge will promote the competitiveness of the cluster.

In light of these ideas, we present the characteristics of the metallurgical cluster analyzed in this paper.

4. A case study: the metallurgical cluster

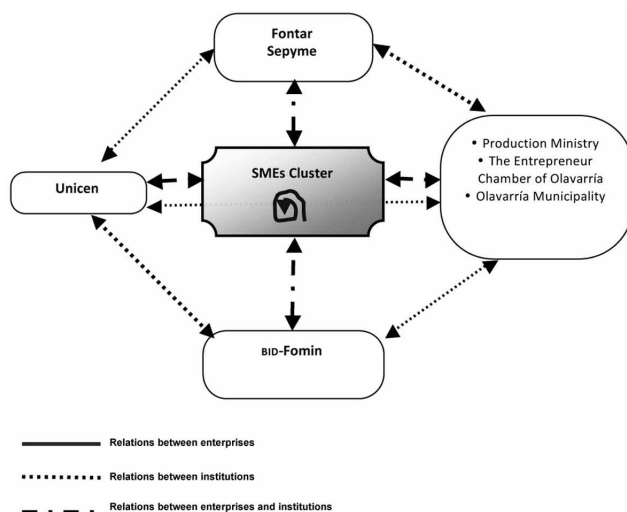
4.1. Actors of the cluster

There are nearly one hundred SMEs in the metallurgic sector (heavy industry, service providers for the industry, lawnmowers, etc.) in the city of Olavarría. These enterprises generate around 1,200 working posts. Services and products for the industry of construction, industrial assembly machining or services of industrial engineering (design projects, calculations, etc.) are offered. Many of these SMEs arose as result of the downsizing processes of local industrial plants in order to supply products and services to them. In the month of February 2007, a cluster called Group of Metallurgical Enterprises of Olavarría was created in this sector. This group is composed of ten local companies of metallurgical value chain. The formation of the cluster mainly came from the relation developed

between the National University of the Center of the Province of Buenos Aires (Universidad Nacional del Centro de la Provincia de Buenos Aires (Unicen) and the National Technological Fund (Argentinean Technological Fund (Fontar); however, other actors participated in this process as well, to name a few the Production Ministry of the Province of Buenos Aires, the Entrepreneur Chamber of Olavarría and the Municipality of Olavarría. In turn, this agglomerate is part of the Program for Local Development and Competitiveness of Small and Medium Companies in Olavarría, being one of the three projects approved and financed by the IDB in Argentina

Figure 1 shows actors involved in the cluster.

Figure 1
The actors of the cluster



Source: authors' own elaboration.

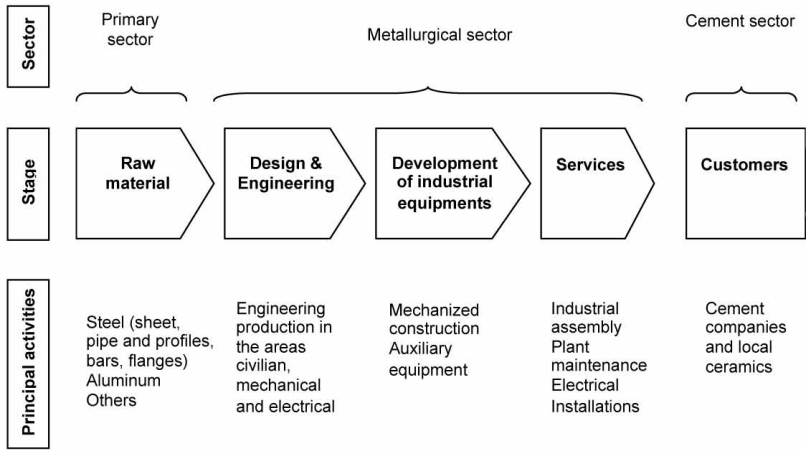
4.2. Value chain of the cluster

The cluster has a range of expertise that complements metallurgical value chain. Figure 11 provides the value chain of the group.

4.3. Characteristics of the cluster

Designing and manufacturing of machinery to allow the separation of fine powder solids (less than 50 microns) was the formation genesis of the group.

Figure II
Value chain of the cluster



Source: authors' own elaboration.

Actually, some of the enterprises make machinery to separate solids, but with a higher number of microns (between 50 and 100 microns); additionally, the separation of microparticles is the most profitable service because it has numerous uses in different markets, for example: cosmetics, abrasives, painting and medical industry.

Some companies of the cluster have already worked together in several projects, but their joint action for the development and construction of the facilities would have been hardly possible without the collaboration of Unicen and funding by Fontar.¹

At present, the manufacture of these machines is in the stage of development. Theoretical research is conducted in parallel with the design of prototypes. In this process, each company brings its production capacity and know-how, *i.e.* each SME manufactures a part of the machinery according to its own knowledge, productive capacities or participates in engineering (design, calculations and other technical specifications).

Likewise, this stage requires the use of basic and adaptive research, as well as the construction of a pilot plant or a testing laboratory; due to this reason, Unicen is working in the construction of a laboratory in which they can test the prototypes designed.

On the other side, in the medium term, the group intends to certify the manufacture of these machineries. The funds granted by Fontar include planned expenditures for both the standardization of processes of the enterprises (because, in order to achieve group certification, the individu-

¹ For more information see: Fontar report at <http://www.agencia.mincyt.gov.ar/>, Pitec Project NA 012/06.

al certification of all firms is needed), as well as the money required for the construction of the prototypes and their testing in the laboratory.

Certainly, the implementation of this whole process would not have been possible individually: the technology and costs (generally undetermined) that characterize the stages of development and introduction of a product in the market, accompanied by great uncertainty involved in the manufacture of these new equipment, represent a significant barrier to small and medium enterprises.

For the long term, the cluster plans to sell this machinery out of Olavarría, in order to achieve some independence from the activity of the cement plants. To do this, they are working on developing a corporate image and have designed a website.

Today the only equipment of microparticles separation that exists in the market is imported; in other words, if the prototypes currently under development are successful, this cluster will be making the first national machines of microparticle separation.

As it is seen, the competitiveness of this sector used the interaction of the companies with actors which not necessarily are firms but acted as a link and support to create an environment of trust and, at the same time, are making possible the construction of a pilot plant for the formation of the technological capabilities of enterprises. Therefore, historical and natural factors had an important role in the initial location of these firms, but they were not sufficient for the formation, sustainability and development of the cluster. The participation of these *bridge institutions* was a key point and it remains crucial in this regard.

5. Guidelines for research: hypothesis and objectives

General hypothesis: managing the whole of knowledge resulting in an increase in innovation processes of the cluster will need to learn the joint learning ability for the companies that are comprised in it.

Objective: examining the processes of knowledge management in the metallurgical cluster in order to investigate how the companies make learning together.

Specific objectives: to define and measure the variables that allow us to: a) analyze the joint learning of the cluster companies; b) understand the nature of cluster knowledge.

6. Methodology

We devised a methodology that allowed the achievement of the proposed objectives (understand the nature of cluster knowledge and the analysis

of their learning ability). Conversely, we sought to prioritize the significance of the results and highly emphasize their statistical linking, *i.e.*, the qualitative and quantitative aspects.

The unit of analysis was the ten SMEs that make up the cluster. Due to their characteristics these companies present (mostly family enterprises with a strong centralization on their owners as for decision-making), we decided to take their owners as units of information.

As well as designing the research, we discussed the more suitable technique for data gathering; in this regard, we discarded observation as a technique. The instrument had to be oral or written. As the qualitative and quantitative study, the in-depth or semi-structured interview was presented as an alternative. However, during the months of June and July 2009 conflicts arose between the Government and the agricultural sector. It led to road blockages and strikes involving the City of Olavarría. As a result of these difficulties we decided to adopt the poll technique. Given the number of variables, neither telephone nor structured interviews were viable. Consequently, we prepared a questionnaire to be filled by each firm (without pollster) with an almost absolute predominance of closed questions. We sent the questionnaire by email to the ten owners of enterprises under analyses. In some cases, the answer came after a few days, expressing interest in the results of the investigation. After two weeks, we contacted by telephone those companies that had not replied yet, asking for a response. Thus, it was possible to increase to seven the number of answers.

For the categorization of the variables, we used an ordinal scale because we believe that employers would find it easier to answer the survey in their own natural language, *i.e.*, by means of a numerical value. The options for each variable dimension were *enough*, *much*, *any*, *slight*, *not applicable*.

This type of scale does not support arithmetic operations with substantive meaning (Fernández, 2004). Consequently, nonparametric statistics emerged as a plausible tool for the analysis of the variables. In all cases the purpose was to verify whether there were significant differences between the responses of the companies, for it the Kruskal-Wallis test was performed.² The procedure followed for the preparation of this test was as follows:

² It is a nonparametric test that aims to verify that k independent samples come from the same population or from identical populations. The hypotheses to contrasting are: H_0 , the k samples come from the same population or from identical populations; H_1 , some of the k samples not from the same population or from identical populations.

- a) We assigned ranks to the observations from the n_i measurements from the seven companies. Rank 1 was assigned to the smallest observation, 2 to the next highest and 7 to the largest. In case of a tie, the resulting arithmetic mean was assigned.
- b) Calculate the test statistics. We resorted to GraphPad Prism V. 5.0 statistical software to do so.
- c) Set the statistical decision rule.
- d) Conclusions in terms of the problem.

Then, with the surveyed data, a data matrix for each variable was compiled.

Prior to fieldwork, we asked experts in the statistical area for their opinion about the questionnaire developed. Because of this consultation with experts, we decided to fix the same categories for all variables (measured in an ordinal scale). The purpose was to make it easier for employers to understand and answer the questionnaire, as well as to streamline the analysis and comparison later.

We then made a pretest with an intentional subsample: we selected a few owners or managers of SMES, to which the questionnaire was sent and, along with the answers, we asked for their perceptions of the questionnaire. From the answers obtained, we made some changes in the presentation and length of the questionnaire, reducing the number of questions in some sections and reformulating others.

In the final stage of the investigation, in order to corroborate some facts and further information, we communicated by telephone with the employers. From these conversations, we gained insight into the characteristics of the partnership project of the group, and the specifications of particle separation process.

Here, we present a research data sheet.

Data sheet

Type of research: descriptive
 Research design: nonexperimental Objective: applied
 Features: qualitative/quantitative
 Temporal scope: sectional/transversal
 Population: cluster companies
 Population size: 10 companies
 Data collection technique: self-administered questionnaire
 Types of questions: closed (multiple choice and categorized into an ordinal scale) and open.
 Number of replies: 7 companies
 Date: June / July 2009

7. Trade relations between companies in the cluster

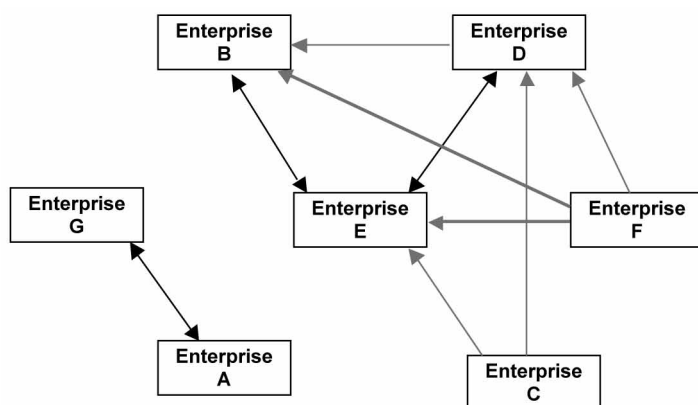
From the identification of actors involved in the cluster (figure 1) and the analysis of questionnaire data, it is possible to distinguish two typologies: institutions and companies.

In turn, taking the Porter Diamond Model (1991), we group the companies that compose the cluster as follows:

- Companies in the cluster (rival firms): compete with each other in products or markets.
- Company supplying (factor conditions).
- Associated or related companies: provide services to major enterprises such as: companies in logistics, transport services, telecommunications and information technology, consulting, etc.
- Customers (demand conditions): companies that buy the final products or services.

Applying this definition, we construct the figures that are shown below. The direction of the arrows indicates the direction of recognition; for instance: $C \rightarrow D$ indicates that C recognizes D as a rival firm. When said recognition is mutual, the arrow points at both directions.

Figure III
Rival firms



Source: authors' own elaboration.

In the previous figure, we highlight several issues. It is interesting to notice that enterprises A and G compete between them, but in a different market or products than the others. These firms principally specialize in the provision of engineering services for the industrial sector (cement and

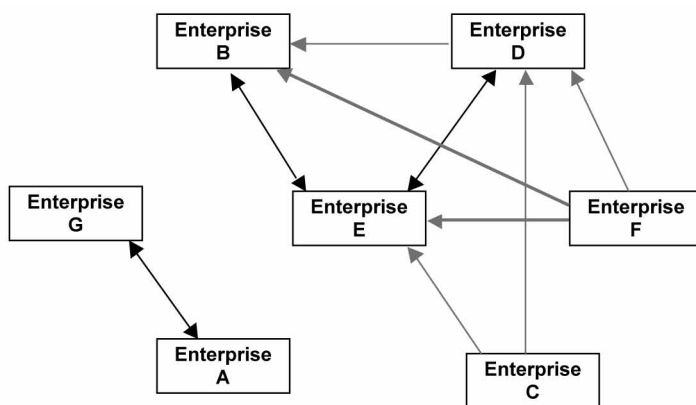
ceramics), made up of engineering projects that include design and calculation, as well as their comprehensive management. While other companies in the cluster are specialized mainly in maintenance, machining repair, assembly and construction of facilities and equipment.

On the other hand, we can also appreciate that some companies do not recognize each other as challenging. For example, company C recognizes companies D and E as rivals in the market, whereas these companies do not identify company C as a competitor. A similar situation occurs with company F and the case of companies B, D and E.

Analyzing the factor conditions in figure IV, the arrows show us the companies that supply their inputs within the cluster. Arrows that point at both sides indicate that companies are providers for one another. Meanwhile, the dashed arrow indicates that company D provides company C with logistics and transportation services.

We identify companies like G, A and B, which do not acquire inputs from any other cluster enterprise. In the case of companies G and A, both centralize their businesses on the provision of engineering services. We believe, so, that this is the reason why these firms do not require inputs (such as metal structures, machining, etc.) for the development of their activities.

Figure IV
Factors conditions ($C \rightarrow B$ means C acquires inputs from B)

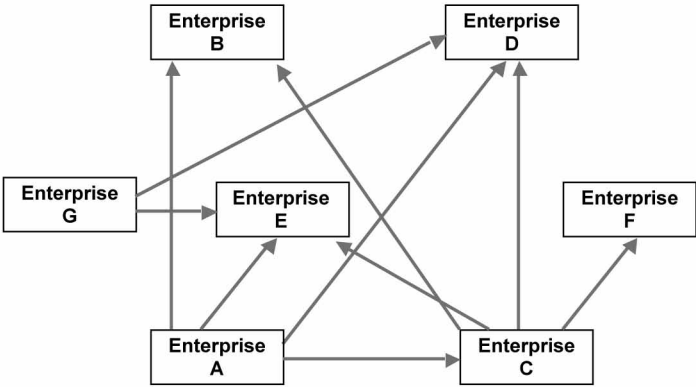


Source: authors' own elaboration.

As we see, enterprise C acquires inputs from enterprises A, B and G; it acquires inputs from D and E too but these relations are reciprocal.

At last, on demand conditions, figure V presents demand relations for products or services between the companies comprised in the cluster. The arrows indicate the *client companies*, that is, firms that buy finished

Figure v
Demand conditions



Source: authors' own elaboration.

Table 1
Collective efficiency and cluster performance concepts

<i>Concepts</i>	<i>Variables</i>	<i>Dimensions</i>	<i>Indicators</i>	<i>Categories</i>
Collective efficiency	Externalities	Skilled HR market	Impact degree of the externality	Not applicable/ Slight/Any/ Much/Enough
		Market for inputs		
		Knowledge spillovers		
Cluster performance	Joint action	Market access	18 questions were developed from the theoretical framework	Not applicable/ Slight/Any/ Much/Enough
		Vertical linkages		
		Horizontal linkages		
	Governance	Multilateral linkages	Each respondent chose the paragraph (four possible) that best represent the cluster organization	Not applicable/ Slight/Any / Much/Enough
		Network		
		Quasi-hierarchical		
	Upgrading	Hierarchical	13 questions were developed from the theoretical framework	
		Process		
		Product		
		Functional		
		Intersectoral		
		Mind innovation		

Source: authors' own elaboration.

Table 2
Cluster context and learning ability concepts

<i>Concepts</i>	<i>Variables</i>	<i>Dimensions</i>	<i>Indicators</i>	<i>Categories</i>
Cluster context	Strategy	Cost leadership	15 dimensions were evaluated within Porter's generic strategies	Not applicable/ Slight/Any/ Much/Enough
		Differentiation		
	Culture	Clan Adhocratic Hierarchical Market	16 questions were made based on empirical research developed by Yeung and the four generic types of cultures proposed by Cameron and Quinn	Not applicable/ Slight/Any/ Much/Enough
Learning ability	Learning styles	Experimentation Acquiring skills Reference brands Continuous improvement	13 questions were developed from the theoretical framework	Not applicable/ Slight/Any/ Much/Enough
		Blindness Candid		
	Learning disabilities	Homogeneity Close coupling Paralysis Superstitions learning Deficiency in disseminating	12 questions were developed from the theoretical framework	Not applicable/ Slight/Any/ Much/Enough

Source: authors' own elaboration.

products or hire services within the cluster. We notice that companies B, D, E and F buy products from some other enterprises, but do not sell their products within the cluster. For instant, $A \rightarrow C$ signifies that C is a client of A.

Having identified trade relations between companies, we present below the variables analyzed to learn the cooperation relations, learning styles and learning disabilities of the cluster.

8. Analysis of variables and results

The following table presents the variables related to the concepts mentioned in the theoretical framework. In table 1 we observe the variables re-

lated to the concept of collective efficiency, organization and performance of cluster; as for the variables related to the context of the cluster and their learning ability, they are presented in table 2.

In the following section, in the first place, the results of each variable are discussed³ and, then, we expose a summary of them in table 4.

8.1. Collective efficiency: externalities and joint action

With the surveyed data, we compiled the data matrix for the *externalities* variable. Then, we identified the median for the external economies recognized by Pietrobelli and Rabellotti (Skilled HR market, market for inputs, knowledge spillovers and market access) and carried out Kruskal-Wallis test. From the p value summary obtained in this test ($p = 0,0568$), we concluded that this sample supports the null hypothesis that there is not significant difference between the responses of companies. Such a circumstance validates the consideration of the median as a representative measure.

It makes sense to conclude that the cluster has an important competitive advantage by having workers with specialized knowledge and a sizable presence in the local market. This advantage is based on the geographic proximity of the companies. However, the formation of the cluster has not stimulated in the same way the exchange of information and expertise between companies, as well as the availability of inputs between them. We have already pointed out this situation on figure iv.

On the other hand, taking into account the classification proposed by Pietrobelli and Rabellotti (2004) (vertical, horizontal and multilateral linkages), we elaborated eighteen questions for the *joint action* variable. Then we carried out the questionnaire using a procedure similar to that mentioned in the previous variable: preparation of the data matrix, identification of the median for each link and performing the Kruskal-Wallis test.

In the analysis of multilateral and vertical links, the p values obtained are sufficiently high to support the null hypothesis of equality ($p = 0,0514$ and $p = 0,4232$, respectively). Therefore, there are no significant differences among the responses of companies in these links. While the p value calculated for horizontal links indicated the rejection of the null hypothesis, this is to say, at least a couple of companies presented significant differences (* $p < 0,05$) in their answers; so, which enterprises are they? To answer the question we resorted to the Dunn's post test.⁴ This

³ For a better understanding of the quantitative aspects of this investigation, it is possible to consult the following papers: Marsanasco *et al.*, 2010a and b.

⁴ Dunn's post test compares the difference in the sum of ranks between two columns with the expected average difference (based on the number of groups and their size).

way, the discrepancy between companies E and G was noticed. In particular, the most significant difference was found in the dimension *Creation of test or measurement of facilities*, for which the company E considered that joint actions had heavy impact, while enterprise F signaled that co-operation in this regard was poor.

Summarizing, the data analysis reveals a weak development of vertical, horizontal and multilateral linkages. In the case of vertical linkages, there is a slight joint action of firms regarding the access to credit and the joint enrollment of specialized consulting. Then, with regard to horizontal linkage, the data exhibit *any* cooperation in the creation of specialized training centers. Later, we observed *any* joint actions for the development of projects in cooperation with institutions (multilateral links).

8.2. Cluster performance: governance and upgrading

For the *governance* variable, each respondent chose the paragraph (four possible) that best represent the cluster organization. Unanimously, all companies chose the corresponding paragraph relating to the types of networks, *i.e.*, the enterprises were identified as a cluster integrated by independent and similar firms that define the product together and combine complementary powers.

Moreover, the analysis of *upgrading* variable followed the same procedure defined for the variables *externalities* and *joint action*. The Kruskal-Wallis test validated the identification of the median because in all types of upgrading the differences between the answers of companies were no significant.

Upgrading in *mind innovation* was presented as the most important type reached by this cluster. The majority of the answers demonstrate acceptance and real understanding of the concept of collective action.

Also, the formation of the cluster favored in *any* to the implementation of the lessons learned in other industrial sectors (intersectoral upgrading), but it has encouraged *slight* the update in modernization and innovation, in terms of production system, product line, use of new materials, incorporation of a higher design content, development of new products, and adding new features to the value chain (process, product and functional upgrading).

8.3. Cluster context: strategy and culture

According to data analysis, the implementation of a generic strategy of differentiation was identified. In particular, it highlighted the development of new products and offer specialized product together. Also, the associa-

tive impulse encouraged (but to a lesser degree) the implementation of the strategies related to R&D like the development of technologies in the operations, innovation in marketing techniques, improved operational efficiency and product quality.

However, the responses of companies for this variable presented very significant differences for the typology of cost leadership and highly significant for differentiation strategy. Then, we calculated the post testing, the results of which are presented in table 3.

Table 3
Comparison of generic strategies

	<i>Different</i>	<i>p value</i>
Cost leadership	Between enterprises A and G	**p < 0.01
Differentiation	Between enterprise G whit companies A, C and E	***p < 0.001

Source: authors' own elaboration.

For the strategy of *cost leadership*, we detected that company A stated considering *not applicable* the extent to which cluster strategy focuses on aspects such as competitive pricing and the development of technology operations. Instead, company G considered that these notions have *much* incidence on the definition of the overall strategy of the cluster.

Then, examining the difference between answers in the strategy of differentiation, we can see that the responses of enterprise G are the most dissenting. This company denoted as important (*much*) a good number of the dimensions that refer to this type of generic strategy. In our opinion, we believe that this assessment (more optimistic than others) is based on the reasons that drove this company to joint the group: this firm decided to joint the cluster with the purpose of forming an engineering company to provide the services demanded by the industry.

The differences found make it evident the existence of dissimilar notions among enterprises about the strategy followed by the *cluster*.

In the diagnosis of the cluster culture, we identified the median for each culture defined by Cameron and Quinn (1999). The analyses emphasized that the data do not exhibit the predominance of one of them. However, answers showing the importance of *much* to items of *flexibility and decentralization of procedures, efficiency, productivity and profitability and participation, open discussion* are detected.

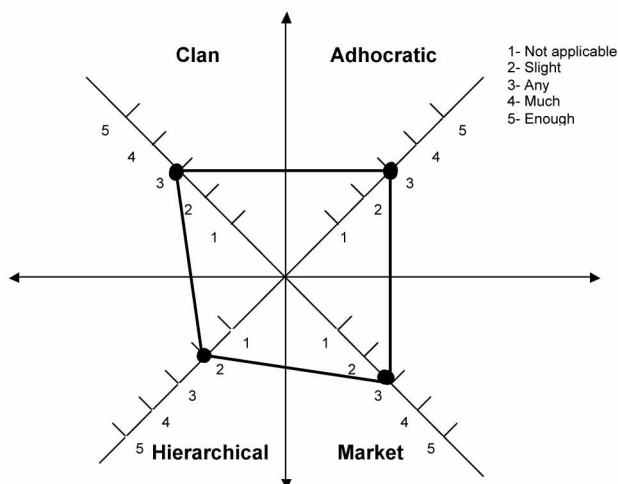
When carrying out the nonparametric test, we found differences between responses. The results of Dunn's test show that company B pre-

sented significant discrepancies with companies D and G. In the first case, the very difference is observed in the type of *markets* (** $p < 0,01$); for company D to focus on the tasks and achievements as well as the excellence and quality of results are procedures with *much* impact on the culture of the cluster. In the second case, very significant differences are seen in the typologies of *clan*, *adhocracy* and *markets*. Company G especially highlights (with *much*) both the evaluation of the concerns and ideas of the employees such as the development of creative processes to solve problems.

Due to the particularities that presented the answers of company B (all the answers were *not applicable*), we decided to repeat the test but, this time, excluding it from analysis. The results of this new analysis exposed the absence of significant differences between the responses of the firms.

Now, with the aim of complementing statistical analysis undertaken to diagnose the dominant culture, we thought it suitable to make a graphical representation showing the clear predominance of the four types of subcultures in the cluster. In view of this, we outline a modified version of the model proposed by Cameron and Quinn (1999). It is presented in figure vi.

Figure vi
Graphic representation of types of cultures



Source: authors' own elaboration.

To compile the above figure, we divided each quadrant with a line at 45° which was numbered from 1 to 5 (according to the scale assigned to the observations of the variables). Axes indicate the median identified for

each class of culture, *i.e.*, the closer to 5 (*enough*) the cluster is in a quadrant, the more dominant that culture is. Consequently, it is clear that in this cluster there is not a dominant culture but, instead, four subcultures coexist. This assertion is based on the resulting flat figure, similar to a parallelogram. If an organization has a dominant culture, the resulting graph would look like a rhomboid.

Although the companies are similar in size, located in the same region and their owners often know each other since the very beginning of their business, etc., the cultures of each firm are different. This is to say, the subcultures within the cluster reflect situations and experiences proper to each company, these experiences are not necessarily shared by the whole nevertheless.

To sum up, the median identified for the strategy variable did not allow a predominant shape. This fact invited us to consider the third kind of strategy identified by Porter (1998), *i.e.*, *approach* or *high segmentation*, not taken into account by Yeung (1999) in his research. The analysis of information allowed us to conclude that the cluster follows a strategy that is consistent with this typology: building prototypes that will be offered to firms that use this sort of machinery to separate fine dust in their production process, but which have difficulties to buy it or, in many cases, they cannot directly acquire said equipment, because its is imported and its market value is very high for SMEs. Therefore, as a result of the synergy arising from the associativity of firms and the know-how shared, the cluster can offer this equipment at competitive prices and will differ from that imported in the provision of a local technical service.

8.4. Learning ability: learning styles and learning disabilities

With the surveyed data the corresponding data matrix was produced. It was identified the median for each variable. The Kruskal-Wallis test was also performed. Measuring the degree in which each of the four learning styles dominates the cluster, data suggest that experimentation is the predominant style, followed by continuous improvements.

The Kruskal-Wallis test showed that no significant difference exists between the medians in *Acquiring skills* learning style. But there are significant differences ($*p < 0,05$) in *Experimentation* and *Reference brands* learning styles, and very significant differences ($**p < 0,01$) in *Continuous improvements* style.

When we achieved the Dunn's post test for *Experimentation* style, we found that there was no significant difference between the answers of employers. This fact validates the consideration of the median as a proxy measure of experimentation as a cluster learning style. In terms of the

problem, it means that the cluster learns mainly looking for new ways to perform the work and trying to be the pioneer to generate a new idea or concept. They aspire to be known in the industry as experts in what they do (machinery for the separation of microparticles). The direct experience of the companies is the source of cluster learning, which makes learning a critical element of the strategy of the group, since enterprises rely on experimentation to generate new ideas. It is common for companies to choose this style of learning when their resources are scarce; this situation in conjunction with the company size makes us to understand the need of the firms to cluster and so take advantage of financial and technological support from the institutions.

On the contrary, when we achieved the Dunn's post test for *Reference brands* and *Continuous improvements*, in both styles we noticed that company E stated *not applicable* for the concepts related to the development generated through activities by other companies, or when they hired people who know the business performance. And something alike happens with the learning that may result from continuous improvements of the products and processes.

Clearly, the study of the differences found in the responses of companies lead us to assume that there is dissimilar knowledge among them in reference to the development of the cluster. In the conclusions, we will graphically display significant differences in relation to learning styles in the cluster.

From the analysis of learning disabilities, in the Kruskal-Wallis test, p values were high enough to validate the identity of the median as a representative measure. We concluded that the cluster suffers in *any* degree of some of these disabilities. Nevertheless, there are disabilities as *homogeneity* and *loose coupling* that seem not to affect the learning of the cluster: independence of companies is a great feature in the functioning of the group. It prevents excessive coordination favoring the nature of the cluster, however if this coordination is deficient, it could contribute to poor organization and communication between companies. This assertion is supported by both the results of the analysis of the variables and the identification of factors that hinder cluster learning. Here we have assessed the opportunities and threats in context, analysis and generation of solutions for failures in performance, lack of stimuli for the generation of diversity of ideas in the group, lack of knowledge and/or poor employee involvement in how to carry out their jobs, and inefficiencies to properly interpret the meaning of experience.

There are some difficulties to identify opportunities or potential problems in the environment of the organization (blindness, for Yeung). Indeed, the lack of a joint vision of the operation of the cluster contributes

to the development of this disability, which simultaneously reduces the capacity of analysis of companies to be able to find, together, solutions to internal problems that may arise (candid, for Yeung).

The lack of clarity in the relation of the actors in the cluster also promotes difficulties to ensure that the actions are consistent with the proposed goals (superstition learning, for Yeung). However, there are disabilities as homogeneity and close coupling that do not seem pose a problem for the group. The variety of ideas and perspectives avoids homogeneity; this idea is based on the considerable (*much*) importance given by employers to participation and open discussion. The weak close coupling gives companies the freedom to try out each different variant and design of the piece of equipment to manufacture. Due to poor dissemination of the lessons learned by any enterprise of the cluster, the variants that will work are probably kept in the enterprise in which they were born, *i.e.*, new knowledge will become part of the individual know-how not shared with the group. This means, in words by Nonaka and Takeuchi (1999), to remain at the stage of knowledge of socialization, or assimilate the knowledge possessed by each company, but in the absence of collective reflection, this tacit knowledge cannot become explicit and pass to the externalization stage, through which this particular tacit knowledge is made available to the entire group.

We think that a good alternative to facilitate this outsourcing would be to keep a record of the evidence, testing and solutions found by each enterprise so that the others can access this new knowledge. At the same time, it would not be only in the *mind* of businessmen.

Lastly, in the table 4 it is possible to look at a summary of the studied variable results.

The set threshold significance level was 0.05; we prefer to use adjectives and asterisks to describe value levels of statistical significance, such as:

<i>P value</i>	<i>Wording</i>	<i>Summary</i>
< 0.001	Highly significant	***
0.001 to 0.01	Very significant	**
0.01 to 0.05	Significant	*
> 0.05	Not significant	ns

Source: authors' own elaboration.

In the next section, we present the conclusions.

Table 4
Summary of variables

Concepts	Variables	Main variable	Mean	P value	Difference significant	
Collective efficiency summary	Externalities	Skilled HR market	Much	0.0568	No	
		Market access	Much		No	
	Joint action	Vertical	Any	0.0514	No	
		Horizontal	Any	0.0109	Yes	
Cluster performance summary	Upgrading	Multilateral	Slight	0.4232	No	
		Mind innovation	Much	0.071	No	
Cluster context summary	Strategy	Cost leadership	Slight	0.0172	Yes	
		Differentiation	Any	***P < 0.0001	Yes	
	Culture	Clan	Any	0.0083	Yes	
		Adhocratic	Any	0.0125	Yes	
		Hierarchical	Any	0.0134	Yes	
		Market	Slight	0.0085	Yes	
	Learning ability summary	Learning styles	Experimentation	Much	0.0229	Yes
			Continuous improvements	Any	0.0068	Yes
			Reference Brands	Slight	0.0297	Yes
			Acquiring skills	Slight	0.0791	No
Learning disabilities		Blindness	Any	0.2395	No	
		Candid	Any	0.1221	No	
		Paralysis	Any	0.1905	No	
		Superstitions	Any	0.1505	No	
	learning	Slight				
	Deficiency in disseminating		0.4232	No		

Source: authors' own elaboration.

Conclusions and future lines of research

The research aimed to examine the processes of knowledge management in a cluster that has great potential for growth and competitive positioning in the treatment of segment of solids. We studied variables such as strategy, culture, externalities, joint actions, governance, upgrading, and identified both learning processes and disabilities that make it difficult. We also noticed the main competitive advantage of the cluster: the presence in the local market alongside a human group with deep knowledge of business and industry. These externalities enhance their collective efficiency and, certainly, have been some of the main factors which led to its configuration.

With regard to relations involving the purchase of inputs and final products, we noticed that, on the one hand, some companies do not acquire their inputs from other in the group; and on the other hand, we found firms that do not have SMEs of the cluster among their customers. Focused on the strategic objective of the cluster (let us remember that it is to manufacture equipment for the separation of microparticles) and the participation that each company will have in this process (providing its know-how in the manufacture of a piece of equipment), we understand that such relationships, which were indicated, are not presented as an objective factor in this association. However, perhaps when the cluster faces the launch of equipments the analysis and possibly the rethinking of the conditions of the factors among enterprises will become relevant.

It is interesting to notice that unlike what we assumed at first, the local proximity of firms and the years in the market favored the building of strong ties between their owners and provide a general knowledge of each other, but this knowledge does not translate equally in their trade relations. The surveyed data reveal that, in some cases, companies do not recognize each other as competitors in goods or services offered on the local market. Additionally, while the cluster is composed of ten companies, there is greater participation and assimilation of some of them in the partnership project they belong to.

This is supported mainly on the degree that each firm assigned to the item *project development with the cooperation of institutions*. We believe that said discrepancies can result from the characteristics of the productive development stage. Indeed, the theoretical developments and the design of prototypes have recently started (without having reached yet the corresponding tests in the laboratory that Unicen currently builds), situations that do not seem yet to require a very close association with high frequency of communication between companies. Nevertheless, given the importance of the construction of the laboratory or pilot plant for the operation of the cluster, it is noteworthy that only two of the surveyed companies responded that the group formation favored *much* to create testing facilities (pilot plant). In this sense, we associate this divergence in answers with the lack of wide dissemination of information and expertise between the companies (the survey indicated that the level of dissemination, in this sense, is *any*). Also, we realized that some of the aforementioned arguments constitute the main reason of the differences found in the variables *strategy* and *culture*.

These ideas are still more significant if we look at the governance of the cluster: the survey reveals that in this cluster governs relations between their various actors in the form of network, *i.e.*, similar and independent companies interact together to define the equipment to manufacture and

combine the productive capacities of each firm. Consequently, efforts should be directed towards the dissemination of beliefs, values and core standards to be accepted by all the companies, since the remaining of several subcultures connected between them increases the risk of not reaching a common understanding about what is important and what is not for the cluster.

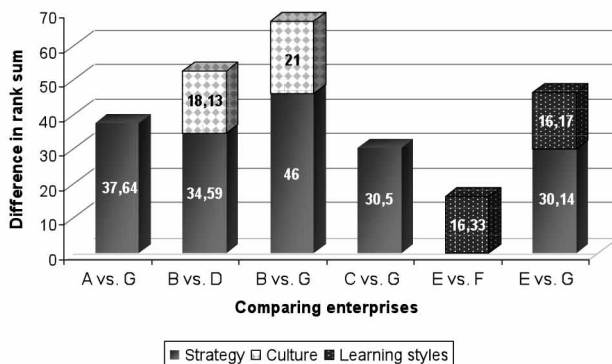
These results become more provocative if we focus on the concept of upgrading. The formation of the group has encouraged *slightly* updates and innovations in the development of new products, but has stimulated *much* the acceptance and understanding of the collective action concept.

Yeung (1999) concludes in his research that experimentation is the most effective style to learn but the least popular. A more detailed analysis of data from his work revealed that, while experimentation has a positive impact in business performance in the long term, temporarily may be in detriment of competitiveness in the short term. This is so because the experiments are often costly, time-consuming and do not to produce profits right away.

Following the conclusions of this author, it is feasible to understand why the creation of this cluster promotes innovation and encourages experimentation as a style of learning, at the same time we try to emphasize that the study of a cluster is not an end in itself but a trigger for regional development.

Moreover, in order to summarize the differences in the several studied variables, we relate in the following figure the results of the Dunn's post test according to difference in rank sum and the variables *strategy*, *culture* and *learning styles*.

Figure VII
Significant difference of variables



Source: authors' own elaboration.

As it is seen in the figure above, the differences are highly significant for the *strategy* variable, less significant for the *culture* variable, and the least significant for the *learning styles* variable.

In the following table, the position of each firm in the value chain (see figure II) and its size are shown.

Table 5
Position in the value chain and size of the enterprises

<i>Enterprises</i>	<i>Position in the value chain</i>			<i>Size</i>	
	<i>Design & Engineering</i>	<i>Development of industrial equipment</i>	<i>Services</i>	<i>Small</i>	<i>Medium</i>
A	◆			◆◆	
B		◆		◆◆	
C			◆	◆◆	
D		◆	◆		◆◆
E			◆		◆◆
F			◆	◆◆	
G	◆			◆◆	

Source: authors' own elaboration.

If we compare figure VII and table 5, we can point out the following:

- Firms A and G are similar in size and position in the value chain (they belong to the *Design & Engineering* category). Nevertheless, the results show us highly significant differences in their strategies.
- The category of *Development of industrial equipment* in the value chain is developed by firms B and D. The sizes of these enterprises are different and they also differ in the opinions of their owners on the strategy and the culture of the cluster.
- In the category of *Services* we found that firms E and F present significant differences both in learning styles and sizes.

Finally, we deem necessary to mention that we are not dimensioning the ways of learning regarding exclusively to the styles defined by Yeung (1999). There are many interesting studies on this problem, like Stephen Tallman *et al.* (2004), “Knowledge, clusters and competitive advantage”. We took the research of Yeung (1999) because of its empirical base and statistical evidence, but we are aware that his research only studied international companies. For this reason we use his work as a starting point, *i.e.* taking into account that as a result of our research (and those to come)

may arise further explanations that will lead us to consider other variables, or even modify or discard some of the proposals. However, such circumstances will be considered as future exploratory research lines.

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Received: March 24th 2010.

Resent: December 27th 2010.

Accepted: May 16th 2011.

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