

Knowledge Transfer in Industrial Clusters

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Abstract—This paper aims at identifying and analyzing the knowledge transmission channels in textile and clothing clusters located in Brazil and in Europe. Primary data was obtained through interviews with key individuals. The collection of primary data was carried out based on a questionnaire with ten categories of indicators of knowledge transmission. Secondary data was also collected through a literature review and through international organizations sites. Similarities related to the use of the main transmission channels of knowledge are observed in all cases. The main similarities are: influence of suppliers of machinery, equipment and raw materials; imitation of products and best practices; training promoted by technical institutions and businesses; and cluster companies being open to acquire new knowledge. The main differences lie in the relationship between companies, where in Europe the intensity of this relationship is bigger when compared to Brazil. The differences also occur in importance and frequency of the relationship with the government, with the cultural environment, and with the activities of research and development. It is also found factors that reduce the importance of geographical proximity in transmission of knowledge, and in generating trust and the establishment of collaborative behavior.

Keywords—Industrial clusters, interorganizational learning, knowledge transmission channels, textile and clothing industry.

I. INTRODUCTION

ONE of the characteristics of the economic and technologic model of the knowledge economy is the formation of global and regional network of manufacture and distribution, which promoted sensible changes in the way of competing, demanding proactive answers from firms such as the innovation capacity, what presupposes the creation or acquisition of new knowledge.

In this context, knowledge management in firms inside industrial remains a subject that requires deeper and specific studies about sharing and collective learning in firm groups [1], [2]. Published material about this subject is mostly based in empirical research and regards difficulties from firms, of learning by means of interactions [3].

According to [1], the concepts of industrial clusters presented by [4] and observe the importance conferred to knowledge and learning, and state that clusters are characterized by geographic proximity, economic links and knowledge sharing between firms.

Reference [6] state that the diffusion of knowledge is one of the main reasons to distinguish successful clusters from the

other agglomerated. In addition, since the first studies from Marshall it is sought to understand the knowledge flux impact in the generation of externalities emanating from joint action [7]. In the recent literature research from [8], [9], [5], and [1], draw attention to the importance of studies related to the knowledge transmission and to learning inside clusters.

Front to this context, this paper has as objective identifying and analysing the transmission channels of knowledge employment in clusters in Brazil and Europe. In order to achieve that, research in textile and clothing clusters was made in the Santa Catarina state, in Brazil (Cluster of Vale do Itajaí), in the northern region of Portugal and in Galicia, Spain (EuroClusTex), and in the industrial Italian district of Capri in the Emilia-Romagna region.

II. THEORETICAL FOUNDATION

A. Industrial Clusters

According to the concepts of [10] and [4], clusters are geographical concentrations of firms that are interconnected and specialized institutions in a field or particular sector. They also cover a collection of industries and entities vital for competition. It can be considered that clusters include sets of industrial firms, and institutions as universities, research centres, trade associations, normalization organizations, technical laboratories among other institutions and suppliers that support the development of sector activities, also appropriating active community publics around, such as schools and universities, quality patterns and market transparency ([10], [4], [11]).

It can be considered that the cluster concept is more generic and has as characteristics being a geographical cut and it considers the relations of productive technical fluxes among firms, and underlines the search for statistic and dynamic externalities. It is also relevant to underline the concept of Italian industrial districts considered by authors as [12] and [13] as a social and territorial entity with a strong cultural involvement, social history and tradition history and that emphasizes on the flexible production and the dynamic externalities generation.

The dimensions relevant for analysis in clusters involve generally three instances: 1) techno-productive cooperation, which emphasises studies on operational efficacy and productive flexibility; 2) inter-organisational cooperation that involves coordination efficacy among firms and structural flexibility and; 3) the technological cooperation related to information exchange and innovative capability [14]. Taking into consideration these dimensions, this paper aims towards studying the third instance: the technological cooperation and it focuses in the collaborative learning analysis as factor of competition in clusters.

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The participation in clusters generates scale economy, considering the set of firms, location economies, and external advantages resulting from the services offers, product specialisation, and distinct gains from the cooperation in the productive, inter-organisational and technological spheres [14].

It is stressed that the clusters may promote gains associated to collective efficacy, and be resultant from local external economies or from combined action of distinct firms. The obtained results from the collective efficacy derives from the standpoint that there is a broad scope for task division among firms in the cluster, as well as for the specialisation and innovation, elements essential for competition [7].

B. Knowledge Transmission Channels

There is a wide literature regarding clusters stating that the geographical proximity propitiates privileged spaces for knowledge spreading, and deflagration of collaborative learning processes. However, the recent additions from [15] and [16], contest the importance of geographical proximity in knowledge transmissions, trust generation and combined action promotion.

The studies regarding the employment of knowledge transmission in clusters by [1] show that a variety of channels coexist, such as: the interpersonal relationships among the cluster companies; the relationship between companies and suppliers of specialized services, raw materials and equipment; the processes of imitation; the work force mobility; the relationship with universities and research institutions and organizational associations.

For [1] the knowledge transmission channels inside the clusters contribute for the development of competitive dynamic competencies, which are very important in environments where reinforcing competitiveness requires continued introduction of innovations in the market. According to these authors, the dynamic competencies can be generated through transmission channels of knowledge related to the mobility of the employees, cultural mechanisms and the particular relationship modalities that a network provides. Among the modalities it can be pointed the relationship between companies inside and outside the network, such as universities and research groups, institutions of technical learning, the government, interpersonal relationships and relationship with the suppliers ([1], [17], [18]).

According to [19] the interaction with the machine and equipment suppliers allows that the technological knowledge be transferred, being able to be formal or informal, and based in personal relations that endure for a long time.

The recruiting of employees from companies inside the clusters promotes information fluxes and tacit knowledge and can be configured as a knowledge transmission channel inside the clusters. When there is a flux in the competent work force between firms, a fast diffusion of new ideas happen. It is considered that the rotation of workers among firms also supplies a base for integration of the firms, since the workers are related with colleagues in other firms [18].

The cultural mechanisms that sustain the network and

facilitate interaction between firms are also considered knowledge transmission ways [17]. It is presupposed that the knowledge circulates through intra cluster relations among the firms, the government and other institutions.

According to [4], the geographical proximity stimulates the occurrence of relations amongst firms, facilitating the imitation practise and improvement of processes and products. The imitation configures itself as a traditional process of knowledge incorporation that originates incremental innovation of processes and products, adequate to peculiar occurrence cases where a raise in the offer is needed, in scenarios where product demand is not too exigent. On the other hand, in order to cope with the new board of competition characterized by a new step of markets globalization, which raises the competition level among firms, associated to the raising of exigency of customers and clients, be it in faster preference changes or in terms of product sophistication, the success of clusters cannot be based in traditional learning processes.

The knowledge transmission channels can be intentional or not. Under this perspective, [1] consider that the specialized literature prioritizes the analysis of intentional channels, ignoring in a way contributions of informal or non-intentional channels.

III. METHODOLOGY

Concerning the adopted technical procedures and the employed method the research is classified as a multi case study, supported by the bibliographic and documental research. Three clothing and textile industrial clusters were analysed: Vale do Itajaí, in Brazil; EuroClusTex, a transnational cluster between northern Portugal and Galicia in Spain; and Carpi in the Italian region of Emilia-Romagna.

In the field research was prioritised the selection of people that had distinct views regarding the researched clusters, what lead to a selection of a broad range of respondents: employers, government members, and leaders of support entities of the textile industry and clothing industry in Brazil and in Europe.

The data collection was made through interviews with 29 key individuals. All interviewees were stimulated to approach the following subjects: a) the cluster structure; b) the advantages of participation in the cluster; and c) the changes in the competitive environment.

In the interview the researchers were aided by a questionnaire containing ten classification categories of a total of twenty five knowledge transmission channels selected from the researches made by [1], [17]-[19]. The knowledge transmission categories consider: (1) Relationship between firms; (2) Relationship with the suppliers; (3) Relationship with the Government; (4) Cultural environment; (5) Investigation and Development; (6) Human Resources recruiting; (7) Capacitation; (8) Collaborative development; (9) Best practises imitation; and (10) Codified knowledge. For better understanding of the interviewed the questionnaire was typed interrogatively, and the Likert scale was adapted to measure the efficacy of the communication channels, considering level 1 as not efficient and level 7 as very

efficient.

The intensity of usage of the knowledge transmission channels researched was unfolded in high, medium or low as exposed in Table I. To identify this variation was employed a simple average of attributed grades by the interviewed.

It can be observed that the perspective of the researchers, based in the speech analysis along the interviews, interfered in the determination of average grades attributed.

TABLE I
CRITERIA FOR THE FIXATION OF THE INTENSITY OF KNOWLEDGE
TRANSMISSION CHANNELS USAGE

Usage intensity / impact of the knowledge transmission channel	Average
High	Equal or superior to 6,0
Medium	Between 3,0 and 5,99
Low	Higher than 1,0 lower than 2,99

IV. RESULTS

A. Cases Characterization

The textile and clothing cluster of Vale do Itajaí exists for more than a century. The Vale do Itajaí region is located in the Santa Catarina state, in the South of Brazil, has around 686,2 thousand habitants, 10% of the population of Santa Catarina, with 13.003,018 km² of extension [20]. The firms that most employ in this region are the textile and the clothing [20]. The organisational structure is heterogenic and the micro and small firms represent around 96% of all establishments. [20], data point out that 9.853 firms of all sizes form the cluster, because it covers firms since the micro unities stage to the nationally widespread firms. It operates in many stages of the productive chain and employs 166.243 workers.

The EuroClusTex is a transnational cluster that pretends fundamentally in consolidating an already existing reality, that is related the binding between textile and clothing firms of Galicia in Spain and of the North of Portugal. The project aims to essentially increment the cooperation and provide visibility for firms located in these regions. In northern Portugal, there is a highlighted specialization in the production/fabrication of textile and clothing, whilst in Galicia there is an expertise in the creation of brands and distribution grids. In this way are characterized as regions with distinct and complementary competencies. These characteristics together with the geographical proximity impulse an intense commercial exchange between these two regions, because many Galician firms, in special the Inditex Group, subcontract manufacturing firms located in the North of Portugal. The EuroClusTex comprises 8.200 firms that in 2010 produced 7.500 million Euros [21].

Carpi is one of the main Italian industrial districts of knitwear. It is located in province of Modena, in the Emilia-Romagna region, a well-developed area in the North of Italy. In Carpi it is underlined the presence of two firm typologies: the leader firms or final firms, and the subcontracted. The first are firms highly qualified in the critical authors that develop activities related to design, distribution and brand management of products in the mesh clothing. From 2000, it has been

observed a reduction in the number of firms and jobs, and a shrink in the external market participation. Data from [22], show that in Carpi 1.109 textile and clothing firms act with 6.966 employees.

B. Knowledge Transmission Channels: Comparative Analysis

In Table II are presented the average points from the ten classification categories of knowledge transmission channels selected.

In this manner, it is considered that the relationship amidst firms is low in Vale do Itajaí (1,94), and medium in the EuroClusTex (3,19) and in Carpi (3,05). It can be stated that the companies in the European clusters are more prone to collaboration and conjunct action when compared to the Brazilian cluster. It was identified that the organisational objectives of entrepreneurs in business fairs organised by the organisational associations in the European cases favoured communication amidst firms. In the Vale do Itajaí it can be underlined the almost inexistent relationship or partnerships among firms. The research revealed that geographical proximity loses importance in the generation of trust and in the relationship promotion between firms.

Along the interviews it was verified that the informal relationship with the suppliers is a multifunctional broad of information. In the Vale do Itajaí cluster it can be observed a high influence of raw material, machines and equipment suppliers in the processes of knowledge transmission. In the EuroClusTex (4,31) and in Carpi (5,80) the influence of these suppliers is smaller than in the Vale do Itajaí. These results show the importance of the strategic role of the suppliers as knowledge transmission channels and reveal that the textile and clothing firms are in a sector of distributed technology, and that innovation many times is not internally developed, but incorporated to productive processes with the buying of machines, equipment and raw material. It must be taken into account that the innovation related to acquisition of machines and equipment is broadly diffused. Currently, it is considered that in the studied textile and clothing firms there is not a big technological difference among leader firms of the market.

The influence of the government in the promotion policies is low in the Vale do Itajaí (2,10), and medium in the EuroClusTex (4,05) and in Carpi (3,10). It is underlined that in the three studied cases occurred a natural selection process that lead to bankruptcy of firms that were not ready to compete except with a low cost of factors. In this context, it can be considered that the public policies were not proactive front to the changes and rising of international competition. It can be observed that in the case of Carpi a strong inconsistency with the actual situation of the cluster and the literature about Italian industrial districts.

It was observed that the cultural environment in Carpi (3,80) and in EuroClusTex (3,90) is the most propitious for knowledge transference and collaboration amongst firms than in the Vale do Itajaí (2,75) cluster. Hence, it is noted that the cultural aspects may interfere in the generation of trust, as well as in the opportunity taking for conjunct action. This result

refutes the research that suggests that geographical proximity stimulates collaborative behaviour.

The research revealed that the interest for knowledge produced outside the clusters is bigger, and that geographical proximity does not limit the access to knowledge. It was noted that the knowledge spreading among textile and clothing firms was raised and globally widespread through information and communication technology, through online clothing sales, and popularization of blogs, photo logs and virtual magazines of fashion. The development of information and communication technologies altered the importance of geographical importance.

It can be pointed out the almost inexistence of Research and Development (R&D) departments in the firms of the clusters Vale do Itajaí (1,87) and Carpi (2,60). In the EuroClusTex (3,03) is the average presence of R&D departments. It is highlighted then the innovation vocation of the North of Portugal in the textile technical segment. With the research, it was observed that in the case of the Europeans there is an emergency of a special group of firms that start to aggregate value to product with development in the design services. In the Vale do Itajaí only big firms have R&D departments.

It was observed that in Carpi the difficulties of micro and small firms to develop R&D activities is recognized by the government of Emilia-Romagna, which develops since 2000 a strategic redirecting of the policies in order to promote competition through internationalization of micro and small firms.

Regarding the mobility of the work force, in the EuroClusTex (3,63) the recruiting of human resources presents medium influence. In Carpi (2,80) and in the Vale do Itajaí (2,75) it is pointed out low influence of the work force mobility in the knowledge transference. These results are considered abnormal, being that the employees have tacit knowledge, which is not available in books or manuals, and that many times is the main asset of firms.

The influence of formation of human resources in the knowledge transmission is bigger in the European cases. It can be observed that in the EuroClusTex (4,00) and in Carpi (4,00) the formation practises are more frequent when compared to Vale do Itajaí (3,00). In all studied cases it can be observed that is very infrequent the formation promoted by clients, and that the formation promoted by firms and by knowledge centres, in special technological schools, present higher influence in the knowledge transmission processes inside the clusters.

Concerning the development of innovation partnerships in the Vale do Itajaí (1,93) and in Carpi (2,40) the R&D practises are low among firms, and between firms and universities. As for the EuroClusTex (3,40) the innovation partnerships are more frequent. Along this research was observed that in the case of the European clusters the institutions of technical formation contribute more to the processes of knowledge transmission than the universities. The lower influence of universities shows the non-usage of opportunities for creation and transference of knowledge and capacitation of dynamic competitive advantages. Although the literature shows that

one of many ways to incentive innovation inside clusters is the interplay amongst firms, universities and technical institutions, and the result reveal the incapacity that these institutions have in answering to the market demands.

It was observed that it is common the imitation of products and the best practices in both the studied cases. This strategy occurs with a higher degree in the Vale do Itajaí (5,74) cluster than in the EuroClusTex (4,54) and in Carpi (4,00). Along the research, it can be stated that the imitation inhibits the motivation for knowledge sharing, as well as the encouraging of initiatives of collaborative development amongst companies in the same sector. In all cases product and processes imitation appears as one of the five most utilized methods of knowledge transmission. The imitation in Carpi registered lower intensity than in the other clusters, even though for the Italian Industrial District model the score (4,00) is significantly high. In general, it is considered that imitation is a modality of knowledge transmission that stimulates incremental innovation.

The research revealed that in all cases the influence of patents and licenses is low in the process of knowledge transmission. Along the interviews, it can be perceived that this low influence may be motivated by the high incidence of imitation among companies. It can be stated a higher influence of patents and licenses in the EuroClusTex (3,10) than in the Vale do Itajaí (2,06) and in Carpi (2,40).

TABLE II
AVERAGE OF MACRO CATEGORIES OF KNOWLEDGE TRANSMISSION CHANNELS

	Vale do Itajaí	EuroClusTex	Carpi
Relationship between firms	1,94	3,19	3,05
Relationship with the suppliers	6,00	4,31	5,80
Relationship with the government	2,10	4,05	3,10
Cultural Environment	2,75	3,80	3,90
Research Technological Development	1,87	3,03	2,60
Recruiting of human resources	2,75	3,63	2,80
Formation of human resources (HR)	3,00	4,00	4,00
Collaborative development	1,93	3,40	2,40
Adoption of processes and products from the competition – "Imitation"	5,74	4,54	4,00
Codified knowledge	2,06	3,10	2,40

It must be underlined that the similarity of results from Carpi and EuroClusTex in relation to the knowledge transmission channels, and in special the degree of relative impact to relationship between firms and the cultural environment, shows transformation in the paradigmatic Italian Industrial Districts, which competition aims for the construction of strategic partnerships with belonging firms and not to the cluster. It can be stated that the Carpi cluster in the last twenty years was invaded by Chinese that feature cheap workforce and are highlighted in the intensive stages in workforce, especially in the confection segment. These new "Chinese-Italian" entrepreneurs although being located in the district do not have trust from the local businesspeople and in this case, it is evident that there is no Italian paradigm characterized by exuberant trust and cooperation anymore.

In general, it can be stated that in the studied cases the insignificant performance in the external market, and the lowering of firm numbers and jobs brought reflexes in the collaborative behavior. However, in the European cases, it was underlined an increasing preoccupation with investing in innovation, in special aimed to creation of valuable brands associated to global distribution chains.

V.CONCLUSION

The reach of the objective shows that in both cases there are similarities and differences related to the degree of usage in the main knowledge transmission channels in clusters in Brazil and in Europe. The primary similarities are the high impact in knowledge transmission channels related to: machine, equipment and raw material suppliers; imitation; and formation promoted by technical institutions and by firms themselves. Moreover, the most impacting difference aims for the relationship among firms takes part in higher intensity in EuroClusTex and in Carpi than in Vale do Itajaí. The same also occurs with the relationship with the government, the cultural environment and the research and development activities. It was observed noticeable unequal situations in the implementation of actions and collective projects aiming the development of dynamic factors of competition and opening of markets.

It was identified that the collaborative learning inside the studied clusters don't depend only in geographical proximity, because it is also influenced by other factors as culture and the adoption of appropriate public policies that stimulate collaboration. This statement in relation to geographical proximity is shown evident in the results related to motivation for knowledge acquisition, human resources recruiting, collaborative development, relationship with the suppliers, and imitation. It is stressed out that geographical proximity does not guarantees collaboration, nor generation of trust among firms.

The research pointed out that the intensity and efficiency of the usage of knowledge transmission channels, within clusters in Europe and in Brazil, influence in the competitive capacity in the cluster sphere as a whole and firms individually, and that in the studies cases the knowledge flux in channels that involve conjunct action and competitive dynamic gains is not high.

With the research, it can be stated that the global economic crisis of 2008 and the emergency of Asia that emerges as holder of cheap and qualified workforce caused changes in the competition patterns, which were not incorporated by most of the companies located in the studied clusters.

From the results of the research, it is suggested the making of studies to understand the knowledge flux and the processes of learning inside the clusters and in other modalities of productive agglomerated.

Great part of the literature regarding competition in inter-organisational networks such as industrial clusters, Italian industrial districts, innovation regional systems, consider that in a globalised world there must be investment in innovation of products and processes, which is promoted with the

acquisition of new knowledge. However, this research puts into question the importance of the localisation as essential location for the promotion of trust and the creation of collaborative behaviour in the clusters. In this way it is underlined the need to review the concepts of collective efficacy in clusters and other modalities of industrial agglomerations.

The real world shows that the ways of competition were altered and the factors that are determining the changes must be studied. It is pointed out that a smaller influence of the geographical proximity in the generation of trust and conjunct action be considered, but this does not determines the discharge of the analytical cut in productive agglomerations nor the disinterest for the continuity of researches.

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