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## THE ROLE OF LOCAL INSTITUTIONS IN THE TRANSMISSION OF INFORMATION AND KNOWLEDGE IN INDUSTRIAL DISTRICTS. A SOCIAL NETWORKS ANALYSIS

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# THE ROLE OF LOCAL INSTITUTIONS IN THE TRANSMISSION OF INFORMATION AND KNOWLEDGE IN INDUSTRIAL DISTRICTS. A SOCIAL NETWORKS ANALYSIS

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## ABSTRACT

In recent times, the international competitive panorama has undergone intense rapid change, due especially to the presence of new competitors, new technology and new markets. These changes and their repercussions have had a significant impact on many industrial districts, which has left many of these agglomerations in critical condition.

When facing these new circumstances, the function of local institutions takes on a much greater importance in how these districts adapt to the new competitive context, connecting companies with external networks which give access to new sources of information and knowledge.

Furthermore, the role of local institutions will always be conditioned by the context in which they are found. For instance, there are significant differences between traditional or *low-tech* districts and *high-tech* districts which offer technologically more advanced products and services. Thus, while for the second category there is a great deal of theoretical and academic evidence that supports the idea that institutions act as leader actors in processes of innovation and improvement, in districts which operate in traditional sectors there is a shortage of research that analyzes the role played by institutions in these *low-tech* districts.

To fill this gap in the literature, we aim with this work to analyze the links established by the companies of two industrial districts, with different levels of innovation activity, with local institutions. We especially analyze the intermediary and pollinating function that these institutions can have within these districts. We have applied Social Network Analysis techniques, analyzing the structure and properties of networks in the district as well as the role played by institutions.

Our aim is to contribute to the debate by establishing a way to measure the flows of information and knowledge between companies and local institutions in two different districts through a social network analysis. The results obtained are of particular interest and are in contrast with the more traditional view that assumes a positive association between the companies' opportunities for learning and the cohesion of the network.

## INTRODUCTION

Generally speaking, local institutions in the industrial districts further than provide firms by supporting services and other resources (Baum and Oliver, 1992), they act as knowledge and opportunities repositories to gain competitive capacities. Consequently, firms can take advantage from their relationships with local institutions which provide a feasible source of information on the available options to improve their

capacities. A great number of authors have already proved the impact of the local institutions on the firm's performance in the territorial agglomerations (for instance, Decarolis and Deeds, 1999; McEvily and Zaheer, 1999).

In this context, is particularly relevant the role played by the local institutions in the districts' adaptation to the new competitive arena, connecting the district's firms with the external networks and facilitating access to new information and knowledge sources (McEvily and Zaheer, 1999). Following this stream of research, we consider that in spite of the extensive attention devoted to the role of the local institutions (Baum and Oliver, 1992; Almeida and Kogut, 1994; McEvily and Zaheer, 1999; Seibert et al., 2001; Molina-Morales and Mas-Verdú, 2008) a lot of questions still remain to be satisfactorily addressed.

Specifically, our paper attempts to analyze the role play by local institutions in the manufacturing industrial districts under the new international scenario. We have applied the *Social Network Analysis* (SNA) to study the relational structure inside both the textile industrial district one of the most affected by the globalization (Sammarrà and Belussi, 2006) and the ceramic tile district. Particularly, we analyze during a period the time the pattern of relationships of the local institutions with external changes for both sectors.

We have structured our paper as following: first, we discuss the theoretical frame of our research, and the main characteristics of the districts object of our study. Then, we propose the method used and the main findings we have obtained. Finally, we discuss implications, limitations and future research

## **2. THEORETICAL FRAMEWORK**

### **2.1 Local institutions in the industrial districts**

Industrial districts include not only specialized firms but also a set of local institutions which are fundamental for the district competitiveness. In the context of our research we consider to the local institutions as local based supporting organizations (both private and public) which offer support to whole firms in district. Examples of institutions are local universities, vocational centers, research centers, industrial policy agencies, technical consultancy or professional and trade associations.

The role played by these local institutions has been broadly discussed (McEvily and Zaheer, 1999). Further than provide generic and specific services for the local firms, they act as repository of knowledge and opportunities (Baum and Oliver, 1992). As a consequence, district firms can take advantage of having a network of ties with these local institutions which provide them from feasible sources of information and knowledge to enhance their capacities (Decarolis and Deeds, 1999; McEvily and Zaheer, 1999). On the other hand due to the intermediary position in districts, local institutions are key actors providing specific skills and knowledge in the territorial networks (Baum and Oliver, 1992; McEvily and Zaheer, 1999). In fact, local institutions are constantly in contact with different external circles and at the same time are close district firms, therefore they can facilitates the exploration and transfer of from the outside the district into the inside of the district. Finally, that intermediary position of the local institutions facilitates the acquisitions of the capacities through the knowledge compilation and diffusion (Molina-Morales et al, 2002). In this way, thanks to the interactions of the local institutions with a great number of firms in the industrial district, these institutions are exposed to a broad range of organizational and managerial problems. Thus, on the base of a solid experience acquired through the observations of diverse situations with similar problems, local institutions accumulate and disseminate capacities and routines (McEvily and Zaheer, 1999).

## 2.2 Information and knowledge networks in the industrial districts

Industrial district can be identified as a social network, where space and proximity determine the structure and content of the relationships and the generation of the tacit knowledge and learning capacity which support the local innovation (Maskell and Malmberg, 1999). In that context alliances are understood as mechanisms to develop cooperative relationships with a broad network of actors, where employees and executives are included, and a large number of social resources support the innovation processes (Asheim, 1996). Additionally, physical proximity facilitates the face to face relationships, frequent and close interactions and a shared culture in the district that can act facilitating the social learning process. Nevertheless, some authors (Lissoni, 2001; Breschi and Lissoni, 2001a, 2001b; Malmberg and Maskell, 2002; Capello and Faggian, 2005; Boschma and Frenken, 2006; Morrison and Rabelotti, 2009), have argued that there are different types of flows of knowledge in the local agglomerations, having to distinguish between free access flows (for instance informational networks) and which are restrictive ones (like knowledge flows). For these authors, beyond the broadly accepted general belief that knowledge is freely diffuse through informal contacts in bounded geographical areas, there is the a rather ambiguous definition of knowledge and information as interexchange concepts. In this way, it can be proposed that inside the district may be distinguished an *informational network* and *knowledge network*.

Informational network is based on the social and institutional relationships which are developed nearly as a routine in the context of the industrial district, accordingly to what was pointed out by Becattini (1990), Pyke et al. (1990) or Malmberg (2003), among others, who suggested that professionals and entrepreneurs which work in the same district are met continuously so, interact about questions related to jobs, market transactions or any other informal or business or professional interaction (Giuliani, 2006). However, when firms search technical advices related to innovation firms select firms which are more adequate to provide feasible solutions, being or not connected in the informational local network and building a different network, the knowledge network. In other words, firms with a weak knowledge base cannot provide value to the other firms, or have no internal capacities to absorb the external knowledge, therefore they will have a marginal position in this knowledge network, even if the occupies a central position in the informational network (Giuliani, 2006).

## 3. EMPIRICAL STUDY

The empirical study is based on a sample of companies belonging to the Valencia textile and ceramic tile districts. Due to the massive importing of products from emergent countries, these districts are under a great competition pressure. In this context, we have analyzed the relationships among the main local institutions, both internal and external to the districts and the district's firms. We are interested in specific relational pattern, analyzing informational and knowledge networks.

### 3.1 Sampling and data sources

On the one hand, the textile industry constitutes a heterogeneous and complex sector that includes a great range of productive activities integrated into its production process. In the Spanish context, this sector accounted for 6.5% of the total manufacturing employment and contributes for the 3% in the GNP in the 2008, according to the *Centro de Información Textil y de la Confección* (CITYC) data. During the last two decades the Spanish textile sector has suffered several restructuring processes to face the increasing international competition. The Valencia industrial district is located in the L'Alcoià, El Comtat and L'Alt Vinalopó counties in the province of Alacant and in the La Vall d'Albaida in the province of Valencia. According to ATEVAL (Valencia textile trade association) in 2010 the Valencia textile industry had 25,600

employees, accounting for 16.6% of the total Spanish textile, and a total value of production of 1,670 millions of €, roughly the 19.7 % of total Spanish production.

On the other hand, we have also analyzed the Valencia ceramic tile district. Products of that district include wall and floor ceramic tiles, decorative pieces, enamel and colors, ceramic machinery and other related activities. That district area (with a radius than no more than 20 kilometers) concentrated more than 90% of the total Spanish production. In fact, Spain is ranked at a top position in international markets with other countries like China, Italy or Brazil. In 2008, Spain had an international market shared about 38%. According to ASCER (Ceramic tile trade association) the main activity production yields 494.7 millions of squared meters and the revenues reached 3,671 millions of € with more than 60% for exporting, and employing directly more than 22,000 people. The selected sample for the district was based in the ceramic enamel and colors manufacturers subsector, and firms dedicated to the distribution and development of chemical additives for ceramics. The reason that leads us to select these firms was its innovative capacity, since they are firms which are the main sources of innovation, particularly in product innovation, inside the district.

We have used as reference the Spanish industrial districts map provided by Boix and Galletto (2006) where both textile and ceramic tile districts are identified, to establish our initial population of firms. That work provides a list of districts and the locations which included each of them. In addition data about companies such as year of creation, address, main activities, total revenues, profits and number of employees by the year of 2008 were collected from the database SABI.

To select companies belonging to the main activity of the textile district we have followed the criterion established by Boix and Galletto (2006). In this way, we consider the CNAE-93 codes and then we filter the corresponding companies, adding as restriction to have more than 3 millions of € as revenues, to capture the relevant firms in the district. In the case of the ceramic tile district we have collected information from different trade associations such as ASCER (Wall and floor ceramic tile manufacturer trade association); ANFFECC (enamels and colors manufacturers' trade association) and ASEBEC (ceramic equipment and machinery manufacturers' trade association). In order to focus particularly on the enamels and colors firms we have included in the sample the total of the firms belonging to ANFFECC which are located into the boundaries of the district (22) and additionally a number of ceramic additive companies suggested by the trade association.

The initial list of companies was filtered through the advice of a panel of experts from the *Universidad Politécnica de Valencia* (UPV), *Asociación de Empresarios Textiles de la Comunidad Valenciana* (ATEVAL), *Agrupación Empresarial Textil Alcoyana* (AETA), as well two leader firms in the textile district. For the ceramic tile district we run some interviews to diverse representatives (leader companies, chamber of commerce of Castellón, Universitat Jaume I. etc.) who support our selection of sample. These panels of experts determine the list of main local institutions to be analyzed in each district. Finally, we have obtained a list of 100 companies and 30 institutions representing to the textile district and 29 companies and 58 institutions representing to the ceramic tile district. The list of institutions is showed in the annexes I and II.

The survey was developed using semi structured interviews to CEOs and executives of companies and institutions during the months of May to July of 2010. Finally, we have obtained a total of 69 valid interviewees from the textile sector and 18 for the ceramic tile sector. The characteristics of the sample is showed in the tables 1 and 2,

**Table 1. Characteristics of the textile industrial district companies**

<b>Characteristics of the companies</b>	<b>Number of companies</b>
<b>Size (number of employees)</b>	
Small (1-19)	13 (18,85%)
Medium (20-99)	43 (62,30%)
Large ( $\geq 100$ )	13 (18,85%)
<b>Company revenues (millions de €)</b>	
Low ( $\leq 5$ )	31 (44,93%)
Medium ( $>5$ , $<9$ )	17 (24,64%)
High ( $\geq 10$ )	21 (30,43%)
<b>Activity developed by the company</b>	
Preparation and spinning of textile fibers	7 (10,15%)
Manufacturers of textile fabrics	18 (26,08%)
Manufacturers of technical textile fabrics	10 (14,49%)
Textile finishing	14 (20,29%)
Made-up textile	20 (28,98%)

**Table 2. Characteristics of the ceramic tile industrial district companies**

<b>Characteristics of the companies</b>	<b>Number of companies</b>
<b>Size (number of employees)</b>	
Small (1-19)	4 (13,79%)
Medium (20-99)	15 (51,72%)
Large ( $\geq 100$ )	10 (34,48%)
<b>Company revenues (millions de €)</b>	
Small ( $\leq 5$ )	4 (13,79%)
Medium ( $>5$ , $<9$ )	5 (17,24%)
Large ( $\geq 10$ )	20 (68,97%)
<b>Activity developed by the company</b>	
Enamels and color	22 (75,86%)
Ceramic additives	6 (20,69%)
Atomized clay	1 (3,45%)

### 3.2. Analysis techniques

We mainly used two analysis techniques. First we applied the *roster-recall method* (Giuliani and Bell, 2005, Morrison and Rabelotti, 2009), by presenting each of the respondents a complete list actors and asking about their relationships with each of them. Additionally, the data were complemented from secondary sources (publications and reports of major textile associations, as well as the SABI database) to increase its validity (Yin, 1989).

Second, we applied social network analysis techniques using UCINET software v. 6 (Borgatti et al., 2002), in order to analyze the structure of interorganizational relations or connections. This technique has been proposed by several authors (Boschma and Ter Wal, 2007; Graf, 2007; Borgatti et al., 2009) as suitable for the study of business networks. In fact, numerous works from the perspective of regional economics use it

for the analysis of local production systems and industrial districts (ID) (Boschma and Ter Wal, 2007, Giuliani, 2007; Morrison, 2008, Samarra and Biggiero, 2008, Morrison and Rabelotti, 2009, Ramirez-Pasillas, 2010).

In particular we have built two relational matrices per district, one for each network (information and knowledge), in which we gathered up the intensity of the corresponding relationships between companies and institutions in the surveyed districts.

### 3.3. Variables

Apart from the general and contextual information on the agents studied, interviews were designed to elicit information leading to the development of quantitative indicators of relations between companies in the district at two levels: the Information Network (IN) and the Knowledge Network (KN).

To operationalize the IN, we have relied mainly on the work of Morrison (2008) and Morrison and Rabelotti (2009). Based on these works the information is considered generic, i.e., declarative knowledge or "know how", so it has been asked to the companies if they exchanged information on new business opportunities, new vendors and suppliers, availability of inputs, features or performance of machinery and technology, regulation and legislation, with the researchers or employees of other organizations on the list. Specifically, we made the following question:

*Q1: Have you exchanged information with the agents on the list in the last 3 years? (For example: New business opportunities, new vendors and suppliers, availability of inputs, characteristics and performance of machinery and technology, regulations and legislation, grants ...)*

*[Indicate the frequency of interaction, according to the following scale: 0 = none, 1 = low, 2 = medium, 3 = high]*

Second, for the KN it has been contemplated the transfer of knowledge related to innovation and technical problem solving, based on the work of Giuliani and Bell (2005), Giuliani (2007), Morrison (2008), Morrison and Rabelotti (2009) and Ramirez-Pasillas (2010). This approach involves going beyond the mere transfer of information which access can be easily achieved by other means (fairs, Internet, magazines, etc.). Thus, it is considered that the knowledge transferred is usually the answer to a question about a complex problem that has arisen and that the company intends to solve, as shown in the following question:

*Q2: Which of the listing agents has helped to solve technical problems, provided relevant expertise to your business or participated in projects focused on R & D, in the last 3 years?*

*[Indicate the frequency of interaction, according to the following scale: 0 = none, 1 = low, 2 = medium, 3 = high]*

### 3.4. Indicators

To perform a quantitative analysis of the networks we used a set of indicators. So first, we applied measures of network density, which is based on the ratio of the total number of links and the maximum that could be, that is to say, the case all agents were related to each other directly.

Additionally, we used indicators of centrality and intermediation of networks (Freeman et al., 1991; Borgatti et al., 2009). These measures reflect whether there are nodes that act as links or bridges between others who have no direct relations with each other, becoming elements of internal cohesion in the network. Specifically, we measured three indices: degree, closeness and betweenness.

First, Degree measures reveal which is the agent who holds more influence or authority in the network based on the number of direct links maintained with other agents. This ratio can also be interpreted as the degree of opportunity to influence or be influenced by other agents in the network.

The Closeness centrality, unlike earlier, does not emphasize the nature of the bond between agents but indicates the closeness of a node from the rest of the network, representing the ability of a node to reach the others. This provides information on each agent's ability to access other network operators indirectly, i.e., using other nodes as a bridge. This type of contact is particularly important to the extent that district agents often circulate information or knowledge of others within the network, so that high values of closeness clearly increase their importance and relative weight within the district.

Finally, betweenness measures indicate the ability of mediation. It shows when a node acts as an intermediary between two others, which gives a clear notion about the importance of that node in the network.

## **4. RESULTS**

This section aims to show the relationships among the major companies in the districts surveyed and the institutions with which they interact, both internal and external to it, examining the two types of networks already explained.

### **4.1. Structural analysis of the network**

Figures 1 and 2 represent circular graphs of the different firm-institution business networks for the textile district, while 3 and 4 are for the tile district. On these figures institutions have been represented by squares and firms by circles. We have used this representation because all nodes are located at the same distance in a circle allowing to easily detect the ones with more connections.

Density has been measured for each of the networks, that is, the total number of existing direct links with regard to the maximum that could be in the case that all agents were directly related to each other.

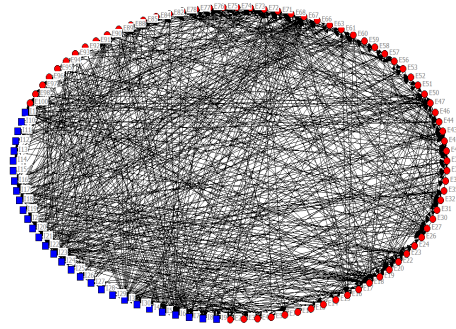
In the textile ID, there are differences between the two networks analyzed, the first (IN) is more dense and highly connected (density: 9.52%), while the second (KN) is less dense (density: 5.59%), with nodes connected by weak links, and even with some nodes isolated and disconnected from the network. This result suggests that the contacts, through which knowledge is exchanged in the textile ID, are focused on stronger relationships based on reciprocity, stability and confidence (Schrader, 1991).

In contrast, the ceramic ID densities are lower and behave opposite to the textile sector. In this case, the denser network is the knowledge one (density: 6%) to the detriment of the information exchanges (density: 3.9%), a result that suggests a greater intensity in the formation of relations that share technical knowledge.

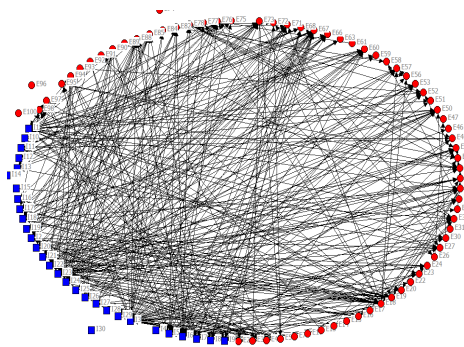
In order to quantify the above observations, in the following paragraphs the structural characteristics of the networks will be analyzed. Measures of centrality and intermediation capacity of the networks have been used to that purpose (Freeman et al., 1991; Borgatti et al., 2009). Specifically, we measured their degree, closeness and betweenness. In addition, we evaluated each of the institutions in the two systems on these three indices, making two different comparative analysis, one with the values obtained on the whole network and another considering actors that belong to the institutional group exclusively.



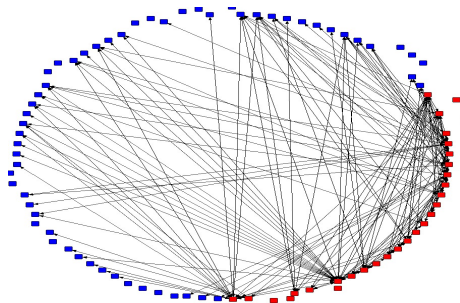
**Figure 1. Information Network (IN) Firm-Institutions on Textile Industrial District.**



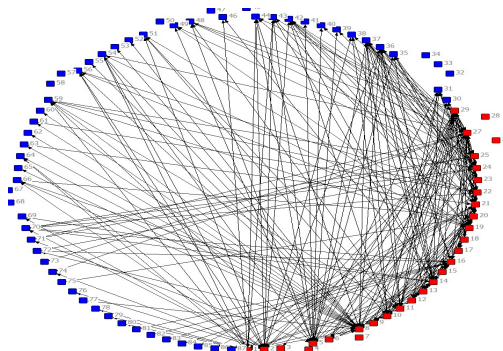
**Figure 2. Knowledge Network (KN) Firm-Institutions on Textile Industrial District**



**Figure 3. Information Network (IN) Firm-Institutions on Ceramic Industrial District**



**Figure 4. Knowledge Network (KN) Firm-Institutions on Ceramic Industrial District**



## 4.2. Networks Degree Analysis

We conducted measures of centrality in the network, in particular, we calculated the degree. This centrality index identifies the agent who holds more influence or authority in the network based on the number of direct links maintained with other actors. The degree can also be interpreted as the opportunity to influence or be influenced by other agents in the network.

The results obtained for the textile ID note that the information network has higher means of direct connections between nodes (9.331), having the knowledge network significantly lower values (5.477). In contrast, in the ceramic ID just the opposite, there are more direct connections between actors and district institutions of knowledge exchange (5.195) than information (3.379).

Table 3 shows the degree values for those institutions above the average of the network, and the position of each of them compared to other institutions and the whole network (institutions and firms). In the textile ID, we can see that the top four positions in both systems studied, whether we look only at institutions or considering the entire network (institutions and firms) are occupied by two business associations (ATEVAL and AETA), the Institute of Textile Research (AITEEX) and IMPIVA, the last three alternating positions including second, third and fourth. The other institutions holding important positions in the networks of information and knowledge are other business associations like Acetex, Chambers of Commerce of Alicante and Valencia, the Valencian Export Institute (IVEX), the Heimtextil fair in Frankfurt and Alcoy Campus of the Polytechnic University of Valencia, which ranks tenth on direct links in the network of knowledge of the district (18th counting all actors) and 12th in the information (29th counting all actors). It is noteworthy that other universities in close geographical proximity to the district, including the University of Alicante and University of Valencia, are valued by businesses and institutions with very little contact with their firms, occupying the last positions on the two networks. It is also interesting to analyze the position occupied by the Chamber of Commerce and Industry of Alcoy, which is at position 11th of 30 in the information and knowledge. If we consider that current legislation does not allow these types of institutions to act at county level, only local interaction is allowed, it is particularly significant to have these positions in the network.

On the other hand, the ceramic ID institutions have a smaller role than in the textile ID since the Institute of Ceramic Technology (ITC) is the best ranked institution achieving position 11th on degree compared with the whole network (firms + institutions). Remarkable is the role of the Universitat Jaume I in the knowledge network and CEVISAMA in the information one. The other institutions holding important positions in both cases are conferences as QUALICER and organizations like the Chamber of Commerce of Castellón or IMPIVA. Also noteworthy is the fact that the information network for the ceramic case presents only 8 institutions above the average of the network in terms of degree. Furthermore, the position occupied by a university outside the province like the Polytechnic University of Valencia (UPV) is better than in the textile sector, above average when it comes to degree and occupying the position 29th compared with the entire network. The last fact to mention is the significant presence of the National Association of Frit, Ceramic Glazes and Colours (ANFECC) in the knowledge network where it occupies the fourth position among the institutions.

**Table 3. Network characteristics based on degree measures.**

Textile ID							Ceramic ID						
IN				KN			IN				KN		
Av.	9.331			5.477			Av.	3.379			5.195		
SD	6.992			5.296			SD	5.253			6.404		
Min.	0.680			0.000			Min.	0.000			0.000		
Max.	40.476			31.633			Max.	30.000			30.000		
I.P. <sup>1</sup>	Institution	Degree	G.P. <sup>2</sup>	Institution	Degree	G.P.	I.P.	Institution	Degree	G.P.	Institution	Degree	G.P.
1	ATEVAL	40,476	1	ATEVAL	31,633	1	1	ITC	7,00	11	ITC	12	13
2	AETA	26,190	2	AITEX	23,129	2	2	CEVISAMA	7,00	12	UJI	11	17
3	AITEX	25,510	3	AETA	21,088	3	3	CÁMARA	7,00	13	QUALICER	9	20
4	IMPIVA	22,109	4	IMPIVA	17,007	4	4	IMPIVA	5,00	18	ANFFECC	7	21
5	CCV	18,367	7	IVEX	13,265	7	5	QUALICER	4,00	23	IMPIVA	7	22
6	CCA	17,347	9	CCV	12,585	9	6	CDTI	4,00	24	CEVISAMA	6	25
7	ACETEX	15,986	11	CCA	11,224	11	7	CONS.	4,00	25	CÁMARA CS	6	26
8	IVEX	15,986	12	UPC	10,204	12	8	IVEX	4,00	26	CDTI	6	27
9	FHF	13,605	16	FHF	9,184	16	9				UPV	6	28
10	FHV	12,585	18	UPVALC	8,844	18	10				ATC	5	29
11	CCALC	11,224	23	CCALC	8,163	23	11				ESCAL	5	30
12	UPVALC	9,524	29	FTF	6,803	29	12				CONS.	5	31

<sup>1</sup> Institutions' Position: Ranking comparing only the values for institutions (only values above the average of the network are displayed)

<sup>2</sup> Global Position: Ranking taking the whole network into account (Firms + Institutions)

### 4.3. Closeness Analysis

The measure of the degree of actor's centrality only shows the immediate links or direct links that each actor has and does not consider the contacts that an organization can establish indirectly, i.e., those produced using other agents as a bridge. This last type of contact is relevant to the extent that agents circulate third party information or knowledge through the network, so it should be explored in more depth.

In order to do that, closeness is the appropriate index to use. This index, unlike the degree of centrality already reviewed, does not emphasize the nature of the bond between agents focusing instead on the geodesic distance from one agent to another, namely, the shortest route that an actor must follow to reach another node. Indicates the proximity of one node to the rest of the network, representing the ability of a node to reach others. Higher closeness values of the nodes indicate a better ability to connect with other actors in the network.

From the results obtained (Table 4) of this index it can be observed that in the Textile ID the network that has a higher mean value remains the information one (23.868), and lower values consequently for the knowledge network (6.904). However, in the Ceramic ID, higher values are for the Knowledge Network (6.175) compare with the Information one (3.978).

If we look at the position of Textile ID institutions, we find this time rather major differences between the two networks analyzed. At Information Network level ATEVAL occupies the first position again, with the rest of the top positions occupied by AETA, AITEX and IMPIVA. These top positions at the institutional level also correspond to the first positions in the whole network. But if we analyze the network of knowledge we can see that these four institutions are the first ones only among the institutions, when we compare with the whole network there are firms that have more prominent roles than institutions.

From position 5th, in both systems, lighter weight of the institutions in the entire network is observed. In fact the campus of the UPV Alcoy appears only in the knowledge network, occupying position 48th of the entire network. The Chambers of Commerce of Alicante and Valencia, as well as Acetex and the Frankfurt Fair remain among the most important institutions, although they lose presence in the whole networks.

As for the Ceramic ID, ITC continues to stand above the other institutions ranking sixth, in both cases, of the total network. The other institutions at the top show a similar pattern to the degree index except ANFECC that in this section does not appear among the top 12, ranking 34th in the entire network. Thus UJI, Chamber of Commerce of Castellón and IMPIVA occupy important positions in both cases. In the information network, however, there are a couple of institutions that were not present in the top 12 in the case of the degree index, the Valencian Export Institute (IVEX) and Bancaja. Finally the presence in the information network of the University of Bologna, with closeness values above the average of the whole network, is remarkable.

**Table 4. Network structural characteristics based on closeness measures.**

Textile ID							Ceramic ID						
IN				KN			IN				KN		
<b>Av.</b>	23.868			6.904			<b>Av.</b>	3.978			6,175		
<b>SD</b>	1.571			1.875			<b>SD</b>	0.049			0,118		
<b>Min.</b>	19.718			1.010			<b>Min.</b>	0			0		
<b>Max.</b>	28.406			8.492			<b>Max.</b>	4.078			6,428		
<b>I.P.<sup>1</sup></b>	<b>Institution</b>	<b>Close.</b>	<b>G.P.<sup>2</sup></b>	<b>Institution</b>	<b>Close.</b>	<b>G.P.</b>	<b>I.P.</b>	<b>Institution</b>	<b>Close.</b>	<b>G.P.</b>	<b>Institution</b>	<b>Cerc.</b>	<b>G.P.</b>
1	ATEVAL	28,406	1	ATEVAL	7,878	2	1	ITC	4,041	6	ITC	6,35	6
2	AETA	26,486	3	AITEX	7,765	4	2	CÁMARA	4,038	7	UJI	6,33	7
3	AITEX	26,344	4	AETA	7,710	8	3	IMPIVA	4,026	13	CÁMARA	6,31	12
4	IMPIVA	26,203	5	IMPIVA	7,692	9	4	IVEX	4,019	16	CDTI	6,29	15
5	CCV	25,323	18	IVEX	7,603	29	5	QUALICER	4,011	19	QUALICER	6,27	21
6	CCA	25,000	22	CCV	7,597	30	6	UJI	4,004	21	IMPIVA	6,25	22
7	ACETEX	24,810	26	CCA	7,562	36	7	CDTI	4,004	22	CEVISAMA	6,24	24
8	IVEX	24,747	27	FHF	7,544	40	8	ASCER	4,002	25	SGS	6,23	27
9	FHF	24,561	35	ACETEX	7,533	42	9	CEVISAMA	3,998	27	UPV	6,23	28
10	FHV	24,257	44	UPVALC	7,475	48	10	BANCAJA	3,998	28	ASCER	6,22	30
11				COEVAL	7,464	51	11	CONS.	3,998	29	ATC	6,22	31
12				CEEIALC	7,464	52	12	UB	3,998	30	CONS	6,22	32

<sup>1</sup> Institutions' Position: Ranking comparing only the values for institutions (only values above the average of the network are displayed)

<sup>2</sup> Global Position: Ranking taking the whole network into account (Firms + Institutions)

#### 4.4. Betweenness centrality analysis.

Eventually, in Table 5, we analyze the betweenness degree. This ratio indicates how often a node appears in the shorter segment (or geodesic) that connects two others. That is, it shows when an agent is an intermediary between two others that are not linked to each other. This index gives us an idea of the importance of each agent in the network.

We can see in this case that in Textile ID the knowledge network stands with highest mean (1.353), ahead of the information network (1.267), in contrast to what happened with the two previous indices. In the Ceramic ID the knowledge network also has higher mean (43.264) than information (36.057).

In the Textile ID, we see that the most important intermediary institution in both networks ATEVAL at institution and whole network level. We found in both systems the association AETA, IMPIVA, the Chamber of Commerce of Valencia, AITEX, ACETEX and the Chamber of Commerce of Alicante occupying dominant positions, considering the whole network. This means that, in this district, business associations, chambers of commerce and technology institutes play a vital role as intermediaries in the exchange of information and knowledge among the actors in the district. Thus, in addition to providing local companies generic and specific services, they act as repositories of knowledge and opportunities (Baum and Oliver, 1992). As a result, companies in the district can take advantage of having a network of linkages with local institutions that provide reliable sources of information and knowledge to increase their capabilities (Decarolis and Deeds, 1999, McEvily and Zaheer, 1999). In short, the middle position of local institutions facilitates the acquisition of skills through the collection and dissemination of knowledge (Molina-Morales et al, 2002). Thus, local institutions allow a reduction in costs related to the search for external sources of knowledge, which is critical for businesses in a district such as textiles, characterized by the presence of small firms with lower individual activity on innovation, generating search economies (Molina-Morales, 2005). Moreover, because local institutions interact with a large number of companies in the industrial district, are exposed to a wide variety of solutions to organizational and management problems. So, based on extensive experience gained in the observation of situations with similar problems, local institutions, acting as intermediaries, can compile and disseminate skills and routines (McEvily and Zaheer, 1999).

It is particularly noteworthy that in the knowledge network, in the textile district, two fairs (Heimtextil and TechTextil) appear within the ten major institutions as intermediaries for knowledge flows.

As for the Ceramic ID the pattern is quite different from the textile sector. In first place highlights the fact that very few institutions are above the average values in both networks. Thus, the most important institutions are: ITC, IVEX, UJE and The Chamber of Commerce of Castellón. It is specially remarkable the high values found on betweenness in the Ceramic ID a sign that there are certain institutions in this sector that exert a strong mediating role in the distribution of information both technical and market related. The position of the institutions above the average over the entire network is similar to other centrality measures analyzed, approximately between the tenth and fifteenth place.

**Table 5. Network structural characteristics based on betweenness measures.**

Textile ID							Ceramic ID									
IN				KN			IN				KN					
Av.	1.267			1.353			Av.	36.057			43,264					
SD	2.566			2.814			SD	102.323			110,015					
Min.	0			0			Min.	0.000			0,000					
Max.	20.488			22.605			Max.	693.275			713,968					
I.P. <sup>1</sup>	Institution	Betw.	G.P. <sup>2</sup>	Institution	Betw.	G.P.	I.P.	Institution	Betw.	G.P.	Institution	Betw.	G.P.			
1	ATEVAL	20,488	1	ATEVAL	22,605	1	1	ITC	100,87	9	ITC	97,792	12			
2	AETA	7,249	3	AITEX	10,021	2	2	IVEX	84,041	11	UJI	46,483	16			
3	IMPIVA	5,278	4	AETA	7,195	4	3	CÁMARA	56,851	13						
4	CCV	5,181	5	CCV	5,394	6	4									
5	AITEX	4,905	6	IMPIVA	4,698	7	5									
6	ACETEX	4,349	7	CCA	3,394	8	6									
7	CCA	4,292	8	ACETEX	2,789	11	7									
8	IVEX	2,048	18	FHF	2,597	14	8									
9	FHV	1,720	20	FTF	2,055	19	9									
10	FHF	1,678	22	IVEX	1,971	21	10									
11							11									
12							12									

<sup>1</sup> Institutions' Position: Ranking comparing only the values for institutions (only values above the average of the network are displayed)

<sup>2</sup> Global Position: Ranking taking the whole network into account (Firms + Institutions)

## 5. CONCLUSIONS

In this paper we have tried to contribute to a better understanding of the relationships between the existing network companies in an industrial district, as well as the study of the local institutions role in it, under the social network perspective. To do this, we have made use of Social Network Analysis techniques. The combination of numerical and graphical results, through this technique, enables a better understanding of the studied phenomenon.

We have analyzed two industrial districts corresponding to traditional sectors with serious problems of competitiveness, which are experiencing a marked decrease in the number of companies and workers. In particular, we analyzed two types of networks within textile and ceramics districts in Valencia (Spain), related to the exchange of information (IN) and knowledge (KN).

The industrial district is an economic reality where the institutional framework provides a set of services that promote the competitiveness of its firms. Institutions that have a set of links to networks outside the district provide new ideas and knowledge. This fact is reflected in the information and knowledge networks. On the other hand, companies can leverage the institutions brokering functionality with external (to the district) knowledge through the interaction with institutions. To do so, they must move away from the traditional working relationship model between local institutions and businesses, moving to a more interactive one. Companies should develop close links with local institutions, exploiting the fact that social networks facilitate the rapid transmission of codified knowledge.

This is especially important in the surveyed districts, as for example the textile one is composed of over 80% of SME companies, where the small size of these can be a limiting factor when establishing external (to the district) links. Therefore, maintaining this relationship with the institutions is in many cases the only way to maintain a higher structural dispersion for firms.

The results are in line with earlier ones (Molina et al., 2002, Molina-Morales and Mas-Verdú, 2008) that suggest a positive effect of local institutions that act as possible knowledge mediators among district agents, both internally, at network level, and externally, allowing access to networks and new sources of information, difficult to achieve for firms in the district by themselves.

However, there are differences between the two districts surveyed. In the Textile ID institutions always occupy the top of the two networks, at both direct and indirect contact level, playing a clear intermediation role and producing more information exchanges than knowledge. In contrast, in the ceramic ID companies occupy prime locations on the networks, having lower information exchanges than knowledge. These differences may come motivated by the characteristics of the two samples analyzed, while the Textile ID, corresponds to a low-tech and relatively low levels of innovation, the sample of companies for the ceramic ID represents the greatest source of product innovation in this district. This may encourage a greater exchange of knowledge than information in tile district, and the lower intensity of these exchanges, as these companies usually have their own external (to the district) relationships.

On the other hand, if we differentiate local institutions in universities and public research organizations, on the one hand, and business associations, chambers of commerce and administration, on the other, we encounter different roles when it comes to act as intermediaries between the district firms and outside networks. Specifically, we found significant differences between the low-tech sector (textile) and the high-tech (ceramic) one already indicated by Belussi and Sedita (2009). In the case of Ceramic ID (more innovative) we found that the university and technological institute operate as leading institutions in the innovation process (knowledge network), in line with results obtained in previous works (Gertler, 2010), while in the Textile ID (less innovative) the Institute of Technology role matches the ceramic, but the university role is not so evident. Coinciding with works like Belussi and Sedita (2009), business associations play a key role.



We believe that our analysis may suggest implications for policy and strategy, both in local institutions and in firms, when carrying out economic development and regional innovation capacity policies, especially those affecting traditional sectors. In this sense, our work contributes to the research in the field of Social Capital and Industrial District in different ways. We have discussed the characterization of networks for information and knowledge exchange in industrial districts, identifying the opportunities and constraints they involve. As a result, we can make some recommendations: 1) the companies must interact with local institutions and other firms that belong to the district to improve local environmental conditions. The dynamics between the formation of tacit and codified knowledge and other elements of innovation processes need a reassessment of institutional arrangements, 2) Businesses can take different strategies for the pursuit of knowledge and skills. These include, among others, strategic alliances with key institutions to influence over education and training of future researchers, research in collaboration with individual researchers or university departments to have privileged access to information, or finally, the creation of hybrid organizations between companies and institutions to develop joint research programs. In conclusion, we suggest the need to develop a distinctive business strategy to shape and optimally exploit the collective resources that local institutions provide.

Finally, our research has generated new research questions. In fact, these issues can be viewed as potential limitations of the study: 1) to investigate in greater depth the process from which the structure of information networks and knowledge is modified. Another fruitful research area is the dynamics of business networks evolution and change in response to external challenges and opportunities. In other words, to what extent the inertia limits the company's ability to reconfigure the network link model. (2) On the other hand, processes of cooperative competition in industrial districts may benefit from a more detailed analysis of the combination of cooperation and competition in the networks. (3) A final issue may arise concerning the diversity of local institutions. Since most of them come from the same industry, the information accessible for local firms may be less diverse. Therefore, a deeper analysis is required in terms of how local institutions can vary the scope of the activities they carry out.

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# ANNEX. I. LIST OF INSTITUTIONS (TEXTIL ID)

INTERNAL DISTRIC INSTITUTIONS	
1	Agrupación Empresarial Textil Alcoyana (AETA)
2	Asociación Comarcal de Empresarios Textiles de l'Alcoià i El Comtat (ACETEX)
3	Asociación Empresarios Textiles Comunidad Valenciana (ATEVAL)
4	Cámara Oficial de Comercio e Industria de Alcoy (CCALC)
5	Centro Europeo de Empresas Innovadoras Alcoy (CEEIALC)
6	Confederación Empresarial de la Vall d'Albaida (COEVAL)
7	Federación Empresarial de L'Alcoià i El Comtat (FEDAC)
8	Instituto Tecnológico Textil (AITEEX)
9	Universidad Politécnica de Valencia – Campus de Alcoy (UPVALC)
EXTERNAL DISTRICT INSTITUTIONS	
1	Asociación Española de Constructores de Maquinaria Textil y Confección (AMEC)
2	Cámara de Comercio de Alicante (CCA)
3	Cámara de Comercio de Valencia (CCV)
4	Centro de Información Textil y de la Confección (CITYC)
5	Confederación Empresarial de la Provincia de Alicante (COEPA)
6	Confederación Empresarial Valenciana (CEV)
7	Federación Nacional de Acabadores, Estampadores y Tintoreros Textiles (FNAETT)
8	Consejo Intertextil Español (CIE)
9	Feria Evtteks Estambul (FEE)
10	Feria Hábitat Valencia (FHV)
11	Feria Heimtextil Frankfurt (FHF)
12	Feria Internacional Maquinaria Textil Barcelona (FIMTB)
13	Feria Mood Bruselas (FMB)
14	Feria Techtextil Frankfurt (FTF)
15	Instituto de la Mediana y Pequeña Industria Valenciana (IMPIVA)
16	Instituto Valenciano de la Exportación (IVEX)
17	Universidad CEU Cardenal Herrera (CEU)
18	Universidad Politécnica de Valencia – Campus de Valencia (UPVV)
19	Universitat d'Alacant (UA)
20	Universitat de València (UV)
21	Universitat Politècnica de Catalunya (UPC)

## ANEXX. II. LIST OF INSTITUTIONS (CERAMIC ID)

INTERNAL DISTRICT INSTITUTIONS		EXTERNAL DISTRICT INSTITUTIONS	
1	INSTITUTO DE TECNOLOGÍA CERÁMICA (ITC)	1	IMPIVA
2	UNIVERSITAT JAUME I (DEPARTAMENTOS)	2	CDTI
3	QUALICER	3	Universidad Politécnica de Valencia
4	ANFFECC	4	Conselleria d'Indústria, Comerç i Innovació
5	CEVISAMA	5	Aenor
6	CÁMARA DE COMERCIO, INDUSTRIA Y NAVEGACIÓN DE CASTELLÓN	6	SGS
7	ASOCIACIÓN DE TÉCNICOS CERÁMICOS (ATC)	7	Ministerio de Ciencia e Innovación
8	ESCUELA SUPERIOR DE CERÁMICA DE ALCORA (ESCAL)	8	Universidad de Zaragoza
9	ASCIER	9	Universidad de Bolonia
10	ALICER	10	Instituto de Crédito Oficial (ICO)
11	INSTITUTO DE CERAMICA ONDA	11	Instituto Valenciano de la Exportación (IVEX)
12	FUE-UJI FUNDACIÓN UNIVERSITAT JAUME I – EMPRESA	12	Universidad de Valencia
13	IES CAMINÁS MÓDULO CERÁMICA FORMACIÓN PROFESIONAL	13	Instituto Tecnológico de Óptica, Color e Imagen (AIDO)
14	CEEI CASTELLÓN	14	Bancaja
15	AYUNTAMIENTO DE ALCORA	15	CAM
16	ASEBEC	16	Comisión Europea de EmpreS.A. e Industria
17	ASOCIACIONES PROFESIONALES	17	Instituto de Comercio Exterior (ICEX)
18	COLEGIOS PROFESIONALES	18	Instituto Valenciano de Finanzas (IVF)
19	ESPAITEC,	19	Price Waterhouse Coopers
20	INSTITUTO DE PROMOCIÓN CERÁMICA	20	Universidad de ManreS.A.
		22	INASMET-Tecnalia
		23	Instituto de Cerámica y Vidrio (ICV)-Madrid
		24	Universidad de la Rioja
		25	Universidad de Castilla-La Mancha
		26	Universidad de Cádiz
		27	Universidad de Barcelona
		28	DOW Chemical Company
		29	BASF Chemical Company
		30	INEOS
		31	AIDICO, Instituto Tecnológico de la Construcción
		32	AIMPLAS, Instituto Tecnológico de Plástico
		33	ITENE, Instituto Tecnológico del Embalaje, Transporte y Logística
		34	Accenture
		35	Comval Emprendre
		36	Garrigues
		37	Sociedad de Garantía Recíproca de la Comunidad Valenciana (SGR)
		38	Tirant F.C.R.