Heterogeneity of innovation and the role of institutions in a low tech context: a case study in a Spanish Textile Industrial District

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Abstract

This case study focuses on the analysis of the Innovation System of the Textile-Clothing Sector in one specific industrial district. The investigation begins by determining the context and the configuration of the main agents, as well as explaining existing behavioural relationships amongst local stakeholders. The paper analyzes the different sources of innovation and specifically it describes the role of institutions in these innovative dynamics in a qualitative way. After this, further research calls for quantitative research tools to complement this preliminary approach.
Introduction

Innovation has long been considered as an interactive process between heterogeneous actors (Kline & Rosenberg, 1986). Therefore, a systemic analysis is called for facing this complexity. Many economists argue that there is a relationship between “spatial clustering, knowledge spillovers and firms’ innovative output” (Jaffe et al., 1993, also cited in Giuliani, 2007: 141). This geographical approach assumes that firms’ agglomeration *per se* lead to generation of innovations. Moreover, regional studies may include several sectors that differ in nature, considering technologies, markets and products, among others. That means that pure geographical analyses of innovation processes are too complex due to the inclusion of too many sectors. On the contrary, other authors argue that innovation and technological change followed markedly different pathways depending on the sector in which they take place (Malerba, 2004: 1). This discrepancy between both intellectual streams is highlighted in this paper. It tries to summarize relevant outcomes from several studies made by a group of researchers between 2004 and 2008\(^1\). They have integrated geographical and sectoral dimensions in the analysis of innovation processes within a specific industrial district specialized in a mature industry: textile-clothing\(^2\).

The textile industry is facing different challenges in each one of the three areas of Market, Technology and Products. Therefore, a better understanding of the different interrelationships among institutions and their impact in the innovation outcomes requires a systemic approach. Firstly, markets are changing because of the increasing competitiveness derived from the openness to emergent economies enabling them to export their products in richer countries. Secondly, the textile industry is characterized by its dependence on the development of technology in other sectors: machinery, information and communication technologies, among others. And thirdly, the pressure for products differentiation has led to a steady increasing diversification of products and services.

Trying to cope with these issues in this paper an analysis of the main local agents of the textile industry is given using Innovation System approach. As we have mentioned

\(^1\) The research idea was originated by both authors when Francisco Javier Ortega-Colomer worked as a Project Researcher in the Department of Business Administration, Polytechnic University of Valencia (campus of Alcoi) where Emilio Golf-Laville was also and is still working. Since 2006 Francisco Javier Ortega-Colomer has been working at INGENIO.

\(^2\) However, this descriptive analysis calls for more sophisticated analytical tools such as Network Analysis which connects with the aim of the Barcelona Summer School 2009 on “Agglomeration, Industries and Innovation”.

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previously, this is a summary of main results derived from different projects in which the researchers have been involved in the last years. The paper is organized in the following way. The first section deals with some introductory theoretical notes. The second section describes the geographical and sectoral approach in this paper, taken into account the different projects from which it has been written. The third section analyzes the context, the role and interrelationships of the main agents involved in the Textile Innovation System. The fourth section includes the main conclusions. Finally, the last section presents some suggestions for future research.

**Conceptual Framework**

Innovation studies have grown within the scientific community in the last years (Castellaci et al., 2005; Fagerberg, 2009). An innovation perspective deals with “the creation of new resources in a situation marked by continuous changes in technologies, preferences and institutions” (Mytelka, 2000: 16). The existence of information asymmetries causes technological changes (Dosi et al., 1988) and creates new exploitation opportunities of this knowledge. Therefore, if we consider that uncertainties and disequilibria are “more the rule than the exception”, (Barge-Gil & Modrego-Rico, 2007: 246) we need an adequate tool to be able to take into account the complexity of the innovation processes. Several disciplines have studied innovation from different angles. For instance, from an institutional viewpoint the focus is on how a set of organizations coordinate different processes and ideas to create new products and services (Galanakis, 2006). A set of given organizations is path-dependent and context-dependent (Pinto, 2009); this is why we need a conceptual approach applicable to the description of the functions and interrelationships among different organizations to be able to understand this heterogeneity. The emergence of National Innovation Systems (NIS) approach traces its roots in the first OECD 60s debates about the “systems approach” (Godin, 2007), and was developed as a theoretical approach in the 80s by Freeman (1982). This perspective was able to integrate many of the factors which had been previously excluded from innovation analysis. The interrelationships between different actors and institutions in the innovation process were a key element of this approach. Some main contributors to the National Innovation Systems approach defined it as follows:

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3 This article was newly published in 2004 in the same journal, see the references.
“...is a set of institutions whose interactions determine the innovative performance of national firms” (Nelson, 1993: 4)

“...is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge” (Lundvall, 1992: 2)

Local Systems of Innovation is a geographical adaptation of the National Systems of Innovation concept. This change was made to capture the peculiarities of different locations even when they belong to the same country⁴. Also from a sectoral viewpoint analysts have emphasized the specific characteristics of innovation in different sectors regardless of their territorial location (Breschi & Malerba, 1997).

“A sectoral system of innovation and production is a set of new and established products for specific uses and the set of agents carrying out market and non-market interactions for the creation, production and sale of those products” (Malerba, 2002).

Therefore, once more the presence of different institutions and their interrelationships is acknowledged as crucial in the former concepts: local/global firms, educational institutions, technology institutes, government regulatory bodies and others. In this study we have adapted Arnold & Kuhlman’s Innovation System model⁵ emphasizing the role of local institutions in the analysis. We have only included those institutions proposed by the model and that have not found relevant in the case study. In the next paragraph, these different parts of the model are presented. Subsequently, we apply this analytical framework through descriptive analysis of the Textile-Clothing Innovation System in one specific industrial district. Before describing the main parts of the system, we also give a picture of the socio-economic framework.

Firstly, the central core for innovation system is constituted by the Industrial System: a set of firms located in the same territory and that belongs to some related industrial activities, for instance, the textile industry and supporting industries. Within this set of firms, a few are “new technology-based firms” adopting new technologies from other fields: ICTs, Chemistry, and Plastics, among others (Storey & Tether, 1998). Secondly, Demand System is included in the analysis because its importance in the generation of innovation. Most of the innovations

⁴ In the case of Spain, there are 17 autonomous regions.

⁵ This model has been used by the European Commission in the annual evaluation: “European Trend Chart on Innovation”.
in this sector are prescribed by the market specifications (Alto Consejo Consultivo, 2007: 150). Additionally, a distribution channels analysis is necessary to gain a better understanding of the specific Innovation System dynamics. Thirdly, **Educational and Research System** is formed by all the private and public institutions whose objective is to transfer technology and knowledge to the industrial system. Within this category we find the so-called “Research Results Transfer Office”, the Technology Institutes, the Higher Education Institutions and other agents such as Intellectual Property management offices. Universities are claimed to play an important role in the innovation processes and consequently in the creation of the European knowledge-based economy (Shattock, 2005, Kitagawa, 2005). Universities can provide not only knowledge and technology, but also skilled personnel that contribute to the local firms as employees and consultants (Bonaccorsi & Piccaluga, 1994). Fourthly, **Social Agents** are mainly formed by business associations, workers unions and consumer associations. Lastly, the **Legal Framework and Policy**, framing these agents and their interrelationships; in other words framing conditions for the functioning and the dynamics of the system.
Graph 1: Analysis Outline of the Sectoral Innovation System Model bounded for a region.

Adaptation from Arnold and Kuhlman’s model (2001)
**Approach**

The dynamics of knowledge generation and dissemination in low tech contexts have to be studied in order to understand the sources of innovation and the role that institutions can play in these dynamics. Some studies have addressed these issues providing a categorization of the different contexts where the industrial transformation was influencing the different roles that, for instance, the university plays in the local development (Lester, 2005). While recent studies have focused on collaboration between industrial firms and universities in the Valencian Region as a whole (García & Fernández-de-Lucio, 2008), this paper concentrates on one specific textile industrial district. The lack of micro-data based on certain localities calls for an in-depth empirical analysis of the delimitation of specific industrial districts, the sources of innovation of their firms and the relationships between their agents.

Our approach has led to circumscribe the analysis within a geographical framework smaller than a region and bigger than a municipality. This is represented by a discontinuous line around the boxes in the Graph 1. It means that although the focus is local/regional the system is an open system with interactions with external actors.

Therefore, this paper analyzes the textile industry in one specific industrial district. It collects the main results and conclusions from different projects in which the authors have participated between 2004 and 2008. In the next table, the main references to these projects are shown indicating the name of the project, the main objectives aimed and the period of time.

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6 The authors acknowledge that there are few firms which do not belong to the local environment and have been included in the study, following the rationale that “innovation processes transcends the administrative borders”, (Nilsson et al. 2006: 20).

7 For instance, those localities that do not correspond with the administrative boundaries: bigger than a locality and smaller than a region.

8 Emilio golf-Laville has been the main researcher of all these projects.
All of these projects have used the conceptual framework developed in the previous section of this paper. Regarding to the data collection, different sources have been used from questionnaires and interviews to the document analysis and statistical databases exploitation.

Although Arnold & Kuhlman’ model focuses the analysis from a sectoral viewpoint, we have adapted it including the geographical dimension. This has allowed us to delimit the study overcoming limitations derived from dichotomy sectoral vs. geographical. That does not mean that this approach has not any limitations. Rather we acknowledge, as Carlsson et al. (2002) also do, for instance, the complexity of establishing the boundaries in this kind of innovation studies. Moreover, in low tech industries just as Robertson and Smith argue:

“The pervasiveness of distributed knowledge bases accounts for much of the diversity that the maps reveal since different firms belong to different, overlapping, networks as a results of many factors including different social connections, perhaps derived form using different suppliers and catering for different customers (Robertson and Smith, 2009: 112)"

Finally, the fact that we stress the focus of our analysis around the Alcoi area not only responds to its industrial past as an outstanding textile area but also its continuing productive

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**Table 1: Main Projects about Textile-Clothing Industry**

<table>
<thead>
<tr>
<th>Project</th>
<th>Objectives</th>
<th>Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Plan Estratégico Textil de las Comarcas Centrales Valencianas”</td>
<td>“Increasing the competitiveness of the Valencian textile firms through the improvement of their technology as well as the distribution channels”. Promoting the qualified workers insertion in the ICT environments, foreign trade, design… Considering the negative effects on the environment, on the consumer rights and on the intellectual property within the changing production Technologies”.</td>
<td>2004-2005</td>
</tr>
<tr>
<td>“Estratex: el cambio estratégico en la PYME textil”</td>
<td>“Extending the main results from the former Project (“Plan Estratégico Textil de las Comarcas Centrales Valencianas”), but taking into account only firms with less than 20 workers”.</td>
<td>2006</td>
</tr>
<tr>
<td>“Canales de Distribución de Textiles Técnicos”</td>
<td>“Analyzing and determining the different distribution channels of the different products within the Technical Textile Segment”.</td>
<td>2006-2007</td>
</tr>
<tr>
<td>“La innovación en el sector textil-confección de la Comunidad Valenciana”</td>
<td>“Analyzing the innovative effort realized by firms which belong to the Textile Sector in the Valencian Region”.</td>
<td>2006-2007</td>
</tr>
</tbody>
</table>

Source: Own elaboration
specialization in textile industry, as we will show later. We have calculated Specialization Coefficient (SC) for textile and clothing industry in all the main municipalities, as follows:

$$ SC_j = \frac{S_{ij}}{S_{ij}/S_n} $$

In this equation:
- $S_{ij}$ refers to the total employment in the specialization sector i in the territory j,
- $S_j$ indicates total employment in the territorial unit j,
- $S_i$ is the variable that shows total employment in the specialization sector i, and
- $S_n$ is the total employment at national level.

We have used the latest data from the “Spanish Population Census”, published by National Statistics Institute (INE, 2006), in order to calculate the Specialization Coefficients (SC). After this, we have used a specific software to map the results.

**Descriptive Analysis**

**Socio-economic Framework**

The genesis of the industrial textile activity in the Valencian Region can be situated in Alcoi and its surroundings (Vallés, 1986). Some craggy mountains around Alcoi area hampered the development of agriculture. This difficult orography besides the use of the river power led to the creation of the first mills and subsequently the beginning of the fledgling textile and paper mill industry in the early 19th century. A model of capitalist town was originated due to two main reasons. Firstly, the production centre moved very early from particular houses to the factory. Secondly, from a societal dimension clear differences were observed between the very coordinated industrial managers and a very poor worker class with ridiculous conditions from economic and human viewpoint.

A great number of economic recessions have taken place from the 19th century on, but some extraordinary orders* originated by fatal events like the First World War, in 1914, facilitated the industrial consolidation of these areas. After this, the industry collapsed because of the political and economic instability derived from the 2nd Republic, the Spanish Civil War, and the Second World War, among others. As long ago as 1960s, low-quality textile industry was declining as Franco’s autarkic regime started to open to foreign imports and influences. Yet,

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* These orders were mainly made by French army and the main products ordered were, for instance, blankets and textile products, among others.
an increase of the houses built and an exodus from rural areas to urban ones, observed from 1960 to 1975, helped to consolidate a renovated textile industry in this area based on Home-Textile. During the reconversion process, technological change was possible by importing machinery from the leading-edge countries as Germany. This process innovation besides the cheap manpower in Spain allowed becoming competitive in the international landscape. Since this period firms were specialized in the market niche of Home Textiles. Blankets, towels, clothes, curtains, among others, would be the main products made in these Valencian Central Counties.

The Valencian Central Counties are traditionally known as an industrial district or cluster specialized in mature sectors, mainly in textile industry, which concentrates the 20% of the Spanish textile industry, after Catalonia (48%). This area is characterized as an intermediate region (OCDE, 2001). That means that its economic and social development dynamics is subjected to many ups and downs derived from the slow-down in leadership of the textile activity towards other sectors. In the past decades, for instance, one important source of incomes came from orders of Jacquard\textsuperscript{10} products ordered by some Arab clients. Cooperation between firms was present at that period to attend this excess of demand. Meanwhile the dependence of the machinery providers introduced an additional obstacle to adapt to technological change in the sector. But this favourable trajectory, which was translated in a steady growth of number of firms, was newly collapsed by some changes in the global markets and in the competitiveness’ sources.

In the last years textile industry has dramatically changed. From the socio-economic perspective, the process of globalization has shifted the competitiveness’ sources of the firms. After the expiration of the Multi Fibre Arrangement, trade liberalization in the Textile-Clothing sector has had important consequences in some of the territories where this activity has predominated during more than a century. In the next table, some results are shown regarding to the future perspectives perceived by some industrial managers according to different products segments.

\textsuperscript{10} It refers to a special technique of weaving.
Table 3: Perceptions Assessment on the future in the Total Textile-Clothing Sector (%)

<table>
<thead>
<tr>
<th>Nº</th>
<th>TOTAL</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>1-2</th>
<th>1-3</th>
<th>1-2-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very pessimistic</td>
<td>20</td>
<td>23.81</td>
<td>20.51</td>
<td>38.89</td>
<td>28.57</td>
<td>20.00</td>
<td>16.67</td>
</tr>
<tr>
<td>Pessimistic</td>
<td>36</td>
<td>42.86</td>
<td>46.15</td>
<td>27.78</td>
<td>57.14</td>
<td>60.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Stable</td>
<td>23</td>
<td>27.38</td>
<td>28.21</td>
<td>22.22</td>
<td>14.29</td>
<td>20.00</td>
<td>33.33</td>
</tr>
<tr>
<td>Positive</td>
<td>5</td>
<td>5.95</td>
<td>5.13</td>
<td>11.11</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Very Positive</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>


Source: Own elaboration from Golf-Laville et al.

Logically, according to this situation most of the managers had to decide whether to continue investing in one sector with serious perspectives or whether to invest in another sector with better expected “Return on Assessments” rate. In fact, the rising housing prices from 90s and the difficult perspectives in the textile sector are the main factors that explain this deviation from one sector (textile) to others (construction and its supporting sectors). This trend can be seen in the Valencian Region, mainly in the coast area (see the map). Additionally, the financial sector has promoted the investments in the building sector not only because the better short term benefits expected by investors but also because the obstacles to offer loans to industry in good conditions. These details are very important to gain a better understanding of the challenges in which industry is facing. Economic structure in the Valencian Region has changed dramatically in the last years. In this context, policy-makers, industrial managers and society as a whole have to rethink about how to regain competitiveness based on innovation rather than low-cost strategies.

Table 4: Textile-Clothing Industry in the Valencian Region, 2006.

<table>
<thead>
<tr>
<th>Valencian Region</th>
<th>Nº</th>
<th>% 99/06</th>
<th>nº workers</th>
<th>% 99/06</th>
<th>Operating Revenues 1,000 €</th>
<th>% 99/06</th>
<th>Investments 1,000 €</th>
<th>% 99/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibres</td>
<td>426</td>
<td>2.65</td>
<td>6,486</td>
<td>-24.83</td>
<td>761,654</td>
<td>-15.54</td>
<td>20,384</td>
<td>-50.04</td>
</tr>
<tr>
<td>Finishing</td>
<td>175</td>
<td>-22.57</td>
<td>3,161</td>
<td>-29.44</td>
<td>310,326</td>
<td>-8.08</td>
<td>9,957</td>
<td>-74.40</td>
</tr>
<tr>
<td>Other Textiles</td>
<td>820</td>
<td>-16.07</td>
<td>9,371</td>
<td>-19.36</td>
<td>986,514</td>
<td>4.78</td>
<td>8,548</td>
<td>-82.95</td>
</tr>
<tr>
<td>Knitwear</td>
<td>143</td>
<td>-11.73</td>
<td>2,219</td>
<td>-27.88</td>
<td>138,070</td>
<td>-15.56</td>
<td>4,567</td>
<td>-150.30</td>
</tr>
<tr>
<td>Clothing</td>
<td>794</td>
<td>-18.65</td>
<td>8,833</td>
<td>-34.91</td>
<td>532,871</td>
<td>-20.87</td>
<td>9,973</td>
<td>-75.05</td>
</tr>
<tr>
<td>Total</td>
<td>2,358</td>
<td>-14.44</td>
<td>30,070</td>
<td>-27.33</td>
<td>2,729,435</td>
<td>4.42</td>
<td>44,295</td>
<td>-75.24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spain</th>
<th>Nº</th>
<th>% 99/06</th>
<th>nº workers</th>
<th>% 99/06</th>
<th>Operating Revenues 1,000 €</th>
<th>% 99/06</th>
<th>Investments 1,000 €</th>
<th>% 99/06</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fibres</td>
<td>1,048</td>
<td>-41.02</td>
<td>20,986</td>
<td>-43.91</td>
<td>2,847,981</td>
<td>-19.63</td>
<td>404,950</td>
<td>148.06</td>
</tr>
<tr>
<td>Finishing</td>
<td>697</td>
<td>-26.71</td>
<td>10,846</td>
<td>-30.74</td>
<td>991,690</td>
<td>-4.22</td>
<td>43,816</td>
<td>-31.65</td>
</tr>
<tr>
<td>Other Textiles</td>
<td>2,995</td>
<td>2.64</td>
<td>32,931</td>
<td>-4.40</td>
<td>3,361,525</td>
<td>30.30</td>
<td>93,029</td>
<td>2.82</td>
</tr>
<tr>
<td>Knitwear</td>
<td>1,172</td>
<td>-16.94</td>
<td>14,801</td>
<td>-31.38</td>
<td>1,490,757</td>
<td>-5.95</td>
<td>23,849</td>
<td>-58.92</td>
</tr>
<tr>
<td>Clothing</td>
<td>7,766</td>
<td>-27.13</td>
<td>88,261</td>
<td>-37.03</td>
<td>790,149</td>
<td>0.34</td>
<td>143,551</td>
<td>8.27</td>
</tr>
</tbody>
</table>

Source: Own elaboration from Industrial Survey of firms (IVE)
The previous table summarizes the different Valencian Textile-Clothing industrial activities. Firstly, the main factor that arises is the Valencian industrial specialization in the Textile-Clothing sector. Obviously, this specialization is linked to the strong tradition in Home-textile articles in the counties of “Vall d’Albaida and Alcoià-Comtat. This was due to the process of reconversion from “pañería” production to this sector. The main pulling force was the domestic market expansion during the 60s and 70s decades. This specialization tried to imitate to certain extent the Italian model of industrial district where several firms are connected along the value-chain and each one is specialized in one part of the production process. That way, activities, such as weaving and, mainly, dyeing and finishing, experimented a significant growth not only in the traditional productive localities, as Alcoi and Ontinyent, but also in all surrounding municipalities that, moreover, had cheaper and more abundant industrial land. One detail to highlight is the strong specialization in all the textile subsectors around Alcoi. This can be compared with the vertical integration experimented in Italy where all the processes are concentrated in the same area.

The fact that we stress the focus of our analysis around Alcoi not only responds to its obvious industrial past as an outstanding textile area but also the elevated presence of territories with a high level of productive specialization in textile industry is considered.

In the following table we represent the most important Valencian municipalities in terms of sectoral specialization.

<table>
<thead>
<tr>
<th>Municipality</th>
<th>Employment</th>
<th>Textile-Clothing</th>
<th>National SC</th>
<th>Valencian SC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>16,329,713</td>
<td>276,700</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>Valencian Region</td>
<td>1,715,025</td>
<td>45,508</td>
<td>1.566</td>
<td>1</td>
</tr>
<tr>
<td>Agullent</td>
<td>952</td>
<td>444</td>
<td>27.52</td>
<td>17.58</td>
</tr>
<tr>
<td>Aielo De Malferit</td>
<td>1,632</td>
<td>344</td>
<td>12.44</td>
<td>7.94</td>
</tr>
<tr>
<td>Albaida</td>
<td>2,443</td>
<td>1,012</td>
<td>24.45</td>
<td>15.61</td>
</tr>
<tr>
<td>Alcoi</td>
<td>23,464</td>
<td>5,071</td>
<td>12.75</td>
<td>8.14</td>
</tr>
<tr>
<td>Atzeneta D’Albaida</td>
<td>509</td>
<td>163</td>
<td>18.90</td>
<td>12.07</td>
</tr>
<tr>
<td>Banyeres De Mariola</td>
<td>2,722</td>
<td>1,314</td>
<td>28.25</td>
<td>18.19</td>
</tr>
<tr>
<td>Bocairent</td>
<td>1,854</td>
<td>627</td>
<td>19.96</td>
<td>12.75</td>
</tr>
<tr>
<td>Canals</td>
<td>5,146</td>
<td>1,095</td>
<td>12.56</td>
<td>8.02</td>
</tr>
<tr>
<td>Cocentaina</td>
<td>4,303</td>
<td>1,313</td>
<td>8.10</td>
<td>11.50</td>
</tr>
<tr>
<td>Enguera</td>
<td>3,040</td>
<td>280</td>
<td>17.99</td>
<td>3.47</td>
</tr>
<tr>
<td>Montaverner</td>
<td>754</td>
<td>162</td>
<td>12.68</td>
<td>8.10</td>
</tr>
<tr>
<td>Muro D’Alcoi</td>
<td>3,131</td>
<td>960</td>
<td>18.08</td>
<td>11.56</td>
</tr>
<tr>
<td>Ontinyent</td>
<td>13,478</td>
<td>4,407</td>
<td>19.30</td>
<td>12.32</td>
</tr>
</tbody>
</table>

Source: Own Elaboration from Population Census (INE, 2004)
As we observe in the previous table, all the municipalities located in the Central Valencian Counties present specialization coefficients significantly higher, not only comparing with Spain (3rd column) but also in regional terms (4th column), highlighting Banyeres de Mariola, Agullent and Albaida. This can be also observed in the map.

Map 1: Distribution of Textile firms in the territory

Next, a detailed analysis of the main agents in the Local Innovation System is addressed taking into account their interrelationships.
**Industrial System**

The classification of the textile industry can be done following three simple factors such as: the fibres used, the different phases of the productive process or the different final products’ uses. The next picture shows this classification in a simple way.

**Graph 4: Inputs/Manufacturing Process/Outputs in the Textile Clothing Sector**

![Graph 4: Inputs/Manufacturing Process/Outputs in the Textile Clothing Sector](image)

Source: Golf-Laville et al. (2005: 21)

Fibres are one of the main inputs of the textile industry. Due to the excess of demand, natural fibres have been substituted by synthetic ones in the last years. The latter are linked to chemical industry and its development have started new functionalities in the traditional textile products. Currently, among these functions we can find high variety of features such as mechanical resistance and microencapsulation, among many others. The main providers are multinational corporations whose principal delegation is located in USA, EU and Japan (for instance DuPont). Chemical products also play a prominent role as a provider of other key products for the textile industry such as dyes or detergents. Again multinational corporations are the main providers of these products. Finally, machinery sector includes a set of machines providers very heterogeneous according to different complexity levels. Although traditionally, there has been a set of national firms\(^{11}\) in the last decades the machines have been imported from countries like Germany or Italy.

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\(^{11}\) Alto Consejo Consultivo (2007) identified 80 machinery firms in the Catalonian area.
Different parts of the value-chain in low-tech sectors such as textile allow us to see several activities as a set of different processes with different patterns and different sources of innovation. For instance, Santamaría et al. (2009: 514) argues that “design, the use of advanced machinery and training are decisive factors for innovation outputs” in low-tech sectors. In this study, the distribution processes, the provision of specific raw materials (chemical products) and the machinery are parts of the textile value-chain where the highest added value is found. Nonetheless, as few firms in the industrial district are specialized in this part of the value-chain, from an innovative dynamics point of view, the region is characterized by high degree of reliance on the provider’s improvements. Pavitt (1984) “indicates that embodied transfers of knowledge are especially characteristic of low- and medium-tech sectors in which there is little intramural Research & Development” (cited in Robertson & Smith, 2009: 102).

There are few micro-data at sectoral and local level about innovation outputs and effort in Spain. That scarce allowed, during 2004 and 2005, one research group\textsuperscript{12} from Alcoi to elaborate an \textit{ad hoc} survey. Textile firms in one specific industrial district were asked via questionnaires and in-depth interviews. The next table shows some of the main results of that study.

\begin{table}[ht]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{Firm Size (Number of workers)} & \textbf{They didn’t invest on R&D (\%)} & \textbf{Expenditures Mean on R&D (3 years in thousands of €)} & \textbf{\% Mean of expenditures on R&D / Sales (3 years)} & \textbf{\% Sales (new products)} \\
\hline
1-10 & 41.67 & 62.08 & 3.82 & 37.07 \\
11-20 & 58.33 & 40.20 & 2.00 & 59.17 \\
21-50 & 33.33 & 92.17 & 7.07 & 38.75 \\
51-100 & 0.00 & 397.29 & 11.50 & 47.78 \\
> 100 & 33.33 & 154.29 & 1.05 & 76.43 \\
\hline
\textbf{Total} & \textbf{37.04} & \textbf{116.41} & \textbf{5.04} & \textbf{48.32} \\
\hline
\end{tabular}
\textit{Source: Alto Consejo Consultivo (2007: 137)}
\end{table}

\textsuperscript{12} This research group is called “Territorial Knowledge Clusters Group” and it belongs to Department of Business Organisation in Higher Polytechnic School of Alcoi (Polytechnic University of Valencia).
The first conclusion derived from comparing official data with micro-data elaborated by this survey is that **industrial managers assert to invest on R&D activities more than the official Innovation Survey**\(^\text{13}\) **shows**. However, we have taken into account that probably only those firms that had undertaken R&D activities considered useful this kind of studies and subsequently they decided to participate on it. If we see the results, we can highlight that the bigger the size of the firm, the higher the investment in R&D, although more than 100 workers’ firms registered lower levels of investment on these activities. Nevertheless, the level of sales explained by new products is higher as the firm size is increasing. This can be linked with a potential better image in the market due to, for instance, a recognized brand.

**Demand System**

The conditions of the demand influence greatly in the generation of innovations in low-tech industries such as Textile-Clothing sector. Beyond the formal R&D and technology investments *per se*, the capability of selling the products and services and managing the product design transferring the requirements along value-chain are crucial for the innovation outputs. These outcomes are based on organizational and functional adaptations to the changes in the environment. For instance, distribution channels have been modified to attend the rapid changes in the fashion clothes and subsectors. Yet, the historical specialization in the processes of innovation in most of the Valencian firms has conditioned their diversification strategies towards “technical textiles”. Although these products are difficult to define, they are predominantly defined by their functionality. We have found that the main difference with respect traditional textiles is based on the different markets towards which they are oriented (Golf-Laville et al.: 2008: 18).

Nowadays, the diversification process towards technical textiles is one of the main strategies adopted by the traditional textile firms (see table X). However, the lack of connections with demand application sectors (civil building, automotive sector, medical textiles…) has led to failure of many firms in the introduction of new products in the market. Specially, Home Technical Textiles have had important obstacles in its introduction into conventional distribution channels, controlled by great specialized distribution chains (40% of the market). These latter have started to substitute national raw materials (sub-products) for imported product from low-cost countries.

\(^{13}\) This survey is carried out by the National Statistical Institute every two years (Spain).
The reduction of market share that characterizes the Valencian Textile activity explains the low level of delocalization of this activity compared to, for instance, big companies like Zara. This kind of strategies requires the exploitation of scale economies based on the exploitation of big consume markets. However, once the reduction of market for the main production phases (spinning, weaving and finishing) has taken place, that interrelationship has affected the whole value-chain.

**Educational and Research System**

- **Higher Education Institutions**

Traditionally, Valencian Central Counties have had very good educational infrastructure. Almost all the municipalities count on Vocational schools with specific modules related to textile studies. Arts and Crafts School of Alcoi is the oldest vocational school in the region and currently there are two courses of clothing design and textile arts. However, low enrolment levels in the last years have led to a situation where these specialities are not going to be offered any more, meaning that they are in process of extinction.

With regard to Valencian universities, Higher Polytechnic School of Alcoi is the only university where students can study specifically Textile Technical Engineering\(^{14}\). Higher Polytechnic School of Alcoi was created by industrial managers in 1850s. Since 1972 it belongs to Polytechnic University of Valencia (public university characterized by a strong engagement with its industrial environment). It started offering five specialities of Technical Engineering: Chemistry, Mechanics, Electricity, Electronics and Textile. Currently, more than 2300 students are participating in ten different degrees. Moreover, Doctoral studies in Textile Engineering are also offered since 90s.

One way of interrelationship with the environment is represented by one unit dedicated to offer Employment Services and connections between offer and demand of projects in the industrial system. All students finish their studies once they have finished a Final Project/Thesis. Most of them apply their theoretical knowledge, learnt during their studies, in one real project within a firm. Since 2005 this kind of interrelationship between student and

\(^{14}\) After the Bologna Process this career will be merged with other studies: mainly with Mechanical and Chemistry Engineering. In the other two places where Textile Industrial Engineering is offered the situation is similar (Béjar in Salamanca and Terrassa in Barcelona). The main reason can be attributed to lack of students enrolled.
industry is also economically rewarded (minimum €300 per month). Almost 20% of the total amount of projects in 2003 was applied in textile firms.

In general, industrial managers perceive positively the university training but they have some difficulties to find highly qualified manpower. Few students are ready to study Textile Engineering due to the negative perspectives of the Textile Sector. That is why the process of developing a Final Project/Thesis within a firm constitutes a proper tool to share the responsibility of student formation between university and industry.

Respect to research groups at Higher Polytechnic School of Alcoi a strong relationship with industry is outlined in all the opinions from different parts. In most cases, they developed specific projects (advanced services offer) more than research in itself. The number of patents developed by the university is almost inexistent. That is why this variable is not the best to measure the innovation dynamics or outputs in this sector. Anyway, a negative feature is that many industrial managers acknowledge they do not know the current research offer from the university. That means that most of the collaboration relationships emanate from the university.

There are few successful examples of patenting in this area and sector. However, recently one firm is exploiting a technological development realized by INESCOP\textsuperscript{15} and one Department of the University of Alicante. This case has been described in Golf-Laville et al. (2008). This is relevant to start this kind of mechanisms to appropriate innovations and promote relationships with technological and scientific institutions. It is also remarkable that beyond to ask for advanced services provision, few firms acknowledge to work together with university researchers in common research projects.

- **Textile Technology Institute**

The Textile Technological Institute –AITEX– was founded in 1985 on an initiative by the Valencian Government. It keeps a strong position as a reference centre for research, innovation and advanced technical services for the textile, clothing and technical textile industry. AITEX is a private non-profit making association, made up of textile companies and

\textsuperscript{15} INESCOP is an acronym translated as Technological Institute for Footwear and related industries.
companies in similar sectors. The institute encourages modernisation and the introduction of emerging and new technologies through R&D projects and in general, through actions which contribute to the industrial progress of the sector\textsuperscript{16}. The number of firms associated to AITEX has grown steadily since its creation. Apart of this condition, any firm can get profit from its services even though they are not partners. According to the last institutional report, since 2004 more than 800 firms were part of this association (see Graph 5).

**Graph 5: Evolution of the number of AITEX partners.**

![Graph showing the evolution of the number of AITEX partners from 1968 to 2006.](http://www.aitex.es/index.php?lang=english)

*Source: Aitex (2009)*

Regarding to its geographical distribution, we can see a changing trend from regionalization to geographical dispersion. That way, in 2004 the firms’ rate from outside the region represented more than 50\% (almost 30\% of the firms were located in Catalonia and the rest in other Spanish regions and foreign locations).

Taking in to account the firms size we observe how big firms tend to be AITEX partner, meanwhile small firms consider this institution as less important. 90% of the firms with 50 workers or more belong to AITEX and conversely only 37% of the firms with less than 10 workers are AITEX partners.

The number of advanced services that AITEX provides to industry is quite elevated. According to one specific survey about the perception of the services provided by AITEX most of the answers were positive, among the firms that were partners. These services are really crucial to achieve quality levels that are difficult to imitate by producers located in low-cost countries. The latter do not usually accomplish to the quality standards, for example, environmental requisites. Laboratories’ services are the most demanded by industry and are followed by quality certifications that improve the customer requirements.

**Intermediaries**

- **ATEVAL: “Textile Managers Association from Valencian Region”**
  This association is formed by more than 500 textile firms. It is the main sectoral representative and it provides services to their partners such as legal consultancy, training and commercial advice. Likewise, ATEVAL coordinates the programme “Home Textiles from Spain” in which all the firms participate showing a joint offer of their products via internet and fairs. ATEVAL is also a bridging institution between the workers union and industrial employers association. This way ATEVAL negotiates the collective agreements for stipulating work timetables, holidays and other workers rights.
  Currently, ATEVAL maintains several agreements with the rest of agents of the Innovation System. For instance, it promotes the University-Industry relationships through students’
stays at textile firms. This way, students can develop a practical project in a firm that in turn it benefits from new ideas. Additionally, ATEVAL coordinates collective action to promote textile products and services through international fairs: managing possible grants, booking the places, contacting potential clients, among others.

- **Textile Business Association from Alcoi**
  This is the oldest local industrial managers association that has been crucial for defending the interests of textile industry in the area. Currently, it provides more specialized services to more than 100 firms related to legal, environmental and administrative issues. Subsidies management is the main service that currently this association offers to its partners. With regard to the relationships with other agents of the Sectoral Innovation System, this association participates in collaboration agreements with AITEX and ATEVAL. These other agents transfer part of their workload to this institution that, as has been mentioned previously, is specialized in the subsidies management and administrative issues (i.e. payroll and social security taxes management, among others).

**Conclusions**

Economic structure in the Valencian Region, as well as in other regions, is changing dramatically in the last years. The globalization process is forcing to change the sources of competitiveness in most of traditional industries including the Textile industries. In this context, policy-makers, industrial managers and society as a whole have to rethink how to regain competitiveness based on innovation rather than previous low-cost strategies. To do so an overall analysis of the main forces is required. The present article has analysed the network of agents in one specific sector (textile) located in one specific region derived from previous projects. Within this region the traditional agglomeration of textile industry has been located in one specific industrial district around municipalities such as Alcoi, Onteniente, and Bocairente. In these locations, industrial employment is very elevated (30% of the total active population). This has historically assured a good endowment of support services realized by different institutions located in the area. However, in-depth analysis of the value-chain is necessary to find the sources of innovation and to propose strategic collective action plans for the sector. This approach is very different from the past actions more based on copying and imitating other firms’ strategies, for instance, competing in the same markets with similar (commodities) products and services.
After analyzing the financial sector and the different possible trade-offs for textile firms we conclude that the sector is facing a difficult situation. Firstly, the lack of financial support from banks has hampered the investment in the textile sector. But also incentives to invest in other sectors with higher short term benefits have led to close many textile firms. Obviously, both reasons have caused negative effects on the socioeconomic environment.

The concentration of the distribution channels is another explanatory factor that characterizes the lack of competitiveness of the Valencian textile sector. Currently, great retailers and specialized chain of stores (mainly under franchised regime) control the principal markets. These establishments are usually provided by products from foreign countries. Many national/regional firms have not known how to adapt to this new landscape. This way, the problem lies in selling goods and services rather than making adequate ones. Here a demand analysis has been included as crucial factor to understand the fashion trends, one of the main key success factors of Zara customer-manufacturer relationship. It seems obvious that the closer user/provider relationship, the better adaptation to the customer needs. One successful strategy followed by a group of firms has been to cooperate in the market places with an integral offer of complementary products.

Another differentiation strategy has been pursued by firms specialized in technical textile. This kind of products is characterized by a prescription of technical needs made by their clients (intermediary or final). This way, fashion, design and brand do not matter so much. Rather accomplishing with the customer’s technical needs is required. Additionally, the distribution channels are less than traditional ones and subsequently competition is less aggressive. Examples of these products are textiles for automotive applications, medical textiles (e.g., implants), geotextiles (reinforcement of embankments) or agrotextiles (textiles for crop protection), among others. Spain as a follower country in this sector has a great potential in this activity due to the importance of scientific and technological knowledge on it. Institutions such as AITEX and Higher Polytechnic School of Alcoi can enormously help to diversify from traditional home-textile to this sector. Another limitation observed in this diversification process is the lack of specialized providers (mainly, fibres and chemical products). These latter are usually multinational companies. Additionally, most of the

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17 The reader can find more info about these sector (Technical Textile) in Golf et al. (2008)
(machinery and materials) providers are not localized within the industrial district. This issue has important policy implications because the innovation indicators in the Textile industry may not include efforts in design, fashion markets research and other non-technological indicators.

There are few successful examples of patenting in this area and sector. However, recently one firm is exploiting a technological development realized by INESCOP\textsuperscript{18} and one Department of the University of Alicante. This case has been described in Golf-Laville et al. (2008). This is relevant to start this kind of mechanisms to appropriate innovations and promote relationships with technological and scientific institutions. It is also remarkable that beyond to ask for advanced services provision, few firms acknowledge to work together with university researchers in common research projects. In this sense, university may rethink its role. For instance, currently most of the university contracts with industry are based on an advanced services provision that is already offered in the market. Rather a higher orientation on basic and applied research would eliminate this direct competence among institutions (such as AITEX) and advanced services firms.

Finally, with regard to the negative image of the Textile industry generated mainly by the mass media, all the institutions should make a stronger effort to promote incentives for young people. This way, they would learn about their industrial heritage and improve the actual situation to the new scenarios through design championships, fashion collections exhibitions or job offers. In fact, since the 12\textsuperscript{th} century this activity in this area has been characterized by its ability to adapt to new challenges and turbulent environments.

\textsuperscript{18} INESCOP is an acronym translated as Technological Institute for Footwear and related industries.
**Further research**

There are lots of gaps to overcome within the present analysis of the Textile Innovation System in a specific industrial district. Although we have tried to integrate sectoral and geographical dimension within the same framework, we need to measure the quantity and quality of the relationships among agents from a more solid methodological perspective. In this vein, network analysis could be an adequate perspective through which the authors would like to gain a better understanding about the present case study. According to Graf (2007) we would be able to:

- Represent graphically interactions among agents (asymmetric relations between discrete objects - networks)
- Perform statistical analyses on these networks
- Balance between internal and external linkages
- Analyze actor’s positions in these networks
- Identify central innovators (in Alcoi area) and gain understanding about how their positions have changed over time
- Determine the cooperative linkages
- And specify the modes of interaction

However, the fact of having a fluid relationship with most of the agents presents a good starting point to overcome these new objectives.

The role of the university in the system must be also studied from an evolutionary perspective to identify the key milestones that defines it. For instance, we propose a set of indicators that may provide more empirical insights about university-society relationships.

- Number of degrees
- Number of training programs in firms
- Employment (job place, level of satisfaction, adequacy to level of studies…)
- Consultancy services (type of firm, term, type of project…)
- Training (tailor-made or generalist)
- Research and Development projects (type of client, type of collaboration…)
- Human resources services
- Knowledge diffusion (scientific, technological, cultural…; mechanisms)
- Commercialisation facilities
Labs services…

Similar sets of indicators have been proposed and used in other contexts such as United Kingdom (Molas et al., 2002) but less has been done in a local context such as we are dealing with in the present paper.

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