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THE LOCATION OF THE SPANISH TECHNOLOGICAL CENTERS

The Technological Centers have been created with the aim of being a supplier of different R&D's activities and services for those enterprises with a lack of material and financial resources to develop by themselves an innovation process. In most cases, these enterprises are SME's (Small and Medium Enterprises) placed in the area of influence of each Technological Center. Usually, these Technological Centers are located in strategic areas with specific characteristics like to be closed to the SME's (one of the valued highly characteristics by them), a good access to qualified staff and the existence of a good innovation environment. So, this situation has promoted that many decisions about the creation of the Technological Centers have depended on the distance between these and the SME's-clients.

The purpose of this work will be the study about where are established the Spanish Technological Centers and it will be analysed if the metropolitan areas have been a key factor in their creation. First, we will analyse the spacial distribution of the possible SME's-clients of the Technological Centers (the Spanish industry). We also study how the Technological Centers are integrated in the national and regional government Technological Policy.

1. Introduction

The technological innovation is a key factor for the economic growth and it was already shown by Schumpeter in the year 1934 in his work "The Theory of Economic Development" and he highlighted again in 1939 in his book "Business Cycles".

Schumpeter established that innovation, a wider concept than technological innovation, supposes the introduction of a new product or non tested production method, the opening of a new market, the conquest of a new input source or the creation of a new industry organization. This list, proposed by Schumpeter, can be completed with the innovative activities of technology transfer developed in the last years.

An element that we can find in all the definitions about innovation (from the traditional of Schumpeter until the most modern) is the success in the market when one industry introduce an innovation. The success in the introduction of the innovation will depend of several factors highlighting the following ones (Freeman, 1995): the intense R&D professional inside the company, the use of patents to protect the innovation and to negotiate with the competitors, the attention to the possible potential market, the efforts dedicated to the client and the managerial effort to coordinate the R&D, production and commercialization. Therefore, the innovation process doesn't make sense if the company doesn't look for the commercial success.

Inside an environment characterized by the globalization of the economy and a high opening degree to the international trade, the investment in science and technology becomes a key element for competitiveness and growth. This way, the innovation becomes one of the fundamental elements for a company to increase its productivity and its profitability because by means of the innovation process, competitive advantages are generated and sustained long term and are decisive for the success of the company (Guarnizo and Guadamillas, 1998). Thus, the current situation determines the needs for a R&D policy on the part of the government with the aim of stimulate the innovation processes inside the firms.

However, the innovation in Spain has been forgotten on the part of the economic politics as on the part of the own Spanish industry. Nevertheless, both industry and governemnt have tried to solve this situation although the fact is that, in spite of the evident effort, the difference with the EU countries (north of Europe) continues being significant

what implies the demand of continuity in the application of innovation processes on the part of the firms to reduce the innovation differential with the most advanced countries in the EU. As illustrative example, for the year 2000 the expense in R&D in relation to the GDP for Spain was 0.94% (obtained data of the INE) while the data for Euro-area was 1,84% and in the whole EU was 1,89% (obtained data of Eurostat). With this indicators Spain appears like one of the European countries that less resources dedicate to R&D.

The structure of the Spanish industry shows that the SMEs represents 80% of the employment and generate 70% of the Spanish GDP. Therefore, given this structure where these small and medium companies prevail, the Technological Centers (TC) have become a very important element in the R&D process.

One of the objectives of this work is to highlight the importance of the Centers of Innovation and Technology as key elements in the innovation process due to their geographical nearness to the companies. The role of the geographical nearness is highlighted by Bania, Calkins and Dalenberg (1992) because it helps the technology transfer process between the investigation centers (public, private or mixed) and the companies. In this sense, this authors highlight the importance of articulating a regional innovation policy (and, therefore, the presence of public capital) that stimulates the regional development through the conexión between the R&D centers and the firms.

The TC would be framed inside the Spanish System of Innovation (SEI) in whose structure we find the firms as unquestionable center of the same one. To their surroundings are located the Public Administrations, the R&D public system, innovative agents that support the innovation process and the environment composed of the necessary institutions to develop the innovation processes like the educational system, the financial institutions or the market.

The innovative agents that support the innovation process form an heterogeneous group constituted by entities with different legal status whose aim is the development of all kind of activities directed to improve the innovation and technological level of the Spanish industry. In this group, with a special relevance the TC appears as services suppliers for the firms, as well as the Technological Parks born from the regional innovation policies that have helped the spatial concentration of innovative firms. This group is completed with different structures like the Scientific Parks that some universities are developing according

to USA model, the Centers of Business and Innovation (CEEI), the Enterprise-University Foundations, the Offices for Transfer of Innovation Results (OTRI) located, in most of the cases, in Universities because their aim is to improve the diffusion of their investigations and, at last, different organisms and agencies of innovation development.

2. The Technological Centers in Spain: main characteristics.

The first TC's are born at the end of the 50's, mainly, from private initiatives the aim of satisfy the technological demands of the firms. Their development and growth is very slow (accelerating in the decade of the 90) as well as the growth of its influence in the spanish technological development. The eighties supposed the support on the part of the public authorities to these centers although, paradoxically, they are not mentioned in the 1986 Science's Law. Due to this support from the public sector, TC's quantity and size increases and this support allows to increase, at the same time, the importance of these centers inside Spanish System of Innovation's agents.

At the present time, the TC constitutes a key element inside the System science-technology-business-society (also known as Spanish System of Innovation). It will be in 1996 with a special law when the importance of the TC is recognized by means of the creation of a special register where is defined the term "Innovation and Technology Center" (ITC). This law defines ITC like those legally constituted non-profit entities and with the purpose of contribute, by means of the technological development and the innovation, to the improvement of the competitiveness of the firms. As we have said, to be recognized as ITC needs to register in the Spanish Science and Technology Ministry.

The necessary requirements to be able to register as ITC are:

- The ITC has to be constituted as a foundation or as non-profit institution.
- They should develop activities of R&D and have the necessary material and human resources to carry out this task.
- The beneficiaries of these innovative activities should be firms carrying out their activity in spanish territory.
- The activity of these CIT should be carried out in Spanish territory.
- It should have been operating during the two years immediately previous sustainedly.

- If the entity breakup, the liquidated patrimony of the same one should be dedicated to activities that are framed inside the aims assigned to the entity in its statutes.

The TC is supported by various established technology programs from the Science and Technology Ministry. The most important is the Scientific Investigation, Development and Technological Innovation National Plan for the years 2000-2003. In this plan it's included the TC inside a special category as any Spanish entity that legally can access to the public funds dedicated to R&D and that it presents proposals for the financing of their activities and takes the responsibility of their execution. Also, the Development of the Technical Investigation Program (PROFIT) approved in the year 2000 include, inside the R&D National Plan, an horizontal action that seeks the improvement of the technological capacity of the TC inside the Spanish System of Innovation.

The objective of the TC consists on the technological development of the firms, users of the TC with the purpose of achieving an increase of the competitiveness that elevates the level of economic and social development of the country improving the quality of life and wealth and generating employment. So, the TC directs its activities toward the generation, development, transfer and diffusion of the innovation to the firms as well as toward the offer of all type of services related with the R&D. At the same time, they look for the integration with the rest of the Spanish System of Innovation's agents. However, a characteristic is the lack of interrelation among its members with the consequence of dualities in the functions of the different TC and the SSI's agents.

To obtain the growth of firms' competitiveness, TCs are characterized by the following:

- Their geographical location, near to the firms.
- The knowing of the industrial sector's characteristics and of its environment.
- The effect of the diffusion of technological innovations on the industrial sector.
- The experience and accumulated knowledge.

Of the four factors, the most important is the location. This factor allows the TC to be in a closed connection with their market and, this way, to adapt their services to the technological demand of the firms.

To achieve this objective, the TC should focus its attention in the company, the

center point of its activity using the innovation like competitive instrument, and to look for the collaboration with all the agents of the innovation system to obtain a better use of the available resources.

The SMEs needs the TC due to their following characteristics:

- They are not able to identify their technological needs (in many cases they produce with obsolete technologies).
- They don't usually have relationships with investigation groups.
- SMEs look for tested technologies and don't have easy access to financial resources to carry out R&D's projects.
- SMEs don't know how to manage the technical changes.

So, if we consider all these problems, the SMEs lacks of own resources (materials and human) to invest in own R&D so the TC appears as external suppliers of this R&D. This way, the existence of the TC allows to the firms to identify their technological possibilities and to get access to new technologies with the objective already mentioned: the success in the commercial application of these new technologies.

Basically, the Spanish TCs present the following characteristics (Giral,1999):

- They are non-profit entities and constituted as foundations or associations.
- TCs are managed by private firms because private sector have more than 50% of the capital although this doesn't guarantee that the administration of the TC is efficient. The control of TCs by private enterprises has the aim of obtain a high level of flexibility and autonomy in financing questions and decision's process.
- The structure of the TCs seems to private firms relating to organization, labor structures,...
- Their main activity is the development of activities of R&D.
- Their mission consists on being the supply of technological services in their area.
- They look for financial independence through the resources obtained by the benefit of their services to cover the TCs' costs.

Therefore, we can establish that the TCs are services firms whose results don't depend so much of the financial results, but of the success in the technological applications that they introduce in their clients (the firms).

However, we can not establish the existence of a general model of TC in Spain neither in functions, administration or services. It's obvious that they are suppliers of technological services for the firms. But, given the sectoral or horizontal characteristics and according to the necessities of the industries of their respective environments, each TC specializes in different phases of the innovation cycle. In fact, the non existence of an unique model comes from the different technological necessities of the firms of the geographical environment in which are located the TCs.

The specialization of the TCs depend on the technical level of each center defined by the technological necessities of the demand, the strategy that adopt the TCs' managers and of the requirements that establish the supplying entities of financial resources.

The TCs offer a wide range of technological services from the traditional R&D programs until the technical audit, the technological diffusion, the specialized formation,.. A more recent product that offer the TCs is the innovation and knowledge's management as well as other more advanced products as the innovation's financing, the integration of the firms in international programs,... They are services that can be offered to firms of all the sizes and of all the sectors.

A more exhaustive classification of services is in the following list:

- R&D
- R&D's projects contracted by firms or public administrations: competitive R&D; production processes; products; mixed services and international cooperation.
- Technological services: scientific, technological diagnoses and audits; advanced technological information services; technological strategy and innovation's management; trends' analysis and viability's studies; prototypes' production and commercial preseries; technological prospective; technology transfer; intellectual and industrial property's management.
- Technological advice's consultants: rehearsals and analysis; approvals and certifications, studies and reports.
- Diffusion and technology transfer: promotion, formative and diffusion activities; diffusion of R&D results and meetings between managers and researchers.
- Training: graduate degree courses; technical training; virtual learning and

benchmarking.

Most of the TC looks for a model with a balance between the own R&D and the R&D under contract. An excessive dedication toward own R&D activities would mean that the TCs would be losing its reference point: the company. And an excessive dedication to R&D's projects under contract would have a fall in the generation of own knowledge. Therefore, this balance needs enough types of financing: public financing and the funds obtained by the development of R&D activities for private firms.

Nowadays, the TCs constitute the main reference for the SMEs in the technological innovation field as well as an access to the EU Framework Programme. They show a great knowledge of the innovation market, have experience and prestige and generate a high yield of the public investment. In spite of their reduced weight inside the Spanish Innovation System regarding human resources, expenses, etc. shows a great relevance in the total of activities.

A characteristic that prevails in the TCs and establish their success, it's the location factor. This factor determines the specialization of the TCs because depend of what type of firms are located in its geographical environment. In fact, the closeness to the users and the knowledge of their characteristics and necessities constitutes the other factors of success of the TCs.

3. Empirical Analysis

This work is focused on the geographical location of the spanish TC and the relationships between this factor and the industrial characteristics of the spanish municipalities. So, the objective is to check the TC location's importance in relation with several variables: municipalities population, industrial density (measured by different indicators) and the participation of SME's in the whole industrial sector.

It has been used the TC database from the Spanish Technology and Innovation Centers Federation (FEDIT in spanish) which has as partners the 70% of the total ITC registered at the Ministry of Science and Technology. The data have been obtained from the FEDIT webpage <http://www.fedit.es>

FEDIT is a non-profit private association with 62 associated centers with a total expected income for the year 2001 of 228€ million obtained from the achievement of

155.000 activities for more than 18.000 firms, 2.300 training courses with more than 20.000 students and almost 4.000 R&D projects. They have a technical staff composed by 5.500 persons (researchers, technicians, ...) and 1.100 research scholarship holders.

It has been used the Industrial Register from the former Ministry of Industry (nowadays, S&T Ministry) to get the data concerning the municipalities. A first look of this database shows that there are more than 8000 municipalities in Spain and 7064 has, at least, one industrial firm. Only 34 municipalities concentrates all the TC.

Table 1 shows the regional distribution of TC. There are two regions that concentrates the TC: the Valencian Region and the Basque Country with 15 and 14 TC, respectively (29.14% and 27.45% of the total percentage). This situation is due to the R&D policies established by the two regions and developed in the last years. This policies has promoted the creation of TC with the aim of satisfy the technological demand of the firms located in their regions. Catalonia and Castilla-La Mancha are the third and fourth regions in number of TC with 6 and 5 far from the other two.

Table 2 includes several indicators of the TC dimension that allows to know the maximum and minimum TC dimension. This chart shows some indicators with the following measures: maximum, minimum, average y total. The indicators are the number of firms users, number of associated firms to the TC, staff, income level, annual investment, net property and equipment and the total area. All the data corresponds to the year 1999.

First, it highlights the non existence of a general model for all the spanish TC because there is a wide range between the maximum values and the minimum values. For example, for the indicator "firms users" during 1999 the maximum is 3565 in front of 5 as minimum. The same occurs with the rest of indicators. This is due to each TC depends of the economic activity of the environment. So, that's the reason each center try to fit their capabilities and services to their industrial sector characteristics and these differences in the values are not significative.

Anyway, the mean dimension of a TC in Spain would be the following: a 4778.2 m² area, a staff of 57 persons and a net property and equipment valued in 2.4 € million. The users mean would be 800 firms and the mean of associated firms would be 136. The total income would be 3.6 € million with an annual investment of 600.000 €.

About the spatial geographical distribution concerning the municipalities dimension,

Table 3 reflects that the TC are concentrated in municipalities with less than 100.000 inhabitants. There are 29 TC located in this kind of municipalities, 57% of the total. Inside this group, it highlights the municipalities with a population between 30.000 and 50.000 inhabitants because they present the highest number of TC (11) which represents the 21,6% of the total. From the rest, the second group in number of TC is the group of municipalities with a population between 100.000 and 200.000 inhabitants that have 10 TC. In third place, it highlights the biggest municipalities (more than 500.000 inhabitants) having 8 TC located in the following cities: Barcelona, Madrid, Seville, Valencia and Zaragoza.

Table 4 shows the spatial distribution of the CT respecting the industrial density measured as the industrial employment per 1000 inhabitants. The main conclusion is that only exists one TC in the 50% of the municipalities. For the rest of groups, we can observe that the number of TC increases in line with the increase of the industrial density. There are 40 TC (78.5%) in the last two groups of municipalities which represents the 20% of the total percentage.

In Table 5 it have been estimated the industrial density like industrial employment per km². The results establish that the TC's concentration is higher than in the Table 4. In this chart, 90% of TC are located in the municipalities (10%) with the highest industrial density (>20).

In the last table, Table 6, we present the spatial distribution of the TC in line with the weight of the small firms (<100 workers) in the total employment of the municipality which has at least one TC. Thus, the results shows the same trend explained in the tables above this Table 6. The TC's number increases in line with the increase of the small firm's weight in the total employment. More than 50% of the municipalities has a 100% of small enterprises which is reflected in the total number of TC, 29 (more than 50%). The other two groups presents a very similar number of TC and a high participation of small enterprises in the total employment.

So, we can conclude that the TC are located in urban areas with less than 100.000 inhabitants, with high level of industrial density and with a high share of small firms in the total employment. These conclusions are in line with the characteristics exposed in section 2 about the geographical location of the TC. Thus, the TC are located in areas with a high concentration of small firms which are the main users of TC. In this sense, the TC are

focused towards these small firms trying to solve their technological lacks due to their reduced own resources to achieve R&D activities.

4. Conclusions

The Technological Centers have increased their importance in the last 20 years, when have been created more than 35 new centers. This increase is due to the support of the public institutions that have allowed the survival of these centers during the first stages with the objective of getting an independence both organizational and financial.

The most important factor of the Technological Centers has been the geographical location of the same ones. It has been observed how more than 50% of the centers associated to FEDIT (56,8%) are located in the regions of the Basque Country and the Valencian Region. It has been the technological policies carried out by this regions what have allowed this by means of the financial and institutional support to the creation of Technological Centers jointly with the different firms associations. This environment is completed with the conscience on the part of the public authorities about the importance of the technological innovation as fundamental factor of economic growth what is reflected, for example, in the R&D National Plan 2000-2003 that has the aim of increase the expense in R&D/GDP from the 0.95 of 1998 to 1.29% in the 2003.

About the TC location we conclude that this location depends of the users' characteristics (the firms), mainly, SME's. In the empirical analysis, the results shows how the TC are concentrated in urban areas where the population level is under 100.000 inhabitants, where there exists a high industrial concentration (measured by diverse industrial density indicators) and where there is a prevalence of small enterprises in the area.

So, the main conclusion is that TC have been created in specific areas to provide R&D services to small enterprises wich didn't have easy access to this sort of services. Thus, a close TC location to the firms have helped them to solve their technological problems providing a wide range of services that they can't achieve with their own resources.

An excessive TC concentration in metropolitan areas could difficult an approach to the small firms located in small industrial areas so, with this situation, the TC couldn't have

the characteristics exposed in section2: a wide knowledge of the specific firms' technological demand and of the industrial area they are located.

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TABLE 1. Regional Distribution of Technological Centers.

REGION	Sectoral	Horizontal	TOTAL
Valencian Region	13	2	15
Basque Country	13	1	14
Catalonia	5	1	6
Castilla-León	3	2	5
Madrid	3	0	3
Navarra	1	1	2
Andalucía	1	0	1
Aragón	1	0	1
Asturias	1	0	1
Castilla-La Mancha	1	0	1
Galicia	1	0	1
Murcia	1	0	1
TOTAL	44	7	51

Source: FEDIT database 1999.

TABLE 2. Main TC Indicators.

	Maximum	Minimum	Average	Total	N
User firms	3565	5	798.5	28745	36
Associated firms	662	3	136.1	5851	43
Staff	202	6	57.4	2927	51
Income	16137.2	339	3637.1	185492.6	51
Annual Investment	3071.2	6	559.8	27432.4	49
Net Property and Equipment	9123.4	72.1	2403.2	117758.6	49
Area	17100	210	4778.2	219797	46

Note: The income is expressed in thousands euros. Area is measured in m². N represents the total data used to calculate the indicators.

Source: FEDIT database 1999.

TABLE 3. Technological Centers's Spatial Distribution (municipality's dimension).

Population	TC	%
> 500000	8	15.7
200-500000	4	7.8
100-200000	10	19.6
50-100000	5	9.8
30-50000	11	21.6
10-30000	5	9.8
< 10000	8	15.7
Total	51	100.0

Source: FEDIT database 1999 and Industrial Register (Ministry of Science and Technology)

TABLE 4. Technological Centers's Spatial Distribution (industrial density: industrial employment per 1000 inhabitants).

Industrial Density (inhabitants)	% municipalities	TC	% TC
<30.6	50.0	1	2.0
30.7-43.3	10.0	2	3.9
43.4-62.4	10.0	3	5.9
62.5-98.3	10.0	5	9.8
98.4-182.9	10.0	21	41.2
>183.0	10.0	19	37.3
Total	100.0	51	100.0

Source: FEDIT database 1999 and Industrial Register (Ministry of Science and Technology)

TABLE 5. Technological Centers's Spatial Distribution (industrial density: industrial employment per Km²).

Industrial Density (area)	% municipalities	TC	% TC
<0.6	50.0	1	2.0
0.7-5.5	30.0	3	5.9
5.6-20.0	10.0	1	2.0
>20.1	10.0	46	90.2
Total	100.0	51	100.0

Source: FEDIT database 1999 and Industrial Register (Ministry of Science and Technology)

TABLE 6. Technological Centers's Spatial Distribution (employment in small enterprises -<100 workers- related to the total employment).

Small Enterprises (%)	% municipalities TC	TC	% TC
<75.0	20.6	10	19.6
75.1-99.9	23.5	12	23.5
100	55.9	29	56.9
Total	100.0	51	100.0

Source: FEDIT database 1999 and Industrial Register (Ministry of Science and Technology)