

Services and innovation systems: European models of Technology Centres

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Abstract In regional contexts with a dense fabric of small- and medium-sized companies, the promotion of knowledge-intensive services through Technology Centres is a key innovation policy. This paper examines four models of Technology Centres in Europe: Baden-Württemberg (Germany), Denmark, Emilia-Romagna (Italy) and the Valencian Community (Spain). Aspects such as the participation of private agents, the financing of the Centres, and the diversity and heterogeneity of the models are discussed. Both the economic-productive base (company structure, sector specialization, location patterns, etc.) and the political–institutional features (distribution of competences, available budget, etc.) are major points for establishing the definition of each model.

Keywords Business services · Innovation · Small- and medium-sized enterprises · Technology Centres · R&D policy

1 Introduction

An innovation system is made up of different elements that “act and interact at a national level in favour of—or against—processes of creation or diffusion of useful economic knowledge”. The focus on innovation systems has shown

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itself to be a particularly valid tool for detecting the innovative capacity of a geographical area¹. Although the creators of the concept (Nelson 1993; Edquist 1997) used it in national contexts, more recently it has also been applied to regional contexts (Koschatzky 2001; Landabaso et al. 2001; Oughton et al. 2002; Asheim and Isaksen 2002; Cooke 2002; Asheim and Coenen 2006).

The innovation system can be broken down into five subsystems: public administration, firms, the R&D public system, the environment and innovation support infrastructures. The latter includes entities whose main task consists of providing companies with services that are operative during one or more phases of the innovation activity, both in areas of technology and knowledge generation and diffusion (Antonelli 2006), or in the preparation of production and commercialization processes. Technology Centres are the paradigm of these kinds of entities.

This paper is structured as follows: firstly we present a conceptual approach to the definition of knowledge-intensive services, and the way in which such services are supplied by Technology Centres. In the following sections, four models of Technology Centres in Europe are analysed: Baden-Württemberg (Germany), Denmark, Emilia-Romagna (Italy) and the Valencian Community (Spain). Finally, Sect. 4 presents elements for debate chosen from the analysed cases. The paper ends with a Conclusion section.

2 Business services and knowledge-intensive services

Business services include a wide range of services that maintain different strategic positions, though they all contribute to the improvement of firm performance in one way or another. For this reason, from the point of view of public policies, different kinds of functions should be distinguished attending to two basic criteria:

- (a) *Added value* or differentiating potential that each type of service provides to small- and medium-sized enterprises.
- (b) The greater or lesser need for *government action* to promote such services, according to the way in which each of them is supplied by the market itself.

By using these two criteria, and without aiming for an exhaustive list, a typology of business services is displayed in Table 1. Services are classified from top to bottom according to the level of added value they contain, and the growing facility for a self-organized provision by the market, taking into account imperfections or market failures, in the absence of public intervention.

¹ The distinct innovative capacities of each territory are, in turn, the result of specific learning trajectories that are incorporated into their respective institutional systems (Isaksen and Hauge 2002). Given the complex and interactive nature of innovation (Lundvall and Johnson 1994) and as learning is a localized process (Asheim and Isaksen 2000), the capacity for innovation can be favoured by the proximity (in a multidimensional sense) of innovation system components.

Table 1 Business services: a typology

Services	Characteristics	Examples
Capital intensive	The supply of these services requires high investments (facilities, lab equipment...) and, thus, they are costly to be produced. The achieving of “critical mass” and scale economies is paramount to make it profitable They produce <i>spillovers</i> : knowledge or information leaking out easily to the environment may widely diffuse earnings beyond the range of the service provider and their direct customers. For this reason, on an individual level, companies are not prone to pay a high price for these costly services and there is a lack of stimuli for a market-guided offering	Research and development, lab testing, technical training schemes for companies’ staff, etc.
Specific or “tailored”	Service must be adapted to the specific need of the customer. Greater added value. The know-how of service providers is important	Engineering, design consultancy, market research, advertising, etc.
Standardized	They can be duplicated and, thus, they are suitable for automation. The producer–user relation is highly repetitive without significant qualitative variation, what makes codification possible (for example, through regular fees)	Accountancy, labour and tax consultancy...
Operatives	Manual labour intensive The basic aim of these services is providing the company with more flexibility and reducing the need for hiring own staff	Cleaning, delivery, catering, security, etc.

Mas (1996)

In addition, Fig. 1 illustrates this classification and shows both the need for government action (horizontal axis), and the level of added value provided by each type of service (vertical axis). In this case, capital-intensive services emerge because of their contribution to the competitiveness of small- and medium-sized companies in terms of added value. In addition, they are the kind of services that require more resolute action from governments because of the external factors involved in providing them.

The fundamental characteristics of knowledge-intensive business services revolve around two key points: (a) the way in which they are offered or produced; (b) the kind of *impact* that knowledge-intensive services have on user companies, in particular small- and medium-sized firms.

With regard to the first question—the way that services are offered or produced—it is necessary to highlight the *interactive nature* of the relationship between the users and suppliers of knowledge-intensive services. Interactivity means that knowledge-intensive services are, in fact, *co-produced*. A direct relationship exists between the degree of supplier–customer interrelation and the potential added value of such “co-produced” services. Both elements—level of interrelation and added value—go hand in hand. However, at the same time, interaction is conditioned, to some extent, by proximity

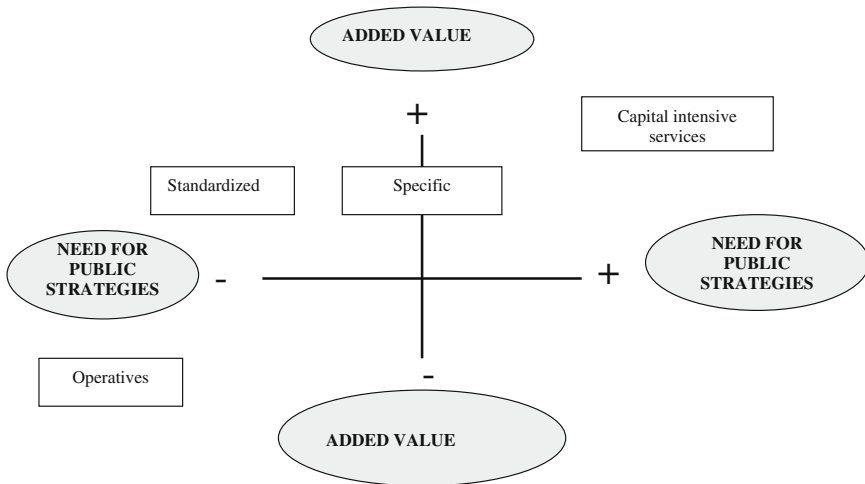


Fig. 1 Classification of business services according to added value and need for government's action

(Lindelöf and Löfnsten 2004). As a result, regional economic spaces are increasingly being chosen as the framework for implementing policies based on providing high added value business services.

The second aspect of knowledge-intensive services that needs to be emphasized is also linked to their interactive nature and has to do with the effects produced on the users: the use of advanced services enhances *connectedness* and *receptivity* (Antonelli 1998) to the networks of information and knowledge.

Definitively, knowledge-intensive services (Hauknes 1999; Metcalfe and Miles 2000; Miles 2001; Martinez and Krishna 2006) play a crucial role in the creation and commercialization of new products, processes, and services. They are fundamental carriers, modellers and creators of innovation.

2.1 Knowledge-intensive services and Technology Centres

Technology Centres are among the suppliers of knowledge-intensive services. Their functions may include the offer of an extensive and varied array of business services. Functional specialization is determined by three variables: users' demands, which are a function of the economic and commercial structure of the environment; the strategic options chosen by the governing boards of the centres; and, if appropriate, the guidelines decided by public administrations that, eventually, may contribute to financing these centres.

Technology Centre activities can be categorized according to different criteria. A first classification criterion concerns the level of immediateness of the problems they address. In the *short term*, problems related to the supply of products and services to the market are dealt with through test laboratories.

Fundamentally, this involves the quality control of raw materials and semi-manufactured or finished products. In the *medium term*, problems related to the maintenance and improvement of the processes of commercial production are dealt with, and are herein considered from their conception and design to their production and production organization. These needs can be addressed through technical consulting services. For the *long term*, Technology Centres can carry out R&D and innovation support projects (new products, new processes of production, and new methodologies, etc.).

A second criterion for service classification has a more functional nature. In this way, Technology Centres can carry out three types of actions: a first group is related to *knowledge diffusion* (training, information, demonstration). A second group is directed towards promoting *interaction among agents* in the innovation system, and especially companies, through promoting co-operational activities or improving information transactions (intermediation). Finally, a third group of activities is of an individual company-oriented nature: the supply of *specific services* to companies on individual contractual terms (training; consulting and technological advice; contract-based R&D; etc.).

3 European models: case analyses

As mentioned in the Introduction, policies for providing services are being promoted primarily in regional economic spaces. Economic transformations of the last two decades have influenced the political–institutional development of most European countries (and the European Union itself) towards a greater level of decentralization (*regionalization*), either through sub-state institutions endowed with some degree of political power, or through the territorial deconcentration of the actions of central political powers.

However, this process of regionalization has not had the same effect throughout the entire European Union; it especially affects the larger countries, but it takes a notably different shape in each of them. German Länder, Spanish Autonomous Communities, Italian and French Regions or the “nations” that make up the United Kingdom involve different political-administrative realities. The European Union collects these heterogeneous realities and abstracts their political nature upon transferring them to Nomenclature Units of Territorial Statistics (NUTS).

This section analyses how the provision of business services by Technology Centres is structured in different European regional spaces. For operational purposes, the concept of region has more of an economic-territorial meaning than a legal-political one. In any case, institutional factors decisively influence the way the actions are designed and developed in each one of these “regional” spaces.

The cases analysed are those of Baden-Württemberg (a federal state within Germany), Denmark (a sovereign state), Emilia-Romagna (an Italian common regime region), and lastly, the model of the Valencian Autonomous

Community, where a significant number of Spanish Technology Centres are located.

All cases allow for a rough comparison in terms of territorial size (between 20,000 and 45,000 km²), and population (between 4 and 10 million inhabitants), though not so much in terms of economy (their gross domestic product per capita fluctuated between 77.2 and 129.5 out of 100 for the whole of the European Union), and they totally differ in political self-governing empowerment.

While these regions have different economic and geographic structures, all of them have developed noteworthy promotional innovation activities in their territorial environments. For this reason, they are good examples for analysing the different elements under discussion concerning the provision of real services to companies: the convergence of public and private agents, the role conferred to the market as a regulator of the supply and demand for services, the existence or non-existence of a coordinating body of the different structures in charge of providing services, and the choice of centralized or decentralized structures for provision. These elements are influenced by two conditioning factors: the *productive economic base* and the *political-institutional framework*.

3.1 The technology service network in Baden-Württemberg

The structure for the provision of technology-based business services in the German 'Land' of Baden-Württemberg is made up of multiple centres that have been developed since the Second World War, although some of them go back to even before this time. Baden-Württemberg, with a population of just over ten million (12% of the population of Germany), represents close to 17% of Germany's total gross domestic product. Industrialization in Baden-Württemberg dates back to the second half of the nineteenth century, and has produced a proliferation of technical higher education centres in close collaboration with the economic fabric. Baden-Württemberg has a diversified industrial structure, where the most relevant areas are the automobile, machinery and equipment industries. Medium-sized companies constitute the core of Baden-Württemberg's industrial fabric.

Most R&D and technology centres in Baden-Württemberg are members of autonomous networks of technology centres operating both inside and outside the Land. The Federal Government, the regional government, universities, and private agents (companies, employers associations, academic professionals, etc...) all collaborate. Centres belonging to these networks have a high level of functional autonomy for drafting their activities and collaborating with companies, although each network has a preferential hand in guiding the applicability of the research they carry out. As a result, there is a degree of overlap in the services they provide, which, in turn, gives firms a wide choice. Networks have relatively complex structures in their governing bodies that allow for a good deal of cross-participation and facilitate mutual co-ordination and co-operation. Likewise, in practice, there is a certain mobility that enables

the transfer of centres from one network to another when changes arise in their orientation. Financing is shared according to agreements between the Federal Government and the Land (or local) Government, with a proportion of 90/10 for large-scale R&D centres, and 50/50 for centres on a smaller scale.

Within the typology of existing centres, the Steinbeis Foundation is particularly interesting and, within it, the Technology Transfer Centres. TTCs do not have legal autonomy but they have operational autonomy to manage their own projects. Most of their staffs, including the Centre director, are not members of the Foundation's staff. They are usually professors from Polytechnics where most TTCs are located, or in other research centres and have part-time commitments regulated by contracts with the Foundation. They have complete autonomy, but they must manage to balance the Centre's accounts on a yearly basis, according to the contract agreement. The Foundation assumes the roles of external representation along with the management of administration and accounting, and gets a percentage of each Centre's earnings as a royalty and as a fee to cover the costs of affiliation and management.

Each Centre freely determines its activities according to its technical capabilities and the demand from the surrounding area. At first, they showed a tendency for an industry-based specialization, but market demand and the capability of Technical Schools for solving different kinds of problems has resulted in an evolution towards horizontally oriented centres, based on technology areas: flexible automation and process engineering, electronics, micro-electronics, software engineering, CAD/CAM, etc. Most Centres strive to provide global solutions for each company problem, where the help of experts from different areas is often essential. The running of all Centres under the umbrella and co-ordination of the Foundation facilitates smooth functioning.

3.2 The Danish Technological Institute

As far as offering of technical business services is concerned, in the context of the European Union, Denmark can be considered a regional space because of geographic, economic and demographic characteristics—it covers an area 20% greater than that of Baden-Württemberg, while its population and gross domestic product are approximately a half. On the other hand, on a political-institutional level, it has complete sovereignty. In addition, the relatively small role of industry in the Danish economy must be taken into account, representing less than 20% of the total gross domestic product.

One of the most important organizations providing technological business services in Denmark is the Danish Technological Institute (DTI). The creation of the Institute, dating from 1906, was instigated by the leaders of the first urban industries that were developing around this time in Denmark, and was inspired by the notable Danish co-operative farming tradition. The DTI has a legal statute as a private, independent, non-profit organization. It operates throughout Denmark and provides integrated solutions to needs both of firms

and society in general through the development and spread of technological innovation.

The activities of the DTI include research and development, consultancy, laboratory testing, certification, training, process and product development, quality control, information technology related services, materials and environmental technology, as well as international co-operation. Some technological services similar to those offered by the DTI are also offered by other entities such as the Academy of Technical Sciences or by different testing laboratories.

Since its creation, the DTI has experienced significant changes in orientation. Initially, its activities were based on offering consulting services for training, but progressively incorporated laboratory testing services. Between 1955 and 1975, the Institute grew with a significant contribution of public funds that came to represent 70% of its total budget. However, after 1975, the DTI entered a phase of progressive withdrawal from the public system: exit of its staff from the civil service framework, the gradual elimination of public programs supporting the contracting of DTI services by firms, which meant a considerable reduction in the demand for services, especially from smaller-sized companies, the end of public contributions for investments in equipment, and a reduction in basic funding (from more than 50% to less than 10% of the DTI's total income at the beginning of the 1990s.)

This drop in the contribution of public funding plunged the DTI into deep financial crisis (losses and debt during the first half of the 1990s) from which it seems to have recovered (in 2000, the DTI obtained a net profit of 3.9 million euros). However, major organizational changes have been made alongside this process in functional areas and in the relationship with the market.

These changes have forced the DTI to reduce the number of activities that do not provide revenue in the short term, in cases where the activities are initiatives instigated by the Institute or if co-financing by the DTI is required. On the other hand, the DTI is encountering more and more difficulties when it comes to accessing national public funds because of the tendency of agencies directly dependent on the Government to manage actions by themselves, and because of the competition with other centres that have taken on similar functions to those developed by the DTI. The DTI's centralized structure does not fit in well with the growing demand for regionalization of the implementation of publicly financed innovation projects.

3.3 Emilia-Romagna: an organization designed for coordination and promotion

Emilia-Romagna is the best-known example of an industrial model made up of "industrial districts". Emilia-Romagna is a part of the so-called "Third Italy", with a medium level of development among the most advanced regions of northwest Italy (Lombardia and Piamonte) and the economically lagging regions of the southern part of the country. However, despite its relatively recent industrial development, Emilia-Romagna has been growing at a faster

pace than other, more advanced regions and in recent decades has become the most dynamic area of the country.

The existence of a number of industrial districts provides Emilia-Romagna, as a whole, with an industrially diversified fabric, both in activities and geographical diffusion. There are districts whose economic activity is fundamentally based on the industries of agriculture and food (Parma), agricultural machinery (Reggio nell'Emilia), ceramics (Sassuolo), clothing (Carpi), mechanics (Modena and Bologna), and footwear (San Mauro Pascoli). Within this diversification, the metal-mechanic industries are the most relevant, representing more than one-third of the total employment in manufacturing in the region. Some socio-economic peculiarities present in Emilia-Romagna are considered as basic components in the dynamic of districts: a dense fabric of medium-sized cities, little social polarization, a flexible production structure with multiple specialization/cooperation relations among companies, and fluid relations between employers and trade unions (many employers are former qualified workers turned employers).

By using self-government capabilities, which until recently were limited to training, craftsmanship, small companies, and territorial development and planning, Emilia-Romagna has managed to build up a network of organizations endowed with functional and administrative autonomy, along with the ability to participate in companies, associations, or consortiums of public bodies that carry out activities to enhance economic and social development or offer region-wide services.

The initial idea behind setting up Service Centres included the aim of advancing toward self-financing in a variety of ways: prices for services, coupled with an increase in the number of users, R&D contracting, sponsorship by private or semi-public entities, etc. However, the experience has shown that the functioning of the Centres generates a self-expanding dynamic of its own: it makes new necessities emerge that were formerly latent or it allows the possibility of envisaging new, interesting actions. Despite these efforts, the idea of self-financing appears to have been largely abandoned.

The arrival of Service Centres was received in different ways by the business environment. At first there was some distrust as services already provided by Trade Associations or Chambers of Commerce could be duplicated. Such mistrust was reinforced by the political leanings of the Region's government, traditionally provided by the Communist Party. The local government opted for a strategy of incorporating the employer's network of associations to the governing body of ERVET, the Regional Organization for Economic Appraisal, as well as involving businesspeople with leadership skills in starting up each Centre. An important task was to differentiate "real" services which could be offered by ERVET's Centres, and "other" actions such as management consultancy or the representation of corporate interests, activities these Centres were not designed for.

The heterogeneous nature of the centres in ERVET's System can also be seen in the diversity of legal statutes. In general, industry-focused centres are based on consortium formulae where ERVET, trade associations, and indi-

vidual, private companies all converge. During the 1990s the System had about 1,000 associated companies, half of them belonging to the Textile and Clothing Industry Information Centre.

3.4 The network of technological institutes in the Valencian autonomous community

As in other regions in Spain, the start of a regional Valencian industrial policy began in the mid-1980s when political decentralization and the reassignment of competences were basically complete and regional government-run institutions began to carry out their mandates. In the case of the Valencian Autonomous Region, industrial policies put in place by the regional Government have combined financing measures supported to a large extent by the classification of the region as an EU Objective 1, and the setting up of a consistent working policy for the provision of services to enhance innovation through a network of Technology Institutes, most of them industry-oriented (textile, footwear, ceramics, toy industry, food industry, etc.) though some others were cross-technology oriented (metal-mechanics, biomechanics, information, electronics, etc.)

This network has attempted to fit in with the basic characteristics of the Valencian industrial fabric: (a) specialization in the products of a lasting nature, aimed at *final consumption*, and export-oriented goods, especially for the European Union, (b) a high proportion of *small- and medium-sized industries*, which accentuates the dependency on exterior resources to feed and help innovation processes; (c) *multi-polar* territorial location: the Valencia Region includes a number of highly industry-specialized nuclei: the Vinalopó Valley (footwear industry); the area of Ibi-Onil, (toy industry), the area of Ontinyent-Alcoi (textiles), and the area of Alcora-Onda-Vila-real, which specializes in the production of ceramic tiles. This list could be extended with some other more locally restricted cases.

These features make up an industrial model with district-based characteristics in which external economies are relevant to the functioning of local systems. Proximity, encompassing geographic, economic, cultural and social factors, is paramount for the global performance of firms as well as for implementing the provision of services.

The regional Agency in charge of promoting and coordinating the region's industrial policy is the Institute for Small and Medium-Sized Valencian Industry (IMPIVA). A primary element in its performance has been the promotion of service infrastructures to support technological innovation in firms (Technology Institutes) and to enhance the diversification of the industrial fabric by setting up a network of incubators (four European Business and Innovation Centres).

The functional provision of services in the Valencian model is based on three main characteristics: (a) *Network organization and interaction*. The network of business service infrastructures tries to achieve interaction between its different components. Technology Institutes and incubators provide

the IMPIVA with a means of action, a decentralized territorial infrastructure and daily operative working contact with companies to provide the necessary feedback. IMPIVA acts as a coordinating body of all available networking resources, provides Technology Institutes and incubators with basic financing and develops financing schemes for innovation projects by small- and medium-sized companies. (b) *Participation of firms*. Most Technology Institutes were founded as industry-based firm associations. Technology Institutes have their own legal status as private, non-profit associations. All members of each association form a part of the General Assembly and provide the president and the majority of members on the board of directors, along with representatives from the Region's government (via the IMPIVA), and from the national Ministries for Industry and Technology. (c) *Territorial decentralization*. Technology Institutes are decentralized and are located throughout the region to attend to the multi-polar industrial fabric in the region. They were designed to be located "at factory gates" with their headquarters in cities where higher concentrations of companies in their corresponding sectors were located, with a view to opening further branches in secondary concentrations.

4 Comparative case analysis: elements of debate

From the previous review of public strategies for promoting the offer of capital-intensive business services, some general considerations can be underlined. The following critical analysis of the models presented provides a useful overview.

4.1 Diversity and heterogeneity of the models

A first consideration from the analysis carried out in part 2 is the existence of a wide diversity of models regarding elements such as (a) the existence or not of a coordinating body for all advanced business services provided by the public sector, (b) the option between decentralized or centralized mechanisms for providing business services or (c) the role conferred to the market as a regulator for the provision of services.

Choices in each of the relevant models are fundamentally influenced by two conditioning factors: the *economic-productive base* in each territory (company structure; sector specialization; location patterns; etc.); and its *political-institutional* features (distribution of competences among administrations; available budget; etc.).

Specifically, the pre-existence of centres offering technological services to small- and medium-sized companies is relevant to the shaping of the model for providing technology services to companies in each region. Such precedents were rare in areas of recent industrial development and areas of lower technology levels such as Emilia-Romagna. In such a case, the region would assume a leadership role in the promotion of a decentralized, industry-based service infrastructure following the patterns of existing industrial districts.

Similar characteristics in a lesser industrialized and less technologically developed context (though with wider political empowerment), can be found in the model implemented by the Valencian Autonomous Community since 1985.

The German and Danish cases, respectively, have in common numerous and extended precedents of centres offering technological services to firms (since 1906 in Denmark, and since the Second World War in Germany). However, they constitute two clearly differentiated models.

In the case of Denmark, services are provided in a *centralized* way through the DTI, complemented with decentralized “entrance windows” (Local Information Centres). On the other hand, Baden-Württemberg, with a considerably bigger scale as far as potential demand for services is concerned, has developed an extended model of technology centres that are *decentralized* throughout the area, benefiting from a widespread, well-established network of technical training centres with a tradition in the provision of business services.

4.2 Participation of private agents

In the case of less developed regions, the lack of a market for technological services makes the public sector face a double challenge. On the one hand, it becomes necessary to promote the infrastructure for the provision of services, either from scratch or from small existing seeding nuclei, normally in universities. However, on the other hand, there is also the need to stimulate a demand that, in the case of small- and medium-sized companies, exists only in a latent form, and is neither well defined nor explicit.

The central problem that public strategy faces when promoting innovation in small- and medium-sized companies is to simultaneously *generate an adequate supply* of services and to *stimulate sufficient demand* for them. For this reason, and according to experiences from successful cases, the amount of trust shown by economic agents (potential users) in the instruments designed for providing services is a key point (Mattila 2004; Yen et al. 2004).

All the models examined herein incorporate, through different formulae, private agents in the organizations that are responsible for the design and management of the strategy for providing services as a way of enhancing the mutual development of supply and demand.

4.3 Financing: the false dilemma of public support versus self-financing

When it comes to generating an adequate supply of knowledge-intensive services and stimulating sufficient demand for them, the price at which services are offered is a key element, in as much as it can turn into an added barrier to increasing demand. This brings up a central question in relation to Technology Centres: the means of financing the facilities, equipment and services they provide.

From the cases analysed in this paper, three basic options can be identified: firstly, there are cases in which technology centres are privately owned but public funding is provided in different ways. These are basically: (a) generic support for the financing of infrastructures (investments and cost of services) and (b) financing for specific projects by means of contracts or through public announcements of aid for which centres compete with other agents in the innovation system (all these means have been used in the case of the Valencian Community). Secondly, there are forms of shared ownership and mixed financing (e.g. the case of the DTI). Finally, a third option is public ownership (Germany provides a number of examples) with financing coming primarily from public funds.

The strategy for self-financing through membership fees and prices for services has been repeatedly considered, at least as an objective in the future (e.g. the Emilia-Romagna real service centres). However, in cases where policies of self-financing have been applied with greater consistency (e.g. the DTI), two types of disadvantages emerge. Firstly, a tendency towards providing rather standardized, less costly services becomes apparent. These are often the kind of services for which a more defined demand already exists, and for which the market itself is more prone to provide an offer. In addition, a second disadvantage in a fully implemented self-financing strategy is to focus the offer of the most advanced, very costly services with a high level of added value to a small group of larger companies as a means of reducing the transaction costs involved when dealing with a large number of small customers. In extreme cases, such a tendency can make technology centres attempt to compete amongst themselves for excellence in order to capture “the best customers” at the risk of detaching themselves from the productive system of small- and medium-sized companies.

4.4 The drafting of the service portfolio: institutional stability and the risk of “fossilization”

One crucial question in the design of a strategy for a model of Technology Centres rests on the development of a catalogue of services. A number of aspects influence the drafting stage: on the one hand, the *recurrent* nature of technology services to companies leads to the convenience of designing a scale of services going from relatively simple services to more complex ones. This is a way of engaging users (Ranaweera and Prabhu 2003), by upgrading strategies for providing progressively more complex services as they are needed. On the other hand, there is the need to be able to count on the right counterparts in companies and business communities to adequately match the *interactive* nature of advanced services to companies. Finally, services offered by technology centres are immersed in a dynamic process of permanent renewal. An unstable balance has to be managed between the need for stability, a necessary condition for achieving trust from economic agents, and the need to focus the catalogue of services in areas with strategic relevance at each moment

whilst withdrawing services from other less relevant services as a way of avoiding *fossilization*.

4.4.1 *The positive service spiral: from standardized to knowledge-intensive services*

Offering services in itself helps to bring to light necessities that may be dormant in a company or in a productive system as a whole, since visualizing a solution, at times, may be the most direct means of becoming conscious of the existence of a problem. And only when such consciousness exists does the demand become real and able to play an active role in the market.

In light of these observations, how could the supply–demand interaction be induced from a starting point in which explicit demand is scarce and thus, its pressure upon supply is also small? In this case, the initiative must come from the supply itself. It therefore seems logical that one of the first steps should be the provision of rather less complex services or services that become compulsory because of interventions from outside the production system (e.g. laboratory tests needed to verify safety, or quality or environmental certifications that become compulsory to be able to continue the activity or to gain access to new markets.²

On the other hand, a gradual strategy allows the opening of a whole array of possibilities for the provision of new services when relationships of trust between provider (technology centre) and receivers (small- and medium-sized companies) have been set up by the successful use of rather simple services. Taking, once again, the case of the toy industry, laboratory tests can serve not only for issuing certifications, but also to diagnose problems related to raw materials, or to suggest changes in the production processes. Experience shows that a gradual strategy like this may be a way for smaller companies to become conscious of the interest in having not only laboratory testing, but also going one step further: obtaining *technology consulting* services.

4.4.2 *The interaction provider/receiver in practice: the need for a counterpart within small- and medium-sized companies*

There are no ideal models for technology centres but rather models that are adapted to their particular reality in their specific environment, and which are able to introduce “upgrading” strategies for companies located in the area.

² This might have been the case of the Spanish toy industry when, in the second half of the 1980s and upon entrance into the European Union, the use of the *CE* mark was introduced as a guarantee of safety. The provision of laboratory testing and certification by the Toy Technological Institute meant a starting point for the development of complementary services. The introduction of the *CE* mark was designed to enhance the role of packaging and product presentation as competitive elements. The toy industry became connected with other industries that were facing stringent requirements in this area (e.g. the wood and card industries as providers of packaging products, and the food industry, with huge demands on packaging and labelling). An increase in technological activities regarding packaging gave birth to a specialized centre, ITENE, focusing initially on packaging and later expanding its activities to transportation and logistics.

For this reason, there are no rules of general value for drafting a catalogue of services to be provided by an ideal technology centre. Let us consider, as an example, the case of specialized training, understood as a service, to companies lacking technologically qualified human resources. A reasonable doubt about whether the improvement of qualifications should be included as an area of action for a technology centre could be suggested. A possible answer would depend, in part, upon the extent to which other components of the innovation system provide appropriate training programmes.

However, it should be taken into account that advanced services require *co-production* between producer/provider and purchaser/user: the help of the user is crucial for the service to match what is needed. In other words, the quality and efficiency of the service will depend, to a large extent, on the *dialogue* between provider and user. For this reason, sufficiently qualified counterparts in relevant companies are needed to guarantee that the supply of business services operates successfully. Counterparts have a paramount role in detecting necessities that can be solved by the use of advanced services as well as in assuring the adequate application of proposed measures.

This is why specialized training services may become a strategic factor in enabling technology transfer and the intake of new technologies or new management techniques.

4.5 The makeup of networks

In contrast to the production of goods, when producing services, and especially advanced knowledge-intensive ones, a mere increase in size does not mean access to economies of scale. On the other hand, access to the market by potential claimant companies, particularly if demand needs to be stimulated from the supply side, tends to favour *decentralized* actions both in a territorial sense because of the need to match the location pattern of the productive fabric, and in a functional sense to match productive specialities.

At the same time, because of the cost of providing knowledge-intensive services, global development offers potential benefits. For this reason, technology centres tend to get involved in networking both on a territorial basis (cross co-operation with other bodies providing business services at a regional or national level), and on an industrial basis (co-operation with other technology centres working in the same industry all over the world). Networking avoids the need to disperse resources, improves co-ordination and reduces risks related to excessive size. The role of coordinating bodies in networks consists of acting as an *interface* throughout the whole of the network, encouraging relationships amongst its components.

5 Conclusion

In regional contexts with a dense fabric of small- and medium-sized companies (Cooke and Leydesdorff 2006), the strategy of promoting the supply of capital

intensive services through Technology Centres (infrastructures for the provision of technology services) can be considered as one of the basic policies for business development (Gorman and McCarthy 2006). The reasons are diverse, but at least three of them can be underlined.

Firstly, the relatively neutral nature of centres in relation to all the economic agents operating in a territory, and the small amount of direct impact they have upon the conditions for competence in the markets, facilitates acceptance within a liberalized and global economic context. Secondly, they provide the capacity to positively influence a numerous, heterogeneous and diffuse target group such as small- and medium-sized enterprises. Such positive effects can be achieved both by directly providing services and by increasing the capacity of the environment to provide externalities. A third reason consists of a relatively favourable relation between the allocation of public resources and its consequences. In spite of the limitations in the available methods for evaluating the performance of most microeconomic policies, experiences to date lead to the conclusion that resources devoted to offering capital intensive services obtain a higher level of additionality than traditional programmes providing financial support.

However, it should be taken into account that the supply of capital intensive services is just one factor, and that there are, at least, two other sources available in the policy makers' *toolkit*. These are (1) financial incentives and (2) regulatory instruments. The effectiveness of each tool, and even the possibility of using them, may depend on how well they are combined with the others. For example, the complementary nature of the relationship between the supply of capital intensive services and financial incentives for investment in new product development and in innovative production technologies should be stressed.

However, when evaluating interaction between services to firm-based policy measures and other kinds of measures, it should also be borne in mind that infrastructures providing business services, particularly capital intensive ones, interact with financing and regulatory instruments. As an example, technology centres may act as diffusing agents of financial schemes and even as collaborative agents in the evaluation of projects. Similarly, service centres often participate in processes aimed at setting up and operating technical standards, providing consultation for companies, carrying out convenient laboratory tests and certifying products or production processes for companies.

From this point of view, the integral and multi-faceted nature of policies aimed at enhancing innovation-based upgrading in small- and medium-sized companies should be stressed.

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