Technology centres: a strategic R&D&I partner for companies

XAVIER LÓPEZ

In many countries and regions, technology centres have become some of the most active players within their innovation systems. The generation of technology by these bodies, their key role in driving business R&D&I, their intensive participation in international R&D programmes and their excellent capacity to generate new business projects have turned technology centres into a highly effective tool of technology policy in different countries.

But what is a technology centre? Which are its main activities? What is the base to their efficiency? What is the reality and experience of these organisations in other Spanish regions as well as in other countries? And lastly, what are the action lines to take on in our country to consolidate these organisations and make them more effective?

What is a technology centre?

The Decree 379/2004 of the Catalan Ministry of Labour and Industry, by which the technology centre registry is created, defines these organisations as legally constituted non-profit bodies with own legal personality and their registered office being located in Catalonia. The statutes of technology centres shall state the improvement of competitiveness of companies by generating and developing technology as well as its dissemination and transfer as their social objective. They further need to comply with the following requirements:

▶ Their statutes shall provide:

  ▶ A majority of members with voting power in the board, executive or management council shall represent business associations or companies belonging to different groups and being representative of their business branch.

  ▶ Their activity shall not be restricted to their associate or collaborating members only but also open to any company or organisation.

  ▶ In case of termination or dissolution, their assets shall be devoted to activities according to the founding mission or equivalent tasks.

▶ Organisations must be established, work and comply effectively with their purposes during at least during two uninterrupted years prior to their application for registry.

▶ They need a business plan ensuring the feasibility of the centre for three years following application.

▶ University and administration shall be represented in the technology centre management, either by taking part in the managing bodies of the board, executive or managing council or being represented in the consultative bodies of the aforementioned.

▶ They must have own resources able to offer technology services directly to companies:

  ▶ **Human resources:**

  Their human resources must include more than twenty people, of which 75% need to have a university degree and at least one a PhD.

  They need a clear and differentiated commercial structure within their organisation.

  ▶ **Material resources:**

  They need material resources to carry out the business of a technology centre.

▶ At least 25% of their revenue must come from R&D activities.

▶ Non-competitive public financing obtained by the organisation shall not exceed 30% of ordinary operating expenses, including human resources.

▶ At least 40% of annual revenue must come from contracts with companies or groups of companies.

▶ Annual turnover must be of at least one million euros.

▶ Their customer portfolio must be diversified enough and in accordance with the structure of the sector or the technology area within which they carry out their activity.

▶ Standardised management models based on excellence and quality criteria must be in place.

Beyond merely administrative obligations as well as slight differences that may exist, these requirements are very similar to related registries in other Spanish regions and parallel to those fixed by the Spanish Federation of Technology Centres (FEDIT) to define what a technology centre is.

The above criteria are aimed at a clear commitment on behalf of technology centres to general interest, as they have to be non-profit organisations, offer their services to all interested companies and organisations and be sympathetic with business needs, among others.

The fact that the majority of voting powers lies with companies independent from each other, that a minimum of 40% of revenue needs to be raised through contracts with companies and the obligation to work for a wide range of customers requires technology centres to stay obligatorily very close to the industrial base and try to suit the R&D&I needs of the industry as their main objective.

Technology centres are non-profit organisations and offer their services to all companies.

Other criteria have effects on the independence of decision-taking at centres (limited public funding, own resources for their activity), ensuring that a part of the activity is devoted to generating own technology and knowledge, not only to transferring knowledge generated by others. A certain critical mass (minimum staff and turnover) and the application of management systems and methodologies geared to efficiency and quality also play a major role.

All in all, this set of criteria defines an organisational model, a model being the recognition of a set of common relevant factors to carry out a certain mission that, in the case of centres, relates to helping companies improve their competitiveness through innovation and technology. In any case, given that these factors are intricately related to

▲ **Barcelona Digital** is a new Catalan technology centre recognised as such by the administration.

their fast changing environment, the model will need to undergo regular review and adjustment, if applicable.

The origins of technology centres

Most of the largest reputable European technology centres (TNO, VTT, Fraunhofer, SINTEF) were created few years before or few years after World War II. In the most advanced European countries, the second industrial revolution, with its young knowledge-based industry and the military technology developed during the war, started demonstrating the power of science and technology as a driver for economic and social development in these countries. Their universities were also con-

centrating on teaching and theoretical research in those years. It is in this setting where the need came up to have organisations aimed at adapting this scientific knowledge to the needs of society and economy and offering additionally a set of technology-based services to their industrial environment.

The first Spanish centres were created in the 1960s, though it was not until the 1980s that they expanded significantly. Most of them were created out of business initiative, as a means to solve technological problems companies were unable to tackle individually, either due to their size or to their limited resources and knowledge.

The creation of technology centres in Catalonia roughly goes along the same lines, although universities have a stronger presence, possibly due to their greater importance here.

the main activities of technology centres

Most technology centres started offering technical assistance, testing and technology advice to suit the most compelling demands by the local industry in that time. Based on the evolution of this demand, centres have been expanding their technological offer to R&D&I projects, advanced technology services, innovation management and promotion of entrepreneurship. In any case, it is now commonly accepted that centres need to serve two basic tasks to comply with their mission:

Graph 1. The two key functions of technology centres and their balance

Strategic R&D

R&D&I under contract

Move away from industry

Technological decapitalisation
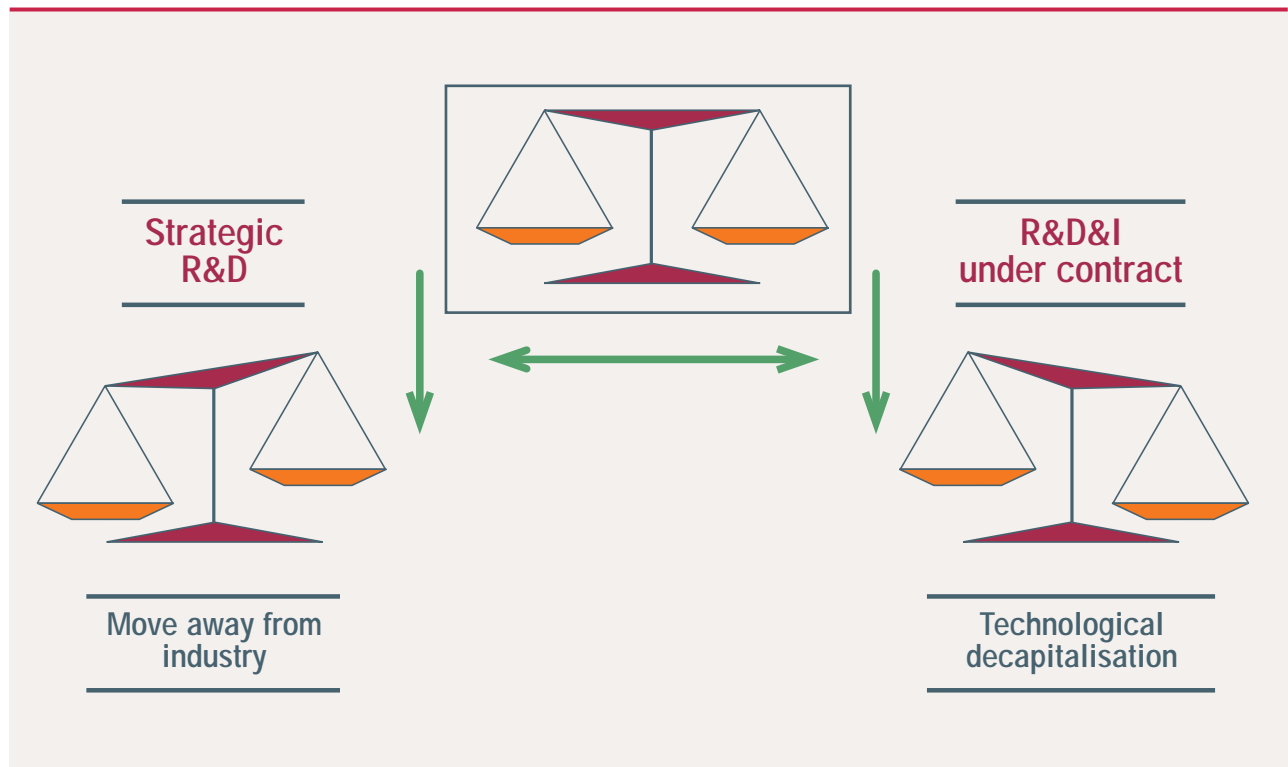
▲ A certain balance between these two functions is crucial.

The first is generating technological knowledge through so-called strategic R&D. This includes those R&D projects and activities generated out of the organisation's own initiative without any specific demand by a given user. Despite being always inspired by current or future demands of the industry, such projects and initiatives are set out for the medium and long term.

The second is transferring this technological knowledge to its environment and facilitating its use by companies through its necessary adaptation.

A certain balance between these two functions is crucial. If a centre does not strategic R&D with adequate intensity, it will become technologically decapitalised in the mid-term, reduce its capacity to generate knowledge and technology and adopt

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a conception close to that of technological service companies or other players in the system the goal of which is exclusively to bring together technological offer and demand.

On the other end of the spectrum, if a centre does not devote most of its activity to transfer, it will lose contact with the final recipients of its knowledge and thus not improve their competitiveness. A centre not having transfer as one of its main functions may reproduce patterns close to those of other research organisations in the system.

In order to further characterise the transfer function, some additional comments will be of use. First, transfer cannot be conceived as a one-way movement. The relation between centres and companies is richer and more complex and knowledge transfer often occurs in both directions.

Technology centres are to generate technological knowledge through so-called strategic R&D and transfer this knowledge to their environment, facilitating its use by companies.

Secondly, mechanisms used within this function are differing. All centres do R&D&I under contract with more or less intensity, that is, they develop projects to suit the demand of a given company or organisation, follow its specifications, offer technology services and technical assistance and do testing as they usually have specialised, well-equipped infrastructure and labs. Most centres also transfer knowledge through training and some offer innovation management services and have programmes to foster the creation of technology-based companies.

As has been pointed out, the different weight of these activities basically depends on business demand as both R&D done in different industrial sectors and the proportion of its externalisation differ considerably.

Generally speaking, however, there has been an evolution in the offer of centres focusing increasingly on transfer activities generating most technological value for users, i.e. R&D-intensive projects and activities. In this respect, many companies having started hiring occasional testing services from a centre some years ago have by now enlarged their demand towards R&D&I activities thanks to interaction with these organisations. Besides, technological demand on the side of companies is increasing considerably in complexity and their R&D activities are becoming increasingly multidisciplinary and bear more risk. Companies find here an excellent ally in technology centres as these organisations provide specialised human resources and working methodologies that allow them to split the risk.

Finally, generating new technology-based business initiatives deserves special attention in relation to transfer. Though not very frequent in Catalonia yet, there are other areas in Spain with many centres having driven massively for creating technology-based companies as a means to place research project results on the market and create a business base. Technology centres are usually good partners for these projects from their earliest stages as they provide technological knowledge, good infrastructure, business awareness and a certain capacity to mobilise financial resources.

Technology centres in Spain and Europe

The Spanish Federation of Technology Centres (FEDIT) currently includes 63 organisations distributed over most of Spain and is highly representative of this group at national level.
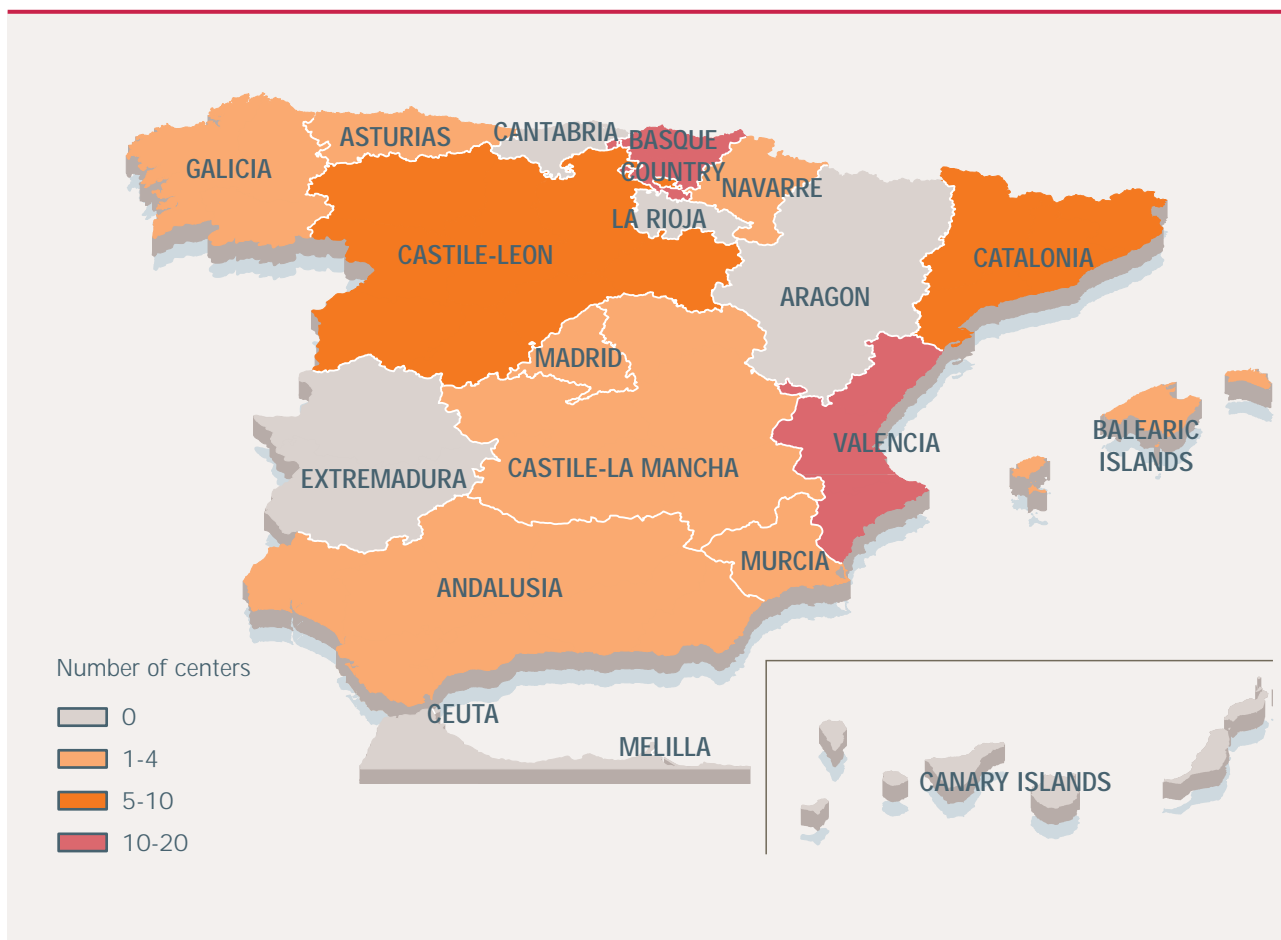
As can be inferred from the map (graph 2), the Basque Country and Valencia are the regions with the highest number of organisations, followed by Catalonia and Castile-Leon. This distribution, apart from bearing a certain relation with the in-

dustrial base of each area, also has to do with the support such institutions have from their respective regional government. Some regions started programmes to support this kind of organisations over twenty years ago as they understood that they could play an important role in reorienting and driving their business base. This is the case, for instance, of Valencia and the Basque Country, where centres are considered a key element in their innovation systems, having achieved very remarkable results.

Technological centres associated to FEDIT have been very dynamic in recent years, with an annual growth rate often exceeding 15% (19% in 2006).
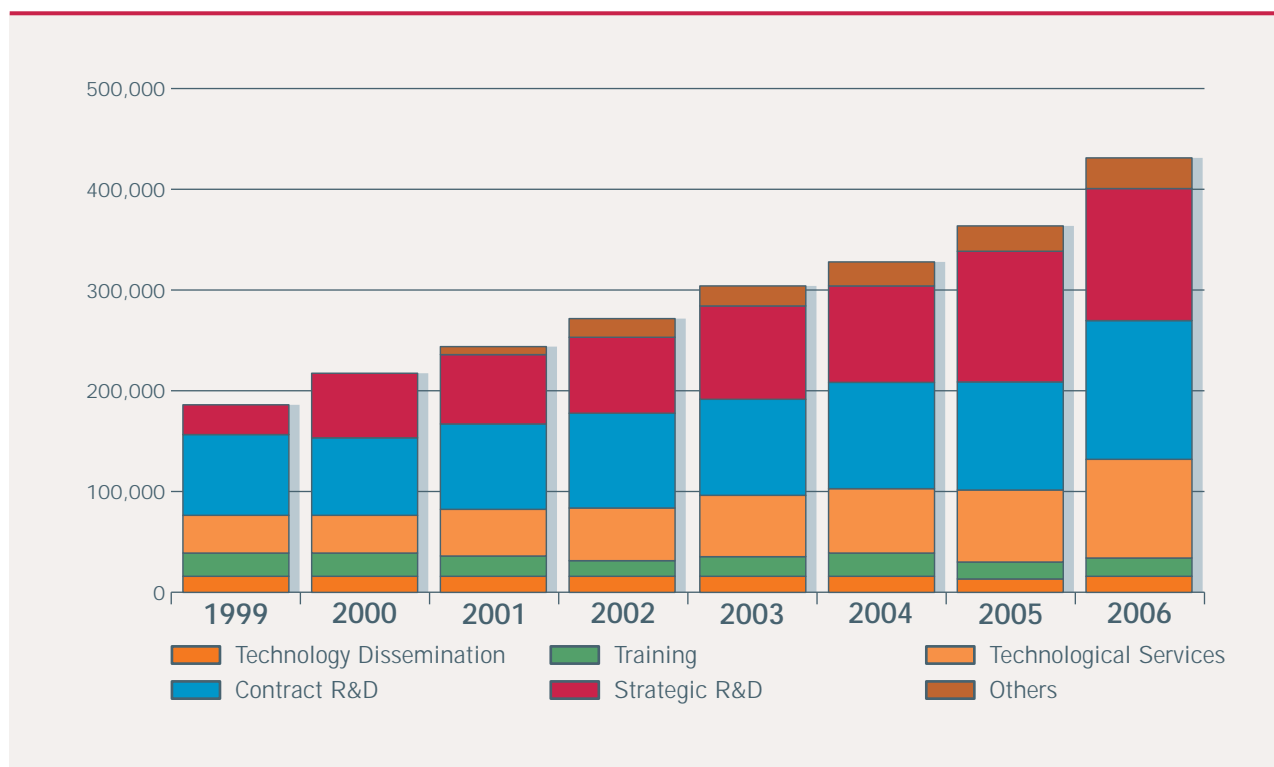
Overall revenue of these centres (cf. graph 3) was at around 440 million euros in 2006, of which 240 came directly from contracts with companies. The total workforce of these organisations is 5600 employees, with the PhD graduate rate having significantly increased in the last two years (30%).

Graph 2. **Geographical distribution of technology centres in Spain**

Source: FEDIT

▲ The Basque Country and Valencia are the regions with the highest number of organisations, followed by Catalonia and Castile-Leon.

Graph 3. Distribution of income per type of activity

Source: FEDIT

▲ Overall revenue of these centres was at around 440 million euros in 2006, of which 240 came directly from contracts with companies.
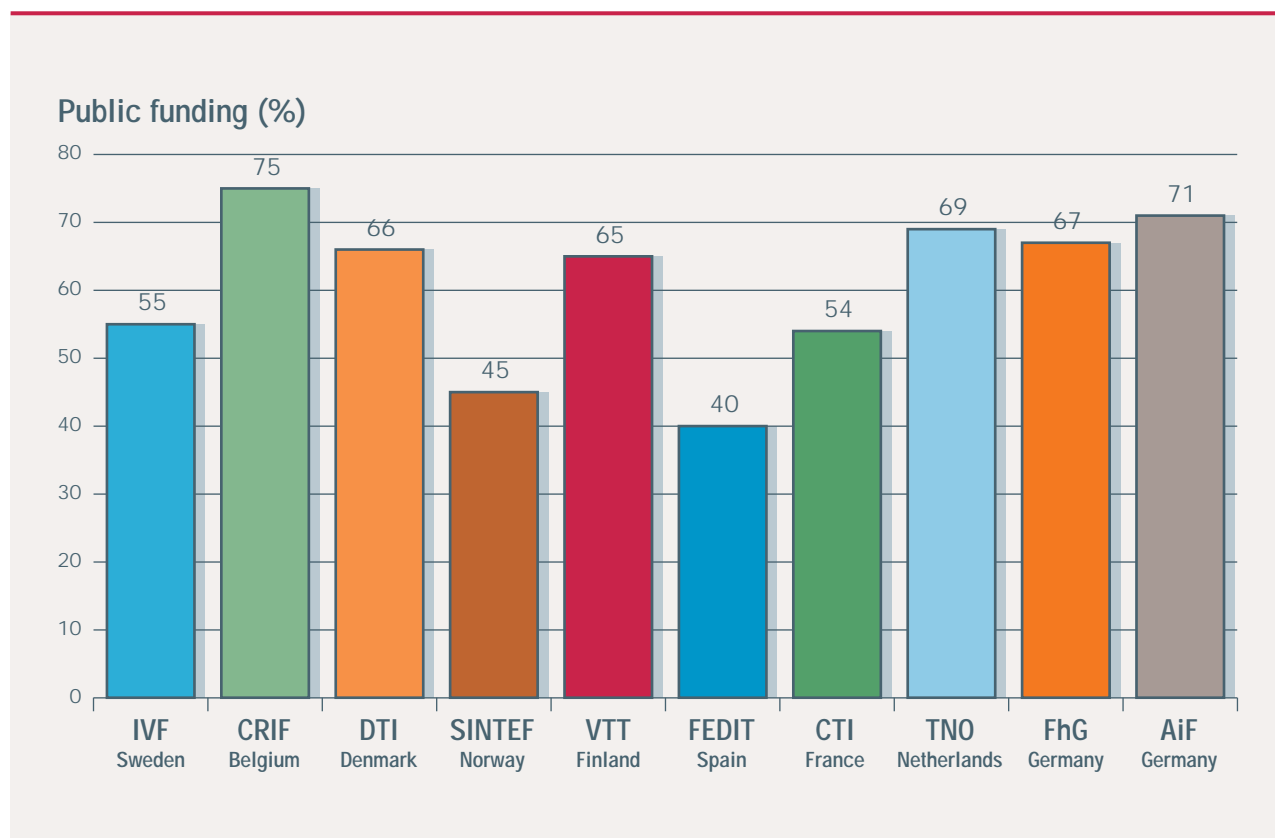
Of overall activity, 31% relates to strategic R&D and further 31% to R&D under contract. The rest is distributed over technology services, training and other transfer mechanisms. The above graph shows how the strategic R&D component is that having grown most in the last years, above the average growth of the rest of activities.

Apart from the effects of demand on the relevance of the rest of activities, a higher or lower degree of strategic R&D intensity depends on various factors. One is the size of the centre, with the relation it has with other players such as university research groups also having its effect, but strategic R&D is above all deeply related to the funding system on which the organisation relies. Those centres with most and most stable public

funding can invest more in this activity in which business investment usually plays a marginal role. Conversely, centres with poor or no financial support by public authorities only can do strategic R&D funded out of their surplus from other activities.

At the same time, strategic R&D is intimately related to generating own technology. In this respect, and despite the shortcomings of the existing financial scheme, technology centres are also a reference within the Spanish R&D&I system. In the last recorded year, they developed and registered 128 patents and utility models and took part in the development of another 54 patents eventually registered by companies. Accumulated figures exceed

Graph 4. Public funding at European TCs

Public funding (%)

Centre	Country	Value
IVF	Sweden	55
CRIF	Belgium	75
DTI	Denmark	66
SINTEF	Norway	45
VTT	Finland	65
FEDIT	Spain	40
CTI	France	54
TNO	Netherlands	69
FhG	Germany	67
AiF	Germany	71

Font: FEDIT.

▲ Those centres with most and most stable public funding can invest more in strategic R&D.

400 own and 260 registered patents by client companies.

Another relevant indicator related to Spanish centres is that they regularly work for over twenty-five companies from different sectors and of different size.

Strategic R&D is intimately related to generating own technology.

This means that proximity to industrial needs and challenges is apparent with these organisations and that technology centres have often become the business' reference allies in R&D&I matters.

The role of these organisations in internationalising Spanish R&D is also important. The participation of Spanish technology centres in different EU framework programmes has traditionally been very strong. In the Sixth Framework Programme, the return rate obtained by Spanish centres was 10.6% of total Spain, being by far the most efficient player in the Spanish R&D&I system in relative terms (return per researcher).

However, the most important issue in the international context is that centres have a clear dragging effect on companies, staying by many of them in their participation in different international R&D calls. A clear example for this is that 685 Spanish companies took part in the aforementioned framework programme, of which 330 did it

together with a centre, and of those 87 took part for the first time.

One last indicator to be pointed out in relation with the whole of Spanish technology centres is the creation of technology-based companies.

The first experience in this field dates from the 1990s and, from then on, centres have launched over 140 technology companies to the market, devoted to exploiting the results of different R&D projects. A part of them are by now consolidated, having generated highly skilled jobs and become powerful R&D service consumers.

All in all, the above figures and indicators show that we are dealing with one of the most dynamic players in the Spanish R&D&I system, with a deep relation with the business base and its challenges as well as a clear potential to be used as an efficient tool for technology policy.

Though it is not finished yet, the first conclusions of a survey done for FEDIT, in which many independent experts and over a thousand companies have participated to measure the impact of the action of centres, corroborate unmistakably the above assertions. Over 70% of interviewed companies having worked regularly with technology centres state a direct and significant impact of this collaboration on their competitiveness.

In most European countries there are also similar organisations. The most renowned ones are possibly those from Finland (VTT), Norway (SINTEF), the Netherlands (TNO) and Germany (Fraunhofer). They are all institutions with a clear incidence in economic development of their countries and the competitiveness of many companies.

The most evident differences compared to the Spanish model represented by FEDIT are the age (as has been mentioned, these centres were created in the 1940s and 1950s, while in Spain it is

not until well into the 1980s that we can talk about a group of centres), size (their size is far beyond that of the biggest Spanish centre and some are even larger than the whole of FEDIT), the deep relationship with their respective government and technology policies in their countries (some of these centres give advice and directives on technology policy to their government), their organisational model combining a strong autonomy of centres and institutes from an operative point of view with a strong centralisation and consistency in strategic aspects as well as their funding model (all have stronger public support, partially based on target-related funding).

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Target-related funding allows an alignment of centres with technology policy priorities, giving them a higher budget stability, which in turn results in a higher strategic R&D intensity.

In this respect, it is interesting to point out some concrete surveys made and measures taken in different European countries in recent years.
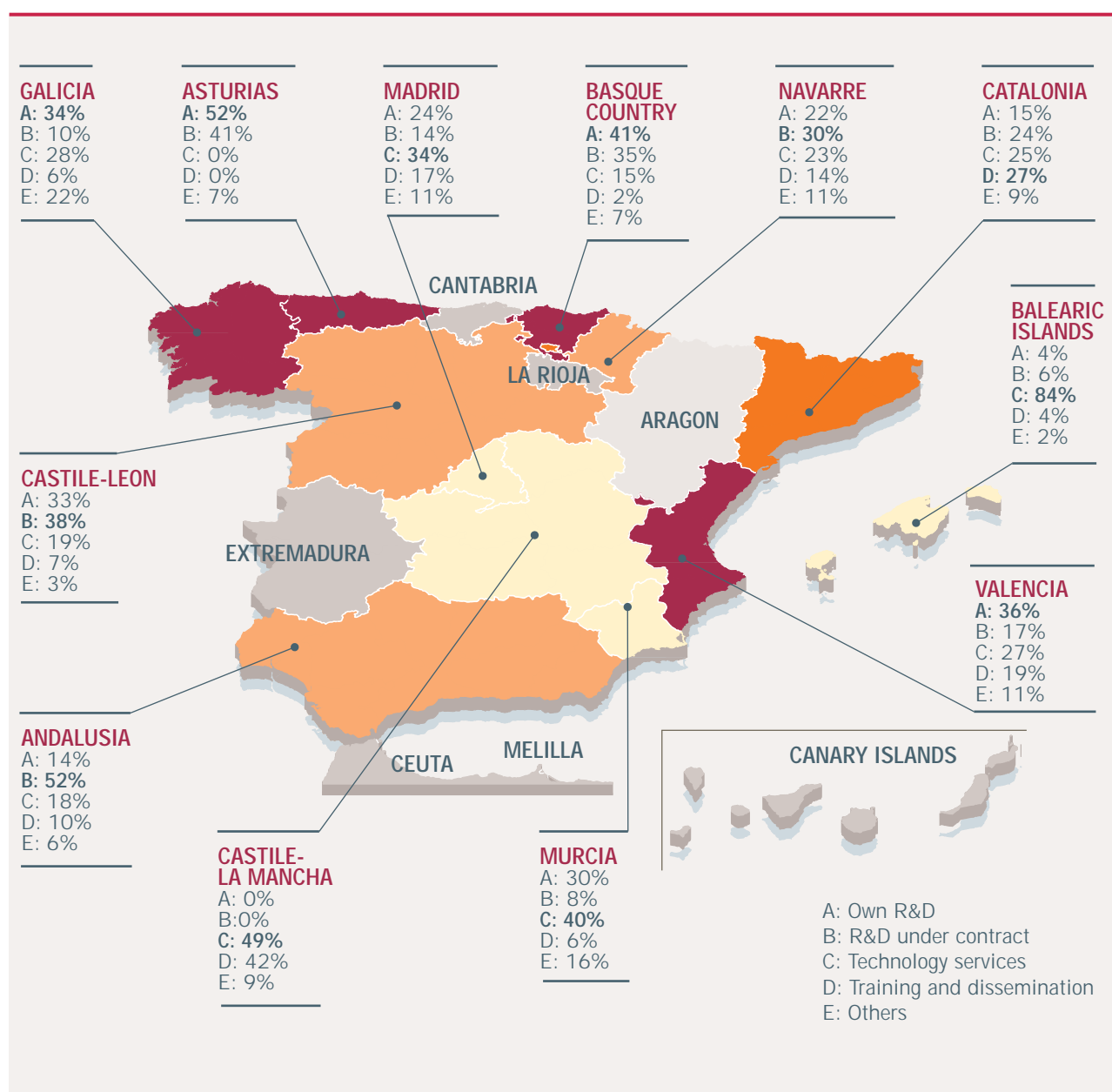
For instance, in the course of a deep revision of its policies on science and technology in 2004, Finland came to the conclusion that the low basic funding obtained by VTT had reduced its capacity to do long-term strategic R&D and that this funding should increase from 30% of turnover in 2003 to 40-50%.

This conclusion is being now implemented through a mid and long-term agreement between the government and VTT, by which basic funding for the organisation will grow at an annual 5% till it reaches about 40% by 2010.

In France, the CARNOT programme was launched in 2006, clearly inspired by the German Fraunhofer model, by which around twenty centres noted for their excellence in working with the industry will obtain variable, target-related funding that will be at around 35% of

Graph 5. **Distribution of activities of technology centres by region**

GALICIA
A: 34%
B: 10%
C: 28%
D: 6%
E: 22%

ASTURIAS
A: 52%
B: 41%
C: 0%
D: 0%
E: 7%

MADRID
A: 24%
B: 14%
C: 34%
D: 17%
E: 11%

BASQUE COUNTRY
A: 41%
B: 35%
C: 15%
D: 2%
E: 7%

NAVARRE
A: 22%
B: 30%
C: 23%
D: 14%
E: 11%

CATALONIA
A: 15%
B: 24%
C: 25%
D: 27%
E: 9%

CANTABRIA

LA RIOJA

ARAGON

BALEARIC ISLANDS
A: 4%
B: 6%
C: 84%
D: 4%
E: 2%

CASTILE-LEON
A: 33%
B: 38%
C: 19%
D: 7%
E: 3%

EXTREMADURA

VALENCIA
A: 36%
B: 17%
C: 27%
D: 19%
E: 11%

ANDALUSIA
A: 14%
B: 52%
C: 18%
D: 10%
E: 6%

CEUTA   MELILLA

CANARY ISLANDS

CASTILE-LA MANCHA
A: 0%
B: 0%
C: 49%
D: 42%
E: 9%

MURCIA
A: 30%
B: 8%
C: 40%
D: 6%
E: 16%

A: Own R&D
B: R&D under contract
C: Technology services
D: Training and dissemination
E: Others

Source: FEDIT.

▲ The FEDIT data for 2005 clearly show that Catalan centres were much smaller than those from areas such as Castile-Leon, the Basque Country, Navarre and Valencia.

CETEMMSA in Catalonia and Fraunhofer in Germany are institutions with a clear incidence in economic development of their countries.

their annual budget. The main target is the volume of R&D programmes signed with companies, and there will be a bonus for working with SMEs.

Technology centres in Catalonia

There are currently ten technology centres in Catalonia recognised as such by the administration. A first group of organisations with a quite long-standing history (AIICA, ASCAMM, CETEMMSA, CTM and LEITAT) has been joined in the last years by BARCELONA MEDIA and CTAE as well as most recently by CENTA, IMAT and BARCELONA DIGITAL.

In some of these latest projects, universities and public administration have played a promoting role, so today Catalonia has a combination of centres with a clear business background and others where the industry is present but its leading role is less apparent.

Moreover, Catalan administration is having a key function in setting up other projects of centres that are to complete this map in the following years.

Although it seems clear that the number of centres in Catalonia is low, especially if compared to other regions and industrial GDP, it is nonetheless true that there are critical voices saying that business involvement in some of these new projects is still insufficient, feasibility studies have not always been made in all its required depth, the existing offer has sometimes not been taken into account and centres generated through public promotion have usually been of short breath.

In any case, the history of such organisations in our country presents two distinct stages. The borderline between both is the creation of the technology centre registry in September 2004.

During the first stage, all centres came up out of business and/or private initiatives, thus being

mostly projects with a clear sectorial orientation. Most of them received some degree of support by Catalan administration, sometimes also backed by local and/or Spanish administration.

The FEDIT data for 2005 clearly show that Catalan centres were on average much smaller than those from areas such as Castile-Leon, the Basque Country, Navarre and Valencia.

Direct dependence on business demand has caused those centres appearing in this first stage to stay very close to the industry, with which they strongly collaborate, but its consequence is that their offer is very geared to technology services, testing and training, thus not generating enough strategic R&D activity. FEDIT data are plain in this respect. In 2005, Catalan technology centres only devoted 15% of their activity to strategic R&D and concentrated heavily on transfer activities, while centres in other regions such as the Basque Country devoted 41% to this area. Moreover, if we consider that this gap is not the result of one single year but the outcome of an evolution of more than a decade and a half, we can quickly infer that the technology knowledge gap between both is really big.

Although it seems clear that the number of centres in Catalonia is low, it is nonetheless true that there are critical voices saying that business involvement in some of these new projects is still insufficient.

At the same time, this lack of strategic R&D, together with the importance of other players such as universities and public research groups and institutions, which are much more relevant in Catalonia than in other regions, has led to a lack of recognition of centres as a player in the Catalan R&D&I system. Very few knew about the existence of strategic R&D and those who did gave it a minor intermediary role between knowledge generated within public research and

production, which is meant to be the ultimate applier of this knowledge.

Apart from creating the registry in 2004 and from implementing a policy to support technology centres, the scenario has changed progressively but quickly. Although it is true that this policy has been very focused on promoting new centres and that financial resources were limited in the first stage, the working scheme, based on which centres were considered a relevant piece within the system and a tool with an excellent potential for driving business R&D, has led to a turn of future expectations within this group.

Today technology centres in Catalonia have a tool (action plans) that, in spite of being far from obtaining the same aid as similar organisations do in other regions, has allowed the most consolidated ones to fund a good deal of their most strategic R&D activity in the last two years and to increase it significantly. Besides, a portion of this funding is linked to indicators, thus taking over, though timidly, the philosophy of target-related funding that is a tool commonly used in different European countries prominent in technological innovation, as has been already shown.

Although it is too early to assess the efficiency of these measures, the first results are encouraging. Catalan centres have increased their strategic R&D, generated patents and technology-based companies and have reached a good representation in demanding national programmes such as CENIT.

It remains to be seen how the Catalan scenario related to such organisations is completed and how the most recent projects are consolidated or reshaped.

The completion of these processes, together with the ultimate consolidation of organisations created in the first stage, will finally determine the relevance and role of this group in our innovation system.

Future challenges

In order to determine which are the most important future challenges from a technology centre perspective, it is first necessary to agree on some basics. The first is to be aware that centres need to comply with their mission of assisting local companies as efficiently as possible in creating long-lasting competitive advantages through technological innovation and knowledge. Besides, centres also need to play an increasingly relevant role by creating wealth of their own through patents, products and technology-based companies. This idea needs to guide all measures and actions.

The second, and possibly obvious, basic condition is that the current and future budget and financial resources are limited, which forces us to be very selective in the actions to support and to try by all means to avoid dispersion and overlapping.

Technology centres need to comply with their mission of assisting local companies as efficiently as possible in creating long-lasting competitive advantages through technological innovation and knowledge.

Once these basics have been defined, the most important future challenges for the most consolidated Catalan technology centres are:

Providing stability and growth to their strategic R&D activity. As has already been mentioned, this kind of R&D needs to be clearly inspired by future needs of local companies, and it is also recommendable that most of it is done in cooperation with other centres, companies and universities.

For this to become true, centres need to have a stable financial system linked to clear indicators

as to results and profitability of such R&D. As has been pointed out, there is currently quite a valid mechanism but it should be financially strengthened to attain a level comparable to other regions and provide a scheme with a stronger focus on target-related funding.

Furthermore, although there are tools to fund centres for doing strategic R&D, the creation of instruments to fund infrastructure and equipment for science and technology is still pending. This shortcoming poses clear competitive challenges to our organisations and makes investment more difficult.

Even if strategic R&D and the size of our organisations grows, the reduced critical mass of Catalan centres still is a clear competitive disadvantage. Certain projects, investments, actions for visibility, internationalisation etc. require a size most Catalan centres do not have today. It is therefore important to accelerate measures to foster the increase of this critical mass through stable and also structural cooperation among our centres and between them and other players in the system.

Another future challenge is the adequate use of the potential of technology centres to provide skills and expertise for good technologists and reward it with measures allowing these organisations to hold back at least a part of the talent they help develop. We need to set up specific programmes for human resources at centres from a double perspective: centres shall become attractive organisations for the career perspectives of young technologists, also facilitating the later absorption of a part of this workforce by companies, and they shall have mechanisms to hold back and use adequately the talent they assist in building up. It is also very important to foster exchange and mobility of workers between different players.

The internationalisation of Catalan technology centres and their ability to have companies participate in international R&D programmes is ano-

ther aspect with much room for improvement. The participation of our organisations in international R&D programmes is important to foster absorption and exchange of knowledge, establish international cooperation relations, compare the quality of our R&D etc.

Our centres have traditionally suffered from their small size, having, with some exceptions, many problems to submit projects to calls, building powerful consortia, convincing companies to enter these consortia etc. Once again, the availability of skilled human resources, devoted exclusively or, at least, mainly to these tasks is a key to make progress in this subject.

Promotion and communication campaigns based on best practices, relevant projects, technologies generated at centres and constant attendance at meetings, conferences and other events related to R&D&I are actions to be fostered.

Catalan technology centres need to go on improving their visibility. In this respect, promotion and communication campaigns based on best practices, relevant projects, technologies generated at centres and constant attendance at meetings, conferences and other events related to R&D&I are actions to be fostered.

Also, cooperation between centres, companies and universities needs to be improved. Fostering joint R&D units consisting of company staff, university research groups and technology centres with common goals and own infrastructure can be a useful tool.

Further, programmes aimed at fostering action at centres to create new technology-based companies, together with other players in the system, can have positive mid-term effects, both in quan-

tity (more companies) and in quality (better innovation capacities in our industry). All these measures should come with actions to facilitate and foster recruitment of centres and other research institutions by companies.

As a conclusion, our country has historically been unable to exploit all the potential of organisations that, as has been plainly demonstrated, do play a

▲ Some of Europe's most longstanding and reputed technology centres are those from Finland (VTT) and Norway (SINTEF).

key role in strengthening competitiveness of the industry.

Although it is difficult to speed up along the way others took many years to go, we have today the opportunity to change this scenario and use centres as efficient tools of our technology policy. To do so, we need to go on supporting them in increasing their capacities, creating stability and concentrating efforts. Our industry will definitely benefit from such measures and strengthen its competitiveness.

XAVIER LÓPEZ

Director general of the ASCAMM Foundation, a technology centre located in the Vallès Technology Park, Cerdanyola del Vallès, Barcelona, specialising in plastic and metal component and product design and production technologies.

Degree in Economic and Business Sciences at the University of Barcelona, auditor and master in Financial Management and Planning.

President of the Spanish Federation of Technology Centres (FEDIT).

President of the Spanish Rapid Manufacturing Association.

CEO of Plastiasite SA, Neos Surgery SL and Hexascreen Culture Technologies SL, new technology-based companies participated by the ASCAMM Foundation.

Associate professor at the Autonomous University of Barcelona.