CHANGES IN BUSINESS STRATEGY FOR R&D IN THE SPANISH ELECTRONIC AND TELECOMMUNICATION SECTOR. IMPLICATIONS FOR PUBLIC POLICY

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References
1. Introduction

The objective of this document is to answer the questions put forward in the document, “Patterns of private and public financing of R&D: Issues and a project plan” (DSTI/STP/TIP(2001)3, based on a brief analysis of the Spanish electronic sector.

The analysis was based on a set of interviews and questionnaires addressed to companies in the sector. First, interviews were held with top executives from four companies in the sector. The interviews followed the format found in the above mentioned document.

The characteristics of the companies interviewed are as follows:

A) One small firm (TEIMA) with 12 employees. All income (0.36 million euros in 2000) proceeds from research results (R&D = 100% of turnover). The company is a spin-off of Madrid Polytechnic University (School of Telecommunication Engineers). Professors from the University continue to collaborate, contributing their knowledge to the company. At present, the company produces IAD (Integrated access devices) for integrated voice and data over SHDSL for SME markets. 100 % Spanish capital.

B) Two medium sized firms.

The first, Eliop, has 169 employees, and showed a turnover of 21,671 million euros in 2000. It allocates 9 to 15 % of its sales to R&D, and it produces 5 different groups of products: Remote control devices, measuring devices, control centres, railway signals and advanced sensorisation. 100% Spanish capital.

The second, Siemens Elasa, has 515 employees, and had a turnover of 10 million euros in 2000. It allocates 5 to 7 % of its sales to R&D, producing public telephone equipment (for street use) which it sells to operators. 100% foreign capital.

C) One big company, Telefónica I+D. With 1180 employees, it carries out a large part of the Telefónica group’s research work. The latter is the principal telephone operator in Spain, with almost 150,000 employees world-wide. Telefónica I+D sales volume stood at 200 million euros in 2000. All Telefónica I+D capital belongs to Telefónica, which quotes on Spanish stock exchanges and several international exchanges as well.

The next stage took the form of a short questionnaire which was completed by 12 companies in the sector. The questionnaire contained the essential elements of the aforementioned OECD document. Amongst the companies were two small firms (with 30 to 40 employees); the rest were medium sized companies (with 120 to 800 employees). Except for the biggest companies, with regard to number of employees and turnover alike, the majority allocate 5 to 12% of their turnover to R&D. Only two of the companies belong to a multinational group. In one case the company is the parent firm, while in the other, the firm has a foreign parent company. The other companies are domestic.
Considering the methodological approach to this paper, the comments made below clearly reflect the result of a set of qualified opinions from the sector, rather than any type of statistical representation.

The rest of the document is structured as follows. Part 2 describes the principal characteristics of the Spanish electronic sector. Part 3 presents the results of the analysis using the methodology described above. These results are presented in the same order as the questions put forward in the OECD document, and the main ideas are highlighted in bold letters. Finally, Part 4 offers a set of conclusions.

2. A few notes about the Spanish Electronic and Telecommunication sector.

The industrial structure of the Electronic and Telecommunications Sector in Spain is characterised by the presence of a high number of small and medium sized firms (65 percent of the total), the majority with one hundred percent Spanish capital.

These firms, together with a large group of multinational companies, make the industrial network highly dynamic, with constant changes in its structure due to market evolution and the process of constantly changing regulations resulting from the liberalisation of Telecommunications.

In the sub-sector of Electronic Consumer Goods, all companies except one are multinationals with headquarters in Europe, Japan and Korea.

In the case of the sub-sector of Electronic Components, small Spanish firms predominate, but there are also five large multinational companies.

The Industrial Electronics sub-sector has a large number of Spanish companies which are all highly specialised, and belong the medium-sized company segment.

Large multinationals hold a significant percentage in the Data transmission sub-sector, although there is also a marked presence of small and medium-sized Spanish firms.

Finally, in the sub-sector of Telecommunication Service Operators, large companies with Spanish capital predominate.

Direct employment for the Electronic and Telecommunications sector in 2000 stood at 150,000 jobs.

TSOSs (Telecommunication Service Operators and Suppliers) account for the largest workforce in the sector (85,236 persons), which accounts for 62% of total employment. The Telecommunications and Computer industry holds second place (36,076 employees in 2000), with 26% of total employment.
In the year 2000, the Spanish market for electronic equipment, telecommunications and telecommunications services attained a value of 40 billion euros, 17 billion of which corresponded to the first group.

During the same year, production of electronic equipment and components attained a figure of 9 billion euros.

Over 50% of this production was exported to foreign markets, which resulted in exportations to the value of 5 billion euros. The Spanish companies with the most intensive R&D activities are also those which export their products.

Imports increased to the value of 12.6 billion euros, mainly due to work in the fields of telecommunications and information processing.

Activities related to Innovation, Research and Development, which are considered critical in all sectors, acquired special relevance in the electronics and telecommunications sector. In this respect, in 2000, companies which form part of ANIEL invested 3% of their production value in R&D, i.e. 1 billion euros. Over 10,000 persons were employed in this area.

The Telecommunications and Information Processing industry takes first place with 0.45 billion euros invested (10% of production), and over 5,700 employees in R&D. Telecommunication Services companies are in second place, with over 0.32 billion euros invested and 3,200 employees in this field. Professional Electronics industries allocate the biggest percentage of production (11%) to this field.

3. Results of the analysis

The first group of questions put forward in the document refer to changes in company strategy in relation to their R&D activities, identifying the following issues to be explored:

Restructuring of internal R&D activities.

*How have firms revised their in-house R&D activities in the last decade? Are they more closely linked to product development divisions and therefore market-driven?*

Companies interviewed answered these questions clearly and unanimously. During the last few years, changes have occurred which have forced modifications in R&D strategies. First, the time required for launching new products has been shortened, i.e. **time-to-market has been reduced.** Second, the market has changed from providing offers to making demands, in which the majority of research is undertaken according to clients’ desires and
needs. In many cases the product is conceived and designed in accordance with such needs from the very outset. This situation generally applies to the sector as a whole, as there are no world technological leaders in Spain. Only certain specific products create their own market, and therefore are ahead of demand.

**Are they focused on a narrower set of strategic areas than in the past?**

The president of Eliop believes that the answer to the question could be "yes" and "no", because on one hand the company has decided to focus on certain more efficient areas from those that the company had worked on before, and, on the other hand, new areas of activity are being developed, i.e. the company is laying its stakes on greater sectorial diversification. It seeks greater survival capability by building many pillars upon which to stand.

The other interviewed companies firmly back a specific focus for their research activities.

**Does this imply a shift toward more applied research or research with a shorter time horizon?**

It is interesting to note that in the opinion of some of interviewees, this premise is not always correct. It is true that R&D activities are closer to market demands, but on occasions the market demands basic research (in Eliop, for example, research has been undertaken on new materials as a result of demand-side pressure).

As a whole, there is a general consensus on the part of companies which completed the questionnaire with regard to these issues. 80% have modified their R&D strategy in the last few years; almost all companies allocate a higher percentage of their turnover to R&D, and all, without exception, are undertaking research of a more applied nature. They also expressly state that basic research has hardly increased, or not increased at all.

**How have central research labs been reorganised to balance quality scientific and technological research with contributions to business objectives? What have been the primary drivers of change (e.g., technological opportunity, maturity of industry sector, increased competition)?**

As mentioned above, the technological change resulting from shortening product life cycles has been a clear determinant in the change. In the case of telephone operators, there has also been a fundamental change in legislation. Monopoly has been replaced by oligopoly, with a high level of competition between operators. This logically implies that cost reduction becomes a basic objective to be met in new research work.

When companies belong to a large group, research influences the strategy of that research, i.e., if the company finances itself, it has shorter term objectives; if the research is undertaken and financed by the parent company, such research is normally of a more
strategic nature and results can be considered over a longer term.

What lessons have been learned to date about the relative strengths and weaknesses of different approaches to the organisation of internal R&D?

The answer to this question varies considerably from one company to another. In short, the perception of advantages or disadvantages in the change is very specific to each company, or is at least specific to the sub-sector in which the company operates.

Thus, for example, one idea may be shared by companies which produce software for the telecommunications sector. R&D activities are an important weapon for fighting in a competitive setting. Indeed, equipment suppliers provide generic products which can be sold to all the companies in the sector. The distinguishing weapon which is used by the operator, or by the companies which sell their products to the operator, is to include greater added value in the service they offer. In this respect, research activities are of fundamental importance.

Some companies state that with regard to cutting time-to-market and reducing costs, market pressure means that today’s R&D normally gives rise to incremental innovations. The incremental change gives more immediate client satisfaction, but entails the risk of disregarding certain fundamental advances which may occur in the company environment. One company is concerned with precisely the contrary. The market moves faster now, productivity has increased and production times and costs have been cut considerably. However, this dynamic is not reflected in R&D activities, which continue at another pace. It is not clear whether the pace of R&D should also change in certain specific lines and product policies, with the emphasis on the short term.

Another cause of concern regards the mechanism by which client needs are identified - now among the most significant sources of information for R&D activities. The doubt lies in whether to create a specific department to identify these needs, and if created, what its relation would be with other departments in the company.

Another aspect of enormous importance is the relation between R&D activities and the economic cycle. The general tendency is for R&D activities to follow economic cycles, i.e., such activities increase in periods of prosperity and decrease in periods of crisis. However, the strategic decision to support research activity in a period of crisis, which was taken by one company, made it a clear leader in its field. Logically, the financial structure of the company (and in particular, the relation between equity and loan capital) is determinant in enabling a company to develop anti-cyclic R&D activities.

Strengthening external linkages.

What are the roles of M&As and corporate venture capital funds in helping firms gain access to new technologies?

With few exceptions up to the present, mergers and take-overs have not been used as a
strategy by the companies studied to pool further knowledge and technology. In the first such mergers and take-overs, the fundamental objective was to increase market share. For example, this option was taken by Telefónica Group in order to enter into Latin America. TEIMA also sold part of its capital to an equipment manufacturer which, at the same time, offered TEIMA the possibility of gaining new clients. On the contrary, the objective of that manufacturer in investing in TEIMA capital was indeed to acquire technology.

However, the take-over of companies as a vehicle for acquiring knowledge - a complementary mechanism to internal R&D - is an option which many of these companies may consider in the future.

What different strategies have been pursued and how successful have different approaches to knowledge acquisition been compared to internal R&D?

For the majority of companies studied, internal R&D continues to be the fundamental vehicle for knowledge acquisition, complemented, in some cases, by co-operation agreements with universities and other firms. This point will be analysed later.

Are these kinds of mechanisms viable in an era of slower growth and reduced stock market valuations?

As suggested earlier, except for very rare cases resulting from a strategic decision, companies reduce their R&D activities in periods of crisis. They look on it as a backward chain reaction: when sales fall, all costs are reduced. The action mechanism is simple: a monetary unit allocated to research will require 10 times more in the design and initial production phase, and even more in the marketing phase. Marketing and production costs are automatically cut in a crisis, and although research costs are not cut so drastically, this research cannot bear the fruit which is expected because the subsequent tasks required to make innovations succeed are not realised.

One company suggests that co-operation with other companies or institutions is unaffected by economic cycles, although it may vary according to the economic situation. Thus, during a boom, co-operation tends to cover surplus demand that the company is unable to meet on its own, and during a crisis, it tends to cover scarcity of resources.

All companies interviewed reveal an interesting relation between research and financial cycle with regard to human resources. In previous crises, they observed that in the face of falling internal activity and the existence of relatively idle research personnel on the payroll, they turned to European R&D projects, which permitted workforces to be maintained. Likewise, it was relatively easy to develop joint R&D projects with universities. The latter offered skilled personnel at acceptable prices for task development. However, during the years of the recent economic boom, companies largely ignored European support programmes, while research with universities was harder due to the fact that most skilled human resources were employed in the business sector at astronomical
salaries. The research activities of companies during the boom years clearly functioned on a short-term basis. They were influenced by market needs, as seen earlier, and focused on an attempt to respond to such needs as quickly as possible.

Companies point out the likelihood that the situation will revert back again, i.e., that many recent or future scientists and engineers may accept less highly paid posts in university departments. It is thus hoped that pre-competitive research will increase, along with cooperation between companies. In short, the suggested hypothesis is that basic research increases when the economic cycle falls. This clearly has limits. If a marked recession occurs, research, including basic research, would be reduced to highly damaging levels.

The relationship between the gross domestic expenditure in R&D by business enterprises and higher education seems to corroborate this hypothesis. The chart below shows that during the last crisis period (1992 to 1996) expenditures made by companies decreased sharply while expenditure in R&D by higher education increased. The opposite occurs in the recovering phase starting in 1997. The same data for the European Union as a whole show a similar picture although increases and decreases are less sharp.

Collaborative R&D:

How do firms determine when to collaborate versus when to conduct R&D internally? How do they decide whom to partner with? How do forms of collaboration differ across industry sectors?

The differences between sub-sectors are also reflected here. For example, in the computer science sub-sector, collaboration in R&D activities is more common than between telephone operators. In order to challenge competitors, the traditional operators have increased their size, and in general their R&D activity is clearly internal, with little co-operation with other operators.

Companies interviewed have scarcely increased their co-operation with universities in recent years, which may support the hypothesis described above that this type of co-operation is more complicated in prosperous times. However, three of every four companies state that there has been a significant increase in co-operation with other companies.

All companies interviewed maintain contacts with universities, but of a very different nature. Such contacts range from the presence of students (telecommunications engineers, industrial electronic and computer engineers) in companies as part of students’ end-of-course projects (as in the case of Telefónica I+D), to contracts which all companies hold with different university departments, or the close formal and informal contacts of TEIMA with Madrid Polytechnic University. However, relations with universities have not increased in recent years, and this is possibly due the economic cycle described earlier.

The co-operation agreements with other companies take place very often with clients and suppliers. The objective of these collaboration agreements for companies interviewed is to achieve loyalty; therefore, such agreements are usually made with important clients. Previous successful experience in collaboration is generally a significant criterion for entering into new agreements, i.e. relations tend to strengthen over the course of time.

One company noted that problems in co-operation with other companies occur in the relations between intermediate management teams. These teams, which are usually highly motivated, are clearly proud of their knowledge, and tend to reject the teams of the other companies. Top executives have a good understanding of each other, but co-operation at intermediate levels is complex, leading to the need for directors to intervene with undue frequency. Such efforts are not always worthwhile.

Patenting and licensing:

To what extent are patenting and licensing activities complementing internal R&D as a way for firms to access knowledge? To what extent does the rise in patenting activity across the OECD reflect new knowledge management strategies within firms that encourage the encapsulation of knowledge in patents and the licensing of technologies that will not be used internally?
Spanish companies tend not to patent, for reasons which remain unclear. Since so little patenting occurs in the sector under analysis, this aspect is not of great significance. Here we should note that just over a third of the companies studied state that they have used external technology acquisition as a means of increasing their knowledge. However, only four companies studied have granted use of patents or know-how to third parties. One company cites the globalisation process as the cause behind the lack of technological transfer to third parties. **Interest in technologies licensing to third parties has decreased, while there is now greater interest in agreements with third parties which lead to greater market share.** At present it is rare for a patent to be sold or licensed in exchange for copyright; those who possess know-how sell the company as a whole.

**In general, the only knowledge which is licensed is that which the company is not interested in developing in-house.** Normally, when a company from the same sector is given a licence, agreements to prevent competition are signed, i.e., the company which sells or transfers the technology undertakes not to produce the goods or service in question, making use of the technology for a certain period of time.

**SMEs.**

*How have small firms changed the R&D process? What kinds of R&D projects do they pursue in comparison to larger firms? What is their role in helping to transfer knowledge between university researchers and larger firms?*

Small firms play a significant role in many sub-sectors in this sector. For example, companies which develop telecommunications software and applications draw up tailor-made products to meet user’s needs, and offer close and efficient after-sales service. Furthermore, this type of company is highly appreciated by large firms, whether the latter are equipment manufacturers or telephone operators, because they adapt the generic product or service which they then draw up according to users’ needs. In this case, small firms act as an interface between universities and large firms, and also between large firms and the end customer.

Companies’ opinions regarding differentiation in R&D strategies vary. The majority agree on the traditional differences, i.e. that small firms are more flexible and can modify the focus of their research activities more quickly, whereas large companies can take on more ambitious projects over a longer term. However, one company believes that R&D strategy is not determined by the size of the firm, but rather on company management criteria, business culture, etc.

**Internationalisation/Globalisation**

Companies in the sector have in general increased their internationalisation in recent years.
Some, such as the Telefónica group, have doubled their activity as a result of investments abroad; others plan to increase their level of foreign activity in the immediate future. Companies also note the increased penetration of foreign capital in the sector.

In companies analysed, processes of know-how and technology transfer almost always take place in a one-way direction, from the parent company to the subsidiary, or subsidiaries.

**How have changes in business strategies for R&D influenced the innovation process?**

Only 4 of the 16 companies studied (4 were interviewed, 12 completed the questionnaire), have not modified their research strategies in recent years. All four companies give similar reasons for this: strategy used in the past has produced good results. In all the other companies, i.e. those which have made modifications, the reply to this question was unanimous: all confirm that they have made advances in their capacity and innovation results, although such advances are different in kind.

In some cases, for example, the range of innovations has increased, but such innovations are more incremental than radical. The scope of innovations has also increased, the longer range permits the companies to deal in different markets and therefore be less vulnerable in the face of crises.

**Public policy.**

*How can government policy best respond to changing business strategies? Levels of government funding for R&D. Basic versus applied research. Whom to fund? What to fund — and how to make allocation decisions? Mechanisms for financing business R&D*

Any analysis of government policies to promote business R&D in Spain is complicated. We are confronted with a paradox: in face to face interviews with businessmen, they are often critical of funding. Some maintain that funding is inefficiently applied, while others actually consider such funding to be unnecessary under the current approach. The questionnaires, and written answers in general, however, do not give the same results. It appears that businessmen are frightened of criticising in writing, possibly because they fear that existing incentives may be withdrawn. The sample analysed for this article is clearly too small to be able to draw definitive conclusions, but the difference observed between verbal and written opinions has also been detected in other analysis.

The main difficulties which businessmen encounter are described below. As can be seen, the majority refer to obtaining funds through loans, grants and competitive projects:

- Problems derived from co-ordinating the dates imposed by government funding with the with the natural timing of companies’ activities. Problems are twofold. On the one hand, there are annual subsidies (resulting from Government budgets), as opposed to company projects which necessarily cover several years. On the other, the Government publishes its offers for grants over a short time period, which does not always permit a
project to be prepared and presented properly. Companies believe that there should be better co-ordination between company practices and government policies.

- Insufficient diffusion of measures. This problem is voiced, for example, in relation to fiscal incentives and other financial support. In the case of fiscal incentives, companies also state that in the event of an inspection, tax inspectors interpret provisions more strictly than would be expected from the reading of applicable legislation.

- Excessive bureaucracy: much information that must be presented initially, and lack of flexibility over the course of the project (for example, difficulties in transferring funds from one item to another).

Some companies clearly support the public financing of company applied research. However, others believe that the choice between financing either basic or applied research represents a false dilemma. The second group states that the public sector should finance projects as demanded by the business sector, providing that projects are well designed and that there is a reasonable probability of success. This requires a closer follow-up and evaluation of projects financed. For this purpose, companies demand a pre- and post-project, multi-disciplinary evaluation, which should largely be done according to business profitability criteria. Companies believe that more human and financial resources could therefore be allocated to evaluation.

Companies also ask for a larger share in decisions as to what and whom to finance, as well as the opportunity of discussing a project in person with those who make these decisions. Recently, Enric Banda, Secretary General of the European Science Foundation, stated that R&D in the public and private sectors is like two inter-connected wheels which need to be co-ordinated. To achieve such co-ordination, companies believe it would be appropriate to design national policy with greater company participation. Companies are asking to be included from the outset; for both parties to sit round a table so that they can listen and talk in turn. In short, companies believe that it is necessary to invest in the creation of a collaboration culture.

In any event, they believe that no company undertakes research merely because it receives a subsidy or grant to do so, or due to any fiscal incentive. Research is undertaken because the company hopes to put a profitable innovation on the market. In short, in the majority of cases, grants enable companies to develop research under better conditions and to free resources for use in other activities - but they do not create a desire or need for research where such a need is non-existent.

*Other policy mechanisms.*

The majority of companies agree on the necessity of nurturing a culture that favours research and innovation. They think that actions could be taken for this purpose, starting at primary education in schools and continuing through all educational levels.

The companies confirm that society’s view must be changed regarding the advantages of new technologies, as must priorities in education. It is possible that excessive specialisation occurs in many fields, to the detriment of global thought capacity. This makes no sense in
an era of fast technological change, because a lot of specific know-how becomes obsolete before there is an opportunity to apply it. In addition, companies believe that they might have some responsibility in training their future personnel. To summarise, they defend policies which give rise to cultural change.

Some companies believe that it would be useful to provide more training in R&D management, and to make greater use of public purchase policies. They believe that long term major government projects are tools which have a positive effect. Companies also suggest that it would be helpful to streamline the patent application procedure.

The interviewees, however, do not believe that strengthening of clusters through state funding is a beneficial mechanism for this sector. Experiences of this type sometimes close markets, even becoming entrance barriers. Lobbies are created which sometimes end up damaging the innovative process.

Finally, one company suggests that Europe would benefit by adopting the change in accounting criteria recently approved in the United States regarding the Goodwill resulting from a take-over\(^1\). In the US from now on, instead of amortising the aforementioned Goodwill, it will be maintained in the assets column of the balance sheet, unless it can later be shown that there is a deterioration in its value, that is, an impairment indicator arises. This accounting criteria allows the company to show higher profits and equity, thus improving the financial performance of the company. This policy also increases the possibility of company growth through the take-over of other companies, because future profits expected from a new purchase are not penalised immediately (because, as said, the Goodwill is not amortised) thus promoting internationalisation of the company.

**Measurement and indicators**

All companies replied to this question, although it is interesting to note that the most commonly used indicator for measuring the results of an innovation (percentage of sales from innovative products) is only mentioned by two companies.

Indicators mentioned by companies refer to the commonly used measurements, such as increase in productivity, increased in profits, sales and exports, the relation between payments and receipts at the technological balance of payments, R&D personnel, participation in international programmes, etc.

\(^1\) SFAS 142 “Goodwill and Intangible Assets”, published by FASB in July this year, contains the new accounting criteria, plus a guide on steps to be followed to verify possible deterioration at the end of each financial year.
4. Conclusions

In view of the analysis results, we can conclude that R&D has become a way of life for companies of this sector. An open economy subjected to growing technological change creates an unstable environment, and the only way of surviving successfully is to ensure constant re-invention of products, services, basic technologies and even business itself.

Almost a century after the ever more fashionable Schumpeter used the term, "destructive creation", this has become the paradigm of the new economy.

Having examined the directional changes which have been made in R&D processes in the Spanish Electronic and Telecommunication sector, a fairly representative panorama has been obtained: Spain is an important market in volume and technological demands, and it has an industrial offer which is dynamic and diversified enough to allow interesting conclusions. It does, however, lack world leaders.

Spanish companies have, with a few exceptions, changed their R&D strategies in recent years, focusing more on applied than on basic research, shortening their time to market response and becoming increasingly aware of clients’ potential demands. Applied resources have grown substantially in recent years, to the point at which the electronic and telecommunications sector, represented by ANIEL, registered 1 billion euros in 2000. This implies direct employment in this area for over 10,000 research technicians, as well as 7% of total production volume costs.

A growing trend in markets backed by R&D is the customerization - often through software - of many products and services.

Mergers and take-overs have not significantly affected R&D in Spain; co-operation programmes have not been particularly prominent either.

The economic cycle has a paradoxical affect on R&D. On the one hand, there is a lack of skilled personnel for this work in boom periods, which can limit growth. On the other hand, during economic slowdowns, although companies may be less willing to spend on R&D, they nonetheless have more human resources available for this purpose.

In Spain the R&D cycle does not follow the economic cycle in all cases; it has its own rules of operation and development, with less ups and downs.

Unfortunately, the Spanish patents’ register is very limited in size, and it does not appear that it will grow in the near future. The technology market based on copyrights may be being replaced by company alliances and take-overs.

Government funding in R&D in Spain has increased over the last decade, but it remains below the European average; the Government and industry are working to promote increased funding, and particularly to apply such funding in a more efficient way.

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2 Entrepreneur Association of the Spanish Electronic and Telecommunication companies
References


Source: Cañibano C. (2001) based on OECD