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## BRIEF OVERVIEW OF SPANISH INDUSTRY TODAY

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# BRIEF OVERVIEW OF SPANISH INDUSTRY TODAY


## Abstract

This working paper provides a synopsis of the state of Spanish industry as of April 2000. The paper is divided into 5 sections:

*1) Profile: Industry by industry*

Companies are described by economic sectors, distribution of employees by economic sectors, Spanish corporations by number of employees, and data are given on specific industries, particularly aeronautics and aerospace. Following this description, the paper presents information about the most important science parks in Spain.

*2) Information and communications infrastructure*

A series of macroeconomic figures show how information and communication technologies are currently being applied, the integration of these new technologies, and the rate of industrial innovation in Spain; they also reveal the overall trends in this area. The figures for e-commmerce, internet use and cellular phones are mainly for 1999.

*3) R&D and innovation in Spanish enterprises*

This part presents the latest available data on R&D investment and the number of people involved in R&D in Spain. The figures provided include technological innovation indicators, investments by regions, Spanish corporations with design and engineering capabilities, the rate of adoption of new technologies in Spanish manufacturing and assembly industries, and companies with automatic materials handling.

*4) Quality certification among Spanish firms*

Throughout the European Union there has been strong support and encouragement for any and every corporate-level initiative relating to quality certification, which is deemed to be vital to enhance competitiveness. This section provides figures for ISO 9000 certificates in Spain, by region, in total, and by business sector. Data on environmental management certifications are also provided.

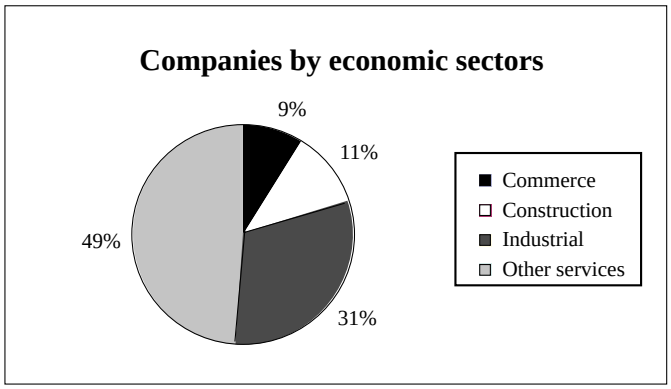
*5) Staff skill levels in Spain*

This section provides data on skill levels in Spanish industry. Training has become a strategic factor today, especially in relation to new technologies. The section also provides figures on employees' formal education, education levels, and the evolution of the labor market by level of formal education. The data on university enrollments and specialties clearly shows the lack of a technologically trained labor force in Spain.

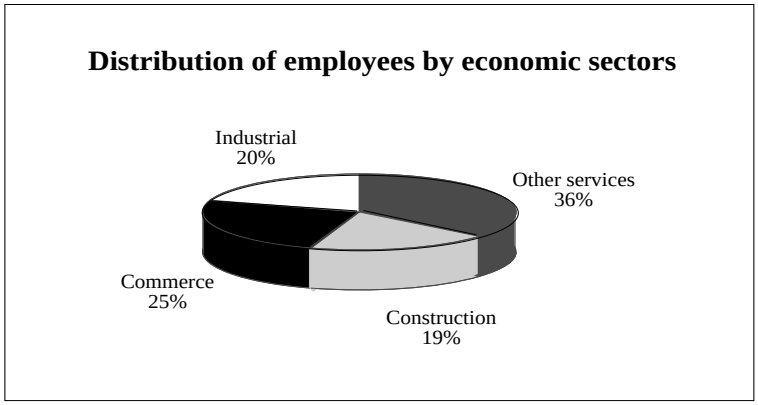
## BRIEF OVERVIEW OF SPANISH INDUSTRY TODAY

### 1. Profile: Industry by industry

Spanish companies have a service industry profile, with an overabundance of Small and Medium Sized firms. The industrial and construction sectors also have a much higher percentage of the total number of employees than would be normal given their weight within the national economy (the industrial sector accounts for 20% of the total number of employees but only 9% of the total national economy) (1). A fact to be highlighted is that 55% of all Spanish companies do not have a single employee, whilst only 1.3% have more than 50 employees. Over 50% of Spanish companies list only 1 or 2 employees. The total number of registered Spanish companies as of 1998 was 2,820,815, of which 160,289 belonged to the industrial sector.

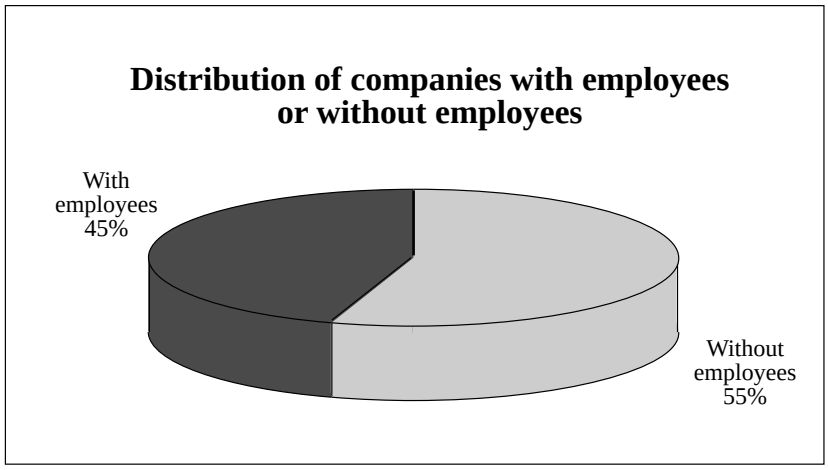



Source: Central Directory of Companies (DYRCE). 1999 statistical results. National Statistics Institute (INE).

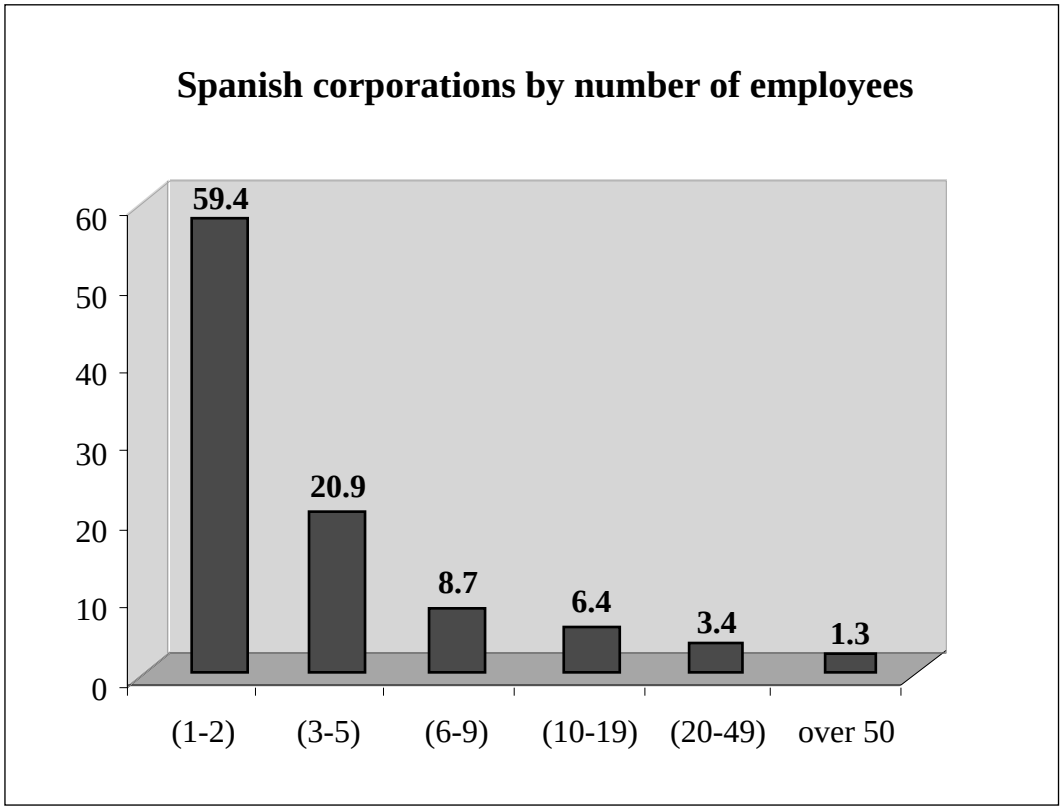



Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.

(1) Central Directory of Companies (DYRCE) 1999.



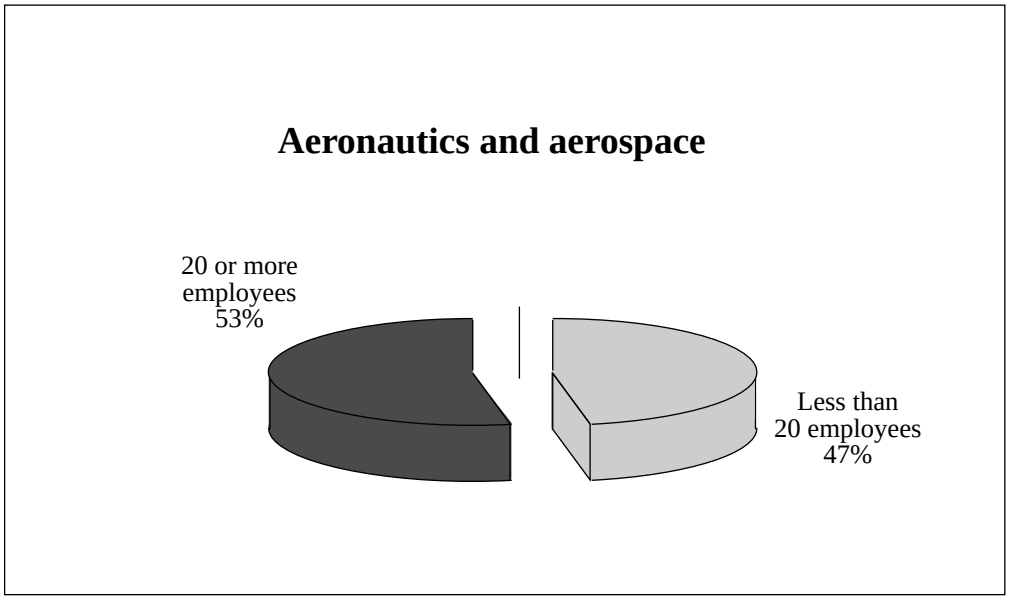

Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.



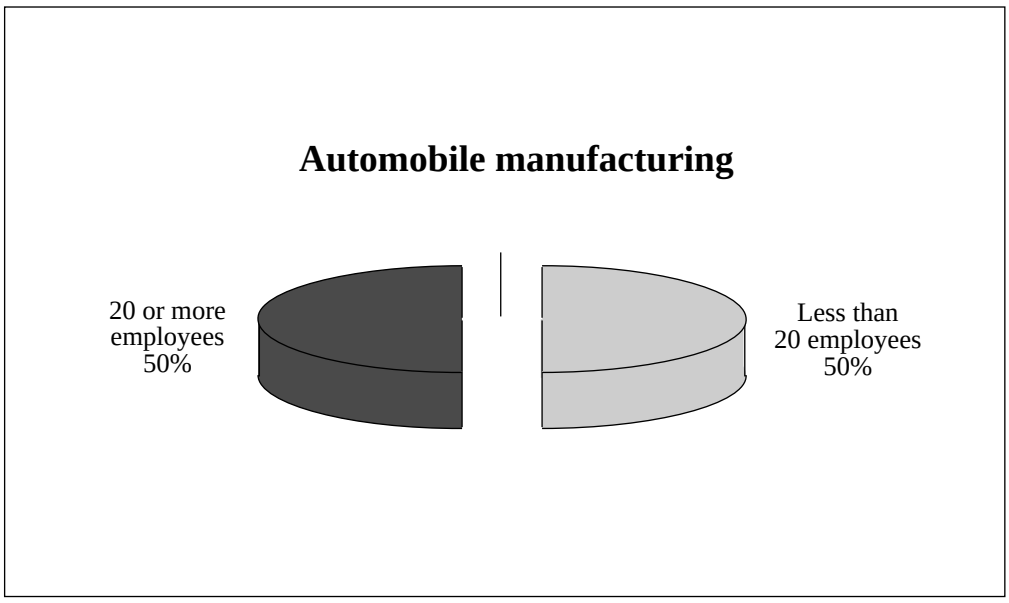

Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.

The DYRCE (Central Directory of Companies) splits Spanish industry into 100 sectors. In 91 of these sectors the “fewer than 20 employees” segment is over 50%. There are exceptions, however, such as the motor vehicle industry, aerospace, aircraft building, or the manufacturing of rail equipment.

In the aeronautical and aerospace industries there is a relatively small number of firms [42], more than half of which have more than 20 employees. The automobile industry is split evenly between companies with more than 20 employees and those with fewer than 20 (2).



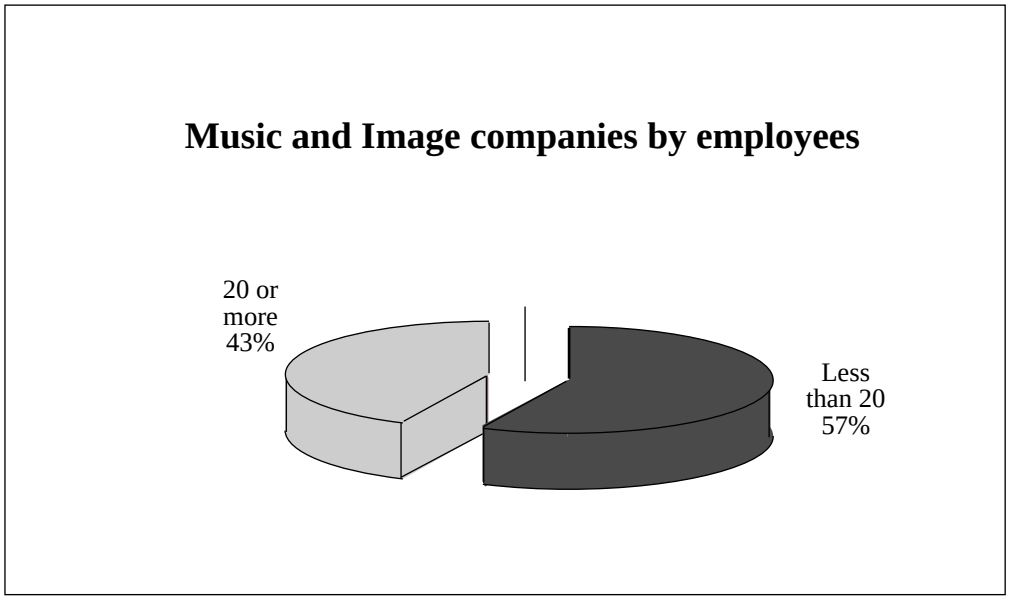

Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.




Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.

(2) Central Directory of Companies (DYRCE). 1999 statistical results. INE.

Another case is the music and image industry, in which the majority of the companies have fewer than 20 employees. The same is true of the radio and television sector, and even more so of the office equipment and computer area (3).

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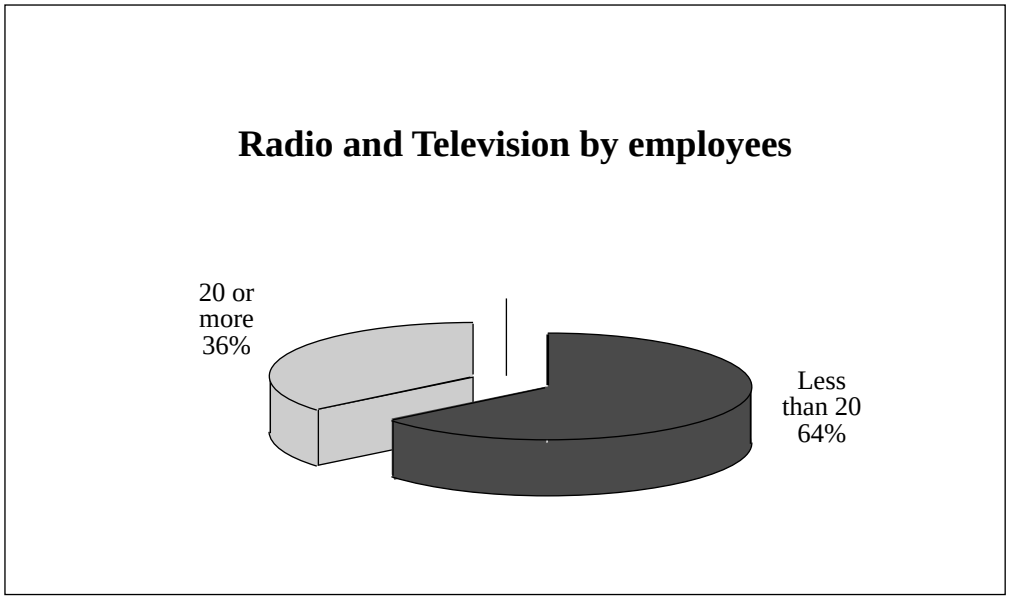
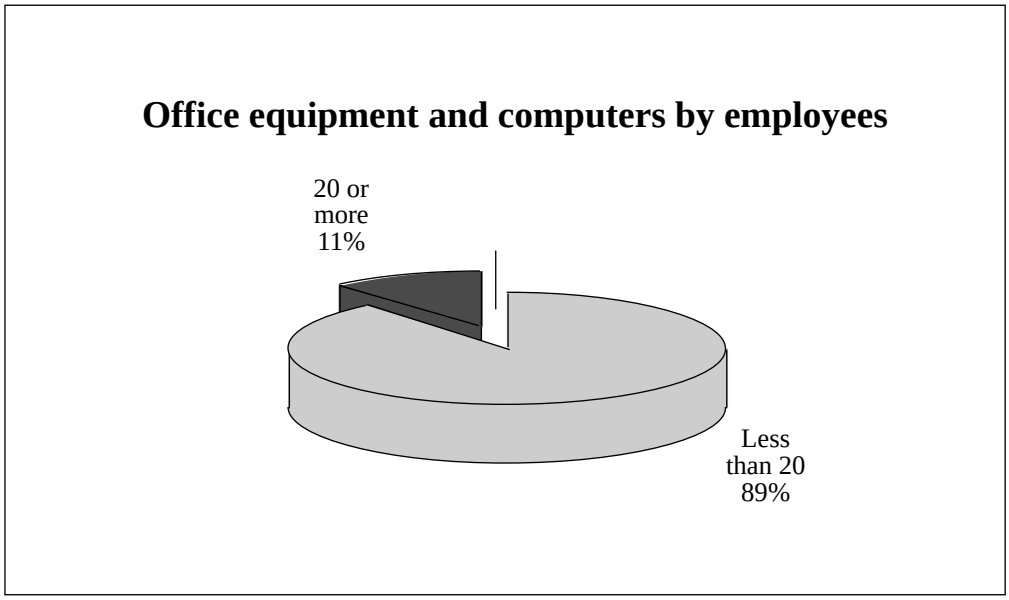



Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.

(3) Central Directory of Companies (DYRCE).




Source: Central Directory of Companies (DYRCE). 1999 statistical results. INE.

*Science Parks*

Science Parks, as defined by the IASP (4), are intended to assist the creation and growth of companies in the industrial or value added service sector, and to foster technology transfer within the park itself and close links with nearby universities and research centers.

The Spanish Science Parks Association has the following 14 members:

– Fundación Campus de la Salud de Granada.
– Parc Científic de Barcelona.
– Parc Tecnològic del Vallès.
– Parque Balear de Innovación Tecnológica.
– Parque Científico de León.
– Parque Científico del Mediterráneo.
– Parque Científico y Tecnológico de Sevilla.
– Parque Científico-Tecnológico de Gijón.
– Parque Cientifíco-Tecnológico de la Universidad de Alcalá.
– Parque Tecnológico de Alava.
– Parque Tecnológico de Andalucía.
– Parque Tecnológico de Asturias.
– Parque Tecnológico de Bizkaia-Zamudio.
– Parque Tecnológico de Castilla y León.
– Parque Tecnológico de Galicia.
– Parque Tecnológico de San Sebastián.
– Parque Tecnológico de Vigo.

(4) International Association of Science Parks.

**Madrid**

A good example of this type of park is the one in Tres Cantos, 25 kilometers north of Madrid. Its strategic orientation is towards combining a reputation for quality and innovation with a will to converge three social and productive functions: the "University of Excellence" (the Universidad Autónoma de Madrid), the creation of a Science Park (Parque Tecnológico de Madrid-PTM), and the establishment of a series of large transnational firms, each providing a high degree of added value. The newly created companies were centered around qualified professionals with experience in other firms, who designed a business project based on innovative, technological content. Fifty-five percent of their employees work in R&D departments, while 14% are involved in manufacturing or assembly tasks and only slightly over 10% work in Product and Services Sales and Marketing.

The close working relationship between the PTM and the universities may be seen in three spin-off companies led by university professors. Twenty percent of the PTM's projects are part of joint research projects with Spanish universities and 80% with universities in Madrid itself, either through post-graduate internships or research projects (5).

The PTM is a highly specialized place, encouraging the creation, development and consolidation of high-tech firms. It acts as an incubator whose final products are new-born companies focusing on such innovative areas as electronics, computer science, telecommunications, industrial automation, health industries, environmental and energy industries, new materials, biotechnology, and chemicals.

The innovative potential found in the PTM is huge, and it is worth mentioning the following two types of research:

– Basic research, carried out by companies in the multinational pharmaceutical sector. Over 50% of their staff are involved in improving and marketing their products through patent usage and secondary research projects into little known technologies, working hand-in-hand with the mother firm's laboratories and/or universities.

– Radical or critical research, conducted by engineering firms aimed at providing solutions to be applied immediately in various industrial areas (software, etc.).

The PTM has its own business park, which provides accommodation for newly created Small and Medium Sized companies. If we break them down by their main areas of business, we find that 30.2% either develop or market software, 18.6% belong to the electronic, communications or media sectors, 14% are small laboratories working with chemical products, and the rest are service companies.

**Andalusia**

This region has three science parks, all directly targeted at aiding advanced technology companies: Parque Tecnológico de Andalucía in Málaga, Parque Industrial Bahía in Cádiz, and Tecnópolis in Seville.

(5) General Research Directorate. Community of Madrid.

Parque Tecnológico de Andalucía is aimed at firms involved in new technologies in the areas of telecommunications, microelectronics, robotics, biotechnology, etc. Along with the production facilities, university and R&D centers are also to be built. Parque Industrial Bahía de Cádiz tends to specialize in companies involved in areas related to metal-mechanical and biotechnology. Sevilla Tecnópolis is a business park concentrating on R&D with emphasis on the development of communication technology, high energy and electronic physics, biotechnology and technology-related food products, environmental issues, robotics and applied computer sciences, among others (6).

**Basque Country**

Parque Tecnológico de Zamudio is a hotbed specially developed for innovative high-technology companies. The proximity of the university community and several research and development centers, along with the well established industrial tradition in the surrounding area, assist the process of technology transfer. The Park acts as a communication infrastructure, promoting exchange of information between training centers, research centers and companies in the same line of business, so that they can take full advantage of their combined technological capabilities.

Parque Tecnológico del País Vasco provides the ideal conditions for starting up an innovative high-technology company thanks to its excellent infrastructure. When a company requests authorization to install its operations in this Park, the following considerations are taken into account to ensure the presence of high quality organizations:

- The R&D work the company plans to carry out.
- Its ability to work closely with the university and other technology centers.
- The degree to which it will be able to integrate its activities into the scope of the Park itself.
- Its capacity to develop, apply and publicize new technologies
- Its potential contribution to technology transfer through its products and advanced services.
- The technological level of its products.
- Its capacity to attract other high-tech companies.
- The company's growth potential.
- Its scientific and engineering potential.
- Its staff's professional qualifications.
- The viability from both a technical and an economic point of view.
- Its contribution to promoting the Park's image as a nucleus of advanced technology.

The technological scope of the Park is based on the seven associated centers in the Basque Technological Network, with over 900 R&D researchers. These 7 centers provide support for on-going business activities in such areas as IT, industrial design and manufacturing techniques, metal and non-metal materials, telecommunications, biotechnology and industrial quality.

Parque Tecnológico de Zamudio offers companies basic infrastructure and logistic support in such areas as business advisory services and communications. Priority is given to non-polluting companies with the following profile:

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(6) Andalusian Development Institute.

– Industrial companies involved in highly skilled manufacturing processes or that require advanced technologies, preferably in the areas of electronics, optoelectronics, telecommunications, computer science, welfare technologies, industrial automation, and environmental and energy technologies.

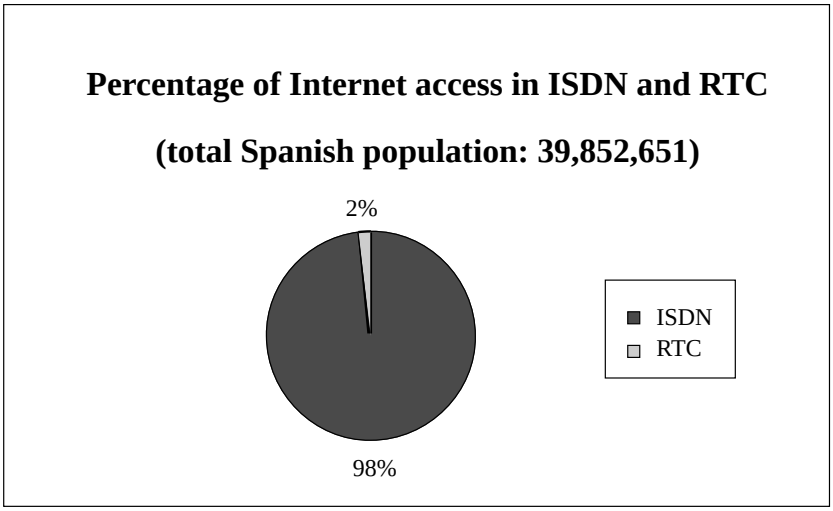
– Companies and institutions from both the private and the public sectors whose main field is R&D.

– Advanced tertiary sector enterprises providing technical or advisory services as support for the on-going businesses already installed in the Park.

At present, there are 40 companies operating in the Park, predominantly involved in telecommunications, electronics, IT, R&D, industrial design and environmental issues. The companies tend to be small, although there are four firms with a staff of more than 100 employees. The total number of people working in the Park is over 1,200, of which 45% are university graduates and 35% work in R&D (7).

## 2. Information and communications infrastructure in Spain

A series of macroeconomic figures show how information and communication technology is currently being applied, the integration of these new technologies, and industrial innovation in Spain. They also reveal the overall trends in this area. As of October 1999, 7.84% of the total population and 9% of those over the age of 14 had access to the Internet, while just a few months earlier, in March 1999, the Euro50.1 Barometer indicated that the figure was no higher than 5%. The 10.5% of Spanish Internet users represents 3,625,000 people (December 1999) (8). The vast majority of Internet connections in Spain do not use ISDN hook-ups, which provide speedy access among other advantages, but RTC lines. The total population of Spain is 39,852,651 inhabitants (9).




Source: 1998 Annual Report. Telecommunications Market Commission. Ministry of Development.

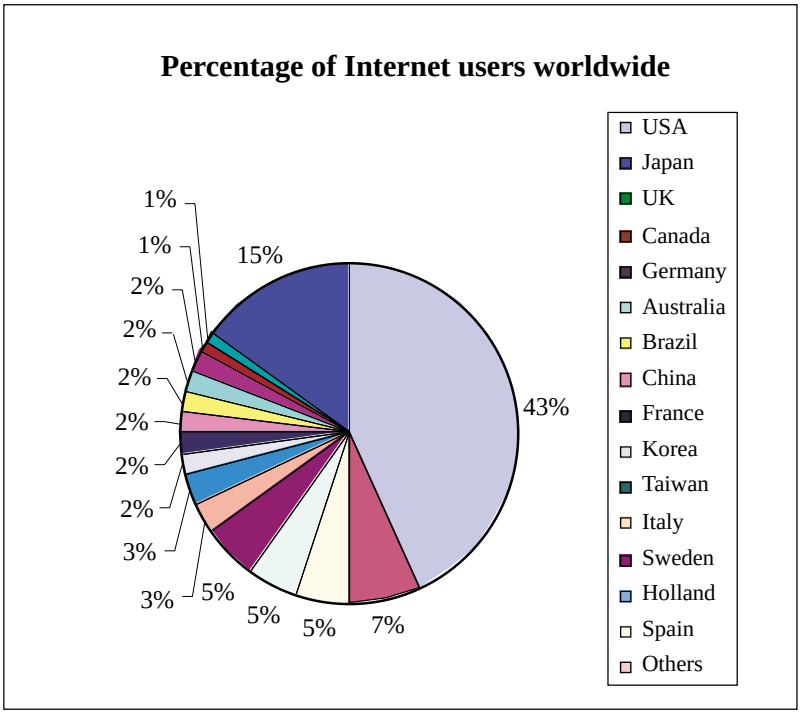
(7) Parque Tecnológico de Zamudio.
(8) Spanish Association of Internet Users.
(9) National Statistics Institute.

| Computer use and Internet access in Spain (over the age of 14) (in thousands) | | |
|---|---|---|
| | **Computer users** | **Internet access** |
| Oct./Nov. 99 | 9,453 (27.4%) | 3,625 (10.5%) |
| Apr./May 99 | 9,444 (27.4%) | 3,107 (9.0%) |
| Feb./Mar. 99 | 8,945 (25.9%) | 2,747 (8.0%) |
| Oct./Nov. 98 | 8,758 (25.7%) | 2,415 (7.1%) |
| Apr./May 98 | 8,548 (25.0%) | 2,247 (6.6%) |
| Feb./Mar. 98 | 7,992 (23.4%) | 1,850 (5.4%) |
| Oct./Nov. 97 | 7,477 (22.0%) | 1,455 (4.3%) |

Source: Spanish Association of Internet Users. November 1999.

| Internet access by Regions (October 1999) | | | | |
|---|---|---|---|---|
| | **Thousands** | | **Penetration** | |
| | **TOTAL POPULATION** | **WITH ACCESS** | **WITH ACCESS** | **USERS LAST MONTH** |
| ANDALUSIA | 6,139 | 374 | 6.1% | 4.6% |
| ARAGON | 1,063 | 98 | 9.2% | 8.4% |
| ASTURIAS | 962 | 46 | 4.8% | 4.6% |
| BALEARICS | 682 | 54 | 7.9% | 5.4% |
| CANARIES | 1,491 | 118 | 7.9% | 6.6% |
| CANTABRIA | 462 | 37 | 8.0% | 7.1% |
| CASTILLA Y LEON | 2,179 | 146 | 6.7% | 5.1% |
| CASTILLA LA MANCHA | 1,431 | 59 | 4.1% | 2.8% |
| CATALONIA | 5,361 | 777 | 14.5% | 11.2% |
| VALENCIA | 3,531 | 392 | 11.1% | 8.6% |
| EXTREMADURA | 883 | 48 | 5.4% | 4.0% |
| GALICIA | 2,380 | 148 | 6.2% | 3.7% |
| MADRID | 4,446 | 505 | 11.3% | 9.8% |
| MURCIA | 930 | 63 | 6.8% | 6.6% |
| NAVARRE | 457 | 31 | 6.7% | 6.2% |
| BASQUE COUNTRY | 1,847 | 203 | 11.0% | 7.8% |
| LA RIOJA | 235 | 9 | 3.9% | 2.6% |
| **TOTAL (OVER 14)** | **34,498** | **3,107** | **9.0%** | **7.1%** |

Source: Spanish Association of Internet Users. October 1999.




Source: Spanish Association of Internet Users. November 1999.

Despite the overall growth in the use of new technologies in the field of information and communications, the amount spent on telecommunications as a percentage of the Spanish GDP is still much lower than that of economically comparable countries, as may be seen from the following table:

| | **IT Investments GDP (%)** | **IT cost per Capita** (euros) |
|---|---|---|
| Japan | 2.6 | 745 |
| USA | 4.5 | 1,075 |
| EU | 2.3 | 445 |
| Switzerland | 3.2 | 1,012 |
| Sweden | 3.5 | 782 |
| UK | 3.4 | 627 |
| Norway | 2.7 | 778 |
| Italy | 1.5 | 268 |
| Ireland | 2.1 | 333 |
| Holland | 2.9 | 578 |
| France | 2.5 | 526 |
| Finland | 2.6 | 520 |
| **Spain** | **1.4** | **168** |
| Denmark | 3 | 803 |
| Belgium/ Lux | 2.4 | 495 |
| Austria | 2.1 | 463 |
| Germany | 2.1 | 492 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

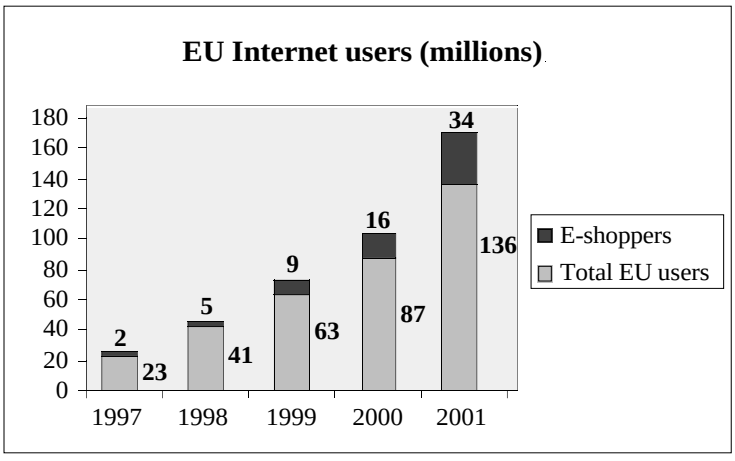
This lesser investment is also reflected in the number of telephone networks in Spain compared with other countries on the same economic level or the tiny number of integrated digital subscribers (ISDN) (10).

Spain has far fewer ISDN lines than countries such as Switzerland, Austria, Belgium or Norway, even though all these countries have far fewer inhabitants than Spain.

| **Number of Integrated Digital Service Users (ISDN)** | | |
|---|---|---|
| | **1996** | **1997** |
| Germany | 1,945,000 | 2,887,000 |
| Japan | 1,106,506 | 2,398,151 |
| USA | 878,396 | 1,175,000 |
| Italy | 104,575 | 334,000 |
| France | 427,000 | 320,000 |
| Holland | 100,000 | 320,000 |
| Switzerland | 125,810 | 208,000 |
| Norway | 43,988 | 149,954 |
| Belgium | 54,652 | 98,548 |
| Austria | 42,018 | 85,700 |
| **Spain** | **35,406** | **85,461** |
| Denmark | 29,863 | 58,341 |
| Finland | 28,981 | 57,855 |
| Colombia | 11,160 | 48,873 |
| Portugal | 19,729 | 45,000 |
| Australia | 35,000 | 37,000 |
| Korea | 8,405 | 25,000 |
| Luxembourg | 3,911 | 10,327 |
| Singapore | 5,366 | 8,901 |
| Taiwan | 2,566 | 8,154 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

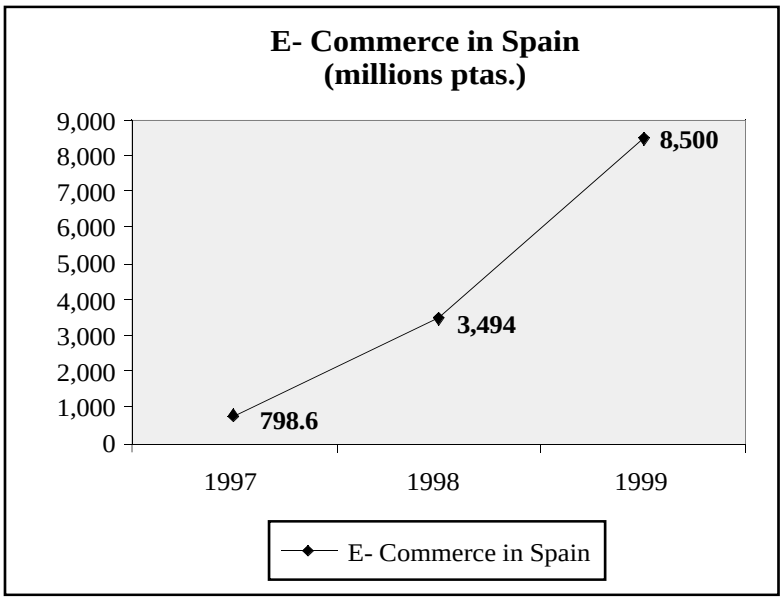
With regard to e-commerce, the short-term growth in the EU is rapid and, in this case, Spain is no exception.




Source: Spanish Association of Internet Users.

(10) Ministry of Development.

The e-commerce market share is one-third that of Sweden and 70% less than that of Switzerland (11). In spite of this, one should not overlook the growing importance of e-commerce in Spain, which saw growth of 143.27% from 1998 to 1999 (12).




Source: Spanish Association of Internet Users.

As far as infrastructure is concerned, the Spanish telephone service sector is the most promising area of information and communication technology. Looking more specifically at fixed telephones and referring to data from 1998, which do not properly reflect the major changes that took place in the field last year, Telefónica is still the leading player. Based on the 1998 data provided by the Telecommunications Market Commission of the Ministry of Development, Telefónica is the operator with the greatest number of operating lines.

Nevertheless, given the rapid changes taking place in this sector in general and in Spain in particular, we need the data on Retevisión and Jazztel, as both these companies are investing heavily to acquire their own lines and thus have the necessary infrastructure.

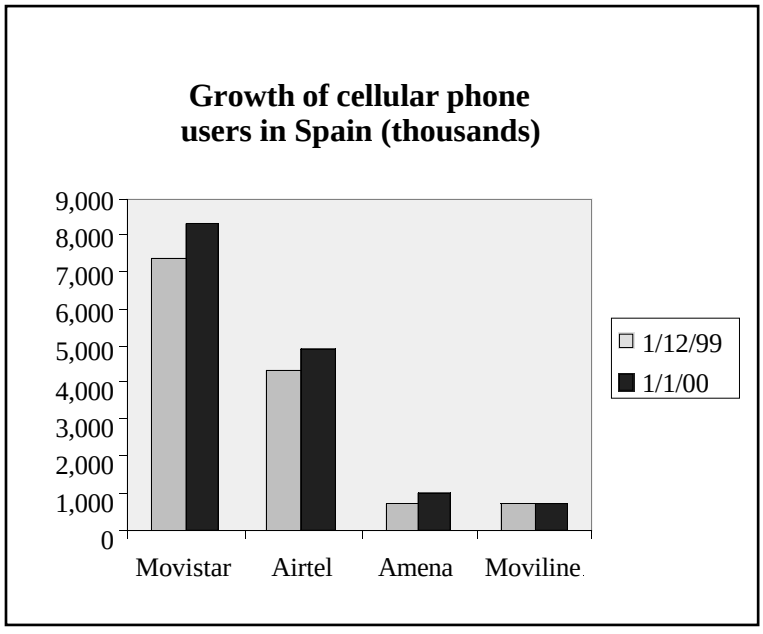
| PARAMETERS FOR RETEVISION, S.A. | |
|---|---|
| | **1998** |
| Lines | 1,500,000 |
| Transmission network (Km) | 18,000 |
| Optic fiber (Km) | 11,600 |
| Investment (M. Ptas.) | 130,000 |
| Billing (M. Ptas.) | 61,000 |
| Employees | 1,800 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

(11) Boston Consulting Group.
(12) Spanish Association of Internet Users.

| PARAMETERS TELEFONICA, S.A. | | |
|---|---|---|
| Service Provided | **31/12/97** | **31/12/98** |
| Operating urban lines (thousands) | 15,854.40 | 16,288.60 |
| Cell phones | 236.9 | 250 |
| Operating ISDN lines | 228,458 | 504,648 |
| Number of intelligent networks in service | 16,944 | 22,115 |
| Rented digital circuits | 28,493 | 55,050 |
| Infrastructure | | |
| Installed urban lines (thousands) | 16,393.10 | 16,766.40 |
| Digital lines | 13,252.50 | 4,466.90 |
| Coaxial cable (km) | 10,120 | 9,990 |
| Optic fiber cable (km) | 47,030 | 49,653 |
| Long distance cable (km) | 58,141 | 57,802 |
| Subscriber networks (thousands of km) | 65,590 | 66,237 |
| Underwater cables (circuits) | 299,173 | 296,280 |
| Hook-ups in transit centers (thousands) | 2,838.60 | 2,753.40 |
| Hook-ups installed in international centers (thousands) | 99.4 | 103.9 |
| Other parameters | | |
| Basic telephone lines in service per 100 hours | 40.3 | 41.4 |
| Employees | 64,109 | 58,127 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.



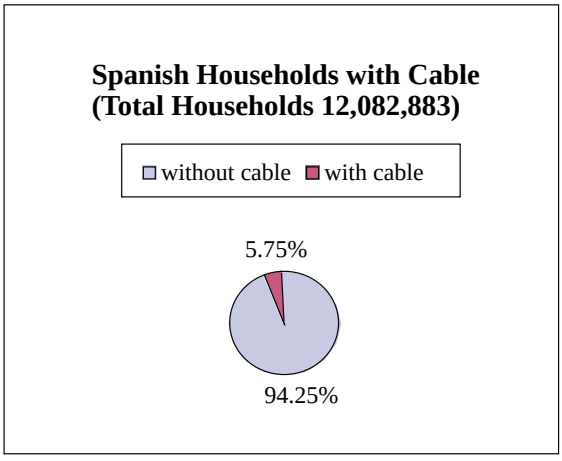

Source: Association of Electronic Commerce and Internet Users.

| Telephone service in countries with a larger telephone network than Spain, compared with the number of lines in Spain | | |
|---|---|---|
| | **Lines (thousands)** | **Index of lines (Spain = 100)** |
| USA | 172,452 | 1,088 |
| China | 70,310 | 443 |
| Japan | 60,381 | 381 |
| Germany | 45,200 | 285 |
| France | 33,700 | 213 |
| UK | 31,878 | 201 |
| Italy | 25,698 | 162 |
| Korea | 20,422 | 129 |
| Canada | 18,460 | 116 |
| India | 17,802 | 112 |
| Brazil | 17,039 | 107 |
| **Spain** | **15,854** | **100** |
| Turkey | 15,744 | 99 |
| Taiwan | 10,862 | 69 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

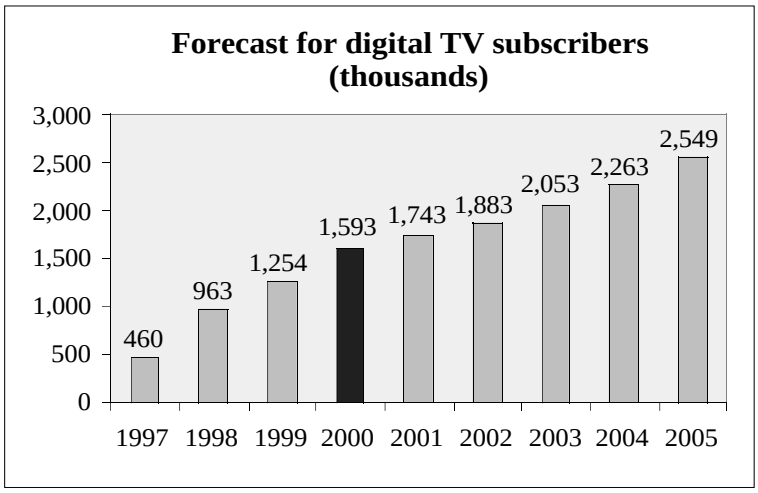
On the other hand, Spain's record in cellular phone usage is better than in the other areas of telecommunications. Penetration in Spain is currently approaching 40% of the total population, and the figure is expected to reach nearly 50% by 2003.

With regard to digital television, a rise in the number of households with cable is expected in coming years. In 1998, the figure was 694,765. The Telecommunications Ministry (Ministerio de Fomento) forecasts an increase of 103% in the number of homes with digital television between 1999 and 2005. The total number of households in Spain is 12,082,883 (13).




Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

(13) National Statistics Institute, INE.




Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

The following tables show the types of service used by Spanish Internet users. Individual access is the most common, followed by corporate use and e-mail.

| **Distribution of users by type of service** | **Number of users** |
|---|---|
| **Type of Service** | |
| Access to Internet: Corporate | 27,542 |
| Access to Internet: Individual | 387,581 |
| E-Commerce | 4,367 |
| Web Design and Production | 1,774 |
| Web Hosting | 17,719 |
| Advertising and Marketing | 584 |
| E-mail service | 5,480 |
| FTP server | 14,487 |
| Proxy | 5,319 |
| Web Server | 559 |
| Others | 40,818 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

| **Internet Connections in Spain** | | |
|---|---|---|
| **Operators** | **No. Lines** | **% Total** |
| Telefónica | 10 | 73.29 |
| BT | 16 | 11.25 |
| IBM | 6 | 4.23 |
| Retevisión | 5 | 3.52 |
| Global One | 5 | 3.52 |
| Whisper | 1 | 0.7 |
| Verio | 1 | 0.7 |
| UUNet | 1 | 0.7 |
| UNISOURCE | 1 | 0.7 |
| Sprint | 1 | 0.7 |
| NETSAT | 1 | 0.7 |

Source: Annual Report 1998. Telecommunications Market Commission. Ministry of Development.

## 3. R&D and innovation in Spanish enterprises

The most recent data available on R&D investment and the number of people involved in R&D in Spain dates back to 1997. At that time, the Spanish private sector accounted for 48% of total R&D investment and employed 22.28% of the researchers. Spanish universities were responsible for 32.7% of the total investment yet had 42.27% of the researchers.

Within the business community, looking at the issue industry by industry, the most innovative sectors are aerospace, automobiles, and electronic components.

| | TOTAL R&D COST (ptas.) | Personnel (total) | Researchers |
|---|---|---|---|
| **Total** | 672,016,663 | 87,150 | 53,883 |
| *Corporations* | 327,922,134 | 30,023 | 12,009 |
| Aerospace | 27,791,775 | 2,273 | 960 |
| Electric and electronic machinery | 52,388,607 | 4,725 | 2,251 |
| Office equipment and computers | 7,841,111 | 475 | 244 |
| Pharmaceutical industry | 36,874,955 | 3,035 | 1,348 |
| Other industries | 155,011,348 | 15,181 | 5,040 |
| Other non-industrial | 48,014,338 | 4,334 | 2,166 |
| Public administration | 116,727,540 | 19,189 | 10,490 |
| Universities | 219,950,845 | 36,843 | 30,649 |
| Private not-for-profit institutions | 7,416,144 | 1,095 | 735 |

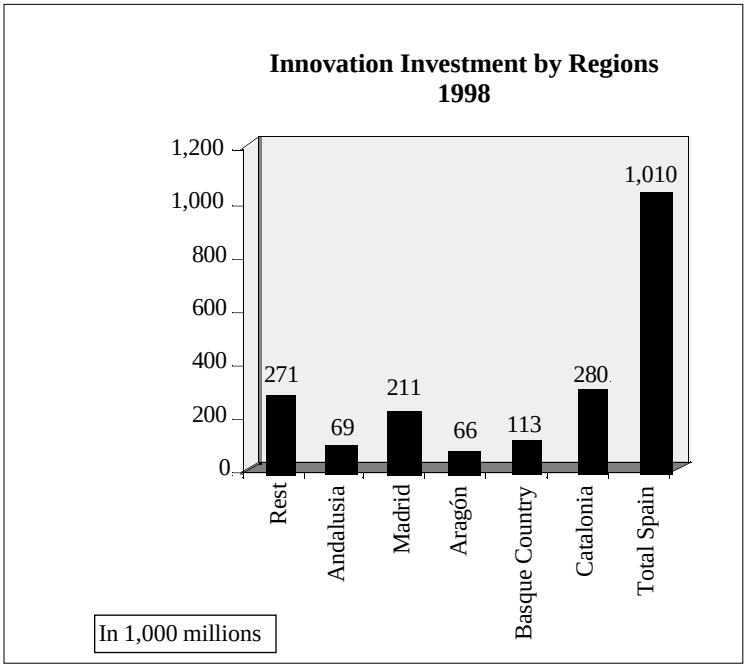
Source: National Statistics Institute, INE, 1997.

| Technological Innovation Indicators 1998 | | |
|---|---|---|
| **Total industry** | **Innovating companies** | **% of total** |
| Metal manufacturing | 2,530 | 9.51 |
| Machinery and mechanical equipment | 1,710 | 18.87 |
| Office equipment, calculators and computers | 37 | 23.71 |
| Electric machines | 497 | 14.49 |
| Electronic components | 163 | 32.64 |
| Automobiles | 452 | 27.06 |
| Shipbuilding | 68 | 7.01 |
| Aerospace | 12 | 27.55 |
| Other transportation material | 42 | 34.2 |
| Other manufacturing units | 292 | 8.57 |

Source: National Statistics Institute, INE, 1998.

The total amount invested in innovation in 1998 by Spanish corporations was over one billion pesetas, and more than 50% of this was invested in either Madrid or Catalonia. The next three regions were the Basque Country, Valencia and Andalusia (14).

(14) General Research Directorate. Community of Madrid.




Source: General Research Directorate. Economic and Social Council. Community of Madrid.

With regard to the size of the companies in which R&D is conducted, the ratio between smaller companies (fewer than 20 employees) and larger ones (more than 20 employees) is 1 to 10 (95 billion ptas. in the smaller companies and 915 billion in the larger ones). Another relevant figure is the innovation intensity ratio, calculated by dividing R&D investment by total revenue and then multiplying by 100. In innovating companies with fewer than 20 employees, the intensity is 7.27%, while in companies with more than 20 employees it is 2.59%. Overall, however, the index is greater in larger companies (1.78%) than in smaller ones (0.93%) (15).

The largest part of the investment in R&D is used by companies to purchase the necessary equipment and finance their own R&D departments.

| **Cost distribution among innovative activities in Spanish corporations, 1998** | |
|---|---|
| R&D expenses | 43% |
| Equipment purchases | 39% |
| Technological material and software | 8% |
| Design and industrial engineering expenses | 7% |
| Training expenses | 1% |
| Sales and marketing expenses | 2% |

Source: INE.

We may also look at this data by breaking it down into manufacturing uses of new technologies as of December 31, 1998 and the short-term forecast for the end of 2000. The conclusion is that there is slow but sure growth in the application of new technologies within Spanish industry.

(15) Central Directory of Companies. National Statistics Institute.

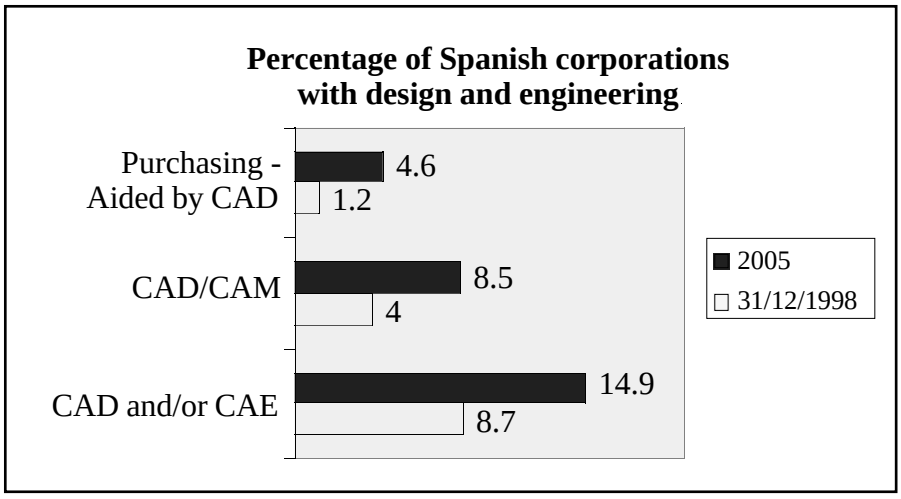
The percentage of companies using CAD systems or equipped with advanced technologies such as robots, which vary considerably in complexity, is no higher than 10%, and if we forecast what is likely to happen by 2002 or even 2005 the change will not be significant (16).

Furthermore, as many as 90% of those interviewed claim they are not planning to implement these technologies as they are either not applicable or not profitable, or for other unspecified reasons (17).

The use of the Internet and e-mail is much more widespread, and the forecast is that by 2005 27.4% of Spanish corporations will be using these two communication tools (18).

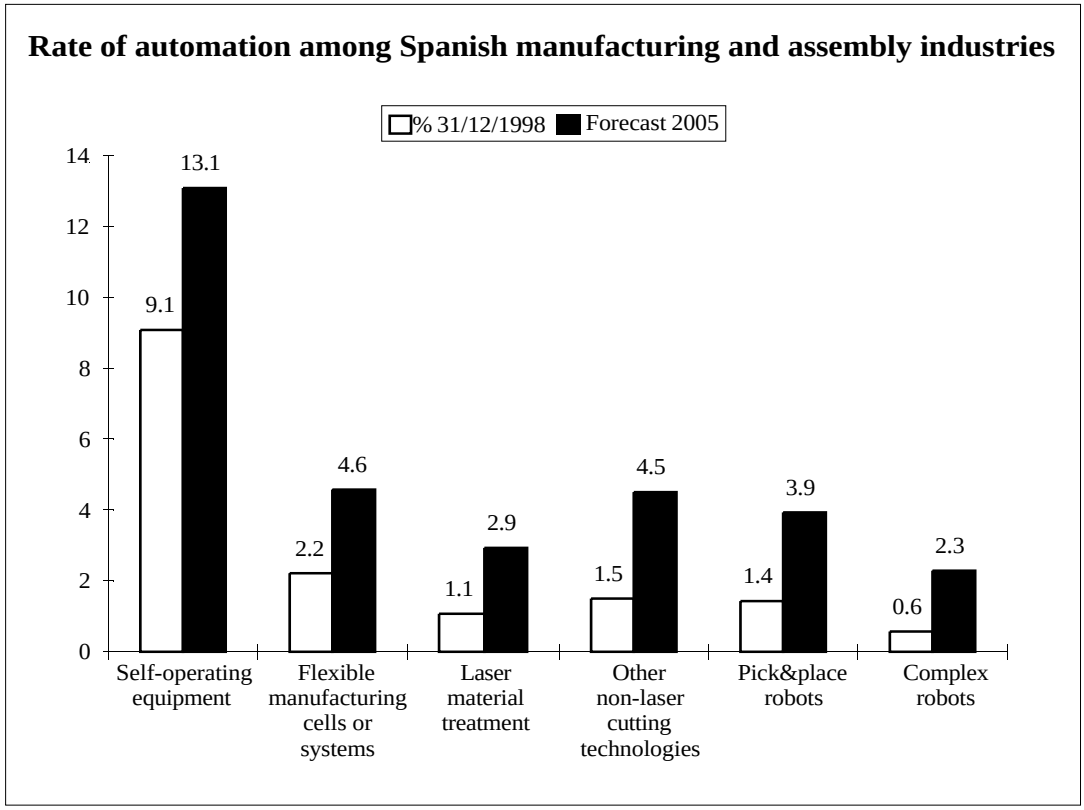
The following bar charts have two columns; the white bar shows the percentage of Spanish corporations already using the stated technologies as of December 31, 1998, while the shaded bar shows the forecast for 2005 made by the National Statistics Institute. For instance, in computer integrated manufacturing, the columns have been added together to give us the grand total for 2005 of 7.9%.

By 2005, an increase of 71.2% in the number of companies using computer aided design (CAD) and/or computer aided engineering (CAE) is predicted. The increase is even greater in computer aided design applied to manufacturing monitoring (CAD/CAM): 112.5%. And the figure for the use of digital CAD output for purchasing purposes is huge: 283.33%.



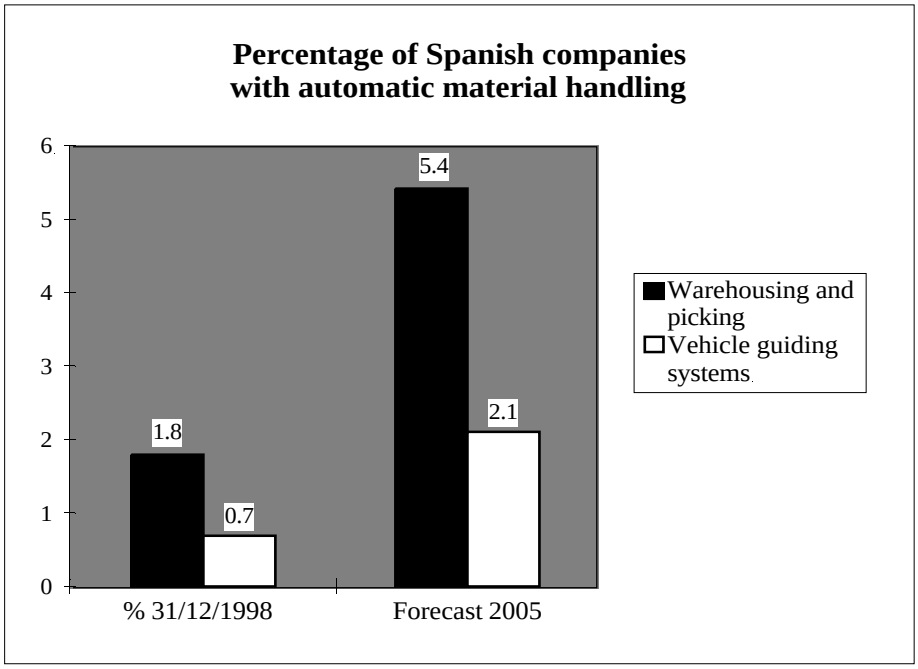

Source: INE. 1998.

(16) National Statistics Institute.
(17) National Statistics Institute.
(18) National Statistics Institute.



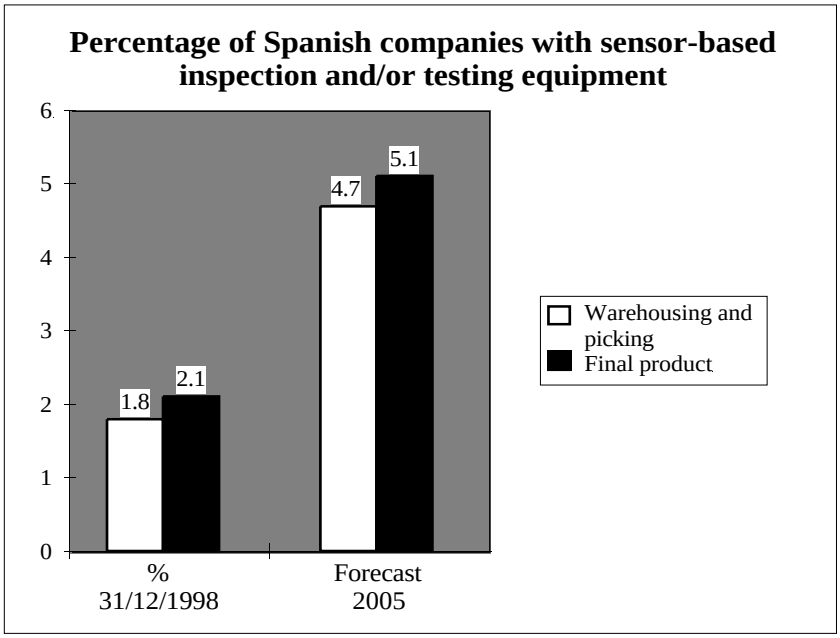

Source: INE.

In manufacturing, machining and assembly using NC/CNC machinery is present in nearly 10% of firms, yet its growth is slow. The prediction is that it will only rise to 13% by 2005, while robots and other technologies included in this item are not, and will not be, present in more than 1% of Spanish companies.



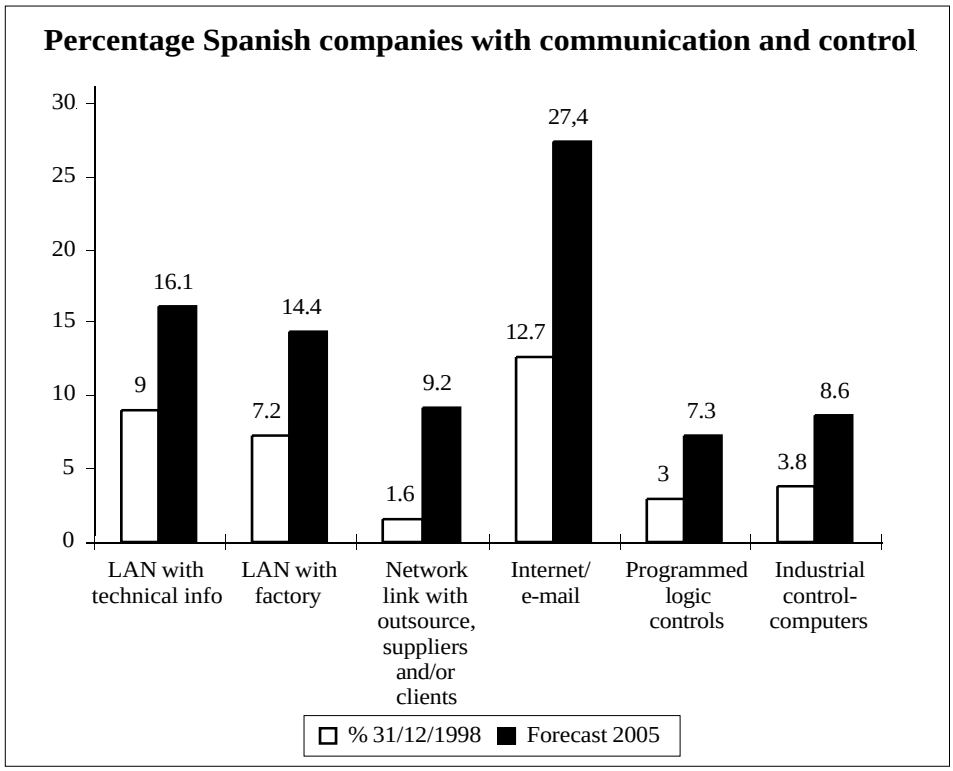

Source: INE, 1998.

The percentage of Spanish corporations with automatic material handling devices is low, although increasing on a percentage basis, with a 200% increase in the implementation of automatic warehousing systems and 100% in automatic vehicle guiding equipment.




Source: INE, 1998.

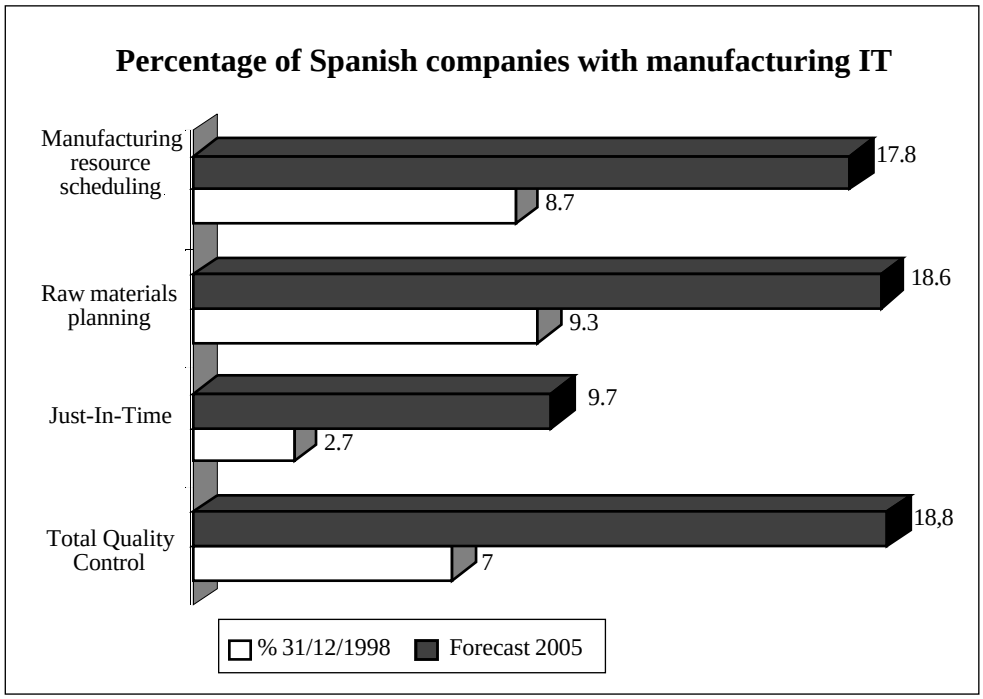
Inspection based on automatized sensors and/or testing equipment placed at the point of entry of raw materials or during the process is expected to more than double (161.11%), yet, as in other areas, the overall use is still quite limited, barely reaching 1%. Inspection of the final product is slightly higher, although the forecast regarding further implementation is lower (142.85%).




Source: INE, 1998.

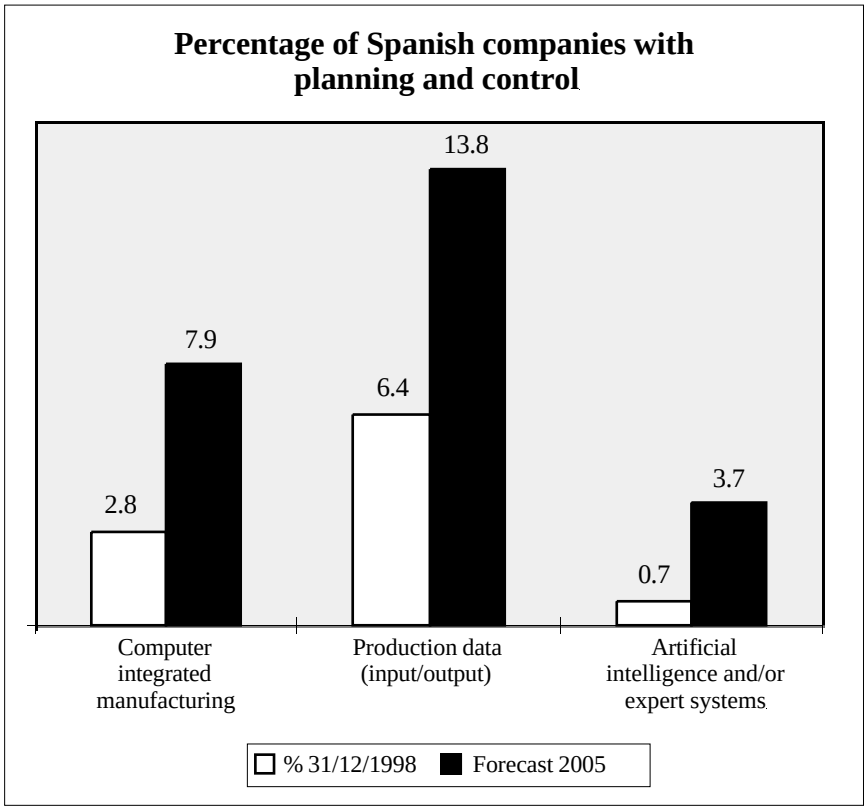
A much larger percentage of Spanish corporations use communication and control technologies, starting with the 12.5% that have Internet access and e-mail facilities, and the figure is expected to rise to 27.4% by 2005. Network-linked computers are also expected to be implemented on a wide scale, both for manufacturing purposes and as basic information tools. Hook-ups with outsourcing agents, suppliers and customers will reach the 9.2% mark by 2005.

Information Systems tied to total quality control, raw material planning requirements and resource scheduling in manufacturing will increase by 20% between now and 2005. Just-in-time logistics will be in place in 9.7% of Spanish companies.




Source: INE, 1998.

The percentage of Spanish corporations with planning and control technologies will exceed 10% with respect to overseeing input and output production. Computer integrated manufacturing and artificial intelligence will not surpass 8% and 4%, respectively.




Source: INE, 1998.

In general, the implementation of new technologies in manufacturing is still quite limited, with the clear exception of the Internet and e-mail facilities, which are widespread and fast-growing tools.

As far as registered European patents are concerned, Spain has 7.1% of the total, whilst 20% are of German origin, 8.5% French, and 6% British; and Spain accounts for only 0.5% of the total. Madrid and Catalonia lead the way in number of patent applications, though there are differences in the industrial area and technological nature of the applications, as Catalonia is much more focused on sectors that tend to stress patent applications, such as chemicals and pharmaceuticals (19).

Spanish industry as a whole is increasing its R&D investment much in line with the effort that is being made in this area. In Spain, Madrid is the only region that exceeds the EU average for R&D expenditures as a percentage of GDP.

Within the framework of the EU and on a national level, Madrid is the only region that exceeds the EU average, while Madrid, Catalonia and the Basque Country exceed the national average (20).

(19)National Statistics Institute.
(20)General Research Directorate. Community of Madrid.

Corporate R&D expenditure is a good yardstick of companies' technology policy, and the territorial distribution indicates the innovative potential of each region. The growth rate in Spain is 0.42% of GDP while the EU average is 1.24% (21).

On a national level, Spain is gaining on the four largest European countries. Among the Spanish regions, Madrid is the leader in technological research, with 34.3% of total corporate R&D investment. This is mainly due to the large number of innovating companies located in Madrid, many of them allocating a large percentage of their resources to R&D.

With regard to GDP, corporate R&D investment in Madrid is 1.18%, well above the national average and close to the EU average. Sixty percent of R&D expenditure is spent in IT, biotechnology, pharmaceuticals, and health care.

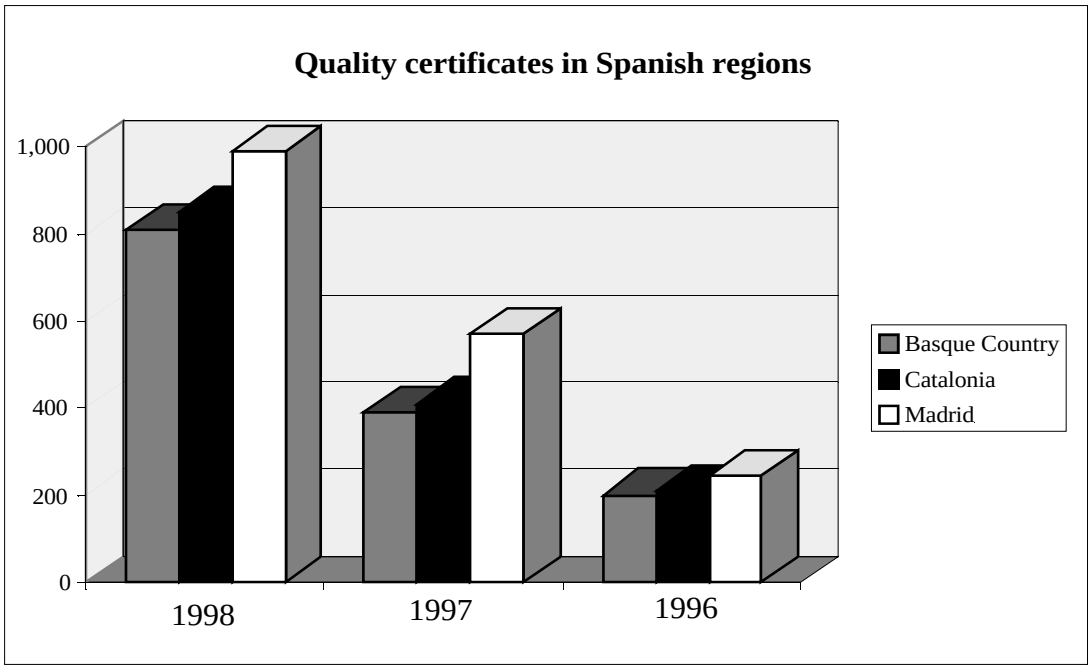
The public administration provides a 5% grant for this purpose. In the Madrid region, the proportion of researchers among total R&D staff is above the EU average (49.1%) and is surpassed only by Germany, even though the underlying reason is that there is less emphasis on applied technical research.

## 4. Quality certification among Spanish firms

Throughout the European Union there has been strong support and encouragement for any and every corporate-level initiative relating to quality certification, which is deemed to be vital to enhance competitiveness. This is true in Spain as well, with two-thirds of all quality certifications coming from the three main regions: Madrid, Catalonia and the Basque Country. The total number of certifications by regions was 2,857 in 1997 and 6,019 in 1998. It should be pointed out that in many cases the same company will have certifications from several regions if it has operational units located in different parts of the country.

The following graph shows the growing number of quality certifications granted by AENOR, with a considerable increase in the three main regions between 1997 and 1998:

(21) Ministry of Development.




Source: AENOR.

UNE is the name of the technical standards on a national level in Spain. ISO is the acronym for the International Organization for Standardization. ISO defines standards for all fields except electronics and electrotechnical items, although there are other bodies that actually award ISO certificates.

Standardization is a group activity used to define stardardized solutions to be applied time and again to repetitive situations. National standards are processed, subjected to public scrutiny, and sanctioned by a body legally empowered to carry out standardization activities on a national scale. In Spain, these are the UNE (ISPO) standards, as approved by AENOR, the body recognized by the Spanish Public Administration to handle standardization (22).

**ISO 9000 CERTIFICATES IN SPAIN**

| Sector /REGION | Andalusia | Catalonia | Madrid | Basque Country | Valencia | Rest of Spain | Total sector |
|---|---|---|---|---|---|---|---|
| Metallic product manufacture | 40 | 189 | 90 | 6 | 30 | 234 | 879 |
| Machinery and metal equipment | 22 | 100 | 64 | 124 | 21 | 161 | 492 |
| Electrical and IT material | 38 | 166 | 149 | 83 | 32 | 142 | 610 |
| Shipbuilding | 23 | 3 | 1 | 4 | 2 | 22 | 55 |
| Aeronautics | 3 | 0 | 5 | 3 | 0 | 1 | 12 |
| Other transportation material | 14 | 96 | 52 | 40 | 15 | 103 | 320 |
| Computer activities | 15 | 37 | 76 | 22 | 13 | 46 | 209 |
| R+D; Technical Advisory Services | 19 | 19 | 58 | 22 | 8 | 35 | 161 |
| **Total of every region** | **711** | **1,897** | **1,444** | **1,183** | **636** | **2,518** | **8,389** |

Source: National Centre for Quality Information. March 1999.

(22) National Centre for Quality Information.

By sectors, electrical and IT have the most ISPO certificates (7.73%), along with machinery and metal equipment (6.43%). By regions, Catalonia, Madrid and the Basque Country together have more than 50% of the UNE-EN-ISO 9001, 9002 and 9003 quality certifications (23).

**Percentage of Spanish companies with quality certifications by sectors**

| Sector | UNE-EN-ISO 9001: 1994 | UNE-EN-ISO 9002: 1994 | UNE-EN-ISO 9003: 1994 | TOTAL | UNE-EN-ISO 14001: 1996 |
|---|---|---|---|---|---|
| Machinery and metal equipment | 305 | 293 | 1 | **599** | 19 |
| Electrical and IT material | 302 | 418 | 0 | **720** | 65 |
| Shipbuilding and repair | 27 | 38 | 0 | **65** | 5 |
| Aeronautics and aerospace | 11 | 8 | 0 | **20** | 0 |
| Other transportation material | 154 | 268 | 0 | **422** | 33 |
| Recycling | 0 | 10 | 0 | **10** | 4 |
| IT related activities | 73 | 50 | 0 | **123** | 1 |
| Technical advisory services | 97 | 62 | 1 | **161** | 19 |
| **Total** | 2,005 | 7,286 | 15 | **9,306** | 400 |

Source: National Centre for Quality Information. January 2000.

**Spanish companies with quality certification by regions (absolute numbers)**

| Region | UNE-EN-ISO 9001: 1994 | UNE-EN-ISO 9002: 1994 | UNE-EN-ISO 9003: 1994 | TOTAL | UNE-EN-ISO 14001: 1996 |
|---|---|---|---|---|---|
| Andalusia | 202 | 679 | 0 | **882** | 30 |
| Aragón | 66 | 273 | 0 | **339** | 16 |
| Asturias | 44 | 164 | 1 | **209** | 6 |
| Balearics | 17 | 72 | 0 | **90** | 1 |
| Canaries | 41 | 150 | 1 | **191** | 5 |
| Cantabria | 20 | 118 | 0 | **138** | 0 |
| Castilla y León | 81 | 384 | 1 | **467** | 31 |
| Castilla La Mancha | 92 | 236 | 0 | **328** | 11 |
| Catalonia | 432 | 1,562 | 3 | **1,998** | 103 |
| Ceuta | 2 | 4 | 0 | **6** | 0 |
| Extremadura | 13 | 58 | 0 | **71** | 1 |
| Galicia | 112 | 411 | 0 | **523** | 8 |
| La Rioja | 12 | 81 | 0 | **92** | 10 |
| Madrid | 391 | 1,208 | 3 | **1,603** | 92 |
| Melilla | 2 | 2 | 0 | **4** | 0 |
| Murcia | 24 | 152 | 0 | **176** | 4 |
| Navarre | 37 | 192 | 0 | **229** | 16 |
| Basque Country | 271 | 880 | 6 | **1,158** | 34 |
| Valencia | 145 | 658 | 0 | **803** | 29 |
| **Total** | **2,005** | **7,286** | **15** | **9,306** | **399** |

Source: National Centre for Quality Information. January 2000.

(23) National Centre for Quality Information.

Criteria used for environment-related certification are as follows:

– Selection of product category. This mark is intended to be used in relation to consumer goods, with the exception of food, beverages and pharmaceuticals.

– Assessment of the product's environmental impact in order to define at what stage its impact is greatest due to the existence of hazardous materials or pollutants. Hence, it is necessary to analyze the entire life cycle of the product, its manufacturing process, distribution channels, use, and disposal. Its impact on all three types of environment (air, water and soil) are measured.

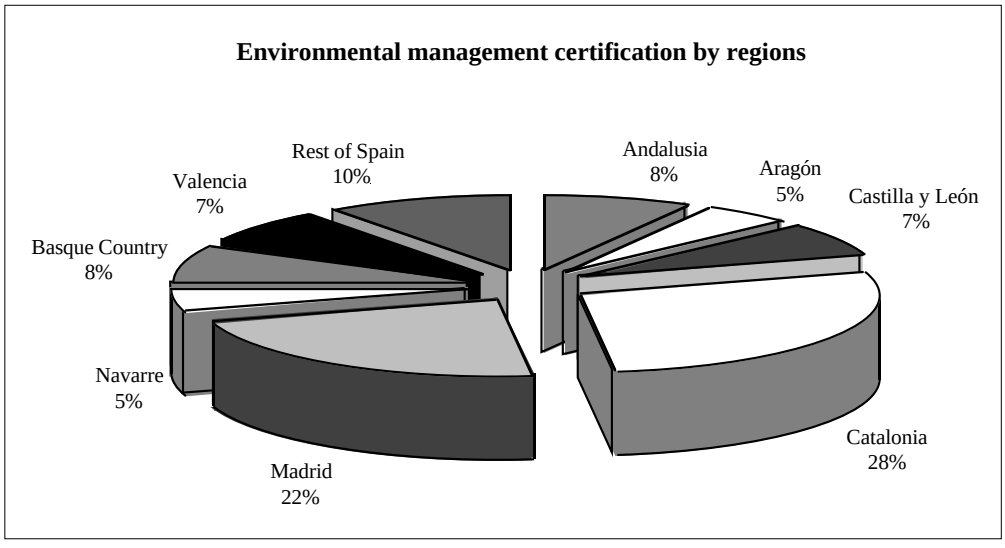
– Definition of ecological criteria. Once the environmental impact and life cycle stages have been defined, the ecological criteria may be defined.

As was pointed our earlier, here again Madrid and Catalonia lead the way, with 50% of the quality certifications between them (22% and 28%, respectively) (24).

**Environmental management certifications by regions**

| Sector | Number |
|---|---|
| Machinery and metal equipment | 23 |
| Electrical and IT material | 77 |
| Shipbuilding and repairs | 5 |
| Aeronautics and aerospace | 0 |
| Other transportation material | 34 |
| Recycling | 5 |
| IT related activities | 1 |
| Technical advisory services | 19 |
| **Total** | **434** |

Source: National Centre for Quality Information. January 2000.

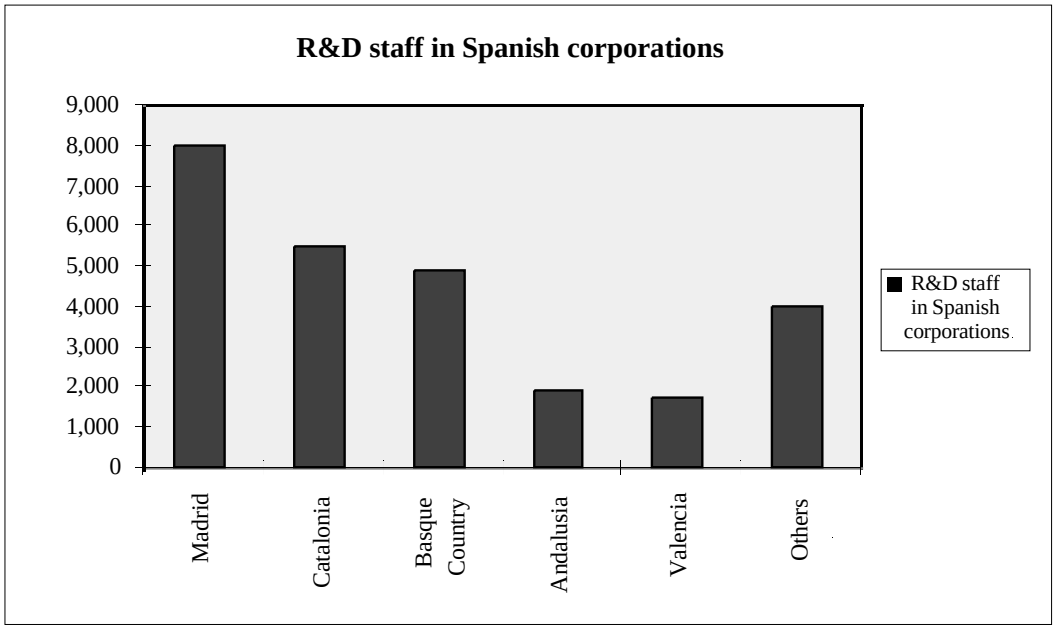



Source: National Centre for Quality Information. January 2000.

(24) National Centre for Quality Information.

## 5. Staff skill levels in Spain

Human resource training has become a strategic factor with respect to the technological change and innovation taking place today, especially in relation to new technologies. Another key factor is the on-going training required to adapt older staff to specific situations created by the implementation of new technologies.




Source: INE.

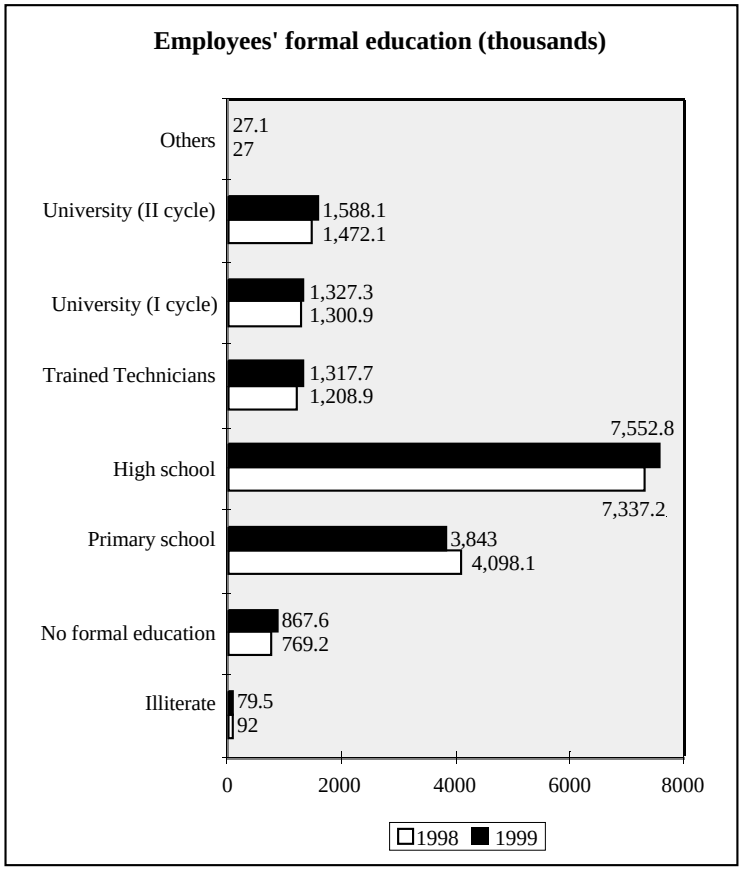
If we look at the level of formal education of Spanish workers, we see that the largest category is that of high school graduates, followed by those with no more than a grade school education. The trend, as indicated by the change from 1998 to 1999, is towards more high school graduates (2.93%) and some technical school training (8.99%), and even 2-year degrees (7.87%). With respect to full 5-year university degrees, the change is quite small (2.02%). The largest change is in the “no formal education” group¸which increases 12.79%, while the “illiterate” category decreases considerably, down 13.58% in 1999. The group of employees with nothing more than primary schooling is also smaller (6.22%), although the decline is less pronounced. Thus, it is safe to say that the overall trend is in favor of higher education and vocational training schools, while lower education is decreasing. Public training programs, often at a municipal level, have also increased the skill levels of Spanish workers (25).

Within the EU, Spain has 6% of the total number of researchers. The technological capacity of Spanish companies, measured in number of people working in R&D, is lower than that of their European counterparts, leading to less strategic innovation and hindering their relationship with R&D work within the public sector.

(25) National Statistics Institute.

Within Spain, Madrid has more people working in corporate R&D than any other region (43% of the national figure), followed by Catalonia.

No more than 25% of the total number of researchers in Spain are in the private corporate sector, compared with more than 50% in the EU as a whole. In Madrid, the number is higher, as there are close links with universities and research centers located in this area (26).




Source: Employed population survey. Ministry of Labour and Social Affairs.

**Formal education levels among Spanish workers**

| | Percentage | | | Thousands |
|---|---|---|---|---|
| | 1996 | 1997 | 1998 | 1998 |
| Illiterate | 0.7 | 0.6 | 0.5 | 67.6 |
| No formal education | 5.9 | 5.2 | 4.5 | 607 |
| Primary school | 28.2 | 26.9 | 25.7 | 3,430.30 |
| High school | 41.8 | 43.1 | 45.7 | 6,101.60 |
| Vocational training or post high school | 6.7 | 7.2 | 5.7 | 763.4 |
| University (I, II and III cycles) | 16.7 | 17 | 17.8 | 2,372.20 |
| Total | 100 | 100 | 100 | 13,342.10 |

Source: Employed population survey. Monthly Statistical Bulletin (INE). December 1999.

(26) General Research Directorate. Community of Madrid.

Nevertheless, the level of formal education most likely to lead to a first job is clearly a university degree (66.5% in 1998). The members of the "high school education" level have 20% less chance of finding that first job, although they are the largest group in the Spanish labor market in absolute numbers (27).

| Professional situation in Spain | | | | |
|---|---|---|---|---|
| | Percentage | | | Thousands |
| | 1996 | 1997 | 1998 | 1998 |
| Employers with or without employees | 20.3 | 19.7 | 19.2 | 2,563.90 |
| Members of cooperatives | 0.9 | 0.7 | 0.6 | 84.8 |
| Receiving support from other members of the family | 3.3 | 2.9 | 2.7 | 362.5 |
| Salaried workers | 75.40 | 76.6 | 77.3 | 10,312.30 |
| Civil servants | 17.9 | 17.5 | 16.5 | 2,201.40 |
| Private sector employees | 57.5 | 59 | 60.8 | 8,110.90 |
| Others | 0.2 | 0.2 | 0.1 | 18.7 |
| Total | 100 | 100 | 100 | 13,342.10 |

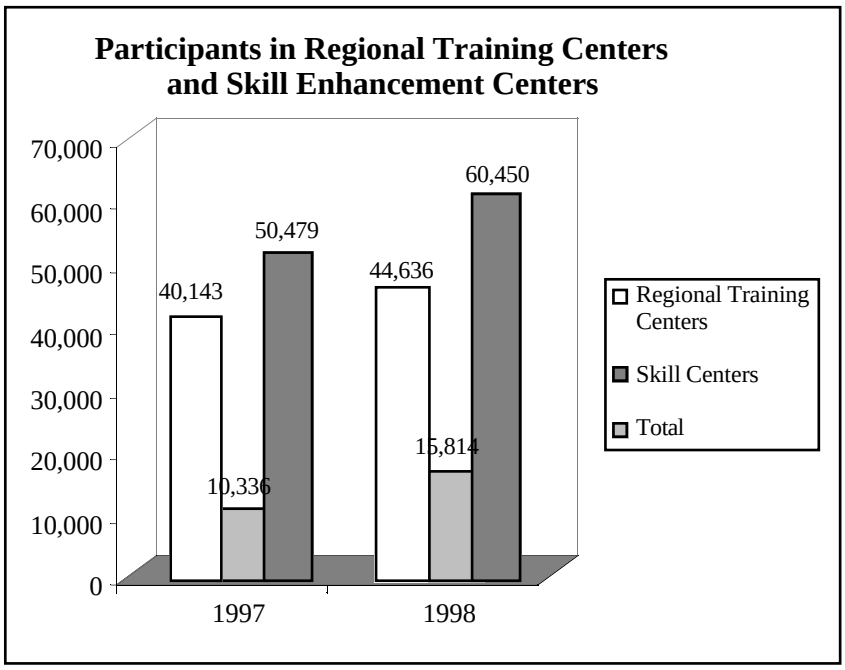
Source: Employed population survey. Monthly Statistical Bulletin (INE). December 1999.

| Evolution of the Spanish labor market by level of formal education | | | |
|---|---|---|---|
| | 1996 | 1997 | 1998 |
| Illiterate or no formal education | 14.5 | 14.1 | 13 |
| Primary school | 34.9 | 34.7 | 34.5 |
| High school (excluding vocational training) | 42.6 | 44 | 46.1 |
| Technical/professional (junior degrees) | 55.1 | 56.8 | 59.4 |
| University degree and others | 64.9 | 65.6 | 66.5 |

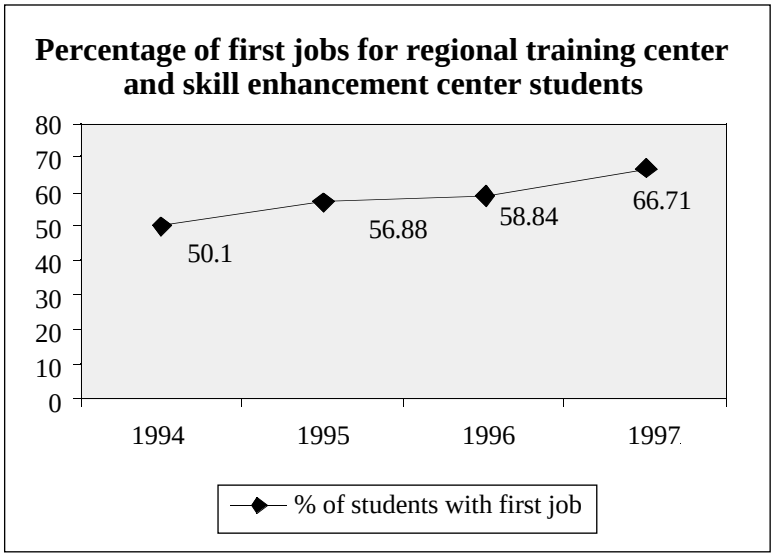
Source: OECD, 1998.

Special mention must be given to those who have gone through the educational institutions known as Special Skill Training Centers. Between 1996 and 1997 this statistic referring to people finding their first job increased by 13.37%. This was mainly due to the increase in the number of students in this type of training center, which increased by 66.71% in the same period (28).

(27) National Statistics Institute.
(28) National Statistics Institute.



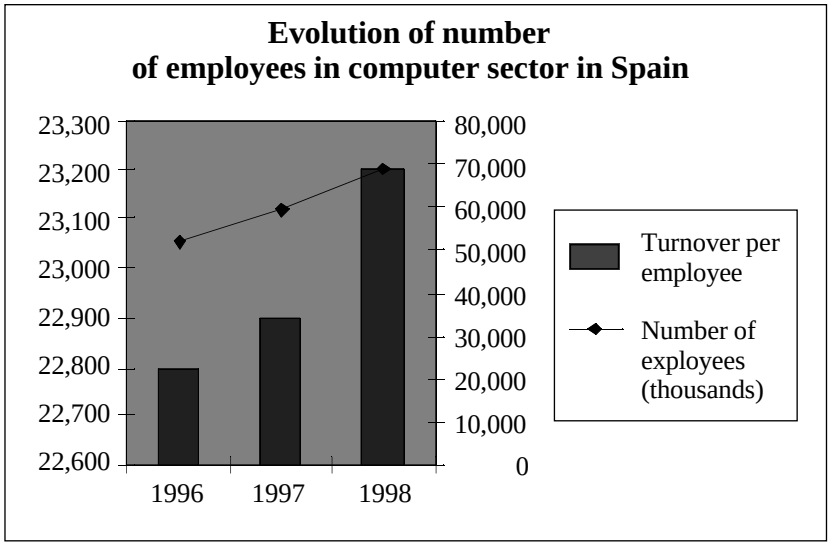

Source: INEM.




Source: INEM.

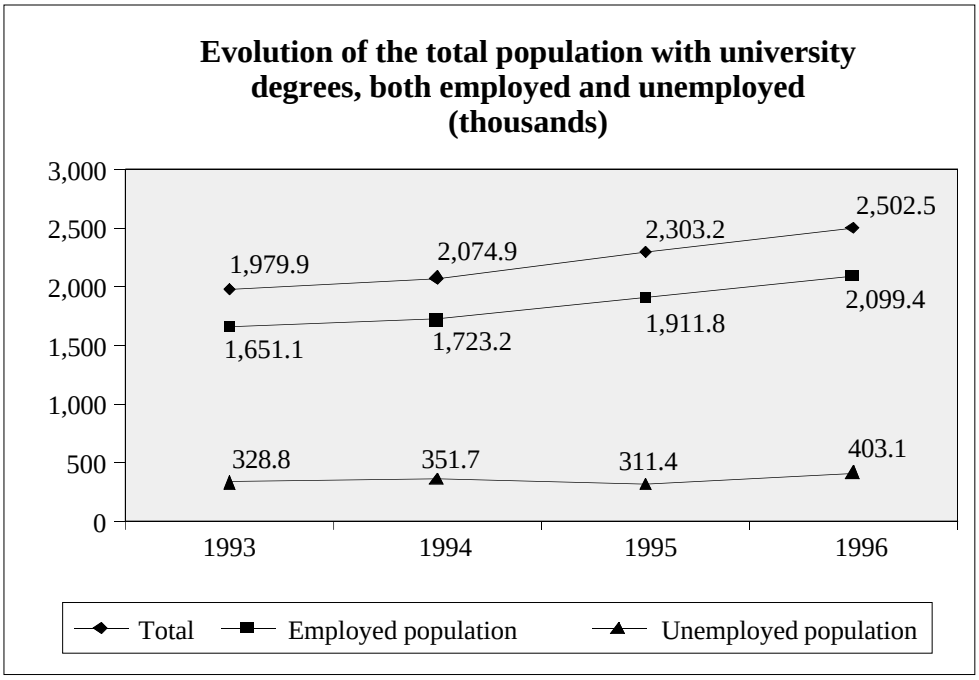
By sectors, the largest increase is in IT, with a rise of 13.46% between 1996 and 1997 and 16.94% between 1997 and 1998 (29).

(29) Ministry of Industry and Energy.




Source: *Las Tecnologías de la Información en España.* Ministry of Industry and Energy, 1998.

The rate of unemployment among university graduates decreased slightly in 1996 (16.1%) compared with 1993 (16.6%). However, it increased if we compare it with the 1995 rate (13.5%).



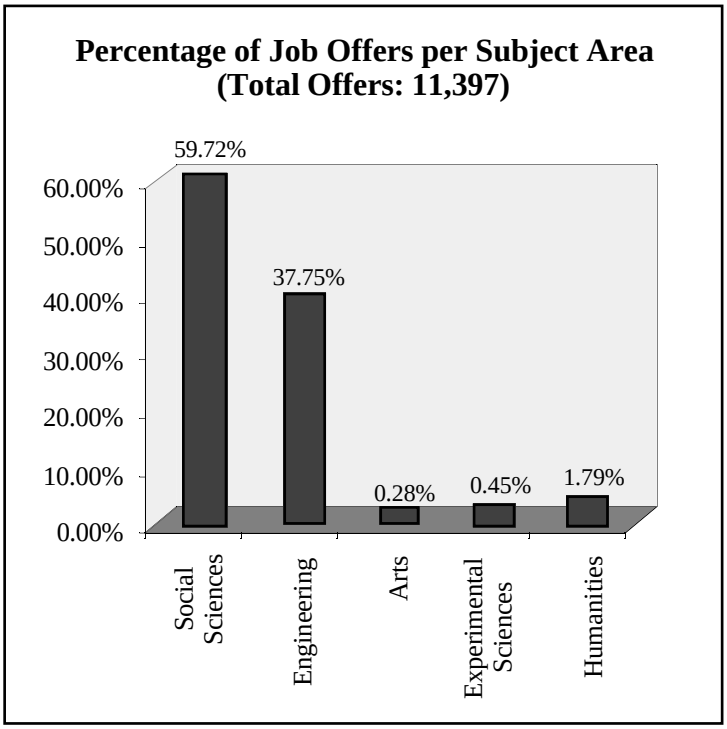

Source: *The labour market for university graduates.* INEM, 1998.

As for the number of university students, the percentage changes from 1996 to 1998 are different in each area of education. From 1996 to 1997 the largest change is the 8.2% increase in the number of students in Humanities, but in this same area the percentage drops to 2.29% from 1997 to 1998. The second largest change is in Engineering (5.91% increase from 1996 to 1997 and 3.88% increase from 1997 to 1998).

| Growth of university enrollments by subject area | | | | |
|---|---|---|---|---|
| | **1996/97** | **% annual change** | **1997/98** | **% annual change** |
| Humanities | 155,735 | 8.2 | 159,300 | 2.29 |
| Social Sciences and Law | 800,381 | 1.25 | 808,000 | 0.95 |
| Experimental Sciences | 129,122 | 2.41 | 131,000 | 1.45 |
| Health Sciences | 110,447 | 1.93 | 111,000 | 0.5 |
| Engineering | 348,477 | 5.91 | 362,000 | 3.88 |
| Own degrees | 7,807 | 0.81 | 8,000 | 2.47 |

Source: *The labour market for university graduates.* INEM, 1998.

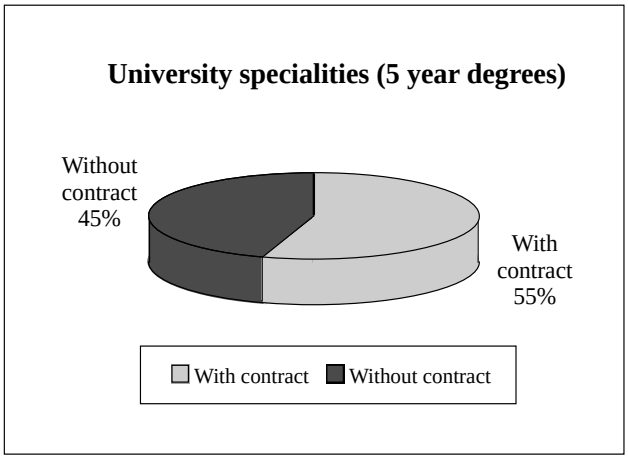
It is interesting to compare the above data with the percentage of job offers per subject area. Engineering students are only 22.45% of the total but receive 37.75% of the job offers.



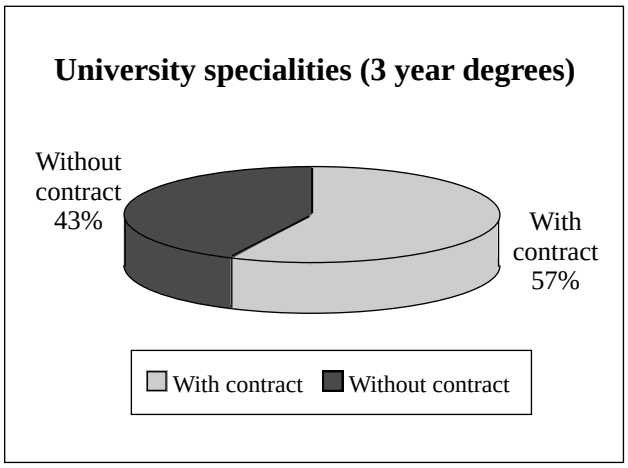

Source: *The labour market for university graduates.* INEM, 1998.

We must mention the main specialties among the 3-year university degrees, as they accumulate almost 30% of the total hirings: specialist in computer aided design (9.6%), computer management applications (8.9%), computers applications for the office (4.8%), and educational methodology (4.7%). Among the specialties in 5-year university programs, the most successful are: tourism (8.8%), chemical analysis (7.2%), social services (6.6%), and footwear design (4.5%). Based on 1996 data, among graduates with 3-year university degrees 4,298 were already working, while 3,196 were still unemployed. Among those with 5-year degrees, 3,084 were already working, while 2,505 remained unemployed.

Comparing the employed university graduates, we find that those with 3-year degrees have a higher rate (57%) than those with full 5-year degrees (55%).




Source: *The labour market for university graduates.* INEM, 1998.




Source: *The labour market for university graduates.* INEM, 1998.

Finally, we include a table that shows the numbers of students who obtained the different types of degrees in the area of engineering in 1998. Technical engineers complete a 3-year course; full engineers do a 5-year course. The number of degrees and the number of job offers are the result of two surveys carried out by the official Spanish employment institution, INEM *(Instituto Nacional de Empleo).*

| Engineering Degrees Obtained in 1998 | |
|---|---|
| | **Degrees** |
| Technical aeronautical engineer | 110 |
| Technical industrial electronic engineer | 474 |
| Technical mechanical engineer | 235 |
| Technical industrial chemistry engineer | 88 |
| Technical textile engineer | 49 |
| Technical computer management engineer | 3,251 |
| Technical computer systems engineer | 3,251 |
| Technical shipbuilding engineer | 211 |
| Industrial engineer in mechanics | 556 |
| Technical engineer in civil constructions | 192 |
| Technical engineer in hydrology | 0 |
| Telecommunication technical engineer | 1,243 |
| Aeronautical engineer | 65 |
| Civil engineer | 456 |
| Telecommunications engineer | 1,298 |
| Electronics engineer | 58 |
| Automation and industrial electronics engineer | 1 |
| Computer science engineer | 2,166 |
| Industrial engineer in mechanics | 2,402 |
| Industrial organization engineer | 40 |
| Shipbuilding engineer | 39 |
| Chemical engineer | 190 |
| Computer science degree | 1,364 |

Source: *The labour market for university graduates.* INEM, 1998. □