

# High Technology Indicators

## General Methodology

# 1. Introduction

The sectors and products that comprise the so-called high technology can be defined, generically, as those which, given their degree of complexity, require a continuous effort in research and a solid technological base. In this sense, the high technology indicators were conceived initially as a measurement of the results and the impact of R&D. In addition, these indicators constitute a tool that is very useful for the analysis of the competitiveness and internationalisation of the economy.

As of the year 2002 (with reference year 2000), the INE compiles this synthesis publication, which offers the main results on the sectors and products considered to be high technology, using as a base the methodology agreed upon by the OECD.

The data presented in this issue, come from the use of the results of the Industrial Companies Survey, the Annual Services Survey, the Survey on Innovation in Companies, the R&D Activities Statistics, the Economically Active Population Survey, the Quarterly Labour Cost Survey, the Survey on the Use of Information and Communications Technologies and E-Commerce in Companies, and the Foreign Trade Statistics. All of the previously mentioned statistical operations are compiled in the INE, with the exception of the last operation, the Foreign Trade Statistics, whose data is available on the website of the State Tax Administration Agency (AEAT).

The study is completed with a summary of the methodology proposed by the OECD for the analysis of high technology, while providing the classifications of the sectors and products used, together with their correspondence with the lists used in this report.

# 2. Methodology

## 1 Definition of high technology

Technology is considered as the stock of knowledge necessary for producing new products and processes. **High technology** is characterised by a rapid renovation of knowledge, very superior to other technologies and due to its degree of complexity that requires continued effort in research and a solid technological base.

For statistical purposes, the definition of high technology is carried out by an exhaustive listing of the activity branches (**sector approach**) and products (**product approach**) that are considered, at a given moment, to be high in technological content.

It is worth highlighting the very nature of high technology, its definition changes over time as high technology of the moment - if maintained - will become traditional technology in the future. The speed at which technological change takes place represents a difficulty for the measurement of this phenomenon, as the scope of the study may vary from one moment to another, which makes obtaining stable historical series difficult.

To determine the list of high technology activities and products, we have begun with the methodological work carried out by the OECD on this subject, and from their adaptation carried out on a European level by Eurostat.

## 2 The sector approach

### 2.1 DEFINITIONS AND CLASSIFICATION METHODOLOGY

#### 2.1.1 Classifications of the OECD

For the compilation of the sectors list based on the degree of importance of their technology, the OECD studied<sup>1</sup>, since 1989, based on its ANBERD (Analytical Business Enterprises Research and Development

Database) database, the **intensities in R&D** for different industrial sectors.

Two indicators are initially used: Direct and Indirect intensities, defined respectively as:

–Direct intensity: relation of R&D expenses with respect to production.

–Indirect intensity: direct intensities multiplied by technical coefficients of sectors obtained from input-output matrices. This procedure is justified by the incorporation of technology that comes, for a given sector, from the R&D incorporated by the purchasing (from the remaining sectors and abroad) of intermediate equipment and capital goods<sup>2</sup>.

From an ordering of the sectors according to their intensities in R&D, in a group of countries (made up of Australia, Belgium, Canada, United States, France, Italy, Japan, Holland, United Kingdom and Sweden, and subsequently, Denmark) and weighted by their respective weight in the production of all the countries, two provisional lists were obtained which facilitated separating them provisionally as high, medium and low technology. The first of them referred to the **period 1970-1980**, and the second to the **period 1980-1995**. The distinction between both lists was judged necessary bearing in mind the changes concerning the technological content of the different industries over these 25 years.

The study was limited to the manufacturing sectors, given the absence of information for the services sector. Both lists are described in Chart 1.

The use of indirect intensities hardly modifies each industry belonging to high, medium and low technology groups, although sometimes its range may be modified. However, even these cases are relatively rare, which shows that industries dedicate a very high portion of their turnover or their production to R&D, also using technologically more advanced equipment.

The second list of sectors, which refers to the most recent period, differs from the first list in three ways.

<sup>1</sup> OECD (1995). Classification of high technology sectors and products Doc. DSTI/EAS/IND/STPP(95)1.

<sup>2</sup> OECD (1997). Revision of high technology classifications of sectors and products Doc. OECD/GD(97)216.

1. The intensity of the branch of electrical machinery is reduced, and that for the scientific instruments remains stable, and thus, these two sectors come out of the high technology group and move into the medium technology group.

2. The medium technology group is broken down into two categories: medium-high and medium-low technology.

3. The evolution of technology itself reclassified some sectors from low technology to medium technology. This is the specific case for naval construction branches, other transport material, stone, clay and glass, non-ferrous metals and metallic products.

**Chart 1. High intensity manufacturing sectors in R&D according to the OECD.**

1970-1980 period	1980-1995 period
<b>High technology</b> 1. Aerospace 2. Office machines and computers 3. Pharmaceutical Industry 4. Electronics-communications 5. Scientific instruments 6. Electrical machinery	<b>High technology</b> 1. Aerospace 2. Office machines and computers 3. Electronics-communications 4. Pharmaceutical Industry
<b>Medium technology</b> 7. Automobile industry 8. Chemistry 9. Machinery and Mechanical Equipment 10. Rubber and plastic 11. Other manufacturing industries	<b>Medium-high technology</b> 5. Scientific instruments 6. Electrical machinery 7. Automobile industry 8. Chemistry 9. Machinery and Mechanical Equipment
<b>Low technology</b> 12. Other Transport Material 13. Stone, clay and glass 14. Petroleum Refinement 15. Naval Construction 16. Non-ferrous metals 17. Ferrous metals 18. Metallic products 19. Paper, publishing and printing 20. Food, Beverages and Tobacco 21. Wood, cork, furniture 22. Textile, leather manufacture	<b>Medium-low technology</b> 10. Naval Construction 11. Rubber and plastic 12. Other Transport Material 13. Stone, clay and glass 14. Non-ferrous metals 15. Other manufacturing industries 16. Metallic products
	<b>Low technology</b> 17. Petroleum Refinement 18. Ferrous metals 19. Paper, publishing and printing 20. Textile, leather manufacture 21. Wood, cork, furniture 22. Food, Beverages and Tobacco



In 2001 the OECD presented a new updated classification, based on the direct R&D intensities calculated from two measurements of production (production value and added value) for 1991 and 1997.

This new classification with its denominations and ISIC (International Standard Industrial Classification) Rev-3 codes is described in Chart 2.

The main novelty, with respect to the previous classification, consists of the medi-

cal, optical and precision instruments category (ISIC Rev. 3, division 33) moving to the high technology group. The OECD explains that, effectively, the intensity of R&D in this category of activities has been increasing since the 1980s which is not surprising if we consider the fact that this category includes activities borne in mind in the definition given by the OECD to the ICT (Information and Communication Technologies) sector.

**Chart 2. High intensity sectors in R&D according to the OECD.  
List in force since 2001**

1991-1997 period	ISIC Rev.3
<b>High technology</b>	
1. Manufacture of aircraft and space craft	353
2. Manufacture of office, accounting and IT machinery	30
3. Manufacture of radio, television and communications apparatus	32
4. Pharmaceutical Industry	2423
5. Manufacture of medical, optical and precision instruments	33
<b>Medium-high technology</b>	
6. Manufacture of automobile vehicles, trailers and semi trailers	34
7. Manufacture of substances and chemical products	24-2423
8. Manufacture of mechanical equipment and machinery n.c.p.	29
9. Manufacture of machinery and electrical apparatus n.c.p.	31
10. Manufacture of railway material and other transport material	352+359
<b>Medium-low technology</b>	
11. Manufacture of other non-metallic ore products	26
12. Manufacture of coke, petrol refining products and nuclear fuel	23
13. Construction and repair of ships and other embarkations	351
14. Manufacture of metal elaborated products, except machinery and equipment	28
15. Manufacture of common metals	27
16. Manufacture of rubber and plastic products	25
<b>Low technology</b>	
17. Manufacture of paper and paper products and publishing and printing activities and reproduction of recordings	21+22
18. Elaboration of food, beverages and tobacco products	15+16
19. Production of wood and manufacture of wood and cork products, except furniture; Manufacture of straw articles and materials which can be weaved	20
20. Manufacture of textile products, tanning and preparation of leather, manufacture of suitcases, handbags, saddlery, harnesses and footwear	17+19
21. Manufacture of furniture, manufacturing industries n.c.p. and recycling	36+37

ISIC: International Standard Industrial Classification

To conclude this section regarding the sectorial approach proposed by the OECD, it is worth highlighting that there are certain limitations, recognised by the OECD, in the segmentation methodology based on R&D spending indicators.

–On the one hand, while the investigation is a significant factor in technology, others may play a significant role, such as scientific and technical personnel, the technology incorporated into patents and licences, forms of strategic cooperation between companies on technological subjects, the rapid renovation of equipment, ... .

–On the other hand, the methodology defavours sectors whose turnover had grown more quickly than R&D spending, as the calculation only reflected movements and not stocks.

–Finally, the research attributed in each sector, to the main activity of the companies which in some sectors such as the aero spatial industry, where a large part of R&D is dedicated to electronics, may create slants.

–Finally, the choice of thresholds to separate the segments is arbitrary.

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### 2.1.2 Eurostat Classification

Eurostat uses the OECD classification, establishing the correspondence with a grouping of NACE Rev. 1 sectors. (Nomenclature of European Community Economic Activities), without any R&D intensity calculation<sup>1</sup>.

With regard to the services sector, Eurostat establishes the selection of activities based on the degree of relation they appear to have with high technology industries.

High technology sectors, both industrial and services according to the classification that Eurostat uses, to two digits, of the NACE and its denomination feature in Chart 3.

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<sup>1</sup> Eurostat(1999). Regional distribution of employment in high technology sectors. "Statistics in brief" series

It is worth highlighting that this classification, in force since 2008, was preceded - as with the OECD - by another list of activities.

Eurostat recognised<sup>2</sup> initially that the segmentation should be carried out based on the NACE classification to three digits, for which the data is not sufficient. In a working document<sup>3</sup> for the R&D and Innovation Work Group statistics, Eurostat subsequently proposed a segmentation of the classification to three digit sectors that only affects divisions 24, *Chemical industry*, and 35, *Other transport material*. This is due to the inclusion of the division 30.3, *Aerospace industry*, considered as high technology.

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### 2.1.3 Classification used for Spain

For its publications, the INE has borne in mind the new classification established since 2001 by the OECD and the recommendation by Eurostat to achieve segmentation of sectors to three NACE digits.

The final list of sectors considered for high and medium-high technology, once the correspondence between the NACE and NACE-09 classifications to 3 digits has been established, appears in Chart 4.

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<sup>2</sup> Eurostat (1998). Human resources in high technology "Statistics in brief" series

<sup>3</sup> Eurostat (1998). Employment in high technology manufacturing sectors at the regional level. Doc. Eurostat/A4/REDIS/103.

### Chart 3. High technology sectors according to Eurostat

NACE	Sectors
<b>Latest technology manufacturing sectors</b>	
Div. 30	Office machinery and computers
Div. 32	Radio, TV and communication equipment
Div. 33	Medical, precision, optical and clocks and watches instruments
<b>Medium or high technology manufacturing sectors</b>	
Div. 24	Chemical Industry
Div. 29	Machinery and equipment
Div. 31	Electrical machinery and apparatus
Div. 34	Automobile industry
Div. 35	Other Transport Material

### Chart 4. High technology and medium-high technology sectors List used by the INE

NACE-93	Sectors
<b>High technology manufacturing sectors</b>	
244	Pharmaceutical Industry
30	Office machinery and computers
321	Electrical components
32-32.1	Radio, TV and communications apparatus
33	Medical, precision, optical and clocks and watches instruments
35.3	Manufacture of aircraft and spacecraft
<b>Medium-high technology manufacturing sectors</b>	
24-24.4	Chemical industry except pharmaceutical industry
29	Machinery and equipment
31	Electrical machinery and apparatus
34	Automobile industry
35-35.3	Other Transport Material
<b>High technology or latest services</b>	
64	Post and communications
72	Computer Activities
73	Research and development

## 2.2 INFORMATION SOURCES

The results tables included in this publication have been obtained from various previously existing statistical operations. For all information sources used in the approach by sectors, the data have been classified according to the main activity of the company. This is understood to be that which generates the greatest added value, or failing this, that which provides the

greatest production value or uses the highest number of employed persons.

A short summary of the information obtained from each statistical operation is presented below.

### 2.2.1 Statistics on R&D Activities

Based on the Statistics on R&D activities 2010, information has been obtained on the



personnel dedicated to research activities, as well as the spending on these activities. For the purposes of this publication, only the business sector is considered, although the R&D statistics also cover the institutional sectors of Higher Education, the Public Administration and Private Non-Profit Making Institutions.

Below is a summary of the definitions of the variables that are used in this publication:

• **R&D activities.** • This is defined as the set of creative work which is undertaken with the objective of increasing the volume of knowledge, including the knowledge of man, culture and society, as well as the use of this sum of knowledge to conceive new applications. These activities may be developed within the company (internal R&D) or they may have been acquired from other companies (external R&D).

According to the previous definition, R&D includes the creative work that is systematically undertaken. This systematic nature implies a minimum of infrastructure, continuously destined by the company for R&D. For the purposes of these statistics, the systematic nature is equipped with the annual hiring of at least one full-time researcher.

Since the year 2002, the R&D variables and indicators that are described in the following points refer to both continuous and occasional R&D.

• **Proportion of companies that carry out internal R&D.** This is calculated as the percentage of companies that have incurred internal R&D expenses with respect to the total number of companies.

• **Personnel employed in R&D activities:** This includes personnel in R&D, all personnel directly employed in R&D activities without distinction of level of responsibility as well as those who supply services linked directly to R&D work such as managers, administrators and office personnel.

Personnel data may be measured in two ways; by the number of physical persons -

accounted for to 31 December of the reference year – and working at a full-time equivalent - the sum of the personnel who work full time plus the sum of the fraction of time that the personnel work part time. For the purposes of this publication, the measurement of R&D personnel is presented at a full-time equivalent.

• **Researchers.** These are the scientists and engineers involved in the conception or creation of new knowledge, products, processes, methods and systems in the management of the corresponding projects.

Also included are the managers and administrators dedicated to the planning and management of the scientific and technical aspects of the work of the researchers, and who, normally, have a category equal or superior to that of persons employed directly as researchers, often dealing with former researchers or part-time researchers.

Also included are postgraduate students with a "student salary/grant" who carry out R&D activities.

• **Technicians:** Technicians and equivalent personnel are persons whose main tasks require knowledge and technical experience in one or various fields: engineering, biological and physical sciences, or social sciences and humanities. They participate in R&D projects carrying out scientific and technical tasks applying operational principles and methods, generally under the supervision of the researchers. Equivalent personnel carry out tasks corresponding to social sciences and humanities under the supervision of researchers.

**Assistants:** The auxiliary staff includes workers, qualified or unqualified, and secretarial and office personnel who participate in the realisation of R&D projects, or who are directly related to said projects. This category includes all managers and administrators mainly occupied with financial matters, personnel management and administration in general, provided that their activities are directly related to R&D tasks.

• **Internal R&D activities spending:** This includes current and capital expenses in R&D activities carried out within the company, whatever the origin of the funds. The expenses carried out outside the company but to support the internal R&D tasks (purchase of supplies for R&D for example), are also included.

• **Intensity in R&D:** This is defined as the quotient between expenses on internal R&D activities (systematic) and turnover, expressed as a percentage.

The definitions correspond to the methodology proposed in the fifth edition of the Frascati Manual, for which their international comparability is assured.

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## 2.2.2 Technological Innovation in Companies Survey

The Technological Innovation in Companies Survey is aimed at industrial, construction and services companies with at least ten remunerated employees.

Based on the statistical operation corresponding to the year 2010, the proportion of innovative companies, as well as innovation expenses, has been obtained. This latter variable is broken down into R&D activities expenses (both internal and external), and other innovative activities.

A summary of the definitions of the variables used in this publication is presented below:

• **Innovative company.** This definition refers to companies which, in the last three years, have introduced products that are technologically new or improved in the market, or processes that are technologically new or improved in their methods for the production of goods or the rendering of services.

Distinction is made between the following types of innovative companies:

- Product-based.
- Process-based.
- Product- and process-based.

### • EIN Company.

This term comprises innovative companies (in the sense of the previous definition) and companies with innovations underway or unsuccessful innovations.

The ratio of innovative companies is calculated as the percentage of companies which, in the last three years, have introduced products that are technologically new or improved in the market, or processes that are technologically new or improved in their methods for the production of goods or the rendering of services, compared to the total number of companies.

• **Innovative activities.** The set of scientific, technological, financial, commercial and organisational activities carried out for innovation. R&D (internal or external, continuous or occasional) is only one of these activities, and may be carried out in different stages of the innovation process. It is used not only as a source of innovative ideas, but also to solve problems which may occur in any phase of the process until its completion.

Apart from R&D activities also included as innovative activities is the acquisition of machinery and equipment related to technologically new or improved products and processes, the acquisition of immaterial technology, industrial design and engineering, tools and launch of manufacture, training related to technologically new or improved products and the commercialisation of technologically improved or new products.

• **Expenses on innovative activities.** The total expenses of all innovative activities including internal and external R&D costs and costs relating to the remaining innovative activities mentioned in the previous section.

To ensure the international comparability of innovation expenses, all company costs on innovation projects are included, regardless of whether they were successful or not. Also included are R&D costs that are not related to a specific product or process (basic research).

It should be highlighted that, to measure total expenses on innovative activities, occasional R&D activities for the purposes of innovation expenses are also considered.

- **Internal R&D expenses.** This includes current and capital costs on R&D activities carried out within the company. Current and capital expenses are included.

- **External R&D expenses.** These are those expenses motivated by the acquisition of R&D services outside the company by means of contract, agreement, etc.

- **Expenses on the acquisition of machinery and equipment related to technologically new or improved products or processes.** This includes all company costs for the purchase of machinery and equipment goods related to technologically new or improved products and processes.

By agreement, the software incorporated in the machinery and equipment goods is also included. Internal capital R&D costs are included as internal R&D costs.

- **Expenses for the acquisition of immaterial technology (excluding R&D).** This includes the costs of acquiring patents and non-patented inventions, the concession of licences and divulging know-how, transactions relating to factory frameworks, designs, utility models and services with technological content related to the innovation of products and processes. The acquisition of computer programs (software) not included elsewhere is also included. The purchase of R&D services will be included as an external R&D expense.

- **Expenses in industrial design and engineering, tools and launch of manufacture.** Comprises:

- Industrial design costs not included in R&D costs (plans and designs aimed at defining processes, technical specifications and necessary functional characteristics for the design, fine-tuning, production and commercialisation of technologically new or improved products and processes).

- Expenses on industrial engineering (changes in production and quality control processes, methods and regulations for the production of products or use of technologically new or improved processes).

- Expenses on manufacture launching (modifications of products or processes necessary for the start of production, including experimental manufacture not included in R&D costs).

In the case of service companies, in this paragraph, preparatory costs to introduce new (or improved) services or methods of supplying the same will be included. These comprise activities leading to the definition of the procedures, specifications and functioning characteristics (including final tests) necessary for the introduction of innovations.

- **Costs of training related to technologically new or improved products and processes.** This includes expenses for training related to the introduction of technologically new or improved products and processes. Expenses on training may include both the acquisition of external services and training costs at work. Training for other activities must not be included.

- **Commercialisation of technologically new or improved products.** This includes costs for the launching of a technologically new or improved product, including prior market studies, experimental commercialisation, adaptation of the product to different markets and publicity of the launch. Costs referring to the implementation of distribution networks with a view to the commercialisation of new products are excluded.

Definitions are adapted to the Oslo Manual, and are therefore internationally comparable.

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### 2.2.3 Industrial Companies Survey

The population object of the Industrial Survey study is the set of companies with one or more remunerated employed persons, and whose main activity is included in sec-

tions C to E of the National Classification of Economic Activities (NACE-93). In other words, the Survey covers mining and manufacturing industries and the production and distribution of electrical energy, gas and water.

As regards the territorial scope, the survey covers the whole country, with the exception of Ceuta and Melilla.

Based on the Industrial Companies Survey 2010, information has been obtained on the number of companies, turnover, product sales value and the total added value, for each manufacturing sector considered for high and medium-high technology.

Data corresponding to each Autonomous Community are also available, having grouped the sectors when the number of companies was not sufficient to guarantee statistical secrecy.

Economic figures referring to the whole of the national territory are calculated according to the company's main activity. Nevertheless, the data by Autonomous Community have been obtained according to the main activity of the industrial establishment.

A summary of the variables definitions that are used in this publication is presented below:

• **Turnover.** This is the total amount resulting from the sum of the net commercial sales of goods and services supplied to third parties. This is obtained from deducting the sales amount of products, goods, etc., and the provision of services corresponding to ordinary company activities, the amount of discounts and other bonuses on sales, as well as VAT and other directly related taxes.

• **Sale of products.** This refers to the total sum of sales of completed products, products in progress, by-products, waste, containers and packaging, carried out by the company during the reference year. It considers the value of net sales (after deducting discounts) at sale prices, without including transport costs or the taxes levied on these transactions.

• **Gross added value at factor cost** This is the gross income from operating activities after adjusting the effect of operating subsidies and indirect taxes.

#### 2.2.4 Annual Services Survey

The population scope covered by the Annual Services Survey is the set of companies dedicated to trade, tourism, transport, information technologies, real estate and rental activities and corporate services.

Based on the Annual Services Survey 2009, information has been obtained on the number of companies, locales, turnover and total added value of the sectors considered high technology (divisions 59 to 63, and 72 of the CNAE-2009).

Economic variables are calculated according to the main activity of the establishment. The definitions of these variables are equivalent to those from the Industrial Survey.

#### 2.2.5 Economically Active Population Survey (EAPS)

Based on EAPS results, with reference period of annual averages for 2010, the number of employed persons in the sectors selected has been obtained, by age group, sex and Autonomous Community.

The information presented in this publication refers to the annual average calculated from the quarterly results.

Results are not published broken down by age or sex for each Autonomous Community and each activity sector, due to considering that such a breakdown may not offer representative results.

An employed person is defined as a person 16 years or over who, during the survey reference week, has worked for others (employees) or worked freelance.

All the characteristics defined in the EAPS refer to the national, rather than the do-

mestic, concept, given that it is not possible to collect information from the population who work in Spain and live abroad, as the survey is aimed at people who live in family dwellings.

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### 2.2.6 Quarterly Labour Cost Survey

Replacing the former Wage Survey for Industry and Services, the Quarterly Labour Cost Survey (QLCS) is a short-term statistical operation that aims to provide information on the average labour cost per worker and month and the average number of hours worked.

The survey covers the whole national territory labour and comprises all workers employed by others, regardless of the type of contract and working day, full-time or part-time.

The concept of earnings refers to all remuneration, both in cash and in kind, paid to workers for time worked for others, independently of the type of remuneration, together with remuneration for periods not worked such as holidays or bank holidays.

The Quarterly Labour Cost Survey provides, with reference period 4<sup>th</sup> quarter 2010, the data for the total wage cost per worker and month and the wage cost per effective hour in the sectors of High and Medium-High Technology defined to two digits of the NACE. By economic activity, this statistical operation offers results that are representative on a NACE division level (two-digit codes).

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### 2.2.7 Survey on the Use of Information and Communication Technologies and Electronic Commerce in Companies (SICTEC).

This statistical research analyses the population made up of the companies that belong to the Manufacturing Industry, or work in the production and distribution of energy, gas and water, construction, trade, accommodation, transport and communications, financial intermediation, renting

and business services, and cinema, radio or television activities. The reference period is, generally, the calendar year.

Based on the results of the SICTEC 2010, the operation provides the percentage of companies in the high and medium-high technology sectors that have an Internet connection, e-mail, a broad band Internet connection and a website/web page.

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## 3 Approach by product

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### 3.1 DEFINITIONS AND CLASSIFICATION METHODOLOGY

This involves constructing technological content indicators for goods produced and exported by a country or industrial sector for the purpose of explaining its competitive and commercial situation in international high technology markets which, due to their characteristics (strong growth in global demand, oligopoly structures) ensure commercial advantages which are higher than average and influence the development of the whole industrial fabric.

The product approach, which has to complement the sectorial approach, opens the route to more detailed analyses in the field of commercial exchange and competitiveness.

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#### 3.1.1 OECD Classification

In 1994, the OECD, in collaboration with the Fraunhofer Institute in Germany, presented a list of high technology products that correspond with the SITC Rev. 3 (Standard International Trade Classification) classification to 3 digits. This list was the result of calculations referring to R&D intensities, by group of products (R&D expenses/turnover), for which six countries were taken into account: the United States, Japan, Germany, Italy, Sweden and Holland



The list proposed by the OECD Secretariat in 1994 constituted a very important initial effort in this new field, and served as a basis for the following work that led to the list in Chart 5. These complementary works were motivated by three problems presented in the initial list:

1. The level of breakdown to 3 digits, while constituting a significant improvement with respect to the sectorial approach, is however, still quite limited. Probably, the most significant disadvantage was the description of products to 4 and 5 digits belonging to the group of products selected. Without any doubt, it would not be possible to justify numerous products in the high technology group at this grouping level, and for the work that has been continued, they have been excluded. For this purpose, when there is a doubt about certain products, the opinion of experts on these products has been requested.

2. The automobile industry. The main points of the automobile industry were classified as high technology. This industry belongs to medium-high technology in the sectorial approach, and it will be difficult to justify a different global treatment for automobiles according to whether the approach is adopted by sector or by product. On the other hand, the considerable weight of automobiles in international exchanges would radically modify the profile of countries. For these reasons, it has been preferred to exclude the automobile from the list of high technology products.

3. Despite the calculations, the technological content of some products manufactured by medium and high technology sectors, even on a more broken down level, was not confirmed by expert opinion. Faced with this dilemma, it was preferred to exclude them from the list of high technology products.

In this way, the list proposed in Chart 5 and presented in a more detailed way in the annex, is relatively compatible with the list of sectors to the extent that the products have been classified according to the sector to which they belong. For this reason, the correspondence between SITC Rev. 4 and

ISIC. Rev. 4 has been used. It is more restrictive than the list by products presented in 1994, and much more so than the sectorial lists. On the other hand, this includes some products manufactured by medium-high technology industries.

A consequence of the lack of detailed data is that numerous products manufactured by high technology sectors are medium technology or even low technology. On the contrary some products manufactured by medium or low technology sectors are high technology.

In principle, to remedy this difficulty, the product approach was developed. However, this also presents another two limitations.

- The selection of high technology products is not based exclusively on quantitative methods unless a relatively high grouping level is adopted. Resorting to expert opinion undoubtedly facilitates obtaining detailed lists, but these are relatively heavy operations whose results may be difficult to reproduce in their entirety with another panel of experts.

- The second limitation refers to the lack of product hierarchy. While the selection is not based exclusively on quantitative measurements, it is difficult to classify products in an increasing or decreasing order that depends on their level of technological content.

The creation of a new database by product referring to foreign trade, based on the list proposed in Chart 5, constitutes a first stage of future work for the OECD. This database will integrate for the first time the unitary values of the different products (values/quantities), for global exports and imports, and also for bilateral trade. The measurements of unitary values will facilitate obtaining an approximate estimate of the range of these products in such a way that significant differences between unitary values for the same products may only be justified by broadly diversified products belonging to different ranges. This will give rise to the possibility of constructing lists of

specific high technology products by country, based on the level of their range.

However, up to the date of this publication, there has not been any significant progress on the classification of products. The same classification of products shown in Chart 5 is used.

### 3.1.2 Classification used for Spain

The correspondence between international classifications and those used in Spain has been established. In particular, the NCPA-96 classification (National Classification of Products by Activities) and its correspondence with SITC (Standard International Trade Classification) and CN (Combined Nomenclature) was used. The use of the PRODCOM classification (European Community List of Products) facilitated establishing links between classifications and information sources.

**Chart 5. List of high technology products. 1980-1995 period**

Group	Sector	SITC code
1	Aero spatial	[7921+7922+7923+7924+7925+79291+79293+(714-71489-71499)+87411]
2	Office machines and computers	[75113+75131+75132+75134+(752-7529)+75997]
3	Electronics-communications	[76381+76383+(764-76493-76499)+7722+77261+77318+77625+77627+7763+7764+7768+89879]
4	Pharmaceutical Industry	[5413+5415+5416+5421+5422]
5	Scientific instruments	[774+8711+8713+8714+8719+87211+(874-87411-8742)+88111+88121+88411+88419+89961+89963+89966+89967]
6	Electrical machinery	[77862+77863+77864+77865+77867+77868+7787+77884]
7	Automobile industry	
8	Chemistry	[52222+52223+52229+52269+525+531+57433+591]
9	Machinery and Mechanical Equipment	[71489+71499+71871+71877+71878+72847+7311+73131+73135+73142+73144+73151+73153+73161+73163+73164+73165+73312+73314+73316+7359+73733+73735]
0	Armament	[891]

It is necessary to highlight that the list of products finally studied may give rise to controversies due to whether or not a product and its components are considered as high technology. It may be that a certain article does not incorporate high technology into some of its parts in such a way that the value of the components would be included, but not the value of the complete products.

Annexes II and III list the products according to the PRODCOM 10, CPA-2008, and CN-2010 codes.

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### 3.2 INFORMATION SOURCES

The statistical results tables on products were obtained from previously existing information sources, one coming from the INE (Industrial Products Survey) and another from the Customs and Tax Agency Special Taxes Department (Foreign Trade Statistics).

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#### 3.2.1 Industrial Products Survey

The population object of study is aimed at industrial establishments that account for 90% of the production of each class of CNAE-09 (4 digits). For each one of these classes, industrial establishments belonging to companies with 20 employees or more are surveyed, regardless of the main activity to which they belong. For certain classes (more than 50%) industrial establishments with more than 10 employees are also surveyed.

Based on the Industrial Products Survey 2010, the production value has been obtained for each one of the elements from the list of high technology products described above.

This Survey uses the NCPA classification, compatible with the PRODCOM community nomenclature.

Some of the products are not studied by the survey, in such a way that the data is not available.

On the other hand, respect for data confidentiality, when a group is obtained as the sum of a limited number of components, prevents publishing the breakdown with the desired precision.

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#### 3.2.2 Foreign Trade Statistics

Annual data on the import and export of products have been obtained from the Foreign Trade Statistics available on the State Tax Administration Agency website. The Customs and Special Taxes Department compiles this information from the Customs Office Declaration, as well as the "In-trasat" statistical declaration, classifying products according to the Combined Nomenclature.

To obtain data corresponding to imports, exports and commercial deficit according to the classification proposed by the OECD, correspondences between the CPA and Combined Nomenclature have been established as shown in Annex II.

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## 4 Dissemination frequency

The dissemination of data from the High Technology Indicators is carried out annually on the INE website, throughout the first four months of the year.

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## 5 Tabulation of results

The tabulation of the results of this publication commences with a summary of the main variables and indicators.

The High Technology indicators are published referring to year t-2, with t being the current year, except for the data from the Annual Services Survey, which has a time reference of t-3 in the publication of these



indicators. This is so because the data from the Annual Services Survey is not available with time reference t-2 at the time of publication of the indicators.

Hereunder is a list of detailed results in accordance with the approaches set out in the methodology, by sector and by product.

The following are listed for the sector approach:

- The main economic magnitudes for the whole of the national territory, according to the company's main activity, and for Autonomous Communities, according to the main activity of the establishment.
- Employment by sex, age, and Autonomous Community.
- Wages in the sectors of High and Medium-high technology.
- The indicators for R&D activities in the sectors of high and medium-high technology.
- The indicators on technological innovation in the sectors of High and Medium-high technology.
- The indicators on information and communication technologies and e-commerce.

The following are listed for the product approach:

- The production value of high technology goods.
- The foreign trade of high technology goods.

This publication is available on paper, CD and on the INE website.

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