**The system of science and technology in Spain / Comisión Interministerial de Ciencia y Tecnología.**

# THE SYSTEM OF SCIENCE AND TECHNOLOGY IN SPAIN

COMISION INTERMINISTERIAL DE CIENCIA Y TECNOLOGIA

# INDEX

# 1. Historical background and legal framework

The origin of the first public actions of promotion and organization of Spanish Scientific Policy goes back, as in the other Western Countries, to the first decades of this century with the creation of the Board for the Expansion of Scientific Studies and Research (Junta para la Ampliación de Estudios e Investigaciones Científicas, 1907). Out of their property and assets and those of the Foundation for Scientific Research and Attempts at Reform (Fundación para la Investigación Científica y Ensayos de Reforma), created in 1931, the Higher Centre for Scientific Research (Consejo Superior de Investigaciones Científicas, CSIC) was founded in 1939. Afterwards, two bodies dedicated to the planning of Science and Technology were formed: The Advisory Commission for Scientific and Technical Research (Comisión Asesora de Investigación Científica y Técnica, CAICYT) (1958), which initially depended on the Ministry of the Presidency, and the Government Delegated Committee for Science Policy (Comisión Delegada del Gobierno de Política Científica (1963), made up of the Ministries of Finance, Interior, Public Works, Agriculture, Industry, Commerce, and Education and Science.

From 1978 onwards the Spanish System of Science and Technology had the Centre for Technological and Industrial Development (Centro para el Desarrollo Tecnológico Industrial, CDTI) as an institution specifically devoted to promoting the technological development of industry. The Centre was created as an autonomous body responsible to the former Ministry of Industry and Energy.

A decisive moment in the development of the Spanish System was the promulgation of the Organic Law 11/1983, August 25th, dealing with University Reform (Ley de Reforma Universitaria, LRU). In this Law, the importance of university research activity for the cultural, social and economic development of the country and, consequently, for enterprises and public and private bodies is explicitly recognized. In particular, in Articles 11 and 45 of the Law and in the subsequent acts which further develop them, the collaboration in R & D projects between enterprises and university research groups, was established; that is to say, it enabled academic research to be brought closer to the productive world.

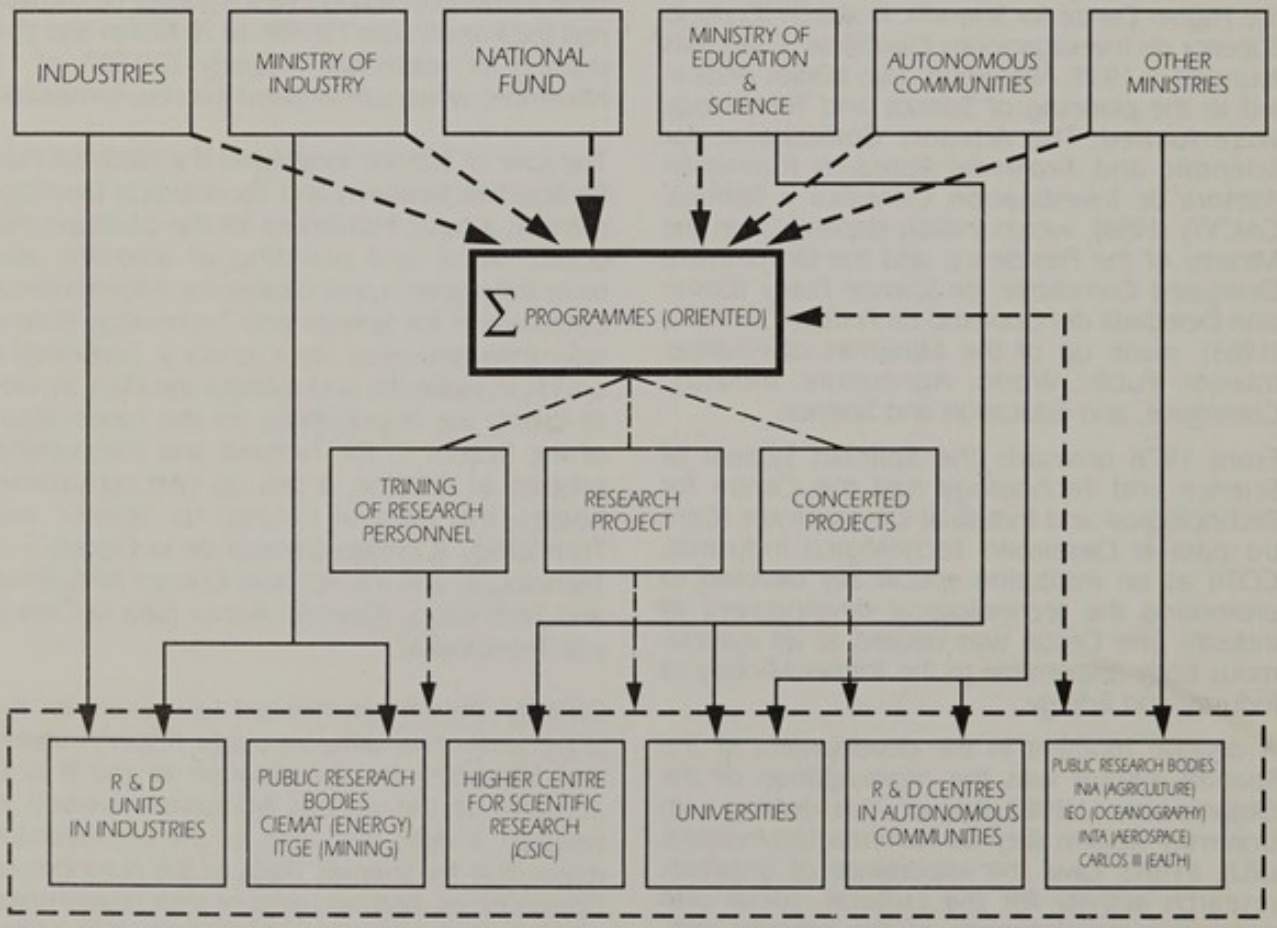
However, the definitive step to reforming the Spanish System of Science and Technology for the future development of the country was the promulgation of the Law for the Promotion and General Coordination of Scientific and Technical Research (commonly known as the Law of Science) of 14 April 1986, which established a new normative framework for the definition and effecting of Scientific and Technological Policy. As well as this, a set of complementary regulations were introduced, among which should be mentioned the Patents Law 11/1986 of 20 March and that relating to intellectual Property 22/1987, of 11 November, which substantiated this new framework.

The Law of Science establishes the National Plan for Scientific Research and Tecnological Development as a basic instrument for the development, coordination and planning of scientific and technical research and creates the interministerial Commission for Science and Technology (Comisión Interministerial de Ciencia y Tecnología, CICYT) to elaborate and monitor the Plan, as well as taking the responsibility for the coordination of the System in the national and international spheres. In addition, it sets up two consultative bodies: the General Council for Science and Technology (Consejo General de la Ciencia y la Tecnología) and the Advisory Council for Science and Technology (Consejo Asesor para la Ciencia y la Tecnología).

Similarly, the aforementioned Law examines the legal situation of different public research bodies and identifies the coordination of the R & D activities of the various Ministries involved in research. It does the same for the organizations responsible for Scientific Policy in the Autonomous Communities, both in terms of their relationships with one another and with the State Administration. With regard to the international Programmes for scientific research and technological development which involve Spanish participation, the Law makes CICYT responsible for coordination and monitoring, defining the National Plan's requirements in terms of international relations and establishing forecasts for their execution.

The outcome of the development of the Law for the Promotion and General Coordination of Scientific and Technical Research has been a greater integration between the public and private agents which make up the System of Science and Technology; the paths of coordination so created are shown as broken lines in Diagram 1.

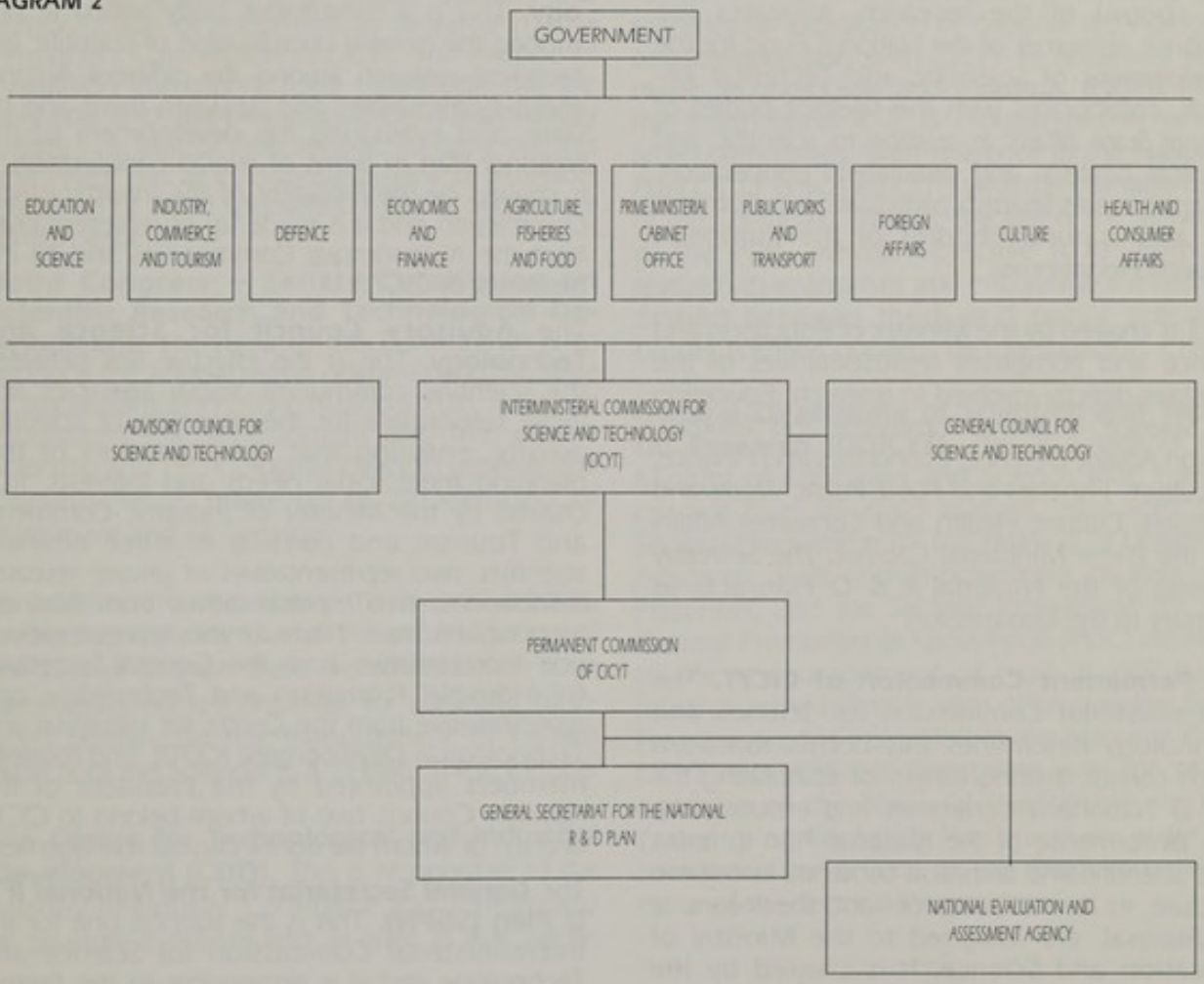
**DIAGRAM 1.–SPANISH SYSTEM OF SCIENCE AND TECHNOLOGY**



# 2. Institutional framework

In brief, the Law of Science and the subsequent regulations which further develop it, determine the creation of new mechanisms of action; formed out of the various different bodies which guarantee the appropriate participation of every element forming the System. These are represented in Diagram 2.

**DIAGRAM 2**



**Interministerial Commission for Science and Technology (CICYT).** This is the official body responsible for the planning, elaboration, coordination, evaluation and monitoring of the National Plan for R & D. It elaborates the general guidelines of Scientific Policy, determines the most appropriate mechanisms for their development, sets the criteria for evaluation. selection and control of the research, allocates the economic resources of the National Fund for the Development of Scientific and Technical Research, collaborates with the relevant bodies of external State affairs in relation to scientific and technical bilateral and multilateral cooperation, and coordinates Spanish participation in Committees and statutory bodies of the European Research Programmes.

CICYT is chaired by the Minister of Education and Science and comprises representatives of the Ministries directly involved in research: Education and Science, Industry, Commerce and Tourism, Foreign Affairs, Defence, Economics and Finance, Agriculture, Fisheries and Food, Public Works and Transport, Culture, Health and Consumer Affairs and the Prime Ministerial Cabinet. The Secretary General of the National R & D Plan acts as Secretary to the Commission.

The **Permanent Commission of CICYT.** The Interministerial Commission for Science and Technology determines this body's functions which consist, among others, of elaborating the R & D National Programmes and ensuring the high performance of the National Plan in terms of its scientific and technical contents. Its organic structure, its human resources and the means at its disposal, are assigned to the Ministry of Education and Science. It is chaired by the Secretary of State for Universities and Research and the General Secretary of Industrial Promotion and Technology of the Ministry of Industry, Commerce and Tourism acts as vicepresident. In addition, the General Director of Scientific and Technical Research (Ministry of Education and Science, MEC), the General Director of Technological Policy (Ministry of Industry, Commerce and Tourism), and the General Director of Planning (Ministry of Economics and Finance, MEH) belong to the Commission.The General Secretary of the National R & D Plan acts as Secretary to the Commission.

The **General Council for Science and Technology.** This is a consultative body aimed at promoting the general coordination of scientific and technical research among the different Autonomous Communities and between them and the State, and evaluating the development of the National Plan in terms of overall coordination. It is chaired by the President of the Interministerial Commission and it is made up of representatives from the Autonomous Communities and all the members of CICYT.

The **Advisory Council for Science and Technology.** This is the effective link between the scientific community, social agencies and those responsible for the planning of scientific activity, ensuring that the objectives of this planning meet social needs and interests. It is chaired by the Minister of Industry, Commerce and Tourism and consists of three eminent scientists, two representatives of private research associations, two representatives from business associations, two Trade Union representatives, one representative from the General Secretariat for Industrial Promotion and Technology, one representative from the Centre for Industrial and Technological Development (CDTI), and fourteen members appointed by the President of the Advisory Council, two of whom belong to CICYT and ten of whom are from industrial management.

The **General Secretariat for the National R & D Plan (SGPN).** This is the support unit for the Interministerial Commission for Science and Technology and it is responsible to the Permanent Commission. Among its most important functions are the coordination of the Programmes and activities —national and international— of the National R & D Plan, technical and financial management and administrative management. In addition, it coordinates and gathers together the scientific and technological information necessary for the Plan's implementation.

The **National Evaluation and Assessment Agency (ANEP).** This body supports and is responsible to the Permanent Commission of CICYT. Its role is to carry out the evaluation of the scientific and technical stardards of projects and other proposals submitted by organizations and research groups taking part in National Plan Programmes. It also carries out studies and prospective analyses of scientific research and technological development as required by the Permanent Commission of CICYT. The method of evaluation commonly used —although not the only one since the proposals to be evaluated vary greatly— is that of peer review. To carry out this task ANEP has at its disposal a bank of assessors made up of 7,000 specialists, 1,400 of whom are foreign experts.

**Joint Congress – Senate Commission on Scientific Research and Technological Development.** The remit of this Commission is to produce the annual report documenting the state of implementation of the National Plan, therefore monitoring its development and that of the Scientific and Technological Policy in general. The Commission is made up of 22 Members of Parliament and 16 Senators.

In addition to the above-mentioned bodies, created specifically out of the promulgation of the Law of Science, there are others which have been assigned responsibility for particular functions relating to the management of certain aspects of the National R & D Plan. These include:

The **Centre for Technological and Industrial Development (CDTI).** This is responsible to the Ministry of Industry, Commerce and Tourism and its structure functions and, in brief, its role within the Spanish System of Science and Technology was redefined in the Royal Decree/Law 8/1983 (30 November), of Reconversion and Reindustrialization and, later still in the Law of Science. In relation to the National Plan the Centre has been made responsible for evaluating the economic and technological interest of the projects in which enterprises participate, promoting the commercial exploitation of national technologies and collaborating with CICYT in obtaining adequate technological and industrial returns from the international R & D Programmes in which Spain participates. With reference to the National Plan CICYT entrusted CDTI with the management of the Concerted Projects, the axis of the activities of the Plan, whose objective is to promote research in enterprises and encourage the collaboration between these and public research centres (centros públicos de investigación, CPI).

**General Directorate of Scientific and Tecnical Research (DGICYT).** This is a unit of the Ministry of Education and Science that, having control over its own budget, manages the Sectoral Programme for the Training of University Academic Staff and improvement of Research Personnel, and the Sectoral Programme for the General Promotion of Knowledge (PGC) devoted to the encouragement of high quality basic research in the different areas of knowledge; both Programmes are integrated in the National Plan. CICYT entrusted this Directorate with the management of the National Programme for the Training of Research Personnel in order to coordinate the actions of this Programme with those of the Sectoral Programme.

# 3. The National Plan for Scientific Research and Technological Development

The Law of Science established the National Plan as a basic mechanism of promotion, coordination and planning in the R & D area and as a fundamental instrument for the development of Spanish Scientific Policy. In the Plan, objectives are set, actions are given priority and resources are mobilized toward areas of particular strategic interest for society's benefit, at the same time as supporting basic high quality research.

Taking into account the previously mentioned situation and the interests and needs of the Spanish System of Science and Technology, the National Plan aims to achieve the objectives expressed in Article 2 of the Law of Science: the progress of knowledge and the advancement of technological innovation and development; the promotion of competitiveness in the various socio-economic sectors; the improvement of the quality of life and other cultural and social aspects which affect society's progress and its future development.

The National Government maintains the right of approval over the National Plan and determines its activities for periods lasting several years, although it is also subject to annual review. As a planning mechanism the Plan integrates financial efforts to promote R & D, organizing research activities in a series of various Programmes which represent its priorities, and planning other activities aimed at achieving its objectives.

## 3.1. PROMOTION OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

The promotion of scientific and technological development is one of the essential purposes of the National Plan. In the short term and in agreement with the priorities established in the National Programmes, the promotional activities should lead to the expansion of the budgets available for financing research projects. In the medium and long term, they must ensure —through corresponding funding— the future of research potential, which will depend on the investment devoted to infrastructure and human capital.

With a view to developing the promotion R & D activities in Spain, the National Plan is structured on the following lines of activity.

**Research Projects:**

These are an essential part of the research activity of the public research centres and non-profit making research bodies, whose objective is the execution of a project of work which is usually carried out over a period of three years. The funds allocated allow the research team to acquire low and medium cost equipment as well as consumables, to attend relevant congresses and scientific meetings, and deal with other minor expenses.

**Integrated Projects:**

The objective of these projects is the development of products or processes which are of a considerable size and for this reason need to "integrate" various technologies, requiring the involvement of different research groups both from public centres and enterprises.

**Scientific-technical infrastructure:**

This is an important line of activity with the essential aim of providing institutions and research groups with the equipment necessary to ensure the effective realization of their research projects. The infrastucture funds are mainly devoted to the acquisition of large scientific instruments and to equipping the workshop and general services areas of the public research centres and the non-profit making research bodies.

**Special Actions:**

These are particular actions carried out at specific times, such as seminars, meetings of experts, etc., which are aimed at complementing and supporting the execution of research projects.

**Training of Research Personnel:**

The National Programme for the Training of Research Personnel has been focussed, particulary, toward priority areas in the National Programmes. It has two aspects: the training of new research personnel and the improvement of existing staff. The process extends beyond national frontiers since a proportion of this training occurs in centres of excellence abroad and foreign scientists and technologists are involved in the work at Spanish centres. Another means of achieving this aim is the promotion of the mobility of research personnel between industries and public research centres and the training of researchers in the R & D units of enterprises.

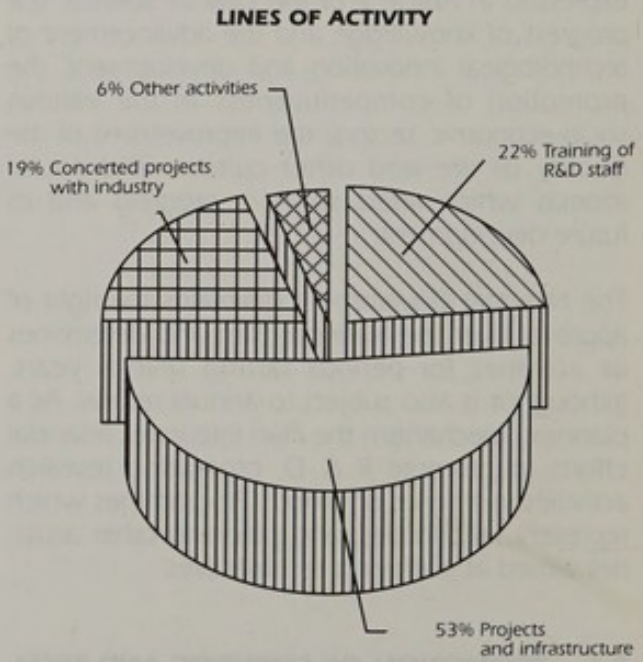
It should be pointed out that the National Programme is by no means the only public initiative in this area. It is complemented by the Sectoral Programme for the Training of University Academic Staff and improvement of Research Personnel (Ministry of Education and Science) the objectives of which partly overlap those of the National Programme, and by other public and private initiatives.

**Concerted Projects:**

Enterprises research projects falling within the framework of the Programmes of the National Plan are partly financed by interest free loans. They have a two-fold objective: to foster R & D activities in enterprises and link up technological and scientific interests with economic interests, that is, to match the initiatives of the Science and Technology System with the needs of industry. CICYT has entrusted the management of this line of activity to the Centre for industrial and Technological Development (CDTI)

The budgetary instrument of coordination for the promotion of scientific research and technological development is the National Fund for the Development of Scientific and Technical Research (Fondo Nacional para el Desarrollo de la Investigación Científica y Técnica). During the period 1988-1991 it has risen to an amount of 80,000 million pesetas. In Diagram 3 the distribution of these funds between the main lines of activity, previously mentioned, is represented.

**DIAGRAM 3.–DISTRIBUTION OF THE NATIONAL FUND FOR THE DEVELOPMENT OF SCIENTIFIC AND TECHNICAL RESEARCH (1988-1991).**




**TOTAL: 615 MECU**

## 3.2. PLANNING OF SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT: THE NATIONAL R & D PLAN PROGRAMMES

The National Plan has the responsibility to plan the public initiatives in R & D. Therefore, the budgetary funds are structured around scientific and technological Programmes. In this way the destination of public funds allocated for R & D

activities is decided in terms of the social, technological and economic interests of the Programmes and the appropriateness of these to the inherent objectives of the Programmes.

The National Plan includes the National Programmes, the Sectoral Programmes and the Programmes agreed with the Autonomous Communities.

The **National Programmes** are approved in accordance with defined priority lines of national interest and therefore determine research which is orientated toward specific preferred fields. Their implementation is usually of a multi-institutional character and they are funded from the National Fund. They include all stages of the technical and scientific process up to its culmination in the application of potential innovations to industrial development.

The **Autonomous Communities** can propose to CICYT inclusion in the National Plan of those R & D Programmes which, because of their nature, may require coordination with the general national interests. The funding of these Programmes is normally shared between the Autonomous Communities making the proposal and CICYT.

**Sectoral Programmes** are orientated toward specific areas of interest to a body or ministerial department and their scope or interrelation with National Programmes justifies their inclusion in the National R & D Plan. This occurs as a result of a proposal by the interested department, which also takes responsibility for their management, and the Programmes may be developed within that department or within other public research centres.

The National Plan has also promoted general research, chiefly at the most basic level, because the achievement of technological innovations in certain areas requires a prior effort to set up a productive scientific base; and also because it is necessary to maintain a substratum of researchers guaranteeing an adequate standard of higher education in all areas of knowledge. These objectives are achieved through the Sectoral Programme for the General Promotion of Knowledge (Ministry of Education and Science) which is integrated in the National R & D Plan.

In Table 1 the Programmes which will be carried out during the period 1992-1995 are shown, and in Diagram 4 the distribution of the total budget for scientific and technological areas for the period 1988-1991 is given.

**Table 1.—PROGRAMMES OF THE NATIONAL R & D PLAN (1992-1995)**

**NATIONAL PROGRAMMES**

**Production and Communications Technologies**
- Advanced Production Technologies
- Space Research
- Materials
- Information and Communications Technologies

**Quality of Life and Natural Resources**
- Agricultural Sciences
- Environment and Natural Resources
- Food Technology
- Biotechnology
- Health and Pharmacy

**Social, Economic and Cultural Studies**
- Social, Economic and Cultural Studies

**Horizontal and Special Programmes**
- Training of Research Personnel
- Antarctica
- High Energy Physics
- Information for Scientific Research and Technological Development

**AUTONOMOUS COMMUNITIES**
- Fine Chemistry (Programme of the Autonomous Community of Cataluña)

**SECTORAL PROGRAMMES**
- General Promotion of Knowledge (Ministry of Education and Science)
- Training of University Academic Staff and Improvement of Research Personnel (Ministry of Education and Science)

### 3.3. ACTIONS IN THE AREA OF COORDINATION

One of the historical shortcomings of the Spanish System of Science and Technology was the lack of coordination between initiatives originating in different institutions. The National Plan has attempted to rectify this by acting as an instrument for coordination, that is to say, linking the various initiatives developed by separate —public and private— agents within the System.

Coordination occurs on three different levels: firstly, through the management of the different lines of activity of the National Plan, in which various administrative units participate; secondly, with the linking up of ministerial R & D initiatives which, because of their themes, deserve general planning; finally, as a result of the promotion of links between the Science and Technology System and industry, in other words, the theatre of economic activity. This objetive is based on the need to encourage the R & D initiatives of enterprises, to make the most of public research capacity in order to strengthen the technological assets of enterprises, and to bring together research tasks and industrial, economic and social needs.

The Law of Science allows CICYT to entrust the management of its actions to those bodies which, in each instance, it considers suitable. This has a diversifying effect which is justified on the one hand, by the need to coordinate the various actions and on the other, by the desire to profit from the management structures which already exist in the System.

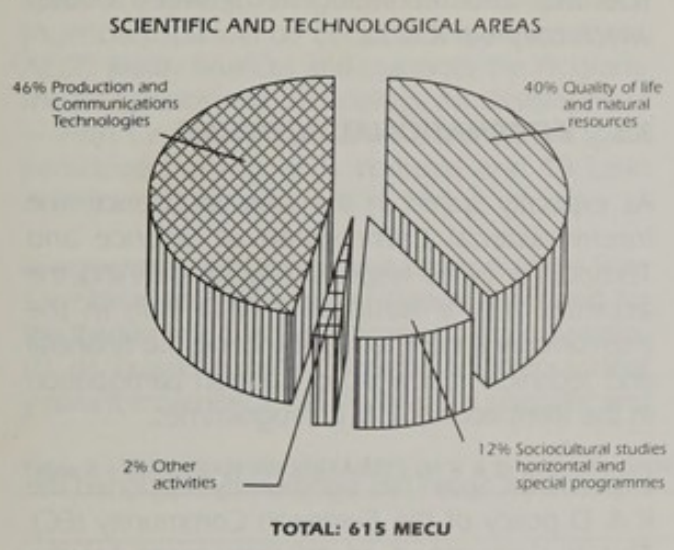
For these reasons CICYT has entrusted CDTI with the management of the Concerted Projects so that this part of the National Plan, aimed at the enterprises, is coordinated with CDTI's own actions and with those of the Ministry of Industry, Commerce and Tourism, included in its Plan of Industrial and Technological Action (PATI). This Plan was published in November 1990, and is aimed at supporting enterprises in the last stages of the process of innovation, particularly in those closest to the industrial development of the process or product.

In a similar way, the management of the National Programme for Training of Research Personnel is entrusted to the General Directorate for Scientific and Technical Research (Ministry of Education and Science) which also manages the Sectoral Programme for the Training of University Academic Staff and Improvement of Research Personnel belonging to that Ministry.

Coordination with the Autonomous Communities occurs, initially, through the harmonization of the official "calls for proposals" and a specialization of actions that is only possible with a sufficient exchange of information. Sometimes this coordination takes place through the co-financing of Programmes or specific actions.

The National Evaluation and Assessment Agency (ANEP) also carries out an important task of coordination through its evaluating activity. The fact that ANEP receives many different types of proposals coming from various bodies, contributes much to coordination, since the aggregate information so gathered helps to improve the quality of evaluation of different actions, avoiding unwanted duplication by separate sources of finance. In short, it can help to streamline the allocation of R & D resources. In Diagram 5 actions evaluated in 1990 are shown as an example.

DIAGRAM 4: DISTRIBUTION OF THE NATIONAL FUND FOR THE DEVELOPMENT OF SCIENTIFIC AND TECHNICAL RESEARCH (1988-1991)

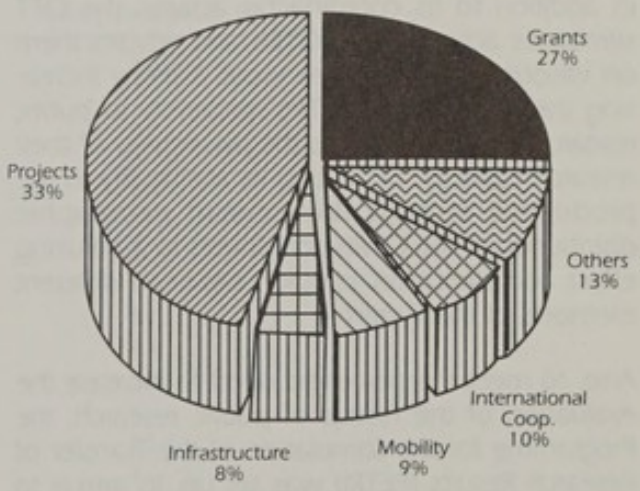



## 3.4. LINKING UP THE SCIENCE - TECHNOLOGY - INDUSTRY SYSTEM

It has already been stated that one of the objectives of the National Plan is the promotion of R & D in enterprises and their collaboration with public research centres. This aims to promote joint action undertaken by these centres and enterprises in R & D activities and the appropriate transfer, to the productive sectors, of the results of public research that may lead to new processes or products of interest to industry. In this way, the Scientific Policy acts as an instrument in the various sectoral policies and the R & D activities contribute to social and economic welfare. To sum up, the aim is to replace the independent operation of the Science – Technology System (SCT) with a linked up Science – Technology – Industry System (SCTI).

The direct relationship between R & D and technological development as well as the need for a swift transfer of knowledge within the cycle of innovation, require coordinated and concerted actions of all the elements making up the System. The National Plan promotes these types of actions, which facilitate fluent communication and exchanges between the elements of the

DIAGRAM 5: ANEP EVALUATED ACTIONS 1990



Plan, and favour the creation of a network which forms the basis of SCTI. Therefore, at the beginning of 1989 the establishment of a dynamic structure, capable of channelling the exchanges between public research centres and enterprises and backing up the function of concerted projects, etc., was designed and advanced.

This interface structure is formed out of the Offices for the Transfer of Research Results (OTRI) which exist in 36 universities, 11 public State and Autonomous Community research bodies, and 13 research associations. They are supported by the General Secretariat of the National Plan, through the Technology Transfer Office, which was created simultaneously.

In addition to its coordinating activity, the OTT stimulates action by the OTRIs and advises them on various aspects of their work, thereby increasing their activity. The OTRIs' proximity to public research centres increases the awareness of their research capacity, facilitating its availability to the productive sectors. Widespread geographic distribution of the OTRIs contributes to a diffusing effect and stimulates contacts between different members of the System.

Also, to meet the perceived need to increase the evaluation of the results of public research, the Programme for the Stimulation of the Transfer of Research Results (PETRI) was set up. Its aim is to provide the OTRI / OTT network with a basic tool which gives them the means to offer incentives to basic and applied research groups, so that they expend part of their effort on R & D actions whose results can be transferred easily and rapidly to enterprises.

Finally, the actions of exchange of research personnel between industries and public research centres, included in the National Programme for Training of Research Personnel, referred to above, are aimed at advancing the work of R & D units in enterprises, as well as creating new units through the temporary inclusion of qualified researchers in enterprises and the temporary movement of scientists and technologists between bodies which carry out R & D.

### 3.5. INTERNATIONAL ACTIVITIES

As explicitly stated in the Law of Science, the Interministerial Commission of Science and Technology holds responsibility for defining the activities of the National R & D Plan in the international sphere, and promoting the financial and technical follow-up of Spanish participation in the International R & D Programmes.

In particular, Spain has significantly supported the R & D policy of the European Community (EC). This is understood as an instrument for the modernization of productive structures, as a means by which disparities within the Community can be overcome, and as a way of stimulating the international competitiveness of industries within the Community.

Similarly, it has been considered essential to promote and encourage the participation of Spanish public research bodies, universities and enterprises in the Community Programmes, which will produce beneficial synergies in the Science and Technology System, resulting in an improvement of competitiveness in the Single European Market of 1993.

The European R & D Programmes in which Spain participates, and the percentage of Spanish participation is shown in Table 2. Spain also participates in the Committees relating to Science and Technology within international organizations such as: OECD (Organization for Economic Cooperation and Development), ECE (Economic Commission for Europe), and UNESCO (United Nations Educational, Scientific and Cultural Organization).

In addition, the Interministerial Commission for Science and Technology, together with the Spanish Agency for International Cooperation (Agencia Española de Cooperación Internacional, AECI), jointly finances and manages the Programme for Science and Technology for Development – Fifth Centenary (CYTED – D) in which Spain participates along with Portugal and 19 Latin American countries.

In agreement with the organic structure of the State Secretariat for International Cooperation and for the Iberian and Latin American countries (Secretaría de Estado para la Cooperación Internacional y para Iberoamérica, SECIP), bilateral scientific and technological cooperation in R & D is basically channelled through the General Directorate for Scientific and Cultural Relations and the Spanish Agency for International Cooperation (AECI), and is developed under the corresponding scientific and technical cooperation and complementary agreements.

The modes of cooperation existing in these agreements vary greatly: the exchange of scientific and technical information, the exchange of scientists and experts, the organization of seminars, meetings and congresses of a scientific and technical character, the carrying out of research projects on themes of common interest, etc.

**Table 2.–EUROPEAN PROGRAMMES OF R & D WITH SPANISH PARTICIPATION (1990)**

| | Spanish participation (%) |
|---|---|
| EC Framework Programme | 8 (1) |
| Other European Programmes: | |
| AIRBUS Programme | 4.2 |
| International Cooperation in Astrophysics | 20 (2) |
| European Organization for Nuclear Research (CERN) | 7.6 |
| International Centre for Advanced Mediterranean Agricultural Studies (CIHEAM) | 21 |
| COST Fund (Scientific and Technical Cooperation between the European Communities and third European Countries) | 5.9 |
| European Molecular Biology Laboratory (EMBL) | 4.4 |
| European Molecular Biology Organization (EMBO) | 5.8 |
| European Space Agency (ESA) | 4 |
| European Science Foundation (ESF) | 5.5 |
| European Synchrotron Radiation Facility (ESRF) | 4 |
| EUREKA Programme | 6.2 (3)<br>21 (4) |
| Max Von Lave – Paul Langevin Institute (ILL) | 1.5 |
| Large Earth-based Solar Telescope (LEST) | 14.4 |
| Ocean Drilling Programme (ODP) | 4 |

(1) Corresponds to the Spanish contribution to the total European Community budget.
(2) Observation time.
(3) Relates to total investment in EUREKA projects.
(4) Relates to investment in projects with Spanish participation.

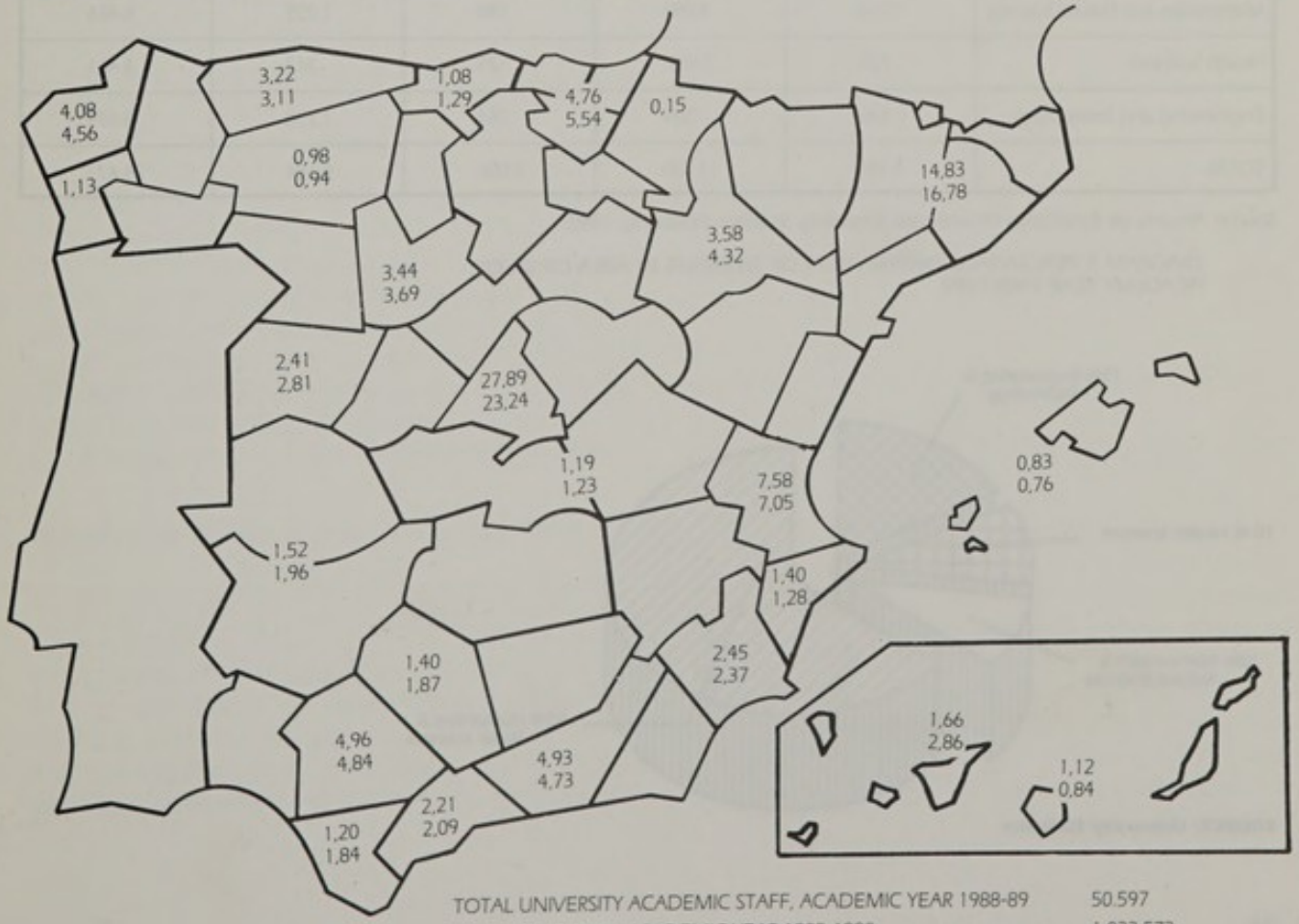
# 4. Research and Development Institutions

## 4.1. UNIVERSITIES

Universities account for 50% of Spanish scientists (on a full-time equivalent basis); that is to say, they constitute the most important potential source of research in the country. In addition to teaching, universities carry out important research and support work for the socio–economic sectors. Both of these activities have increased considerably over the last few years.

There are 37 public universities in Spain, including the Menéndez Pelayo International University and the one recently created at Castellón. Their geographical distribution is shown on the map in Diagram 6 where the percentages of students and university academic staff are also given (excepting those of the Pompeu Fabra University [Barcelona] and the Jaume I University [Castellón], where courses were not held during the quoted years). Similarly, the information concerning numbers of university academic staff at the public universities of La Coruña, Vigo, Carlos III (Madrid) and Navarra is not given. In addition to public universities four private universities exist (Deusto University, Navarra University, Pontifical University of Comillas and Pontifical University of Salamanca) which account for 3.21% of the total number of university students in Spain. Tables 3 and 4 show respectively, the distribution of university students, by type of centre, and the total number of professors and lecturers, by area of specialization. Diagram 7 shows the distribution, by area of study, of students.

DIAGRAM 6: GEOGRAPHIC DISTRIBUTION OF STUDENTS (UPPER NUMBER) AND UNIVERSITY ACADEMIC STAFF (LOWER NUMBER) AS PERCENTAGES OF THE TOTAL FOR PUBLIC UNIVERSITIES 1989-1990




TOTAL UNIVERSITY ACADEMIC STAFF, ACADEMIC YEAR 1988-89 50.597
TOTAL STUDENTS, ACADEMIC YEAR 1989-1990 1.033.573

Source: Anuario de Estadística Universitaria (University Statistics Yearbook), 1989.

**Table 3.–DISTRIBUTION OF STUDENTS BY TYPE OF CENTRE (ACADEMIC YEAR 1989-90)**

| Types of Centres | Public Centres | Private Centres | TOTAL |
|---|---|---|---|
| University Faculties and Colleges | 661.024 | 28.134 | 689.158 |
| University Schools (non-technical) | 213.341 | 2.314 | 215.655 |
| University Higher Technical Schools | 66.073 | 3.166 | 69.239 |
| University Technical Schools | 93.135 | 687 | 93.822 |
| TOTAL | 1.033.573 | 34.301 | 1.067.874 |

Source: Anuario de Estadística Universitaria (University Statistics Yearbook). 1990.

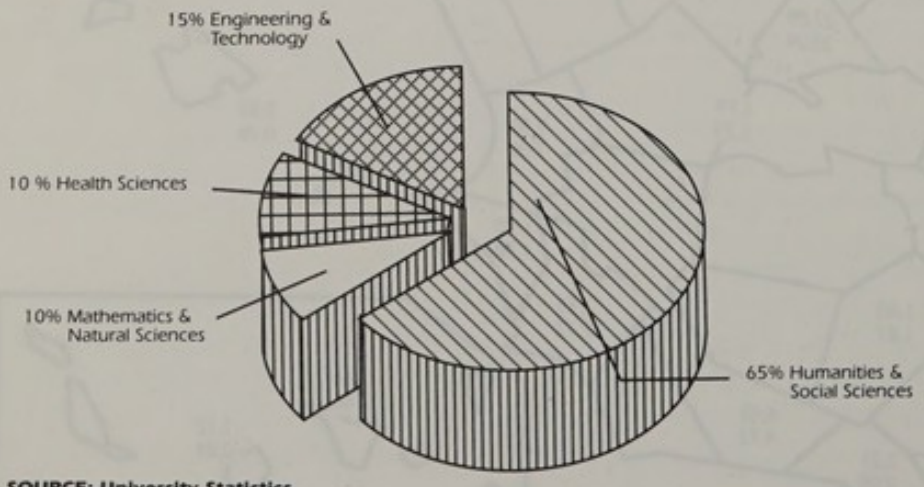
**Table 4.–DISTRIBUTION OF UNIVERSITY ACADEMIC STAFF IN PUBLIC UNIVERSITIES BY AREA OF SPECIALIZATION**

**(19 JUNE, 1990)**

| Areas | University Professors | University Lecturers | University School Professors | University School Lecturers | Total |
|---|---|---|---|---|---|
| Humanities and Social Sciences | 1.833 | 5.392 | 580 | 3.080 | 10.885 |
| Mathematics and Natural Sciences | 1.150 | 4.091 | 190 | 1.035 | 6.466 |
| Health Sciences | 720 | 2.403 | 25 | 313 | 3.461 |
| Engineering and Technology | 646 | 1.534 | 261 | 1.218 | 3.659 |
| TOTAL | 4.349 | 13.420 | 1.056 | 5.646 | 24.471 |

Source: Anuario de Estadística Universitaria (University Statistics Yearbook). 1990.

DIAGRAM 7: PERCENTAGE DISTRIBUTION OF STUDENTS BY AREA OF STUDY. ACADEMY YEAR 1988-1989

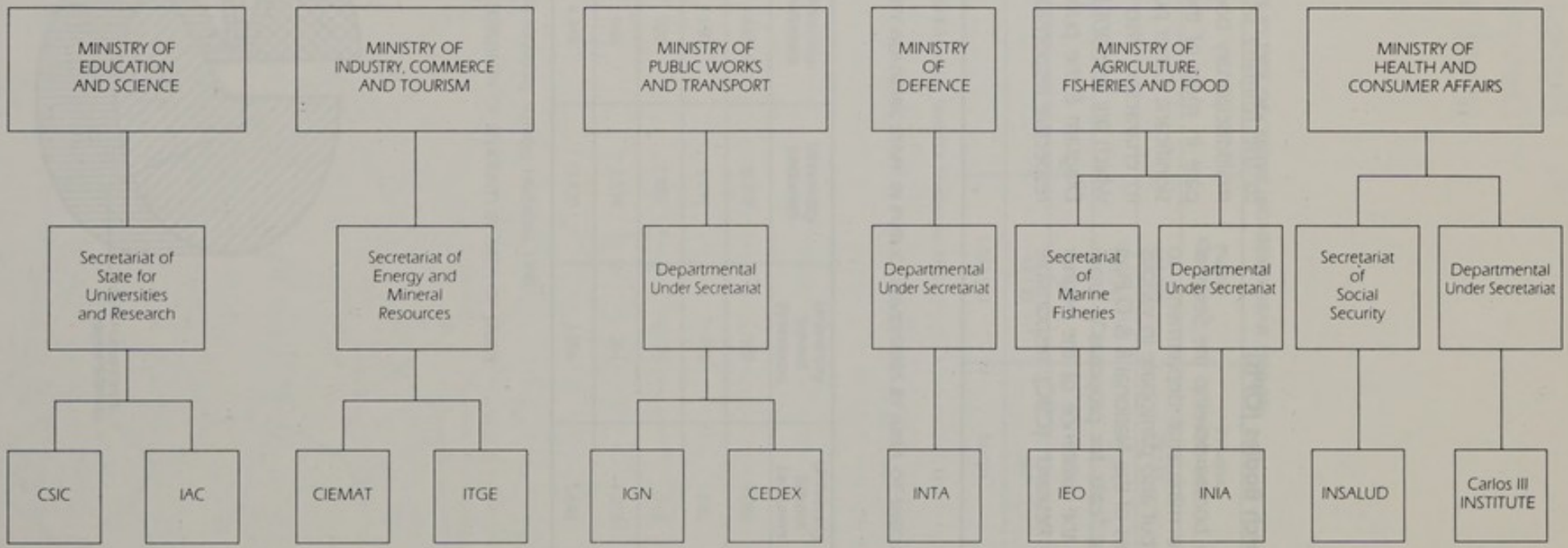



**SOURCE: University Statistics**

## 4.2. Public Research Bodies (OPIs)

The public research bodies develop the Sectoral Programmes for the ministerial departments to which they belong but also participate in various National Programmes of the National R & D Plan (through the annual "calls for proposas"). From this point of view, the existence of the Higher Centre for Scientific Research (CSIC), responsible to the Ministry of Education and Science, a multidisciplinary body whose researchers participate in most of the Programmes, is particularly significant. Other public research bodies, sectoral in character, also participate in Programmes which are relevant to their own area of work. In Diagram 8 the public research bodies and their respective responsible Ministries are shown.

DIAGRAM 8.—PUBLIC RESEARCH BODIES



## Ministry of Education and Science

a) HIGHER CENTRE FOR SCIENTIFIC RESEARCH (CSIC)

The CSIC is the largest public research body in Spain. Its character is multisectoral and it develops its research activity in the following scientific areas: humanities and social sciences; biology and biomedicine; agricultural sciences; space and Earth sciences; mathematics physics and chemistry; technology. It also provides support centres (database, information, etc.) and central administrative centres. CSIC's total budget in 1990 amounted to 45,295 million pesetas (348,4 million ECU), out of which 33,015 million (254 million ECU) represented its ordinary budget, it has 101 centres and 6,500 staff of whom approximately 2,200 are researchers.

b) THE CANARY ISLANDS INSTITUTE FOR ASTROPHYSICS (IAC)

The development of scientific research projects in the field of astrophysics and related areas is the main purpose of this Institute. Through the International Cooperation Agreements in Astrophysics, IAC's observatories of Roque de los Muchachos (La Palma) and Teide (Tenerife) have been internationalized. Spain guarantees research activity and the protection of the observatories in accordance with the International Astronomical Union guidelines. The budget for IAC in 1990 totalled 1,243 million pesetas 9.6 million ECU) and it has 178 R & D employees of whom 111 are researchers on a full-time equivalent basis.

## Ministry of Public Works and Transport

a) NATIONAL GEOGRAPHIC INSTITUTE (IGN)

The Institute is reponsible for national basic cartography. Among other things it coordinates the R & D activities of the centres responsible to it; covering the areas of geodesy, cartographic training, astronomics and geophysics, cartographic processes, metrology, seismology, etc. Research in geophysics is carried out through the National Seismic Network and the Geomagnetic Observatories. Research in astrophysics takes place at the Astronomical Centre of Yebes and the Calar Alto Observatory among other places. The IGN budget for 1990 amounted to 5,145 million pesetas (39.5 million ECU), out of which 561 million (4.3 million ECU) was allocated for research activities. This centre employs 70 R & D staff, including 24 research workers on a full-time equivalent basis.

b) RESEARCH AND EXPERIMENTAL CENTRE FOR PUBLIC WORKS (CEDEX)

This is a Centre of technological and multidisciplinary support for civil engineering and public works devoted to high-level research, development and technical assistance; from planning, to work inspection, to staff training. CEDEX carries out studies on materials and structures for public works, soil dynamics, harbours, coasts and oceonagraphy, hydrology and hydraulic resources, hydraulics, general and energy mechanics, etc. The budget for 1990 totalled 4,777 million pesetas (36.7 million ECU), 404 million (3.1 million ECU) of which were devoted to R & D, and some 1,268 million (9.7 million ECU) to studies and technical assistance. The Centre employs 688 R & D people, 70 of whom are researchers on a full-time equivalent basis.

## Ministry of Industry, Commerce and Tourism

a) TECHNOLOGICAL GEOMINING INSTITUTE OF SPAIN (ITGE)

This Institute carries out most of the R & D activities in the following areas: geology, mining, hidrogeology, geotechnics, sea-bed research, environmental geology, mining safety and geological hazards study. In 1990 ITGE's budget for R & D activities amounted to 5,529 million pesetas (42.5 million ECU). It employs 521 R & D staff, 254 of whom are researchers on a full-time equivalent basis.

b) CENTRE FOR ENERGY, ENVIRONMENTAL AND TECHNOLOGICAL RESEARCH (CIEMAT)

The R & D activities carried out in this Centre are chiefly directed toward solving energy problems, paying special attention to the study of alternative energy sources which, while allowing the development of industrial activity, will protect public health and conserve the natural environment. It is divided into four departments, each dealing with a specific field: Renewable Energy, Radiation Protection and the Environment, Nuclear Technology, and Basic Research. In addition, it has the Technology Directorate as a support unit and the Energy Studies Institute for the training of staff. The CIEMAT local budget in 1990 was 7,587 million pesetas (58.4 million ECU) and it has a staff of 1,392 R & D employees including 507 researchers on a full-time equivalent basis.

**Ministry of Defence**

a) NATIONAL INSTITUTE FOR AEROSPACE TECHNOLOGY (INTA)

This research and development body specializes in the diverse fields of aerospace and aeronautic technologies. The largest projects in which it participates are EFA (European Fighting Aeroplane) in the aeronautic sphere, and the development of the Helios and Hispasat satellites, and minisatellites in the aerospace sphere. In addition, it develops other programmes and facilities such as the Official Trial Centre (OTC), the Trisonic Tunnel, and the Centre for the Treatment and Exploitation of images of Helios (Centro para el Tratamiento y Explotación de Imágenes del Helios). Many of INTA's activities are carried out under international cooperation agreements and contracts —particularly with NASA and ESA— and by subcontracting with Spanish and foreign companies. Its budget for 1990 amounted to 9,042 million pesetas (69.5 million ECU). At present it has 1,153 R & D staff, 325 of whom are research workers on a full-time equivalent basis.

**Ministry of Agriculture, Fisheries and Food**

a) SPANISH INSTITUTE FOR OCEANOGRAPHY (IEO)

This Institute deals with the research of scientific problems in relation to oceanography and fisheries: marine biology, fishing technology and biology, marine pollution, oceanographic physics, marine geology, oceanographic chemistry, etc. Its budget in 1990 amounted to 2,949 million pesetas (22.7 million ECU). It has 375 R & D employees, of whom 142 are researchers on a full-time equivalent basis.

b) NATIONAL INSTITUTE FOR AGRICULTURAL AND FOOD TECHNOLOGY AND RESEARCH (INIA)

As a result of extensive decentralization in the promotion and execution of R & D in agriculture, each of the Autonomous Communities has assumed responsibility for carrying out R & D while the coordination of a national agricultural research programme, international relations, and much of the finance remains the responsibility of central government. INIA deals with agriculture, sylviculture (forestry) and livestock breeding, specifically within these categories: herbaceous cultivation, ligneous cultivation, animal husbandry, forestry development, etc. Its R & D budget in 1990 amounted to 5,564 million pesetas (43 million ECU). The Institute has approximately 1,200 employees 675 of whom carry out R & D activities and 311 of whom are researchers on a full-time equivalent basis.

**Ministry of Health and Consumer Affairs**

a) NATIONAL INSTITUTE OF HEALTH (INSALUD)

This is the body responsible for medical and sanitary assistance policy and the promotion of health in general. It finances clinical, pharmacological and biomedical research through the Fondo de Investigaciones Sanitarias (Health

Research Fund, FIS), whose purpose is to carry out studies and activities which may contribute to the improvement of the provision of public health facilities. FIS coordinates its actions with the National R & D Plan through joint "calls for proposals" with the Sectoral Programme for General Promotion of Knowledge, integrated in the National Plan. The FIS budget in 1990 was 4,167 million pesetas (32 million ECU).

b) THE CARLOS III INSTITUTE OF HEALTH

The Institute provides scientific and technical support to the Ministry of Health and to various health services of the Autonomous Communities. The main tasks of this body are to promote and carry out research activities in the fields of health and biomedicine, as well as in those of clinical research, pharmacobiology, food safety and environmental pollution. The Institute has several National Research Centres and finances joint programmes with other public research institutions. The R & D budget in 1990 totalled 8,837 million pesetas (68 million ECU). It has 768 employees engaged in R & D activities, of whom 138 are researchers on a full-time equivalent basis.

## 4.3. INDUSTRIAL ENTERPRISES

The promotion of R & D activities in enterprises is one of the main objectives of the scientific and technological policy. The creation of own technology is essential in terms of increasing the competitiveness of production both in the national and the international market and it is one of the basic requirements for reducing the balance of payments deficit resulting from the acquisition of foreign technology.

In conjunction with the various methods of assistance given to achieve these objectives —mainly by the National R & D Plan and the Plan of Industrial and Tecnological Action (Ministry of Industry, Commerce and Tourism)—, since 1989 tax incentives for R & D have been offered. These allow private enterprises to reduce their corporation tax contribution by 30% of capital investment and 15% of other expenditures on intangible assets for the research and development of new products or industrial processes.

Spanish enterprises have increased R & D expenditure over 1982-1990 by an average annual cumulative rate of 23%, which represents one of the largest increases of the OECD over that period. At present the enterprise sector accounts for 58% of Spanish expenditure on R & D activities.

According to various estimates there are about 1,000 enterprises carrying out significant R & D activities. The most important R & D initiatives are to be found in the following sectors: chemicals (about 18%), motor and transport equipment (17%), electronics and electrical products (11%) and computer software (7%).

Around 20% of enterprises are responsible for over 75% of R & D expenditure in the business sector and utilize 70% of human resources. This high concentration of R & D activities does not prevent the increasing incorporation of small and medium-size enterprises in these activities, as can be seen from a study of the distribution of aid given by the R & D National Plan and that given by the Ministry of Industry, Commerce and Tourism.

### – Public enterprises

About 20% of enterprise R & D initiatives are carried out by public enterprises. Among those that should be mentioned are those belonging to the National Institute of Industry (INI), a holding company subject to a policy of economic

guidelines laid down by the Government, as well as those belonging to the National Institute of Hydrocarbons (INH) (Ministry of Industry, Commerce and Tourism), RENFE (Spanish National Railways Network), FEVE (Narrow-gauge Railways), and the National Telephone Company (CTNE); the major shareholder of these enterprises is the Spanish State.

The INI group acts mainly in the area of basic industries and transport industries, such as the production of aluminium and the aviation industry. It is responsible for over 80% of shipbuilding and half the production of ammonia. It also accounts for a large proportion of national electricity, steel and coal production. In 1990 expenditure on R & D in the INI group amounted to 34,500 million pesetas (265.3 million ECU), out of which the most outstanding sums were spent in the aerospace (50%), energy (19%) and defence (13%) sectors.

The INH is made up of the REPSOL group, which operates in the field of the oil, gas and petrochemical sectors. In 1990, the INH spent 2,800 million pesetas (21.5 million ECU) on R & D in various areas of activity (mainly exploration, oil and petrochemical refining).

The National Telephone Company of Spain (CTNE) has a subsidiary (Telefónica Investigación y Desarrollo, S.A.) which deals with the development of services, network structures and new exploitation techniques in the field of telecommunications. This enterprise has more than 500 employees, of whom 75% are graduates, and in 1990 the turnover for R & D services in CTNE and other enterprises belonging to the group was 5,700 million pesetas (43.8 million ECU).

**Private enterprises**

In 1990 the expenditure on R & D by private enterprises represented about 0.7% of their turnover. This was very unevenly distributed, not only between different sectors but also within each sector.

Of the sectors carrying out significant R & D activities, the most important is the chemical industry and more specifically the pharmaceutical sector, which devotes approximately 1,000 scientists and about 6% of their turnover to R & D; but there are other sectors which are constantly increasing the level of their R & D activity, such as electronics, computer software and telecommunications.

In traditional industrial sectors such as footwear, wood products and furniture, textiles, toy manufacture, etc., there are enterprise research associations whose aim is to develop research projects, at the pre-competitive stage, into new products or manufacturing processes, which are relevant to their sector. Over the last few years these associations have devoted most of their efforts to the incorporation of computer and robotic technologies in their production processes, and to the development and application of new materials.

# 5. Expenditure on and finance of R & D activities

## 5.1. GENERAL INFORMATION ON SPAIN

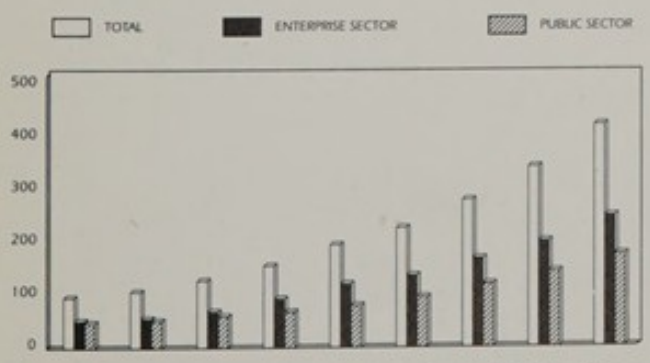
- Area: 504,750 square kilometres.
- Population: 39 million inhabitants.
- Currency: peseta. 1 ECU = 130 pesetas.
- GNP = 49.7 billion pesetas.

## 5.2. EXPENDITURE ON R & D

In Spain financial expenditure on R & D has grown very rapidly over the decade of the 1980s, particularly since the coming into force of the Law of Science.

Diagram 9 represents the growth of total expenditure on R & D in Spain over the last few years. The average annual cumulative rate of growth in expenditure on R & D (at constant prices) during the period 1983-1989 was above 15%, practically double the average rate of growth for equivalent expenditure in the most advanced industrial countries, which began with a total of expenditure more in line with the needs of the production system. The estimates for 1990 reflect a strong increase in expenditure in comparison with the previous year: the total expenditure amounts to a figure of 410,000 million pesetas (3,154 million ECU) compared with 340,000 million (2,615 million ECU) for 1989.

DIAGRAM 9.–EXPENDITURE ON R & D
(THOUSAND MILLION PESETAS)

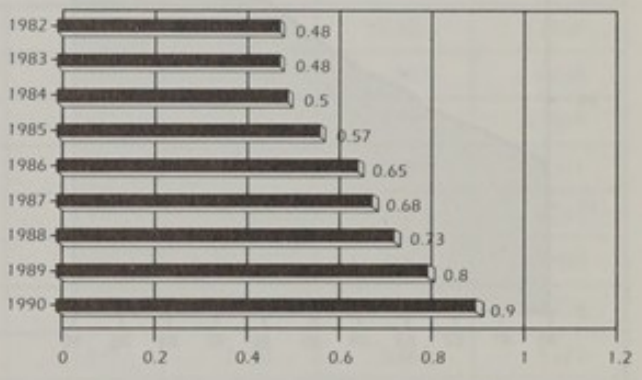



Source: National Statistics Institute (Instituto Nacional de Estadística, INE).

Note: The information for 1988, 1989 and 1990 is an estimate INE-SGPN.

The relative indicator for Gross Domestic Product (GDP) at factor cost has gone from 0.48% in 1983 to 0.90% in 1990 as can be seen in Diagram 10. The increase is less important than that shown for expenditure in absolute terms owing to the simultaneous increase in the Gross Domestic Product (GDP), as represented in Diagram 11.

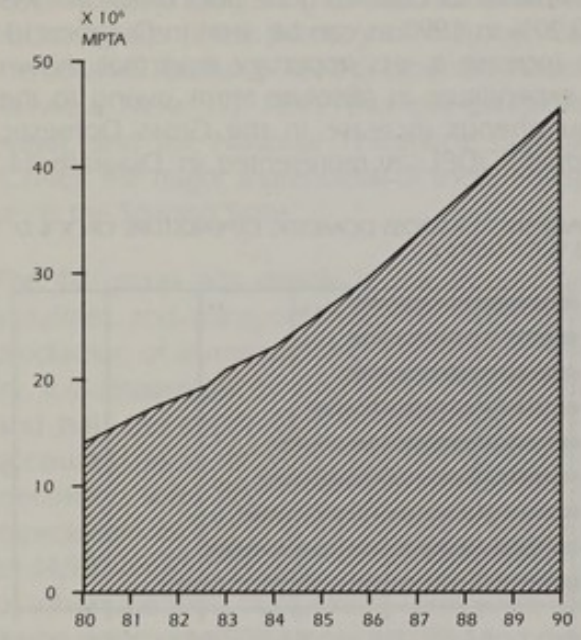
DIAGRAM 10.–GROSS DOMESTIC EXPENDITURE ON R & D
(AS % OF GDP F.C.)




Source: National Statistics Institute (Instituto Nacional de Estadística, INE).

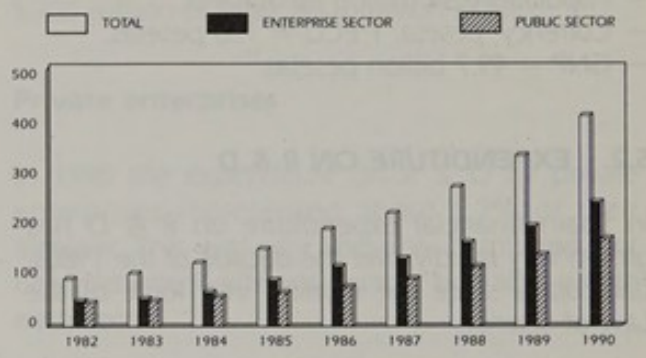
Note: The information for 1989 and 1990 is an estimate INE-SGPN.

DIAGRAM 11. GROWTH OF GROSS DOMESTIC PRODUCT (AT FACTOR COST)




**Source: National Statistics Institute (Instituto Nacional de Estadistica, INE).**
**Note: 1989-1990 estimates made by the Ministry of Economics and Finance.**

DIAGRAM 12. FINANCE OF R & D (THOUSAND MILLION PESETAS.)




**Source: National Statistics Institute (Instituto Nacional de Estadistica, INE). 1988 - 89 - 90 estimates SGPN**

The enterprise sector accounts for approximately 58% of total expenditure, the higher education sector 17%, and the public sector 25%. In relation to the finance of expenditure (Diagram 12) in 1990 the public sector financed 60% of national expenditure, which reflects net transfers from the public sector to the enterprise sector, corresponding to the volume of promotional initiatives in R & D in enterprises, undertaken by the State. This operational and financing structure is similar to that of other industrial countries with comparable socio-economic conditions.

With regard to public financing of R & D, in Table 5 the sectors, by objective, and according to the information provided by NABS (Nomenclature for the Analysis and Comparison of Science Programmes and Budgets) are indicated.

**Table 5. PUBLIC FINANCING OF R & D BY NABS OBJECTIVES IN MILLIONS OF PESETAS (NOMENCLATURE FOR THE ANALYSIS AND COMPARISON OF SCIENCE PROGRAMMES AND BUDGETS)**

| NABS Objectives | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|
| Exploration and exploitation of the Earth | 12.221 | 11.158 | 15.121 | 13.488 |
| Infrastructure and planning of land use | 317 | 587 | 957 | 1.159 |
| Control and prevention of environmental pollution | 2.641 | 2.799 | 4.881 | 11.559 |
| Protection and improvement of human health | 13.434 | 13.917 | 15.289 | 18.311 |
| Production, distribution and rational utilization of energy | 4.110 | 4.199 | 7.143 | 6.701 |
| Agricultural production and technology | 9.180 | 10.709 | 13.061 | 13.930 |
| Industrial production and technology | 31.642 | 33.161 | 39.359 | 44.734 |
| Social structures and relationships | 1.317 | 1.281 | 3.061 | 4.077 |
| Exploration and exploitation of space | 8.148 | 11.718 | 14.643 | 14.950 |
| University research | 28.042 | 30.333 | 37.916 | 48.533 |
| Non-orientated research | 12.487 | 20.799 | 24.171 | 27.468 |
| Non-classified research | 4.862 | 5.849 | 8.596 | 12.859 |
| Defence | 12.172 | 24.833 | 49.211 | 49.665 |
| TOTAL PUBLIC EXPENDITURE | 140.580 | 171.349 | 233.414 | 267.439 |

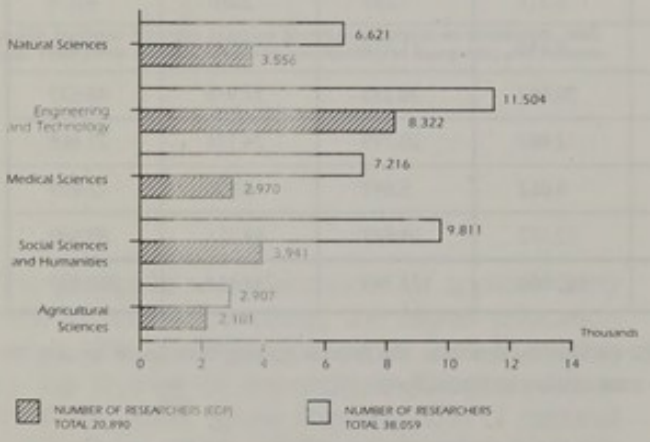
Note: The estimates for public finance (by objective, according to NABS) exclude, by definition, the finance coming from Social Security. In addition, the contribution made by universities accounts for 16% of the total amount of the budgets.

## 5.3. R & D PERSONNEL

The growth in national R & D initiatives has in turn produced a large increase in research personnel. The number of researchers per one thousand members of the active population had reached 2.6 by 1990 compared with 1.02 in 1982. This increase was based on an average annual cumulative rate of the number of researchers on a full-time equivalent basis (EDP) which was nearly 14% for this period.

In 1987 National Statistics Institute (INE) information indicated that the number of people employed in R & D was 38,059 and the total number of researchers on a full-time equivalent basis (EDP) was 20,890; the number of researchers by scientific area is given in Diagram 13.

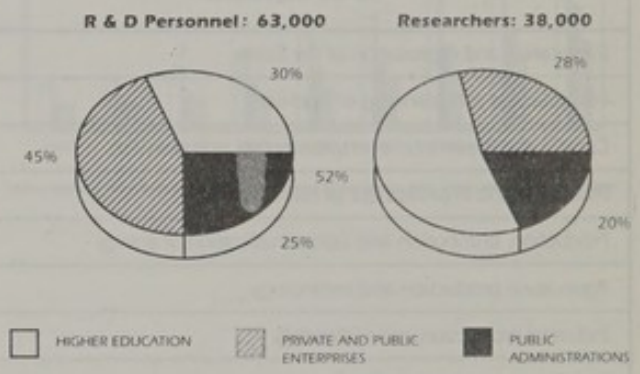
DIAGRAM 13. NUMBER OF RESEARCHERS BY SCIENTIFIC AREA IN 1987




Source: National Statistics Institute (Instituto Nacional de Estadística, INE).

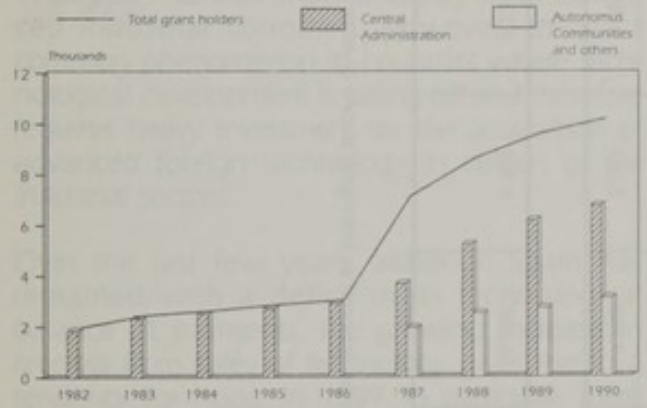
In diagram 14 the distribution of personnel engaged in R & D in 1990, according to the estimates of the General Secretariat for the National R & D Plan, is given by sector. The substantial increase that has taken place since 1987 can be clearly seen.

DIAGRAM 14. PERSONS ENGAGED IN R & D IN 1990 (ON A FULL-TIME EQUIVALENT BASIS)



On the other hand, as well as an increase in the number of researchers, there has also been a significant growth in the training of personnel, as a result of National Plan actions and other private and public initiatives. In diagram 15 the growth in the number of postgraduate and improvement grants, awarded to the Programmes of the Plan, both in Spain and abroad, as well as those financed by the Autonomous Communities and other private and public institutions, between 1982 and 1990, is given.

DIAGRAM 15. RESEARCH GRANT HOLDERS IN SPAIN




## 5.4. RESULTS

From the information provided in the previous sections, it can be concluded that during the last few years the Spanish System of Science and Technology has undergone a significant expansion, not only in terms of the proportion of national resources allocated to R & D, but also in terms of the number of researchers involved. This has had the effect of consolidating the System, visibly enhancing and increasing scientific and technological achievements.

This is evident to begin with from an analysis of the recent growth in the volume of Spanish scientific output, measurable by the number of papers published by Spanish scientists in relation to the number published by scientists in the rest of the world. Scientific output has undergone a considerable increase between 1982 and 1990, rising from 0.8% to 1.6%, as Table 6 shows. In Table 7 the growth in each of the main scientific and technological areas is shown

**Table 6. RELATIVE PERCENTAGE OF SPANISH SCIENTIFIC PUBLICATIONS (Institute for Scientific Information)**

| | 1982 | 1985 | 1988 | 1990 |
|---|---|---|---|---|
| Spain/ Rest of the world | 0,8% | 1,0% | 1,3% | 1,6% |
| Spain/ France | 16,3% | 20,4% | 25,3% | 29,9% |
| Spain/ Germany | 12,7% | 16,4% | 20,3% | 23% |
| Spain/ Italy | 35,8% | 41,8% | 51,1% | 55,7% |
| Spain/ United Kingdom | 11,3% | 13,9% | 17,8% | 20,4% |
| Spain/ United States | 2,2% | 2,8% | 3,7% | 4,2% |

**Table 7. SPANISH SCIENTIFIC OUTPUT DURING THE PERIOD 1982-1990**

| SCIENTIFIC/ TECHNOLOGICAL AREA | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | Increase in competitiveness in relation to world total |
|---|---|---|---|---|---|---|---|---|---|---|
| AGRICULTURAL SCIENCES | 497 | 524 | 598 | 697 | 853 | 1.024 | 1.102 | 1.243 | 1.360 | 166 |
| CLINICAL SCIENCES | 1.552 | 2.024 | 1.922 | 2.108 | 2.202 | 2.567 | 2.654 | 2.512 | 2.598 | 61 |
| ENGINEERING | 255 | 230 | 322 | 360 | 469 | 507 | 481 | 616 | 688 | 173 |
| LIFE SCIENCES | 1.969 | 2.045 | 2.148 | 2.536 | 3.123 | 3.139 | 3.439 | 3.723 | 3.974 | 105 |
| PHYSICS AND CHEMISTRY | 1.448 | 1.781 | 2.212 | 2.362 | 2.833 | 2.865 | 3.127 | 3.393 | 3.634 | 135 |
| TOTAL | 5.721 | 6.604 | 7.202 | 8.063 | 9.480 | 10.102 | 10.803 | 11.487 | 12.254 | |
| **TOTAL OF DISTINCT PUBLICATIONS** | 4.967 | 5.643 | 6.068 | 6.955 | 7.221 | 8.816 | 9.331 | 9.995 | 10.374 | 107 |

Source: Institute for Scientific Information (ISI).

Note: Totals do not correspond exactly since individual publications may be counted as belonging to one or more areas.

In terms of technological output, the relative indicators of growth for the technological balance of payments and patents should be mentioned.

The technological balance of payments records transactions between countries in the area of technology, and more specifically, evaluates financial outlay for the acquisition or use of patents, licences, know-how and technical services. The growth of the cover rate for technological exchanges —receipts over payments— from 1982 through to 1988, reflects a deterioration in Spain's technological balance of payments which is of the same nature —although different in degree— to that experienced by other advanced industrial countries. However, this is a common phenomenon in countries where technological development is taking off and therefore requires heavy investment for the acquisition of advanced foreign technology in certain of the industrial sectors.

Over the last few years, although Spain has remained with a deficit in its technological balance of payments, the growing increase in receipts from sales of technology gives rise to a tendency for hope. In 1989, in particular, there was a 66% increase in the receipts for technology compared with the previous year; whereas payments increased by a mere 24%, resulting in a cover rate of 18.4% in comparison with that of 13.5% for 1988. The movement of the cover index continues to be positive. In 1990 it had reached 19.3% and the receipts continually increase in percentage terms over those of payments.

The other chief indicator of technological output —that of patents— shows that, in the last few years the rate of penetration of Spain, by foreign patents, has substantially increased. This phenomenon coincides with a sudden opening up of national markets to international competition and its corresponding interest in these markets. In any event, the movement of the indicator reflects the degree of exposure to international competition of the Spanish Technological System.

The average annual cumulative increase in the number of patents presented abroad, by Spanish residents, during this period, is larger than that of national residents in neighbouring countries. This fact seems to reflect the greater presence of Spanish technology in the international System of Science and Technology.

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# Acronyms and abbreviations

AECI
Agencia Española de Cooperación Internacional (Spanish Agency for International Cooperation)

ANEP
Agencia Nacional de Evaluación y Prospectiva (National Evaluation and Assessment Agency)

CAICYT
Comisión Asesora de Investigación Científica y Técnica (Advisory Commission for Scientific and Technical Research)

CCAA
Comunidades Autónomas (Autonomous Communities)

CDTI
Centro para el Desarrollo Tecnológico Industrial (Centre for Technological and Industrial Development)

CEDEX
Centro de Estudios y Experimentación de Obras Públicas (Research and Experimental Centre for Public Works)

CERN
Conseil Européen pour la Recherche Nucléaire (European Organization for Nuclear Research)

CICYT
Comisión Interministerial de Ciencia y Tecnología (Interministerial Commission for Science and Technology)

CIEMAT
Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (Centre for Energy, Environmental and Technological Research)

COST
Coopération Européenne Scientifique et Technique (Scientific and Technological Cooperation between the European Communities and European third countries)

CPI
Centro Público de Investigación (Public Research Centre)

CSIC
Consejo Superior de Investigaciones Científicas (Higher Centre for Scientific Research)

CTNE
Compañía Telefónica Nacional de España (National Telephone Company of Spain)

CYTED-D
Programa de Ciencia y Tecnología para el Desarrollo - Quinto Centenario (Programme for Science and Technology for Development - Fifth Centenary)

DGICYT
Dirección General de Investigación Científica y Técnica (General Directorate of Scientific and Technical Research)

EC
European Community

ECE
Economic Commission for Europe

EDP
Equivalente a Dedicación Plena (Full-time equivalent basis)

EFA
European Fighting Aircraft

EMBL
European Molecular Biology Laboratory

EMBO
European Molecular Biology Organization

ESA
European Space Agency

ESF
European Science Foundation

ESRF
European Synchrotron Radiation Facility

FEVE
Ferrocarriles de Vía Estrecha (Narrow-gauge Railways)

FIS
Fondo de Investigaciones Sanitarias (Fund for Health Research)

GDP
Gross Domestic Product

GNP
Gross National Product

IAC
Instituto de Astrofísica de Canarias (Canary Islands Institute for Astrophysics)

IEO
Instituto Español de Oceanografía (Spanish Institute of Oceanography)

IGN
Instituto Geográfico Nacional (National Geographic Institute)

ILL
Max Von Laue-Paul Langevin Institute

INE
Instituto Nacional de Estadística (National Statistics Institute)

INH
Instituto Nacional de Hidrocarburos (National Institute of Hydrocarbons)

INI
Instituto Nacional de Industria (National Institute of Industry)

INIA
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (National Institute for Agricultural and Food Technology and Research)

INSALUD
Instituto Nacional de la Salud (National Institute of Health)

INTA
Instituto Nacional de Técnica Aeorespacial (National Institute for Aerospace Technology)

ISI
Institute for Scientific Information

ITGE
Instituto Tecnológico Geominero de España (Technological Geomining Institute of Spain)

LEST
Large Earth-based Solar Telescope Programme

LRU
Ley de Reforma Universitaria (Law of University Reform)

MEC
Ministerio de Educación y Ciencia (Ministry of Education and Science)

MEH
Ministerio de Economía y Hacienda (Ministry of Economics and Finance)

NABS
Nomenclature for the Analysis and Comparison of Science Programmes and Budgets

NASA
National Aeronautics and Space Administration

OECD
Organization for Economic Cooperation and Development.

ODP
Ocean Drilling Programme

OPI
Organismos Públicos de Investigación (Public Research Bodies)

ORFEUS
Observatories and Research Facilities for European Seismology

OTC
Oficial Trial Centre

OTRI
Oficina de Transferencia de Resultados de Investigación (Office for the Transfer of Research Results)

OTT
Oficina de Transferencia de Tecnología (Technology Transfer Office)

PATI
Plan de Actuación Tecnológico Industrial (Plan of Industrial and Technological Action)

PETRI
Programa de Estímulo a la Transferencia de Resultados de Investigación (Programme for the Simulation of the Transfer of Research Results)

PGC
Promoción General del Conocimiento (General Promotion of Knowledge)

PPNN
Programas Nacionales (National Programmes)

R & D
Research and Development

RENFE
Red Nacional de Ferrocarriles Españoles (Spanish National Railways Network)

SCT
Sistema Ciencia-Tecnología (Science-Technology System)

SCTI
Sistema Ciencia-Tecnología-Industria (Science-Technology-Industry System)

SECIPI
Secretaría de Estado para la Cooperación Internacional y para Iberoamérica (State Secretariat for International Cooperation and for the Iberian and Latin American countries)

SGPN
Secretaría General del Plan Nacional (General Secretariat for the National R & D Plan)

UNESCO
United Nations Educational, Scientific and Cultural Organization

Secretaría General del
**Plan Nacional de I+D**
COMISION INTERMINISTERIAL
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