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SPRITTE- Spanish Policy Research on Innovation & Technology, Training & Education.

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CIEMAT - Centro de Investigaciones Energéticas

Medioambientales y Tecnológicas

(Research Centre for Energy, Environment and Technology)

1. Introduction on Context and History

The *Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas*, was born in 1948 as the *Junta de Energia Nuclear* (JEN-Nuclear Energy Commission).

In the early eighties, when the socialist party arrived to the government, the centre started a process of diversification of its traditional research mission. From concentration in nuclear energy areas, it moved towards a new orientation on general energy and environmental research. Many of the competencies and services that JEN monopolised over decades were distributed among other newly created organisations and firms: In 1972 the government created ENUSA a firm to work on nuclear fuels; in 1980 the Consejo de Seguridad Nuclear (CSN- Nuclear Safety Board) took all the competencies for security after an Act that was approved by the Parliament, and in 1984 a new firm, ENRESA, was created to manage the Spanish nuclear waste.

In the mid eighties it changed the name from *Junta de Energia Nuclear* (JEN) to the present CIEMAT and it was recognised as a "Public Research Centre - PRC" (OPI-Organismo Público de Investigación), and thus it received the legal capacities to act as such entities by the Science Act. In spite of being dependent on the Ministry of Industry and Energy, CIEMAT entered the same organizational field where the rest of PRC were placed. Over the eighties those changes tried to enhance its commercial capabilities and its scientific performance.
After the 1986 Act was passed, it took more than a decade for the government to approve the Statute that define the new organisational structure. A Government Decree (RD 221/1997) defined the basic elements of the governance and the new functional structures.

More recently, new efforts for improving the coordination among the different PRCs, culminated with the rearrangement of their political dependency under the newly created Ministry of Science and Technology. In the year 2000 new efforts from the Ministry took place to standardise regulations, norms and employment procedures among all of them approving a new Statute (RD 1952/2000, December 1) that redesigned the governance structures.

CIEMAT is one of the largest Spanish centres and it does basic and applied research, development and also technical assistance for the nuclear industry. It manages large facilities on nuclear energy research (both fission and fusion) and

fundamental physics and solar energy. It is internationally well positioned and related, and it enjoys a good reputation in its field.

2. Situation Today

Main features: ownership and mission

As a Public Research Organisation,[1] CIEMAT is an *autonomous public organisation* under the new Ministry of Science and Technology at State Secretariat for Science and Technology Policy.

CIEMAT's mission has changed over the last two decades and it has evolved, *from* basic and applied research in nuclear physics and development of nuclear energy facilities, *towards* research and development of different sources of energy and general environmental issues. Now it covers areas such as solar and wind energies and environmental and technological issues related with energy exploitation. It has extended the *mission* from their former *core capabilities* into those fields related with energy (mainly nuclear energy), particle physics, materials science, and even biology (from their studies on *dosimetry* and the effects of radiation). Its Statute states explicitly "(…) *its goal is the promotion and development of activities on basic research, applied research innovation and technological development, with special attention to the energy and environment areas, to contribute to the development of more efficient industrial processes, with the inherent restrictions to preserve human health and the environment*".[2]

CIEMAT also provides technological transfer to the industry and collaborates with firms. Although the Technology Transfer Office (OTRI) at CIEMAT was created ten years ago, the promotion of transferability has been part of its mission since the fifties. The 1986 new regulatory framework provided some institutional mechanisms that improved its commercial dimension, and now it offers a wider range of technologies, as far as its capabilities are more.

CIEMAT has research facilities in three different locations: Madrid, where most resources are concentrated, Almeria, that hosts a Solar Platform, and Soria, where the facilities for the development of biomass projects are located.

Research Outputs, Areas of Capabilities and Sectors

As a service provider, mainly for the nuclear industry, it avoids covering fields in which commercial firms are operating –except those services rendering national, regional or local governments. International connections are also important, both in

[1] "Organismos públicos de investigación", known as OPI, were defined by the *Law of Science*, Ley 13/1986, de 14 de abril de Fomento y Coordinación General de la Investigación Científica y Técnica (Law of General Fostering and Co-ordination of the Scientific and Technical Research).

[2] It is a very recent Decree, 1st of December 2000 [Real Decreto 1958/2000, de 1 de diciembre, Boletín Oficial del Estado 289, p. 42306]. This has not change the *mission,* as did the reform in the eighties.

terms of collaboration with international laboratories, and in terms of commercial activities under contract with foreign institutions. CIEMAT competencies and areas of research are better understood in connection with its different departments.

The **nuclear fission department** is the core of CIEMAT's capabilities, though it is not the largest. It concentrates 12.5% of researchers. It works mainly in nuclear plant exploitation and it has recently started working on Nuclear Transmutation processes. Its capabilities include *materials* resistance to radiation-induced corrosion, and nuclear plant *safety*. It also works on nuclear waste technology both in high activity irradiated fuels and medium and low residuals from industry and hospitals; it studies the long-term behaviour of irradiated fuel in order to prepare geological repositories. Work has started in Ergonomics within a project related to complex systems safety and human-machine systems. A *nuclear plant work organisation* was created, that also covers public perception and communication of risks. Capabilities of this department are the main contribution of CIEMAT to one of the corporations it owns, LAESA (see below, *Sources of Income* section), and it has an applied commercial scope for its research.

The **fossil fuel department** works in the efficiency improvement of processes involving fossil fuels, including both energy production and new materials synthesis; *fuel cells* is one of the new working fields. It also works on the control of pollutants and toxic chemicals.

The **department of fusion and elementary particles** studies mainly *magnetic confinement fusion* and *materials for fusion* (it has built its own fusion *tokamak* reactor, TJ II), and *high-energy experimental physics*. Its scope is commercial development of fusion energy in the long term. 20% of CIEMAT's researchers work carried out in this department. The department manages the LNF (*National laboratory on nuclear fusion)*, which spends 9.7 millions € that are part of the department's budget). It has started working with *superconductivity* –in the high-energy physics project– in collaboration with the CEDEX (Centre for Public Works Studies and Experiences), another large public centre. The department works within larger international groups (ITER) and for other international laboratories (they participate in the construction and operation of the LHC at CERN). Finally, the department also prepares metrology standards on ionising radiations, as a national reference laboratory.

With the form of the eighties and in direct relation with the progressive diversification of its mission, the **department of renewable energies** (12,3 millions € and 105 researchers) was created *ex novo*. It was around this new competence area where international connections have arisen. From its creation, it has become the second largest in terms of its share of research staff since it comprises almost 22%. It works mainly in solar and wind energies, and biomass fuel production. The department manages one of CIEMAT's larger facilities, the PSA (Almeria's Solar Platform). Originally created in 1987 as a facility jointly managed and operated by CIEMAT and the German DLR, the PSA has been recently reorganised. The German partner left the agreement in 1998 and changed the relationship to one of collaboration in particular projects leaving management and operation in the hands of CIEMAT. The main effect of this increased responsibility and autonomy as well as an extension of PSA areas of research to include other groups of CIEMAT. This

illustrates how an international collaboration and its evolution has had effects on the internal organisation. On solar energy, it works both on photovoltaic devices and materials, and on building components both active and passive; it also provides standards on those building components. In the wind energy field it develops new turbine technology, and it has designed new maps on wind resources (within IRESMED project to develop *wind farms*); it is the reference laboratory for standards under the name of LEA. Its capabilities have extended to aerodynamics. The biomass area works on liquid (ethanol) and solid bio-fuels. Finally, another large project is devoted to chemical applications of solar energy (water detoxification, for example). Transferability of results is more and more an organisational objective. All the department laboratories try to develop viable commercial devices (and carry out studies to identify market commercial targets).

Starting from radiation impact studies, the **department of environmental impact of energy**, with the largest share of researchers, 23%, has spread its interests to what they call "conventional environmental studies", although most of the work is related with energy. Main areas are on radiation measurement and impact, and air pollution. Capabilities have extended to Geology, Edaphology, Social-economics and Molecular Biology (the department supports a high quality group). There are other new projects related with chemistry and electronics that are not in a specific department.

Research outputs are standard publications in scientific journals –in fundamental physics, for instance–, resources maps, reports under contract of public (national or regional) administrations –on pollution, for instance, or potential wind or solar resources–, device prototypes both for Administration or Industry, and pilot plants. Sectors addressed with those activities are *Natural Resources, Energy and Environment* (mainly), *Industry* (connected with energy production and distribution), and *Government/Public Services* (pollution control, regulation of nuclear settings).

After some analysis of the environment in which CIEMAT operates, a new strategic Plan (1997-2001) was established.

Management and Organisational Structures

CIEMAT is dependent on the Government, historically through the Ministry of Industry and Energy and since 2000 from the newly created Ministry of Science and Technology. Thus, the Ministry has the competencies to approve the governance and functional structures of the Centre. Then, the organisational environment of the CIEMAT is shaped by the legislation and normative development.

The Ministry of Science and Technology, through a Government Decree (RD 1952/20000, December 1st) has reshaped it and it has recently changed CIEMAT governance structures.

The **Government Bodies** of the CIEMAT are: The **Governing Council** composed by a President, that is the Vice-Minister of Science and Technology Policy, and two Vice-Presidents (one is the Director General of the CIEMAT), and 13 representatives of different Ministries and private institutions. Their competencies

include the definition of the basic lines of action of the CIEMAT, the approval of the annual draft budget or the Annual report, etc.

The effective head of the CIEMAT is its *Director General* who is appointed by Government Decree by the Ministry of Science and Technology, and formally executes the directives established by the Governing Body. The *Director General* is assisted by a *Direction Board*, composed by the heads of the functional units of the CIEMAT and by a *Scientific Advisory Committee*, for scientific management, composed by 4 CIEMAT researchers and 6 researchers external to CIEMAT appointed by the Ministry of Science and Technology.

In the previous arrangements, the President of CIEMAT and its Governing Council was responsible to the Ministry responsible, like the State Secretary (Vice-Minister) for Science and Technology Policy. However, with the creation of the Sub-Secretariat for Science Policy at the Ministry of Science and Technology which oversees the Public research centres under the Ministry, and effectively is a "monitoring" structure that has been created to coordinate and standardizes the structures and regulations of the public research centres, the Sub-Secretary acts as Vice-President of CIEMAT.

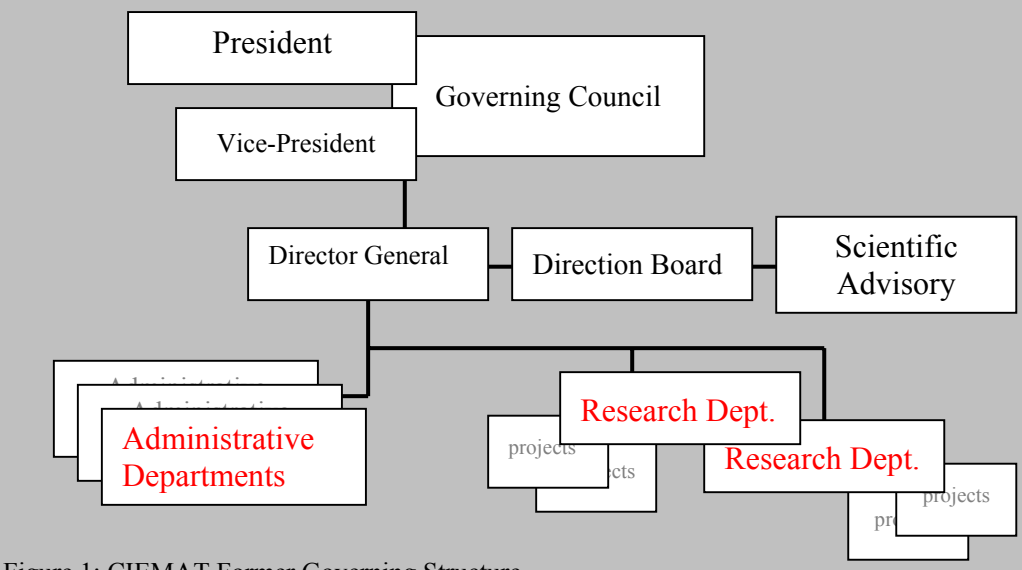

Figure 1: CIEMAT Former Governing Structure

The functional structure of the CIEMAT approved by the Ministry has eight vice-directors. Three are related to management and administration, and head the areas: "External and Institutional Relations", "Economic Managements, Administration and Services" and "Human Resources". The other five correspond to each of the technical departments areas: "Nuclear Fission", "Fossil fuels", "Fusion and Elementary Particle", "Renewable energies" and "Environmental Impact of Energy".

The former Institutes of the Centre (about 7), in the last two organisational reforms of 1997 and 2000, have been renamed into departments and reduced in number. This restructuring was attributed by the interviewees as a "centralisation" process. It appears that the former Institutes had more competencies than the present

departments, in economic management of the projects and resources, *vis a vis* the management and administration units. It looks like the main functions of management in the CIEMAT are more centralised, including the budget. With the annual amount of funding coming from the Ministry, the Economic Management vice-directorate distributes the allocated funds and communicates with each project through the so-called UFAs, Functional Support Units within each technical department to carry on the administrative work of the projects. Another centralised Infrastructure and Services vice-directorate supports projects' activities and charges a *fee* for its services to the project's account.

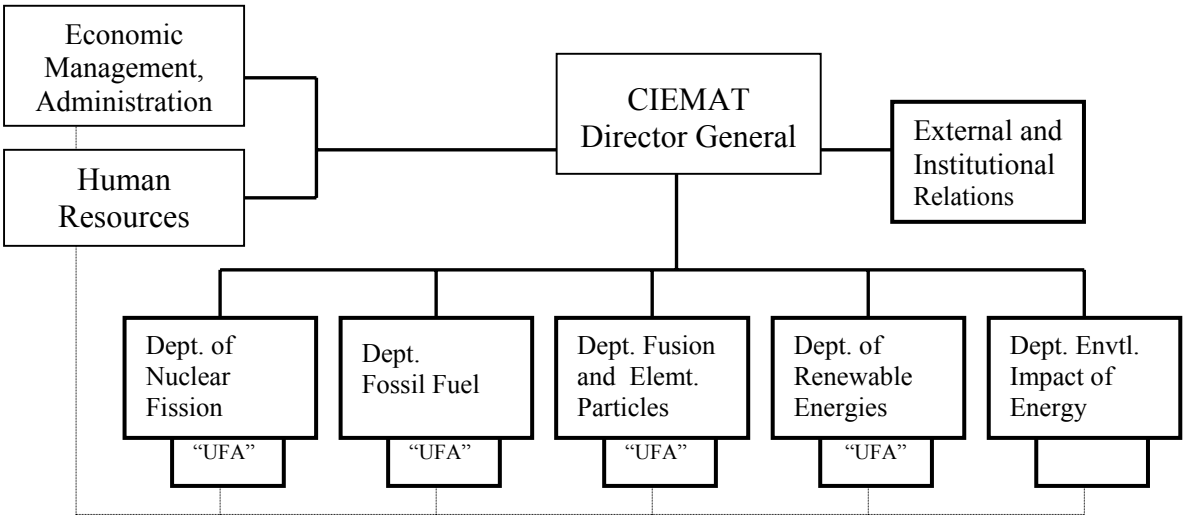

Figure 2: CIEMAT Governing Structure

At the same time, scientific management of each project has been entrusted to a project manager (about 40) appointed by the Director according to her or his merits. This manager also represents the project for the external contracts, and has a direct contact with the customers –whenever it is the case.

Formerly, CIEMAT's organisation was less centralised in the administrative aspects of its Functional Structure (see figure above). It had several Institutes (corresponding to the new departments) which had management and direction of its own. The Board of Directors was formed by other staff. In the new structure all the managerial issues go *up* to the Economic, Management and Control, and the Infrastructure and Services Units. They control all the large purchases and contracts, and centralises issues on human resources. Main scientific direction is formally made by the Director General and the Direction Board following the lines of the Governing Council. Daily management goes *down* to the *project managers* –what is explained by interviewees as a kind of *decentralisation–*. *Project managers* became the visible heads on external contracts and projects, and they sit now at the Board of Directors.

Minor organisational changes are under the responsibility of the General Director. It is independent enough to proceed with reforms that imply only to adjustment. Changes that apply to both administrative and scientific aspects of the

organisation are not included since management of the main issues are centralised in offices above the former Institutes but scientific management is spread between units below those institutes (*projects*).

One important element is that the CIEMAT is regularly operating under a Four year Strategic Plan (1997-2000).

Sources of Income

CIEMAT is one of the largest research centres in the Spanish scene. The 1999 income budget for the CIEMAT was 58.30 million €, with 43.73 million € – 75 %– as regular *core funding* that originates from the General Budget approved by the Parliament.

CIEMAT Budget		
National Government	43,735,651 €	75%
Public Sector Contracts	5,294,917 €	9%
Private Sector Contract	3,239,455 €	5.6%
European Union	3,882,538 €	6.7%
Otras Fuentes Internacionales	2151623 €	3.7%
Total	**58,304,184 €**	**100%**

Figure 3: CIEMAT Budget for 1999

Most of the external funding is related to a few elements to which it has almost a monopolistic relationship: ENRESA subcontracts CIEMAT to do its research activities and the European Union funding that comes from EURATOM-FUSION Programmes.

Public sector contracts in CIEMAT account for 9% of the total budget and are mostly competitive funds from national and regional governments, but also includes some EU funds.

A large part of the *private sector contracts* –a 5.6%– comes from medium size enterprises partly owned by the Centre: ENRESA, ENUSA, and LAESA. They are a kind of "*captive clients*" that entrust most of their research to CIEMAT. The rest of the contracts with private sector are large companies in the energy sector. The *other international* figure –a 3.7%– is a long-term agreement with DLR, a German institute, for sharing use of the PSA.

CIEMAT partly owns three companies. The conglomerate is in fact a different way to manage the former JEN; CIEMAT shares some benefits and receives most of their services' demands. It owns 80% of the *Empresa Nacional de Residuos*

Radiactivos, ENRESA,[3] whose activities were formerly part of the Centre but it is not exactly a *spin off*. The Government owns the remaining 20%, and both the Parliament and the *Consejo de Seguridad Nuclear*- CSN closely control the firm. CIEMAT also owns a 40% of the public *Empresa Nacional del Uranio*, ENUSA, which was created in 1972. The third one, *Laboratorio del Amplificador de Energía*, LAESA, is not a public company; CIEMAT owns a 5% of that laboratory, and makes part of the research activities referred to *radioactive transmutation* and *energy amplification*. CIEMAT gives services and does research under contract for other private and public companies –mainly nuclear power and electrical stations.

Users, Audiences and Strategy

CIEMAT is a public research organisation that nevertheless has been moving towards innovative forms such as the co-operative centres mentioned above. In this sense, its strategy has been one of searching for some flexibility by externalising some lines of research out its traditional organisational forms.

Users of CIEMAT capabilities and outputs have always been diverse. CIEMAT advises both National and Regional Governments on issues related with energy production and, along with the CSN agency, in those related with nuclear safety. On the services provision side, regional and local authorities demand services on pollution measurement and control, and natural resources –solar and wind energies. The Centre also gives advice on specific issues –industrial accidents, for instance.

CIEMAT had some regulatory competencies that are now in CSN; but it remains as a *reference laboratory* for standards related to radiation and energy production. CIEMAT does research for CSN.

CIEMAT's links with the EU are mainly through Euratom programmes (ITER Fusion, for instance). They have contracts in all of the major programmes related with their capabilities, energy, materials science: Framework Programme (JOULE, BRITE-EURAM, etc.) Through its Solar Platform in Almeria, the largest experimental facility in Europe for photovoltaic research, CIEMAT participates in the European programmes of Access to Large Research Facilities. In the next two years, it will give access to almost 70 European research groups, a figure that illustrates CIEMAT's degree of connection with its international environment.

CIEMAT's place within its scientific community has somehow changed since 1986. The Law of Science located the centre within the same organisational field together with other PRCs. The Centre has been slowly and progressively signing agreements and working together with most of the largest Spanish and European universities. It collaborates mostly in those areas in which it lacks expertise or skills. CIEMAT works along with all of the largest Spanish centres on its areas of research (166 collaborations in 1998). Major agreements are with CEDEX (already mentioned) and CSIC.

[3] ENRESA is the National Company for Radioactive Wastes; CSN is the Nuclear Safety Council, a public agency devoted to the control of all nuclear settings in Spain that was formerly part of the CIEMAT; ENUSA is the National Uranium Company; LAESA is the Energy Amplifier Laboratory.

Most of the CIEMAT's audience is composed of large foreign laboratories working on similar issues, and in the Euratom network (HALDEN International Reactor, for instance); it also works with CERN, and with NASA and ESA in space programmes (Alpha space station, for instance); it works in committees of OECD (security comparability), ICRP (on radiation protection) or OIEA (on biomass); it works together with some large centres in molecular biology and cancer, like the Paterson Institute (UK) or the M.D. Anderson Cancer Centre (USA); *etc*. CIEMAT collaborates with 256 centres in more than a hundred agreements in 13 EU countries.

Human Resources

The CIEMAT staff is formed of four different type of personnel: a) Civil servant personnel, either researchers or technicians, assigned to the CIEMAT. b) The scientific personnel temporary contracted under the regulations of the Science Act. c) The personnel under the standard labour relationship, either permanent or temporary, contracted by the CIEMAT. d) Training researchers. Therefore we find, at research and technical levels, that there is a situation where civil servants and contracted workers co-exist but are regulated by very different norms.

Since mid eighties we have observed a decline in the number of people working at the CIEMAT, because of the stagnation in the growth of the public sector. As an example the total number of staff in 1984 was 1,700, but in the year 2000 there was less than 1,300.

CIEMAT's Staff

		%
Civil Servants	391	31.89
Long Term Employees	580	47.31
Short Term Employees	171	13.95
Personnel in Practices	53	4.32
Scholaships Holders	31	2.53
Total Staff	1226	100.00
Of which ***Research Staff*** is		
Civil Servant .	126	10.27
Long Term .	179	14.60
and *Short Term* .	148	12.07

Figure 4: CIEMAT Staff

Even today staff number is large, compared with other Spanish centres: 1,226 people (11% of the CSIC's staff). Most of the employees are civil servants (391, or 32%) or long-term public employees under labour relationships (580, or 47%). 405 of them are *qualified researchers*. 148 are *temporary research staff*, and about 31 are grant holders (paid by the CIEMAT or other institutions); most of them are Ph.D. students

The centre has both *public servants* and *public employees* (most of them with *long term* contracts) –except in the **new co-operative institutes** which do not have public servants.

Human resource policy is very much regulated by the Government. The government has to approve the "job position catalogue" for civil servants and defines the maximum number of people contracted under labour relations. Contracts (including personnel) are subject to the public administration regulations[4], and approval by the Public Administrations Ministry. This means that the CIEMAT needs to ask for permission to do contracts, and up to a certain amounts procurement must be previously authorised.

Personnel contracts under labour relationships develop in an internally centralised way (except for grant holders); *project managers* can propose employees, but the personnel policy is centralised for the entire Centre in an administrative department. The evolution of CIEMAT after 1986 was based on the increase of public employees (called *laborales*), *vis a vis* with civil servants. However, in the last years there is a new trend aiming to transform the public employees into civil servants, especially those that are researchers. A recent regulation did set two new levels for research and technical staff, that will allow the transformation and the mobility with other public research centres.

3. Analysis of Key Dimensions and Changes

CIEMAT as we know it today is the outcome of an evolution since the late seventies that includes changes in its mission, legal status, organisational structures and political governance.

CIEMAT is an interesting case because it illustrates the tension between the organisation search for flexibility and increased autonomy and the attempts made from the political authorities to retain the administrative control through processes of standardisation with some similar public research organisations.

Over time, pressures to change the environments of CIEMAT has come from various sources: the transformation of the nuclear industry that is the sectoral environment of CIEMAT; the political will to diversify, transform and extend its missions to cover the new environmental concerns; and the governmental preferences about how PRC should be and act in the future.

CIEMAT appears to be moving into "centralisation" within management structures of some activities in the organisation and under a more strict control by the Ministry of critical issues like regulation or human resource policies. This can be attributed to the general political context causing pressures in expenditure control and stagnation of the permanent personnel working at CIEMAT. However the organisation still has some room for manoeuvre and tools for gaining flexibility, those included for the PRC in the 1986 Science Act, that allows them to develop or to

[4] Ley 6/1997, de 14 de abril, de Organización y Funcionamiento de la Administración General del Estado

participate into private companies or foundations, or to contract temporary researchers for the execution of the research programs.

The 1986 Law of Science allows the Public Research Institutions to create new research units or new co-operative centres (with research institutions, universities or regional governments). In addition to the shares that CIEMAT historically owns in two firms, last year, CIEMAT created or became involved in two *non--profit foundations*. The first one is partly owned by a large private foundation (Marcelino Botín), it is installed at the CIEMAT in Madrid, within the facilities and groups working in molecular biology. It is devoted to Gene Therapy, and is closely related with other research institutions (the Molecular Biology Unit at the Hospital Universitario Marqués de Valdecilla in Cantabria, is the largest). The regional Government of Navarre promoted the second one and it will work as a Technical Centre on *renewable energies*, which are strongly supported by this Government.

In the interviews, directing members of CIEMAT explained that the formula – co-operative centres working as non-profit foundations subject to private law– is the most flexible in order to manage a research organisation and cope with all the problems of contracts, both of research projects and personnel, and of procurement under the public contract regulation. Although we can assess this new formula as a reaction facing that *legal* environment (and other minor changes in the environment) this initiatives are small compared with the centre's size.

It should be mentioned that the core funding from the national government has been stagnant for almost a decade, although, the sources of increase in incomes has come from external funding, that grew significantly up to 40% in 1994. In interviews, respondents from the Board of Directors explained that it is easy to get Spanish *competitive funds* in its core areas, since CIEMAT virtually has no competitors in Spain; but they also succeed when they compete –for European contracts, and in *not-core* areas.

There is some degree of stability as regards to users and audiences of CIEMAT research outputs. Transferability, although enhanced by successive regulatory reforms, has always been part of its strategy. In this sense, it has been conducting applied research for the private sector for decades. In the view of some interviewed, the organisational changes of 1997 have implied a closer relationship between project managers and specific clients. At the same time, its political structural dependency has implied stability in the sense that the Government, though its central administration, has exercised a directive role over the organisation. Changes in the political environment, such as the process of decentralisation of Spanish political structures, created the conditions for new actors, the regional governments, to become new users. Further changes in CIEMAT's traditional economic sector environment, the energy one, have created new markets related to new technologies and renewable energy sources, in which the organisation has entered.

Personnel incentives and mobility are a complex matter. First, both are dependent on civil servants' or public employees' very limited schemes. For the public employees there are Collective Agreements signed with the Trade Unions. Second, it is difficult to evaluate productivity in such different contract situations,

different research occupations, qualifications and skills (from Aeronautical Engineers or Biologists to Physicists). It is even more difficult for a Centre that does work in a spectrum that goes from basic research to technological services and produces both academic papers and pilot plants.

Those that we interviewed commented that difficulties with labour incentives and mobility are a good reason to use non- profit foundations as management tools (which allows an easier exchange of personnel, for instance): "Incentive mechanisms are the big problem and one of the negative issues this centre has to cope with".

4. Conclusions

Over the last two decades CIEMAT has changed significantly. Most of those changes have been the result of intentional political action that has tried to cope with the specific challenges of the nuclear energy industry's transformation and new environmental concerns. These influences have mainly affected CIEMAT mission that has experienced a considerable diversification.

There is a second dimension of forces that have driven the evolution of CIEMAT. Over time, there has been a tension between, on the one hand pressures for autonomy coming from CIEMAT's research structures, and, on the other hand, ministerial search for increased control over the centre's strategy and administrative procedures.

Some of the organisational changes we have accounted for have been part of an adaptive response from the organisation to cope with changes in its environments: those coming from the nuclear energy industry, those coming from the political environment and reflected in new regulatory frameworks, and those coming from the organisational field in which the centre was located in the eighties, that of research centres. This location has had effects on the way CIEMAT has started to collaborate, cooperate, compete for funds, and participate in international projects, and contrasts with how in the past it operated.

Despite the fact that it undertakes some commercial activity, the centre is not exposed to free market: main clients are both captive (nuclear industry) and part of CIEMAT (ENRESA or ENUSA). Competitive funding for research projects is a small proportion, and has not substantially changed, and it has virtually no competitors in the Spanish scene; centres themselves in Europe –and CIEMAT in Spain– define priorities in this area, and thus contribute to define its own environment. On the other hand, labour as an *input* depends on personnel whose incentives are difficult to manage. Directors admit they do not have means to evaluate performance or to assign *direct incentives*. And in such a bureaucratic organisation *indirect incentives* –through reputation or credit– are difficult to achieve.

Finally, CIEMAT, in its present organisational form, appears to have difficulties for developing its activities under the regulations of the Spanish public administration. In this context, new developments like external *non- -profit*

foundations ruled aside with private ones or other public institutions, and cooperation with third actors are illustrative in how this organisation searches for a more flexible management framework.

IMIM - Instituto Municipal de Investigaciones Médicas
(Barcelona local council Medical Research Institute)

1. Introduction on Context and History

The Municipal Institute for Medical Research (IMIM) is a local health research centre run by the Barcelona Municipal Institute for Healthcare, (IMAS). The total expenditure budget is 5,972,257 €, and there are up to 230 people working within IMIM.

Although it is a local centre, IMIM has reached a high level within the national medical research scope. Moreover, its research activities are not only the backbone of three hospitals, but its outputs are also oriented to universalistic research objectives, not necessarily linked directly to the provision of health. This aspect is what makes IMIM an interesting case study. It represents an organisation that, despite its political dependence in administration, has been capable of developing a certain degree of independence in terms of its activities and thus has extended and centred its mission on universalistic health research. Its link with the university has been one of the relevant factors in this process. This particular dimension of IMIM's relationship with its environment has even altered its mission since, looking at the evolution of its sources of income, it seems that non-health provision-related research has been a more recent focus. Over time, the centre has managed to increase the proportion of external and competitive sources of finance and thus its degree of freedom.

Since its foundation in 1947, IMIM has suffered important changes. It was submitted under IMAS' structures when such enterprise was created, in order to achieve a more rational organisation of the medical services in Barcelona. Later, a positive transformation took place following changes in its environment. New financing possibilities and new research fields were opened, leading to a relative change in its mission. Moreover, a new public university was founded in the city, and strong academic links were established. IMIM is the case of a centre, strongly dependent on its political parent organisation, that nevertheless manages to diversify its mission and sources of funding. Links with a broad scientific community seem to be central in this evolution. The creation of a foundation within its structure is another sign of its search for some managerial flexibility.

2. Situation Today

Main Features: Ownership and Mission

The *Municipal Institute for Medical Research* (IMIM – Institut Municipal d'Investigació Mèdica) is a biomedical and healthcare related research centre located in Barcelona, and run by the *Municipal Institute for Health Care* (IMAS – Institut Municipal d'Assistència Sanitària) which is owned by the local government of the city of Barcelona. It is responsible for the support, promotion, co-ordination and management of research at centres of IMAS, namely, the *Hospital del Mar*, the *Hospital de l'Esperança*, and the *Centre Geriàtric*. It has a parallel non- profit foundation that belongs to IMIM, the so called *Non Profit Foundation IMIM*.

The mission of IMIM is to manage, to promote, to co-ordinate and to implement scientific research on biomedicine and health sciences, besides training research human resources in these areas.

It is possible to trace three periods in the evolution of IMIM. The origin of IMIM was a decision by the Barcelona City Council in 1947 to create, following the suggestions of a group of doctors from Hospital del Mar, a health research centre. It was inaugurated by Sir Alexander Fleming one year later in 1948, and in 1950 they started working as a high-performance centre. In 1984 a new phase begun. However, IMAS, the structure under which IMIM would be from the mid-eighties, did not exist yet. It was created in 1984 as an autonomous organisation responsible for municipal health care, and so IMIM was reorganised and transformed under IMAS' structure in what it is nowadays. IMAS' foundation fostered the development of a specific policy for the local hospitals and such process provided the opportunity to redefine the functions of the old IMIM. The pharmacology group of the Hospital del Mar was incorporated to IMIM, and so was the new group of medical computing research from the Autonomic University of Barcelona. After this and the constituency of their own official budget, a new IMIM was born within IMAS. In 1987 and 1988 two more groups were incorporated, the Immunology Research group and the Epidemiologist Research group. Since 1985 it has officially accredited to carry out anti-doping drug testing by the International Olympic Committee. Moreover, it is an assistant centre for the European Regional Office in the field of abusive drugs. In 1992, IMIM moved into its current building (newly constructed) and was responsible for anti-doping drug testing during the 1992 Olympic and Special-Olympic Games held in Barcelona.

In 1995, a new reorganisation of research at IMAS was started. Such reorganisation aimed to introduce several changes at different levels, namely, the establishment of a specific scientific policy of IMAS, the development of multi-disciplinary Research Units, the improvement of administrative services, and the enhancement of research training by the development of a scientific program for postgraduates. As a result of this process, research groups were reorganised, IMIM's researchers were integrated with other groups from different IMAS' centres, and the IMAS Research Committee was established.

Research: Outputs, Areas of Capability and Sectors

IMIM is involved in basic research, applied research and development. As already stated, in 1995 a new reorganisation of the research activities within IMAS was undertaken. It directly affected IMIM's research work because a scientific policy for IMAS was established. Multidisciplinary research units were created, the administrative processes were improved, and research training was promoted through a new PhD program in Biomedicine within the framework of the Department of Experimental and Health Sciences of the Pompeu Fabra University. As a result of this, a Research Commission was created and all the research groups belonging to IMAS were reorganised and co-ordinated.

According to 1999 annual report, IMIM had 85 ongoing research projects supported for 93 research specific funds, and grouped in its main research areas, namely: basic, clinic and epidemiological research in cancer; pharmacology and abusive drugs research; healthcare services effectiveness research; cardiovascular diseases research; environmental health and respiratory medicine research; bones' pathological physiology research; and health informatics research.

In relation to scientific production, around 400-450 papers are published in specialised journals per year. Data from 1997 shows that up to 450 papers were produced in that year. 96 original research articles were published in international scientific journals, 42 original articles were published in Spanish scientific journals, 18 doctoral thesis were defended, 24 cases reports and short communications were published in international journals, 22 cases reports and short communications were published in Spanish journals, 35 books, book chapters and review articles were published in the international literature, and 201 books, book chapters and review articles were published in the Spanish literature.

Following data processed for CINDOC-IMIM from SCI and SSCI data bases, IMIM's position is the fourth in ranking of scientific production compared with other health centres in Spain. In such ranking there are 31 consigned Spanish health care centres. They have a 0.71 rate of articles per personnel, which is quite high compared with its counterparts that average 0.34.

Management and Organisational Structures

IMIM is an *expenditure centre* of IMAS, as all the other institutions within IMAS and therefore they do not have their own legal nor economic status. IMIM is the part of the IMAS in charge of the health research work. They are the institution for managing, promoting and co-ordinating research work within IMAS. The *Hospital del Mar* is physically located in the same building as IMIM, and most of the research outputs of IMIM are applied and clinically tested.

A non profit foundation has been created within IMIM. The foundation aims to provide the organisation with a parallel institution in order to be prepared in case they need to use it for managing purposes. Recently it is being used only for managing European projects, and the rest of the projects are managed within IMAS' structure.

The management structure of IMIM is quite centralised, a feature common in centres so deeply embedded in local political structures. The Board of Directors forms part of the Executive Council of IMAS and is assisted by the IMAS Research Committee in many of the decisions. He has signatory powers in different areas by delegation of the IMAS Board of Directors' President.

The Management Council is the main organ of IMIM. It is formed by the heads of each of the units of the full management structure, namely, the Administrative and Financial Management, the Human Resources Management, the General Services Management, the Studies Services, the Research Groups and Units Co-ordination, and the Scientific and Technical Services Management. Apart from that, a Research Co-ordination body exists for managing all the Groups and Units working lines. The research teams are organised in *groups* and *units*. IMIM has made big efforts in order not to divide their research inputs. Therefore, most of the units share a common policy. There is a co-ordinator of research groups and units that is *responsible* for maintaining common research lines. From their point of view and their experience, this concentration and this co-ordination are essential conditions for high level scientific outputs. The research lines are decided depending on the working capabilities of the researchers. Decisions about research lines are not decentralised. Apart from supplying with all the necessary administrative facilities, one of the management tasks is avoiding research dispersion. However, this is done in a flexible way. Such a direction is supposed to achieved better outcomes in terms of the quality of research outputs. After 15 years of work, IMIM considers that their research groups are already mature, and so they can regulate and control their inputs. IMIM has avoided Research Commissions due to their belief in the self responsibility of each team. The only external evaluation comes from the Regional Government which aim is to get public funds. As already mentioned, research is organised in units and groups (depending on size) which receive the internal qualification of "recognised" or "accredited" according to periodic evaluations based on scientific characteristics. In 1998, within the framework of the 2nd Research Plan for Catalonia, seven of the groups received specific support as consolidated research groups.

Regarding corporate bodies, there are two independent committees: the CEIC (Clinical Research Ethical Committee) and the CEEA (Animal Experimentation Ethical Committee). Their composition and functions are governed by the standards set by the Regional Catalonian Government (the Generalitat) and the central Spanish Government.

Sources of Income

Even though IMIM is an *expenditure centre* of IMAS, it has a different financial structure than other *expenditure centres.*

IMIM Budget		
FIS (Health Research Fund)	439,436 €	9.7%
Agreements with Private Enterprises	1,071,268 €	23.7%
Clinical Tests	438,950 €	9.7%
CICYT-DGYCIT	422,055 €	9.3%
Quality Control Tests	935,770 €	20.7%
CIRIT	54,043 €	1.2%
National Plan against Drugs consuming	42,070 €	0.9%
European Union	641,844 €	14.2%
Other subventions	343,827 €	7.6%
Other Incomes	84,568 €	1.9%
Donations	41,890 €	0.9%
Regional Government	9,016 €	0.2%
Total	**4,524,737** €	**100%**

Figure 1: IMIM Budget for 1999

The budget of expenses shows that 47'2% of the total expenses come from IMAS and its regular contribution, and the other 52'8% come from external organisations, either private or public.

IMIM Expenses		
Personnel Salaries	**3,228,637** €	**54.1%**
IMAS contributions	2,322,310 €	71.9%
External resources	906,326 €	28.1%
Assets And Services Purchase	**1,915,425** €	**32.1%**
IMAS contributions	405,683 €	21.2%
External resources	1,509,742 €	78.8%
Regular Transferences	**467,588** €	**7.8%**
IMAS contributions	91,354 €	19.5%
External resources	376,234 €	80.5%
Investments	**360,607** €	**6%**
IMAS contributions	0 €	0%
External resources	360,607 €	100%
Total	**5,972,257** €	**100%**

Figure 2: IMIM Expenses for 1999

As the figures show, the total expenditure in the 1999 budget was 5,972,257 €. The expenditure total budget is made up of two different sources: ***regular contribution from IMAS,*** which means 47.2% of the total budget. It is used mostly for personnel salaries (82.4% of IMAS contribution), also for grants (14.4% of IMAS contribution), and finally for investments (3.2% of IMAS contribution).

The final amount of ***external resources*** –reach up to 52% of the total budget. It is money that has to be obtained from competitive funds. The main entry is used for purchase of goods and services, which represents up to 47.9% of this money. In second place, up to 28.8% of those external resources are used for personnel payroll. The remaining 11.9% of the money is used for paying grants, while another 11.4% goes towards investments.

Human Resources

One of the most striking features of the IMIM research staff composition is that the great majority are people that belong to other institutions, mainly local hospitals, and who participate, in different forms, in research projects within IMIM and thus use the centre as a resource. There are 43 researchers working in IMIM. Only 13 of them are permanent workers. There are 27 technicians for researchers support, but only 16 are permanent workers. There are 22 administration people. Apart from this, there are up to 100 doctors that belong to the *Hospital del Mar* and participate –with different degrees of involvement - in research projects.

The human resources structure also reflects the importance that the IMIM considers training of researchers and technicians; there are 79 grant holders working in certain projects and 41 of them are writing their PhD thesis. Most of them are financed by external organisations.

IMIM and the Private Foundation IMIM have the same physical location and share the same staff. From 1995, a very sharp evolution of its research staff has taken place: the *permanent researchers* have grown very little in comparison with the *temporary associated researchers.* In 1995 *permanent staff* where 51 and in May 2000 that amount had turned into 56. On the other hand, in 1995 the latter group where 20 people, and in May 2000 they where up to 98 (almost 5 times the initial amount, while the first group grown only 1%). This particular evolution is quite symptomatic of the internal evolution policy of the Institute, and reflects budgetary structure, and probably the growing proportion of competitive funds for particular projects.

With the creation of IMAS in 1984, IMIM became the research part of such enterprise, and many things related to human resources changed within the Institute. Until then, most of its staff were civil servants, but from then on, the new comers were under labour contracts. Management took advantage of the changing situation and they begun a transformation of the organisational model that included human resources as well. Therefore, young new researchers entered the Institute. Currently, human resource policy is ruled by IMAS and its collective agreement

The personnel classification within IMIM is as follows:

- *Permanent workers* are either civil servants or labour contracted. There are very little number of civil servants –no more than 10- due to the fact that this is a declining type of contract relation.
- *Temporary workers* are contracted for specific work. This is the most common way of labour bounding. It is used for any kind of researchers, technicians,

and research assistant personnel. Labour conditions are reflected in the collective agreement.

- *Grant holders* are usually young researchers that are beginning their research career. There are different financing organs for those grants: the CICYT (Central Government), the FIS (Health Research Fund) that belongs to the Health Institute Carlos III, the CIRIT, the Ministry of Education and Culture, the AECI (Spanish Agency of International Co-operation), the CSIC (Higher Council of Scientific Research), the Generalitat, the Private Foundation IMIM, the FUCAP, and the European Union. Most of these grants –51.9% - are pre-PhD; 25.3% of them are for research assistance; 8.9 of them are post-PhD; 7'6% of them are for practising doctors; 5.1 of them are for UDIMAS students, and 1.2 of them are collaboration grants. Grant holders however have very little opportunity to join the permanent staff of IMIM when their grant period is finished.

The research staff of IMIM is organised in *groups* and *units*. It is an own internal organisation made by the management bodies of IMIM. The difference between them is the number of people within each; *units* are smaller than *groups*. *Units* are made up of one or two leaders, plus ten researchers more or less, including senior permanent staff, temporary contracted staff and grant holders. *Groups* are made up of two or three *units*, minimum. Each *unit* and each *group* has its own area of speciality. These areas do not correspond directly with medical specialities. The hierarchy within the IMIM is not the same as the one in healthcare services, it is not that objective nor formal. The basis for the hierarchical pattern is on the high level research outputs.

Those *units* and *groups* are also the point of reference for the external evaluation that the Generalitat makes periodically. The regional government of Catalonia has set up its own qualification and accreditation process for research groups. They make an evaluation every two or three years. IMIM has eleven units accredited, and they believe that this is a good external feedback. Moreover, this external recognition has a financial translation as well. It is a institutional feedback mechanism, that is complementary to the Central Government.

IMIM has its own internal labour market. When there is need of personnel, IMIM's head of human resources looks for the best candidate within the temporary staff or the grant holders of the Institute. There is a very direct and rather personal contact with all the staff due to the fact that they are a small number of people working there, and so it is easy to know each one of the workers. Internal communication is informal in nature.

In relation to the promotion criteria, for the permanent staff it has been the so-called *professional career,* although obviously not applicable to temporary workers. It consists in economic rewards to growing knowledge.

Users, Audiences and Strategies

From the IMIM director's point of view, the belief that the users of research outputs are only limited to patients is narrowly focused. They think that the direct user and audience of their outputs is the scientific community as a whole because the

research projects carried out within IMIM do solve much bigger issues than every-day health disease problems. IMIM's research manager compares their work with the University work or with the Higher Council of Scientific Research. He feels his work much closer to those institutions than to hospital institutions. After a long process of evolution, their connection with health provision presently is rather indirect. It goes through diffusion and consists in training and changing physicians' habits, but it is an uncertain non measured phenomenon.

The communication channels between IMIM and hospital spheres are not that clear due to the fact that there are many research lines with no direct clinical application. Actually, the main research output usually are scientific publications in specialised journals. Furthermore, research training is also a very important way of materialising their work. IMIM is very much proud of carrying out this work, they believe that young researchers training is one of their best assets. In fact, they feel very proud of the high quality workers they produce. Within IMIM 4 or 5 PhD thesis are defended on an average every year.

The IMIM researchers feel very much a part of the international scientific community. Due to the academic character of their work, IMIM has collaboration agreements with three Universities in Barcelona (the *Universidad Autónoma de Barcelona,* the *Universidad Pompeu Fabra,* and the *Universidad Central*), and with a Vocational Training School that trains technicians. In this sense IMIM is a very agile institute. There is fluent horizontal mobility and exchange with other institutions in the same field. This particular dimension of its relationship with its organisational field, mainly universities and other centres, combined with the link with doctors that are at the same time researchers, explains much of the extension of its mission, and the salience the centre has gained within its scientific area, developing a considerable degree of independence from its political parent organisation.

3. Analysis of Key Dimensions and Changes

The way of working inside IMIM has been very much affected by environmental conditions. They have a rather particular *institutional biography*. IMIM is located in the new Olympic Villa, which is an area that before the Olympic Games of 1992, it was a degraded and run-down part of the city. It has been greatly reformed, and has transformed from being a peripheral poor neighbourhood into a modern well-cared area with a high standard of living. That affected very positively the IMIM and its annexed hospital, the *Hospital del Mar.* In addition, IMIM managed to make a good use of its particular location by being the institution in charge of the anti-doping control for the Olympic Games .

Moreover, in 1990 a new public University was created in the same neighbourhood. IMAS was historically linked to the Autonomous University of Barcelona. They had research training common programs, but when the University medical studies curricula was revised, there were disagreements between both institutions that ended their collaboration. As a result of this, new contacts were begun with the newly founded University Pompeu Fabra. Nowadays this process is still

going. Both Universities have a link with IMAS, although they are walking in opposite directions.

The current IMIM is very different from the old original IMIM. Since its appointment under IMAS' structures, it has been rebuilt almost entirely. In the last twenty years, IMIM has greatly extended its operational capabilities and its competitiveness level. The most important change has been that of extending research lines to those not necessarily related to hospital health care. The managing body of IMIM has been working in building the best model that suited both research and management tasks. Although there is an exception at this point, one of the main demands of IMIM's directors when interviewed was that there was no official regulated training for managing health research work.

In 1995 an important reform took place. IMIM was definitely set up not as an organisation obligated to produce research outputs for backing up health provision but rather a research institute with wider aims. This, however, was the final output of an evolution that started in 1984. This change has had effects on the organisation of work since medical staff that worked mostly in medical care duties entered into the research work. Moreover, an external and periodical evaluation from the Regional Government was institutionalised in order to get public funds, and the institute accepted the idea that people and personal capabilities were decisive in order to plan and organise research activities.

One of the key changes was to separate clearly management tasks from research tasks. Researchers are required to do only what they best do: research work. That way they are relieved of administrative and external tasks. On one hand, this policy reduces quite a lot researchers' degree of freedom, but on the other hand it means a lot of administrative support for them. They have been working under the idea that it is necessary to have a strong research management in order to be able to do good research outputs. They do very much believe that good research requires certain degree of administrative centralisation. That internal reform was undertaken from the old healthcare-organised model, in order to make up a new structure that suits the Institute properly. Those interviewed in IMIM stated firmly that health management system is radically different from research management system. Therefore, these *groups* and *units* have their own way of working.

IMIM has always worked very fluently within IMAS. It has been able to maintain a comfortable economic autonomy that has saved it from depending on the economic vicissitudes of the health provision and the main management lines are designed in IMAS. However, it has been very common that public organisations have created private foundations for managing research funds. Actually, all the new creation research centres created inside the regional Catalonian Government are mixed private-public foundations. There is a *de facto* separation between the research management and the assistance management that has been working already for 16 years.

It has to be pointed out how unusual it is within the Spanish science system to find such large proportion of competitive funds in the budget. It is very unusual for a public research centre to get around 50% of its budget coming from external sources. In their own words, IMIM's staff believe the public sector and public administrations should be obligated to pay only a minimum *survival amount* for regular services such

as building maintenance, administrative staff, and so on. What could be called *the skeleton.* Nevertheless, obtaining the funds needed for doing competitive research work should be each centre's responsibility, in order to promote high-level and quality research.

The units and groups of IMIM are very much competitive in relation to external sources of income. They are aware of the fact that high level research outputs need strong financial investments. Therefore, they are ready to compete for those funds. A certain percentage of the money that the groups and the units get for their own work is taken by IMIM for financing *core necessities.* That *overhead* that comes from their work is then used for every-day maintenance.

It is important to note that the proportion of competitive funds has shown a growing pattern over time. This has been certainly possible following the extension of its mission, but it also has had effects on the relative autonomy of the centre with respect to local political structures, from which, in relative terms, they have been obtained a increased proportion of independence.

When interviewed, the human resources department head stated that promotion criteria were very difficult to manage in an Institute with a higher proportion of temporary workers than permanent staff. On the other hand, researchers' best rewards are their own outputs. Although in the academic setting, publishing in a high impact scientific journal, becoming a well known group within your scientific area, and receiving large sums for projects are the best feedback possible, even better than economic rewards.

Since they believe that an individual and divided way of working is not the optimum for research work, they have set up a working line that tries to concentrate efforts and co-ordinate different groups.

Collaborative relations exist, then, with the scientific community as opposed to competitive ones. IMIM believes that collaboration is a good feature, although competition is evident especially in this field because funding is limited. They stated that it would be much better having a bigger community that made them a commitment to increase their output level working together. Nevertheless, they manage many projects in co-operation with many other institutions, but the main collaboration lines of work are with the Pompeu Fabra University.

IKERLAN – Centro de Investigaciones Tecnológicas especializado en Mecatrónica (Technological Research Centre Specialised in Mechatronics)

1. Introduction on Context and History

IKERLAN is a private co-operative with an important link with the Regional Government of the Basque Country. What makes it a remarkable case of study is the strong connection line among the University of Mondragón, the Regional Basque Government, and the Industry sector.

In countries like Spain, where R+D policies have historically not been fostered properly, private initiatives are commonly found. IKERLAN is a technological centre born in a fully private environment, thanks to favourable economic development conditions. It was, in a way, a product of its environment. But at the same time it has had important effects on it over time. IKERLAN has fostered the technical development of its member enterprises and it has had an important input in the transformation of the Polytechnic School into the University of Mondragon. It was initially created to give technological services to a certain group of enterprises, but its mission was largely expanded quantitatively by a specific policy of incentives from the Regional Basque Government. Therefore, IKERLAN was the object of public incentives which led it to become a collective resource, widening its activities to the whole region. Such an expansion provided IKERLAN with the power influencing its environment.

2. Situation Today

Main Features: Ownership and Mission

The *Centro de Investigaciones Tecnológicas Especializado en Mecatrónica* – (Technological Research Centre Specialised in Mechatronics) IKERLAN, is a technical centre and a not for profit foundation, which ownership belongs to the private sector.

IKERLAN's mission is to strengthen the innovation capacity of the region's industrial sector, and to improve it's competitiveness on the international stage, through grasping, assimilating and transferring outstanding technologies to the productive industries, through solving specific problems with products and processes, and through the provision of efficient solutions and high quality technological services.

IKERLAN was created in 1974 within the Mondragon Cooperative Group (MCC). This Co-operative Group was born in 1956, and it is nowadays the biggest industrial co-operative group in the world, based on four main co-operative values: co-operation, participation, social responsibility and innovation. MCC entails 140 associated enterprises from four different areas: 5 distribution enterprises, plus 100 financial enterprises, plus 13 distribution enterprises, plus 11 research and training centres (including IKERLAN), plus 10 coverage and international relations entities. It was founded by the catholic priest José María Arizmendiarrieta following socialistic ideals, and it has a clearly defined working philosophy, namely, joining both the underpinning competitiveness paths from regular business and democratic organisation patterns, creating jobs, and developing its social environment.

At the beginning, the Mondragon Co-operative Group used to enter into agreements with international centres in order to get the technological support their enterprises demanded. When such technical dependence hindered its thriving path, they decided to tackle such goal themselves and IKERLAN was created. It was a joint action of the *Professional School* (Escuela Profesional), the *People's Laboral Savings Bank* (Caja Laboral Popular), and the MCC's cooperatives. Each of them contributed with a specific input: The Professional School was founded in 1943 by Jose María Arizmendiarrieta, it has grown up and developed within the so-called "Mondragón Movement", and nowadays is the Polytechnic School of Mondragon University. It had created an own research and development unit for studying new technologies, therefore creating a technological research centre would foster their teaching work. Actually, in its first stages, IKERLAN´s staff used to come from the Polytechnic School. As a result of the collaboration with all the enterprises of the MCC, mostly with IKERLAN, the Mondragon University's Polytechnic School has grown enormously. The People's Laboral Savings Bank have social benefit aims among its goals. It financed IKERLAN's buildings, the first installations and the first equipment. The group of co-operatives members of MCC took on the responsibility of the economical support needed for the creation of their technical centre, and they financed IKERLAN in its first years. Therefore, as a result of this collective action, IKERLAN was born inside the MCC *co-operative of co-operatives*, and it was created as a co-operative group itself too.

Since 1982, the Regional Government of the Basque Country has been boosting research and technological development works within the region. The already set up laboratories and research centres, namely, LABEIN, INASMET and IKERLAN, were enhanced thanks to the Regional Government's acknowledgement about how important research outputs were to get industrial advances. At that time IKERLAN was a fully private centre that belonged to a few enterprises from MCC, and the Basque Government offered it the possibility of getting public financing in exchange for opening the possibility of membership to any enterprise of the Basque country. IKERLAN signed their first Collaboration Agreement with the Basque Government, and so it became a centre under the Regional Government's supervision (*Centro Tutelado*). The agreement aimed to foster high quality research work within the already existing centres, and it advocated for an outstanding level of technology as industry's hallmark in the region. From that moment onwards, IKERLAN's working capabilities were increased due to the fact that the Basque Government contributed with 50% of IKERLAN's total budget. In interviews, managers argued that the Centre wouldn't have been able to reach the high level of technical development without the

regional government financial support. The compensating factor was that IKERLAN opened its users' scope, and it evolved from a situation of working exclusively for enterprises of the Co-operative Group, to another of working for external clients as well.

Later, following a private initiative, the Basque Association of Technological Research Centres (EITE) was created by its eight members (CEIT, GAIKER, IKERLAN, INASMET, LABEIN, LEIA, ROBOTIKER, AND TEKNIKER). Moreover, in 1997 the Basque Technology Net was created, joined by EITE plus other independent research and development units from private companies, specific laboratories of the sector, and the small part of public organisms devoted to such areas.

Research Outputs, Areas of Capability and Sectors

IKERLAN does applied research in a percentage around 30% of its total research work, and development in an average percentage of 60%, mostly related with large enterprises equipment.

Main sectors addressed by IKERLAN are industry and natural resources, energy, and environment. Its main areas of scientific and technological capabilities are engineering technology, electronics and other engineering, while physical sciences, maths computer sciences and chemical sciences are present but minor in the organisation. IKERLAN's technological areas are mechatronics and energy. Within mechatronics field, IKERLAN works in two sub-fields: Electronics and Systems, and Technologies for Design and Production. The Electronics and Systems sub-field spans automation and control engineer, sensors and artificial vision, electronics and communications, artificial intelligence, and electronic prototypes. Technologies for Design and Production sub-field spans CAD/CAM technologies, mechanical engineering, production systems, and mechanic prototypes. Within energy field, IKERLAN works in efficient use of energy, alternative energies, conditioning and comfort, and combustion. These research lines are chosen interlocking both the technical evolution lines of the enterprises and their own forecasts about future needs. IKERLAN makes the effort to foresight what would be needed in three-four years time, and that is part of their success as research centre.

IKERLAN does not provide facilities to users because they do not have any highly specialised machine nor device. When interviewed, it's marketing director stated how they rejected having highly specialised equipment, that wouldn't be used enough to pay for themselves. Thus they use external equipment, when needed, rather than having their own equipment idle most of the time. Nevertheless, IKERLAN is currently investing in a new leading area, namely, Microsystems, and a high investment of more than 3 million € will be necessary in order to get proper installations such as white rooms and clean chambers. In relation with this investment, IKERLAN is negotiating a way of enhancing researchers training through spanning PhD students education.

IKERLAN has a standardised certification for research and development projects: the ISO 9001. A big effort was made not only in order to get it, but also in order to be sure of its usefulness, due to the fact that it is a certification suitable for, say, experimental laboratories. IKERLAN does work under projects paces and they

do not make marketable products but prototypes, therefore quality norms do not fit their work very much.

IKERLAN is a high profile research centre, linked to the medium and small-sized enterprises' technological needs. Their mission is clear and three main activities have been depicted in order to achieve it, namely, technologies **surveillance**, **assimilation and generation** of their own outputs, and **transferring** technological outputs to the industrial enterprises (mainly medium and small sized enterprises). Such a link has been one of the most significant characteristics of IKERLAN since its foundation, and it makes IKERLAN's activities much oriented towards market needs. Therefore, IKERLAN work is organised according to its three main activities. In order to fulfil **surveillance**, **assimilation and generation** of technologies, IKERLAN works with *generic projects* and *cluster-oriented projects.* The *generic projects* are proposed inside the Centre for their own technicians and do not have any specific client waiting for the outputs. They aim IKERLAN's own knowledge development, and they are entirely financed by public institutions, mainly the Basque Country Regional Government. Nowadays, IKERLAN is working on 17 generic projects. Such projects entail up to 29% of the total income budget (following 1999 data). In the other hand, the *clustered oriented projects* are carried out in order to fulfil already identified future technological demands of the industrial net. Such projects belong to areas specifically under promotion that have clients paying for them. Those areas were self-organised in clusters that generated strategic research interests, classified as "very important" in the last Regional Plan for Science and Technology. 90% of the financial support for these clustered oriented projects comes from the Regional Government, and the rest 10% comes from each cluster's enterprises. Such projects entail up to 62,4% of the 1999 incomes budget.

Following its third activity's requirements, namely, **transferring** its technological outputs to its member enterprises, IKERLAN carries out research and development projects under contract with certain enterprises which finance them. IKERLAN also makes technological advice and assessment, as well as personnel training and staff transferring to the enterprises involved. Research under contract is the leading activity of IKERLAN; it accounts for 2/3 of the Centre's activity. The total number of enterprises being covered is 66. The most demanded research sectors are electrical appliances (33% of the total demand), and investment goods (30%). Demands on computing and electronics are 15% of the total demand, demands on machinery are 12%, demands on energy are 5%, and there is another 5% of unspecified demand of "others". Nowadays, IKERLAN is working on 112 projects under contract: 92 of them are individual projects for certain enterprises, 10 of them are co-operation projects, and 10 of them are international projects. Moreover, IKERLAN is working on 48 specific studies and services. The leading kind of work designed for IKERLAN is development and enhancement of industrial products.

IKERLAN's main research output is *know how.* Such *know how* is transferred through services' offering. Given the nature of their work and their areas of capability, publishing in specialised journals and participation in congresses are not priority activities for them, and so they have not been fostered. Nevertheless, the management is currently promoting that every department makes a minimum of publication per year. To IKERLAN, publishing and congresses' participation is interesting for market

diffusion purposes, in order to make the industrial sector know what the results of their work are, rather than for scientific diffusion.

They are not very fond of getting patents' ownership. When IKERLAN invents something to be patented inside a project for an enterprise, all the results including the patent are the enterprise's property. When the invention is made within an internal project, IKERLAN owns the patent. However, it is not considered as an interesting output for investment, due to the fact that it is a rather expensive goal that exceeds its validity in an average of two years, and so it is not considered worthy.

Users, Audiences and Strategies[5]

IKERLAN's main environment is the industrial sector of the Basque Country in first place, and the industrial sector of the rest of Spain in second place. These linkages are influenced by the Regional Basque Government and by the fact that they belong to the Mondragon Co-operative Group, which is its parent organisation.

As already mentioned, its major linkages and major financial relations are with the industrial sector; they have 700 clients and 31 associated enterprises. Linkages with the Regional authorities are strong: IKERLAN gets special economic support under a special renewable agreement with it. Linkages with the National authorities are present but minor through participation in competitive programmes. Academic links are strong with the *Eskola Politeknicoa* of the University of Mondragon, and present but minor with the Basque Country University and some foreign Universities such as the Lawrence Berkeley. Links with the Commission are minor; IKERLAN participates in its Framework Programmes. IKERLAN also have linkages with other public sector laboratories, such as the National Institute for Aerospace Techniques-INTA, and the Centre for Electrochemical Research and Development-CIDETEC.

IKERLAN's research outputs main users are its 31 member enterprises. IKERLAN works for them under contract for developing and enhancing industrial products, and rationalising, simplifying and automating design and manufacturing processes through the application of technologies and advanced methodologies.

IKERLAN's number of clients have grown largely in the last few years. Demands have also grown enormously in a qualitative dimension. In the last five years they have experimented that once an enterprise enters into an agreement with IKERLAN for technical support, it wants it to be permanently advised by them. This is mainly due to the fact that such enterprises do not have capabilities for technological development themselves. The growth of the enterprises' demands have been both quantitative and qualitative boosted. IKERLAN takes special care of a certain number of *key customers* that entail large amounts of money for contracting projects.

[5] Here there are a few examples of IKERLAN's products in our every day life: in houses one can find electrical appliances, elevators and locks. In the street and in cafeterias one can find selling machines, coffee machines, public telephones, and slot machines. While travelling, one can find IKERLAN's information systems in airports and train stations, in Bilbao, Madrid, and Hong Kong undergrounds, and in Irizar company buses. Fagor automatization control systems, Fagor presses and cutting lines, and Mecalux' warehouses can be found at working places. At space IKERLAN has developed devices for NASA and has design a positioning device for antennas for the European Space Agency.

In relation to other *technical centres*, IKERLAN keeps open relations. Each department is in charge of being attentive to international research within the same sectors and fostering its co-operation relations with the leading groups, in order to make good co-operation works and to produce outputs up to the level of the *state-of-the-art*. Since 1985, they have joined the European Framework Programs and they have participated in European projects such as ESPRIT, EUREKA, BRITE, COMETT, SPRINT and TELEMAN.

IKERLAN research works are always oriented to practical applications. Nowadays, IKERLAN has got to a point that they do not want to grow anymore, therefore they are controlling the people they contract and the projects they get involved in. Projects demands are beyond their capabilities, thus they are selecting which works they accept, and bargaining very long-term deadlines. IKERLAN has had an important effect over its industrial environment, together with other research centres they have contributed to a change of the region industrial culture, in the sense that research investment is now considered a basic issue for a leading enterprise.

IKERLAN works better with enterprises that have their own research and development units. In interviews, they stated that they do not work properly if the enterprises clients depend entirely on them, because their products need to be fully adapted to the demands and need to be monitored in order to optimise benefits. Therefore, a minimum level of research capabilities is required in order to be accepted as a client or as a partner in a project. The lack of such facilities is understood and pointed out as one of the biggest problems of medium and small enterprises for being on the top of the industrial production. In order to avoid their products to remain idle once they are finished, when working with a small or medium sized enterprise, IKERLAN requires an specialised worker to be hired for taking care of the output's development. Otherwise, such big research investments are not worthy.

Management and Organization Structures

IKERLAN is part of the World largest industrial Co-operative Group, the Mondragon Co-operative Group, that has 22,000 associated members. At the same time, IKERLAN is a co-operative itself too.

IKERLAN is accountable to its shareholders. Shareholders are both its own associated workers and the 31 member enterprises (most of them co-operatives too). It is partly supported by the Regional Government of the Basque Country through long-term contracts. As already stated, this relation with the Regional Government started in 1982, when a policy to foster industrial and technical research was implemented by the Regional authorities. They opened an official financing program, and IKERLAN opened its services selling to any industry and not only to their member enterprises. IKERLAN is structured as a single unified organisation with two branches, namely, Mechatronics branch, that includes one department of electronics and systems and another one of technologies of design and production, and the Energy branch. IKERLAN has two operating units located in the region.

Organization structures in IKERLAN have been recently. The internal management structure of IKERLAN is organised in three main bodies: the Members Assembly, the Government Council and the General Direction.

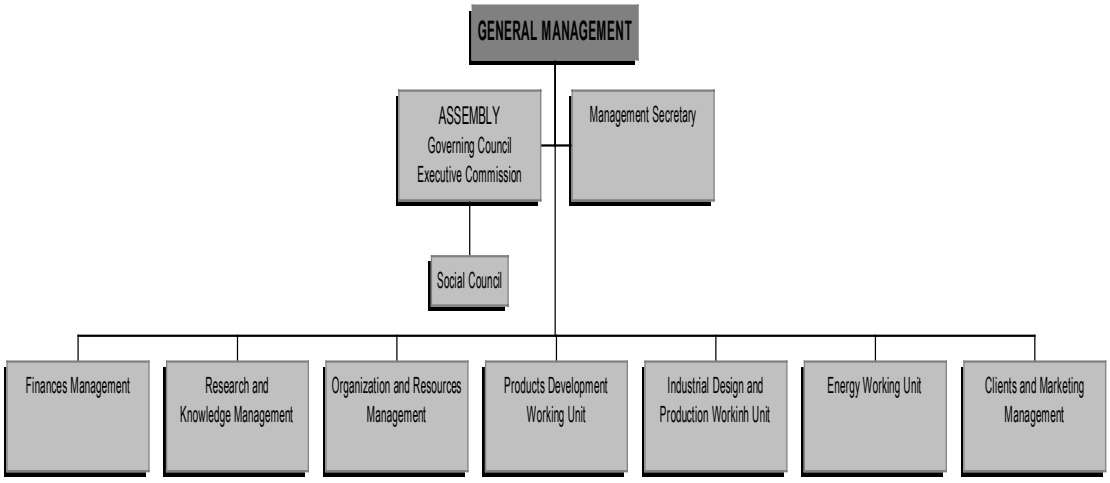

Figure 1: IKERLAN Governing Structure

The **Members Assembly** is the body that brings together all the associated members (as already stated IKERLAN is a *second degree* co-operative group, which means that not only every worker but also every associated enterprise is –in a proportional degree- owner of the Centre) The workers of IKERLAN are 45% of the Members Assembly, another 45% are the associated enterprises, and the last 10% are the institutions members (such as the University of Mondragón and the Caja Laboral among others). This body controls IKERLAN's accounts and its annual interventions. They elect the **Government Council**, which is made up of 15 members: 5 of them are workers of IKERLAN, and 10 of them are part of associated enterprises and member institutions. The Regional Government participates in the Council as a guest with no rights for voting. This body takes decisions about management activities, approves the Centre's four-year research planning, and the Centre's annual management planning. Representation quotas are different from one body to another. This is due to the fact that IKERLAN wants the Governing Council to be mainly ruled by enterprises; since it is in charge of depicting research lines in a medium / long term, therefore users' demands (i.e. enterprises' demands) must be properly weighted. The Governing Council elects the **General Direction**. The General Direction is in charge of the research strategic planning, of management guidelines, of depicting objectives, and of controlling and evaluating such management. The rest of the organistaion depends on it: all the Working Units (*Unidades de Negocio)*, the Clients and Marketing Management, the Finances Management, and the Resources and Organisation Management.

Working Units are rather independent units in terms of personnel, research lines, and financial administration. They all share the same *Knowledge and Research Management* in order to develop a co-ordinated work. Within each of the working units there are researchers from complementary knowledge areas that develop

research projects together. Each Unit has a *Projects Direction* that organise, controls and works together with all the *Projects Leaders.* Each project leader leads a *Projects' Team* at the same time than a *Knowledge Area,* where senior and junior researchers and PhD students develop their work. The most valuable characteristic of the working units is that they are fully autonomous for establishing co-operation linkages and for governing its own resources. Although they follow the General Direction guidelines, Working Units have a certain degree of freedom for internal organisation when facing a client's project. The main advances achieved through the new structure are working units agility and its numerous and open communication channels both with upper and lower resorts.

The **Clients and Marketing Management** is an intermediate body between both IKERLAN's management level and its working units, and it also works as intermediary with the Administration. But it doesn't function only as a qualified communication channel, it is also responsible for the co-operative identity and image. It is the leading body for processing market's demands and for co-ordinating the work of the groups dealing with key clients. It has three dependent departments, namely, *Key Clients Management Department, Commercial Management,* and *Communication and Image.*

The third body depending on the General Direction is the **Finances Management**, and the last one is the **Resources and Organisation Management**. It has three lower departments: *Human Resources Department, Services Unit,* and *Quality Control and Improvement Department.*

The old structure was rather simple; the Associates Assembly was the main body, and under it were the Governing Council and the General Direction. Marketing, Administration, Human Resources, and General Services were four departments under this hole governing structure, and the rest of IKERLAN was divided –following areas of capability– in Mechatronics Unit and Energy Unit. This new organisation aims optimising the Centre's structure in order to better fulfil its mission. IKERLAN has designed an *Strategic Plan* for 2001-04, through which it wants to foster development of products. In order to be fully prepared for achieving strategic goals, a deep reform was needed. Therefore, three divisions have been created: product development, industrial design and production, and energy. Product development and energy are two units very close to each other because their working capabilities are inter-connected. The research guidelines depicted in the *Strategic Plan 2001-04* have been decided by consensus and workers have expressed their opinion and have contributed their input. Inputs have been going up from lower to upper decision levels. The basic core of the structure are the area meetings, namely, meetings where all the workers meet and all them have the chance to talk. Each area has between six and twelve people, plus some PhD students, part-time students, and some workers under contract.

Acting criteria inside IKERLAN are mostly managerial guidelines. The products they offer are very much oriented to market's demands, therefore they need to keep in mind market fluctuations when thinking about solutions for its enterprises.

Sources of Income

IKERLAN's incomes in 1999 were up to 10,920,000 €. The Government core funding was 3,053,141 €, private sector contracts were 692,365 €, and investments incomes were up to 631,750 €. Outside investments cover 126,460 € from FEDER funds spanning 1997-99, plus 32,110 € from CICYT (Inter-ministerial Commission for Science and Technology), plus 135,220 € from ATYCA, plus 266,370 € from the Regional Basque Country Government, plus 71,590 € from the Mondragón Cooperative Corporation. Own IKERLAN' funds investments are 459,860 €.

IKERLAN Budget		
Generic Projects:		
Basque Country Government	2,399,000 €	22.8%
National Government	319,000 €	3%
MCC	241,000 €	2.3%
Projects With Enterprises	92,000 €	0.9%
Projects Under Contract:		
Enterprises	5,411,000 €	51.5%
International	1,042,000 €	9.9%
Public Entities	92,000 €	0.9%
Training Courses and Others	9,000 €	0.1%
Member Quotas	371,000 €	3.5%
Others	533,000 €	5.1%
Total	**10,509,000 €**	**100%**

Figure 2: IKERLAN Budget for 1999

IKERLAN is not a public Centre, even though it has a special status that links it with the Regional Basque Country Government. Therefore they depend on private sources of income, both external contract and members quotas. IKERLAN gets funds from *generic research projects* through arranged public financing, and it gets funds from *under contract projects* through services selling. IKERLAN has an ideal financial model which is a combined figure of equilibrated private and public incomes. At the very beginning, IKERLAN used to get 50% of its incomes of services selling and transference of technology, and the other 50% of member founders contributions, Basque Government contributions, and Central Government contributions. Nevertheless, such model has been developed into another one that is 1/3 of the total incomes come from technologies surveillance, assimilation and generation, and the other 2/3 come from technologies transferring.

The so-called ***generic research projects*** cover projects with the Regional Government of the Basque Country that entails 22,8% of the total incomes (2,400,000 €); projects with the Central Government Administration that entails 3% of the total incomes (319,000 €); Micro-systems projects for the MCC that entails 2,3% of the total incomes (242,000 €); and projects with enterprises that entails 0,9% of the total incomes (92,000 €). The total amount of generic research projects incomes is 3,053,000 €, 29% of the total budget incomes.

The so-called ***under contract projects*** generate 6,554,000 €, namely, 62,4% of the total budget incomes. It covers projects with enterprises that entails 51,5% of the total incomes (5,411,000 €); international projects that entails 9,9% of the total incomes (1,042,000 €); public entities entail 0,9% of the total incomes (91,000 €); and incomes derived from training courses and *others* entail 0,1% of the total budget incomes (9,000 €).

The **associated members** quotas entail 3,5% of the budget incomes (371,000 €), and the last income entry, the so-called **various,** entail 5,1% of the budget incomes (533,000 €).

Human Resources

Total number of staff in IKERLAN is 230 people. There are 149 permanent full-time workers, 41 scholarship holders, and 40 part-time workers that are students from the engineers school of the University of Mondragon. The new structure fosters personnel internal promotions and makes it easy to discover individual capabilities and potential skills.

	1994	***1995***	***1996***	***1997***	***1998***	***1999***	***2000***
Permanent workers	*117*	*117*	*120*	*121*	*125*	*134*	*149*
Part time workers	*30*	*37*	*33*	*30*	*33*	*30*	*40*
Scholarship holders	*20*	*20*	*20*	*25*	*29*	*40*	*41*
TOTAL	*167*	*174*	*173*	*176*	*187*	*204*	*230*

Figure 3: IKERLAN Staff distribution from 1994 to 2000

IKERLAN's workers are mainly industrial engineers, or PhD engineers. There also are physics graduated, computer scientists, and chemistry graduated in a very small proportion. All its 149 **permanent workers** are associated members of the co-operative group. When hired, they had to buy shares in the company to the value of 10818 euros. Every "worker-owner" gets a monthly estimated amount of benefits, that are kept inside IKERLAN's central box until workers want it to be sold if leaving the Centre and get the investment back. They have such access possibility over 80% of their shared capital, and the other 20% belongs to IKERLAN. Salaries are calculated through the so-called *solidarity index*, namely, a certain amount calculated through an specific percentage of outside's salaries. For high specialised jobs, such index is 70%. There are three different categories of researchers: A (the highest), B (medium) and C (the lowest). Each of them has a specific definition and an already set up band of economic retributions. Each researcher's economic retribution is a carefully calculated amount of money that depends on the number of participating projects and their response to certain inputs. "A" researchers are only 15% of the total staff. Researchers have an open possibility for being promoted if they fulfil certain professional requirements. They do not have an strict model of specific number of places in each level; promotion does not depend on categories' quotas, it depends on IKERLAN's needs. Following its working volume, IKERLAN would grow in a 33% more.

IKERLAN shares part of its staff with the University. Actually, the first workers that raised the Centre belonged to the University. The Polytechnic School has designed an academic syllabus that combines regular studies with the chance to work part-time. Therefore IKERLAN counts on 40 **part-time workers** from the University of Mondragón.

As already mentioned, there are also up to 41 graduated **workers** holding a **scholarship** in IKERLAN. A private foundation exists for paying such scholarships, the *Technological Centres Foundation for Technology Development*, but in fact such money comes from Regional Governmental sources through indirect paths. That scholarship lasts for two years, and after those two years they are hired with a training contract. That makes a period of four years of apprenticeship in IKERLAN. After such period they become experts in a certain and very specific field. They might join IKERLAN as regular workers, but this is getting more and more difficult since IKERLAN has recently started to control its development.

Staff recruitment takes place mainly in their own environment, namely, the University of Mondragon. IKERLAN hires an average amount of 7 workers per year after a four-year training period. IKERLAN has got to a point considered as optimum in terms of human resources and projects joining. In addition, external researchers sources are becoming more and more popular, since people trained abroad are more likely to have different qualifications like, say, micro-systems. IKERLAN wants to break up with the endogamy path in contracting people in order to get richer inputs in their working units.

Moreover, IKERLAN has access to a labour market data base from the University of Mondragon. They have data about their post-graduated staff training, and their working experience. Such labour market is partly made by IKERLAN, and it is not available for all the centres of the Mondragon Co-operative Corporation but only for IKERLAN. Even though it is not usual for them to resort it, IKERLAN has also access to some labour markets from other member enterprises from MCC.

3. Analysis of Key Dimensions and Changes

The most significant feature in the evolution of IKERLAN since its origins was the link with the regional government which provided the organisation with the possibility of widening its users' scope. Public financial incentives made the centre evolve from a situation in which it was a private resource available exclusively to the co-operative member enterprises to another in which it was turned into a collective resource in the Basque regional economic environment. IKERLAN is key example of centre that has modified and influence its industrial environment (changes in the technological profile and culture of the regional industry has been remarkable), but it is important to note that it has been able to do so thanks to the connection with the regional public administration. The case is interesting because it represents the conscious public will to instrumentalise an already existing private co-operative organisation for public purpose through incentives, instead of developing the same capabilities through public centres. Another important environmental change that has

been partially a product of IKERLAN's activities concerns the growth of the University of Mondragon and the mutual influence that has developed through recruitment and apprenticeship practices.

More recently IKERLAN has changed its organisational structure. The new organisation, operating since January 1st 2001, aims to break the old strict departmental structure, where roles tended to crystallize into rigid dependent relations, and the way of working lacked dynamism. IKERLAN outlined the problem and started working in what nowadays is their new organisation. Therefore, a wide net of communication channels among the different parts of the organisation were opened. The new structure also strengths projects needs' guidelines, i.e. human resources are organised in a very flexible way in order to be at research paths' service. Working units are easily created and cancelled depending on the extent of the industrial market demands. Leadership within this new open structure is in the units as a whole, and not in any specific person.

In relation to changes in their mission, there are two facts to be pointed out. In first place, IKERLAN's clients scope was very much increased after the agreement with the Basque Government. Purely speaking, their mission didn't change but their beneficiaries and users expanded. In second place, its evolution has brought some priorities-establishment problems. IKERLAN has grown significantly and it has become more selective about new projects and research paths as well as about personnel recruitment, which is recently changing to pay more attention to sources other than the Mondragon University in order to gain in qualification diversity.

INESCOP - Instituto Tecnológico del Calzado y Conexas

(Technological Institute for Footwear and Related Industries)

1. Introduction on Context and History

INESCOP, *Technological Institute for Footwear and its Related Industries*, is a research association with the legal status of a non-for profit foundation. Since its creation INESCOP has had a strong symbiotic relationship with the Spanish Public Administration. It was created as part of a public initiative for promoting cooperative research in industry.

Its relative success has been remarkable, compared with other technical centres created at the same time, and considering the industrial sector it serves –a traditional one made of extremely fragmented small and very small sized firms. However, the footwear sector in Spain is a large industrial sector with high economic importance in terms of volume of exports in Spain (following the *automotive* industry) and one of the largest in labour intensity. Data from 1999 exports reflect an amount above 1,803 million €. It is a sector that relies on high quality production and extremely fast production rhythms, and has a strong need to incorporate new production technologies.

Since its beginning, INESCOP has widen its areas of competence –initially centred on technical assistance – to reach applied research and development in other domains. Over the last thirty years, INESCOP has grown and expanded greatly. It begun with 300m² of facilities with only four employees, and less than one hundred associated members. Currently, INESCOP's installations are up to 8,000m² in 10 sites at 6 different Spanish Regions, with over one hundred people employed, and over six hundred firm members. The budget has also grown very markedly: it begun with 12,000 € and it has grown to 6 million € (in current terms). It is internationally connected as well as very strong institutional links.

2.Situation Today

Main Features: Ownership and Mission

INESCOP (Technological Institute for Footwear and its Related Industries) is a research and development technical centre that has more than 600 associated private enterprises all around the country. Its mission is to carry out those scientific and technological type of activities that footwear enterprises cannot develop individually, but are essential to maintain a competitive advantage in such sector. Therefore, INESCOP's aim is to fill this gap and meet the technical needs of its associated members.

INESCOP was founded in 1971 as a co-operative society and became a *research association* in 1979, recognised within a public program in support of cooperative research, that enabled INESCOP to receive public funding. The Royal Decree in 1996 (2009/1996) established a new official recognition for the status as a "Technology and Innovation centre". INESCOP is currently a firm association recognised as a "Technological and innovation centre" by the CICYT (Inter-ministerial Commission for Science and Technology). However, apart from the changes in legal denomination, the nature of INESCOP has showed a certain degree of stability. It has always been a non- profit voluntary association of footwear enterprises to co-operate, in order to achieve technological developments of common interest. This general mission has nevertheless evolved in an extensive way so that over time INESCOP areas of competence have increased both quantitatively and qualitatively. Gradually, INESCOP acquired technological capabilities and began designing machines, copying them first –and doing some technological learning. Nowadays, INESCOP works in applied research and development, quality control, technology, worker's training, information, environment, fashion surveillance studies and documentation. INESCOP offers to their associated enterprises direct services, transfer of knowledge, and long term generic research.

Research: Outputs, Areas of Capability and Sectors

INESCOP's research activities are focused on applied research and development for the footwear industry.

INESCOP's main outputs are services directed towards quality control, organisation of productive processes, material testing, development and adoption of advanced technologies for the production chain, environmental concerns, industrial design, and surveillance of fashion tendencies. Therefore, it's main research fields are mechanics, electronics, specialised software development, and materials. Chemical sciences and engineering technology are major research fields for the centre as well. It holds collaboration agreements and common projects with other technological centres, both national and international, Public Research Centres (PRCs) like CIEMAT, and with some Universities. Within the University of Alicante it maintains a strong collaboration link with a research group specialised in adhesion and adhesives.

The footwear sector in Spain follows a strategy of high-quality production, therefore total **quality control** is an important aspect for INESCOP. It is carried out through tests and analysis on both raw materials and manufactured products, through developing its own quality control systems, through elaborating its own methodology for materials composition tests, and through contributions to standardisation norms. INESCOP is well-equipped to deal with more than 300 different types of tests that range from analysis performed on plastic, rubber, tanned hide, textile, thread, cord, adhesive, and final work shoes among others. The Department of Quality Management provides the associated enterprises with consulting and field audit services for quality.

Certification and standardisation work are also carried out by INESCOP, due to the importance of adapting the footwear industrial activities to international (mostly European) rules. INESCOP collaborates with AENOR (Spanish Association for Standardisation and Certification), with CEN (European Standardisation Committee) and with ISO (International Standardisation Organisation) organising national and international committees and specialised working groups. Moreover, INESCOP elaborates rules and technical documents for national and international forums, promotes their diffusion and dissemination. INESCOP has developed a certification system itself for quality assurance on finished products. Moreover, they work together with the Administration in order to set a proper use of certification and standardisation.

In addition, INESCOP is the *reference certifying laboratory* at the national level to test all the special working shoes for specific purposes, shoes that must adjust to extreme working conditions, and those that had to accomplish legal norms.

The footwear sector has traditionally been **environmentally** friendly and not very problematic, although it keeps itself up to date on such topic due to the general social awareness and concern of its importance and the development of new national, international and external legislation. Therefore, INESCOP has opened a research line on environment issues and concerns in which there are several running projects.

INESCOP also makes research on **design** and **fashion tendencies**. By attending national and international fashion trade fairs, the design department (called MODICAL) prepares its own samples and distributes them among the associated enterprises. New preferences for new materials always needs technical support.

Graphic design software for footwear is developed by the computing department which works to promote the introduction of information and communication technologies in the footwear industry through the use of design software that speeds up the initial creation and design process for new shoes.

Diffusion and dissemination is an important aspect of INESCOP's work. One of their main activities are their **training and specialisation courses** for footwear sector's workers in their Training Resources Centre, given by either their own staff or by contracted external specialists.

INESCOP disseminates **periodical bulletins and monographs**. It carries out an information processing labour and edits periodically high specialised, very short and very concrete papers that are distributed among its associated members. When interviewed, head director explained how much aware of the fact that their target audience do not have much time to spend on reading, therefore they decided send them short pieces of paper with all the information condensed after careful selection and procession of the information. Apart from that, INESCOP's facilities house a library and they are engaged in a project together with the *Patronal Nacional de Calzado* (FICE – National Footwear Employers) and the support of the Secretaría de Estado de Telecomunicaciones (State's Secretary for Telecommunications) for installing an Information Provider Centre (CPI) for the sector, available on Internet. Such CPI would supply with a telematics space for the enterprises to insert their

commercial offers, and with access to data bases on fashion tendencies, exports and imports, training courses, legislation, trade fairs, etc.

Management and Organisation Structures

INESCOP facilities are bigger than 8,000 m². Apart from its main building, which is located in Elda (Alicante), INESCOP has seven more technical units located close to footwear factories all around the country. They also have two associated centres. This laboratory network is a singular way of organising services, due to the fact that each of these technical units are fully prepared laboratories at the disposal of factories necessities, and they also behave as communication channels between the factories and the Institute.

INESCOP's management and organisation structures are as follow:

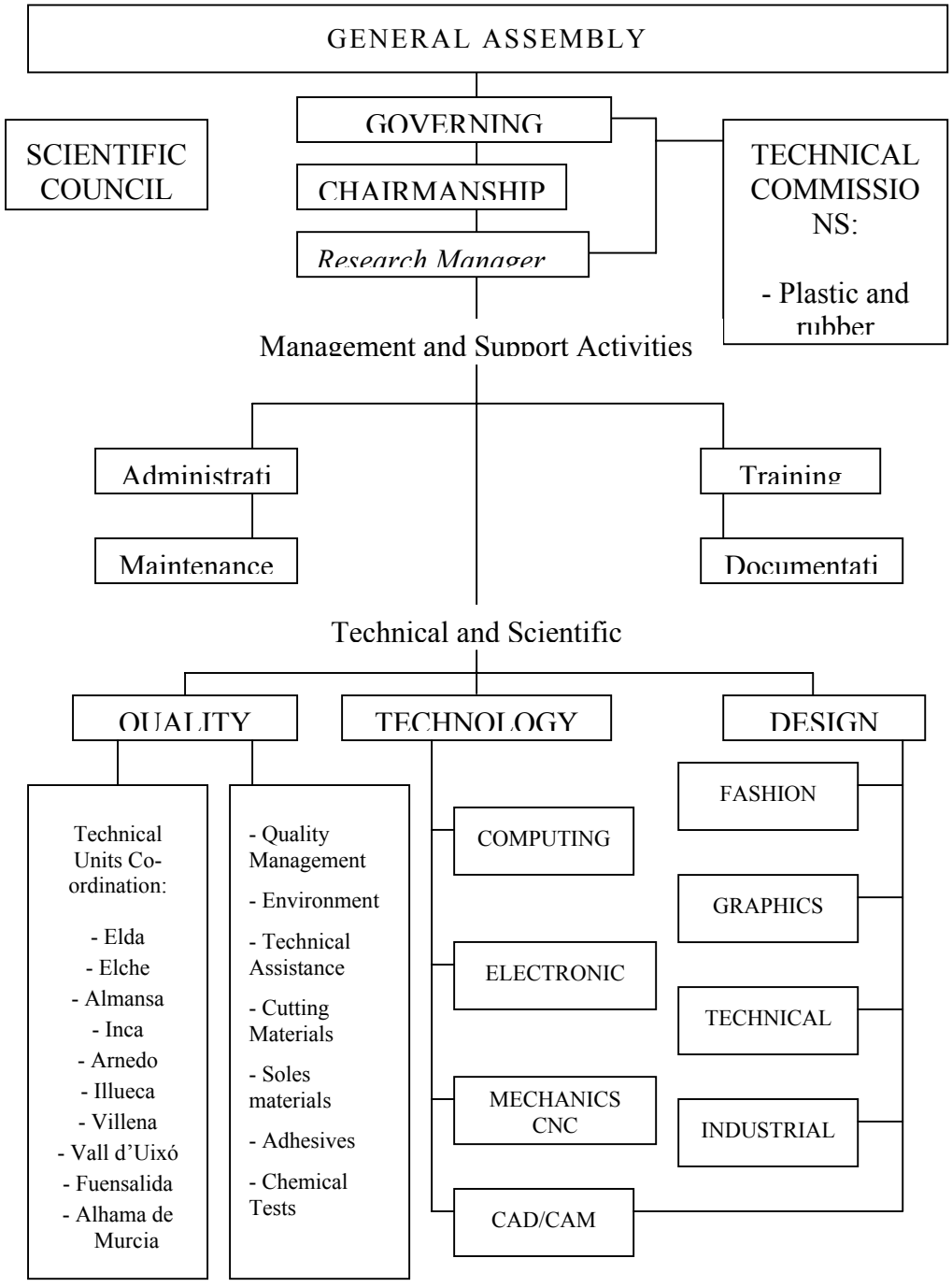

Figure 1: INESCOP Governing Structure

The **General Assembly** is formed by all the member enterprises, and it is in charge of formally approving the annual budget and the Projects and Activities annual report. Currently, INESCOP has 606 member enterprises. These companies represent 65% of the total number of enterprises in Spain, 85% of the sector industrial activity, and 80% of the work force.

The **Governing Council** is the most powerful management body. It is the one in charge of setting up all working guidelines. It is formed by 21 people: there are 10 industrialists from different sectors, and 5 representatives of the administration: 2 people from Valencia Regional Government, 1 person from La Rioja Regional Government, 2 representatives from CICYT (Inter-ministries Commission for Science and Technology) and 1 representative from the Ministry of Science and Technology. With the exception of these political members, the rest of the members, as well as the President and the Vice-president are elected by the Assembly. Within this council, decision making processes are carried out following technical and managerial criteria. Although public administration at different levels are present in this governing body, nevertheless some key positions such as, the treasurer and vice president are held by industrialists. The presence of representatives from the Ministry of Science and Technology (including those from the CICYT) responds in part to a strategic movement to support recognition as a status of "Technological and Innovation centres". The presence of representatives from the regional administration merits some attention since it was an strategic option of INESCOP to give them such a role. By means of this decision, INESCOP made this political link stronger, and , as we will see, it has obtained considerable financial support from it. As already stated, the Governing Council manages research and work paths. Their work is, directly connected with enterprises' feedback following research outputs. The information upon which they make decisions comes rather elaborated and the decision making process is performed over an already delimited scope of alternatives. Most of INESCOP's innovations are step by step developments over already known technologies, therefore the flow of information with factories and about industrial needs is an important input within the whole decision making process within the Council. Industrial representation within this collective body is the most powerful mechanism through which these interests influence the organisation's governance.

The rest of the formal structure is organised around two main areas *which* are dependent of a Research Manager, whom is required to be a qualified technician or scientist, is designated by the Governing Council and has broad executive powers on human resources' management and research development, especially related to medium and long-term frameworks.

The management and *Support department*, is where the technological structure of the Association is made up. There are five units within this department: Maintenance, Technical Assistance, Documentation, Library, and Training.- *The Scientific and Technical functional area*, which is formed by the Departments of Quality, Technology, and Design. The Department of Quality is in charged of co-ordinating the ten technical units spread all around the country. It also works in quality control analysis, environment, technical assistance, chemical analysis and soles materials, cutting materials and adhesives. Within the Technology Department there are four laboratories: computers, electronics, mechanics, and CAD/CAM.

Finally, the Design Department has four sections: fashion, graphics, technical design, and industrial design.

Research priorities are decided through a complex process. As already mentioned, industry interests are strongly represented within the governing council. However, it is between technical units and firms where information flow channels are established. Research projects are drawn either from sector interests or following enterprises' demands. Their research planning is built up over two different temporal frameworks: short term projects and medium-large term projects. On the one hand, projects involve those that particular firms demand to be develop and are willing to pay for. These normally deal with short-term needs. On the other hand, INESCOP does its own research and development with an important foresight component. INESCOP has technical units spread around the country and close to factories, from which ground information is obtained. Decisions about this second type of research are mostly taken at the Research management level, and it is around it where the organisation has gained some autonomy and the real relative advantage of the collective organisation as opposed to the individual member firms. When interviewed, directors explained it is also common that the tests demanded by the factories to INESCOP's technical units end up becoming the origin of more ambitious projects. Technical units act like communication mechanisms between factories needs and INESCOP's research programming. Therefore, paying attention to what kind of demands their technical units receive, INESCOP is able to do foresight .

Both kind of projects are normally developed inside a firm or in cooperation with one or more. When a firm demands a particular development, an agreement is made by which the enterprises involved are responsible for a share of the financing, and in exchange they get the right to add some inputs in the research process, and more importantly, get property rights over the final outputs. However, most of the outputs are available for any member enterprise interested. Their membership gives them the right for purchasing such outputs once they are finished, even though they didn't participate in the project's development.

Sources of Income

The total budget for 2000 was 6,010,121 €: 2,103,542 € (34%) comes from laboratories services and member enterprises quotas, up to 16 % comes from three different National Government sources of income, and a significant proportion of 21% comes from the Regional Government. Therefore, more than 37% of total incomes come from public sources, which is higher than one third of total budget. 1,021,721 € comes from enterprises projects, and 661,113 € comes from their own incomes, namely, technology selling. Therefore, incomes from diverse private sources are around 63% of total budget. The main source of income are services sold such as quality control tests, technological developments, information sourcing, technical support, and product licences. These services are available for any enterprise, both members and non members. By contrast, technology selling is carried out when a certain project has developed an specific output, and such technology is only available for its enterprises members. The *projects with enterprises* entry includes European projects in programs like BRITE, CRAFT, ESPRIT, LIFE, INNOVATION, LEONARDO, ADAPT, IMPACT and RTT.

INESCOP Budget		
Associates quotas and laboratory services	2,103,542 €	35%
General Direction for Small and medium sized enterprises (Central Government)	480,810 €	8%
MINER (Central Government)	420,709 €	7%
CICYT (Central Government)	60,101 €	1%
IMPIVA (Regional Government)	1,262,125 €	21%
Projects with enterprises	1,021,721 €	17%
Technology selling	661,113 €	11%
Total	**6,010,121 €**	**100%**

Figure 2: INESCOP Budget for 1999

INESCOP has access to the public subsidies that the government gives for the footwear sector as a whole. That funding represents 15% of the total budget of the centre. This intermediary role of INESCOP as an association provides its member with the capacity to benefit from an indirect financing that would otherwise be out of their possibilities. The key example of these subsidised activities for the whole sector are normalisation rules. The small footwear firms are not equipped enough for achieving such high level negotiations themselves, and so it is INESCOP acts as representation. INESCOP is, then, the intermediary body between the State Administration and the footwear companies for part of the financing of their research and development functions. Apart from getting funds from different Administrations, they organise training activities within their laboratories and with their own staff and equipment. At an European level, this topic has an enormous impact over the national industry. Such small enterprises have chosen to unify their interests as an strategy for being more powerful and having a more solid representation in international forums. Besides INESCOP the Spanish Federation of Footwear Industries (FICE) exists. It is the sector's business organisation and it also represents the general interests of the sector both in national and international levels.

Moreover, INESCOP also takes part in periodical public calls for public competitive funds , given either by European, central, or by regional administrations. The proportion of public funds that are competitive is not very high. For instance, projects funded by CICYT represents just a 1% of total income. In order to get that type of funding, INESCOP has to compete with the Universities, with the Higher Council of Scientific Research, with big companies, and with technological centres. Legal features are important when talking about competitive sources of income. INESCOP is a technological centre according to CICYT criteria, and an association non-profit foundation according to legal criteria. The legal figure of *technological centre* was created in 1997, and it was established in order to identify which centres would take part in the so called National R&D Plan. However, some of the indicators relevant for CICYT evaluations do not fit with their way of working.

Relations with External Actors

INESCOP interacts with a variety of actors: industry, technological centres, policy makers at regional, national and international levels. One of the clearest patterns in INESCOP strategy has been the establishment of links with the political context, especially at the regional level, that is the autonomous regional administration. It is at this level that INESCOP has a fluent relation with IMPIVA.[6] When IMPIVA was created in the mid-eighties, it took INESCOP's organisation and working paths as a model, and proposed it for the 16 technical centres of different sectors that were under construction in the region. Every year, INESCOP and IMPIVA sign an agreement for the latter to finance up to 20% of INESCOP's total budget. *It seems to be the case that this political level allows for more flexible and extensive exchanges. INESCOP strategically decided to strengthen this link and invited IMPIVA to be represented in its Governing Council.* There are periodical technological centres' presidents meetings where IMPIVA takes place as well, and also common projects with some other institutes.

Turning to the national political arena, the perception of those interviewed indicated that their relations with CDTI[7] are not that fluent. They attributed this to the fact that for them CDTI has way of working that is rather focused on big companies and it is not the best financial choice for small enterprises. They claim that regular savings banks offer good credits such as CDTI, and even better rates. At times, the costs of the relationship with CDTI exceeds the benefits due to its rather slow way of working and to all the administrative paper work requirements.

At an *international level*, there is an association of technological centres of nine different countries for collaborating and working together in European projects. Such association is called EURIS and is made up with Spain, France, Portugal, Italy, Belgium, United Kingdom, Holland, Germany and Greece. They began working together in international projects even before Spain joined the European Community. This network started in 1980 with the former "ESPRIT" program that was dedicated to find out tactical positions for the footwear industry market. At that point there were no computer programs nor computers able to work for this sector. Nowadays, that start has turned into a rather solid collaboration scheme and INESCOP is involved in more than twenty European projects together with most of their international associates. This is a fluent and very well connected network. They are used to work with each others and it is easy to get in contact among them. There is an European level R&D strategy defined for the footwear market. Within that network there has been set an idea of "unique laboratory", which means that every country's technological centre acquires a very concrete specialisation in a certain area, in order to be able to do the others that very service. The underlying idea of this collaboration

[6] *Instituto de la Mediana y Pequeña Industria Valenciana* (Institute for Valencian Small and Medium-Sized Industry). It belongs to the Valencian Regional Government.

[7] *Centro de Desarrollo Tecnológico Industrial* (Centre for the Development of Industrial Technology). It is a Public Business Institution dependent on the Spanish Ministry of Science and Technology that promotes innovation and technological development among Spanish companies. CDTI has as its purpose to encourage industry competitiveness in Spain by developing the following activities:
- Techno-economical assessing and funding of R&D projects developed by companies.
- Providing support for Spanish involvement in international R&D programmes.
- Promoting international technology transfer and providing support to technology innovation.

is to strengthen local industries good qualities and put them in common. It is not clear whether in this environment, the benefits of co-operation justifies INESCOP's contributions, since it seems to be the case that it has a comparative advantage position with respect to the rest of partners. There are periodical meetings every four months for discussing important facts with international repercussion, for instance environmental legislation or normalisation rules.

Users, Audiences and Strategies

Footwear firms associated within INESCOP are the collective *principal* in this relation but at the same time they are also INESCOP's outputs' main users. The sector constitutes its main economic environment. All their clients and associates come from such sector. Those industries turn to INESCOP their problems and needs and so INESCOP provides them with the proper tools in order to solve their problems. The member enterprises are involved in the experiments performances and in the technological developments. Enterprises must, then, be able to identify their own problems and be able to transmit them to INESCOP. This is not always that easy; those industries are very small sized and so they have small management core that in most cases have to take care of so many things at the same time. The enterprises pay for those products, either directly by buying technological advances once the research outputs are available, or indirectly through their membership quotas. When an industry demands a certain technical improvement it usually gets involved in the whole process and so, even though those inputs would sooner or later be available for any other interested member company, it gets a privileged position for testing and acquiring new products. Without this co-operation and direct mutual feedback INESCOP's work would not be possible. This is the only way of attending high complicated technological demands.

All the enterprises members get the very same services from INESCOP, even though among them are strong competitive relations. INESCOP does not make any difference among them, they all have the very same rights.

The footwear sector in Spain is very specialised. There are industries only for making heels, others only for making soles, others only for making leather pieces, others only for putting all the pieces together and so on. They used to be large integral factories but they subdivided themselves in order to have the best structure for receiving technological advances. The associated enterprises of INESCOP are rather small sized: 40% of them have less than 10 workers. The way of optimising these factories production is organise them as small, tiny enterprises.

Human Resources

Human resources management is mostly located within the Research Manager area of competence, who has directive functions about it. INESCOP has a multidisciplinary way of understanding research in this area. They have working teams of chemistries, physics, telecommunication engineers, and so on. This type of collaboration is organised and promoted from the management on the belief that this is a superior way of working. In 1999 there were 129 people working at INESCOP: 48 qualified researchers, 8 temporary researchers, 3 doctoral students, 6

administration workers, 6 specialists, 39 assistants and 19 post graduate scholarship holders. There are up to 9 Doctors among the staff, and this gives INESCOP a higher profile of professional qualification. 12 doctoral thesis related to footwear and raw materials have been presented where 8 were supervised within INESCOP.

All the staff of the Institute have a labour contract. There are no other kind of contracts, apart from grant holders. INESCOP is not fond of temporary contracts made for specific works with a delimited duration, instead, they understand human resources as a basic piece of the Institute, therefore permanent training and long term contracts are their normal way of managing workers conditions. The professional profile of INESCOP's workers has changed following the centre activities' evolution.

When there is a need for personnel, searching procedures begin within INESCOP staff. After depicting a proper job description they first try to find a good candidate within lower professional levels in INESCOP, or even among grant holders. If no possible candidates exists, then they rely on the external labour market. Their main external recruiting source is the Polytechnic School of the University of Alicante. INESCOP management shows a clear preference for using their internal labour market rather than the external one because it is a way to get some returns from the investment the make when they train their workers or grant holders in the specific qualifications relative to the sector of the footwear and its related industries.

Incentive mechanisms do not work at an individual level. The management fosters working groups, and therefore incentives are also collective hallmarks. Each worker gets its regular stipulated salary, and payments increase depending of the scope and economic dimensions of projects demanded. INESCOP works on the belief the output of specific units are collective resources for the rest of the organisation. This might be problematic regarding incentives since no technical unit's outcomes belong exclusively to it. Therefore, establishing the ownership of successful advantages is rather difficult when each worker depends on the rest of the institute's work.

3. Analysis of Key Dimensions and Changes

The evolution followed by INESCOP illustrates the case where a co-operative organisation becomes a powerful collective resource, and thus gains a certain degree of independence from its members. Within the context of this particular industry, research and development activities have acquired the characteristics of a collective good, in such a way that the benefits for maintaining its contributions greatly exceeds the costs of withdrawing from the association. An important component of INESCOP´s behaviour has been to develop strong links with public administration at different levels. This has had a double edge objective. On the one hand, it has provided the organisation with some public funding for its activities. On the other hand, INESCOP has adapted to a political environment in which public funding for applied research has gained political salience and it has managed to adopt an intermediary representative role between its associates and the administration, a role that has empowered the organisation itself and added legitimacy to its work.

Initially its mission was centred around quality control work. Such activity was developed in a historical context were there was a considerable lack of quality control analyses available for footwear sector factories, and so enterprises involved decided to unify efforts in order to achieve a common advancement and to defend their common interests. The origin was thus a collective decision to externalise quality control functions, in a context big factory model threats and the emergence of industrial district. It is important to note that this evolution has meant that INESCOP's mission has gradually exceeded any member's capability to achieve a similar outcome on its own. This factor accounts significantly as part of the explanation of the survival and increase of the organisation within such a changing environment, even with the presumption that members are market competitors.

As explained, the Spanish footwear sector is made of very small and very specialised factories. That makes possible a unique management system, which means that they are very flexible and keeps fluid dialogue for establishing agreements, making proposals or starting new projects, which is a very good attribute of this sector. Big and huge enterprises are very tiring to work with. That quality has made possible that in Spain footwear sector is still on the top of the industrial production scale. The geographical concentration, mostly in Alicante, is also a very good feature because it provides an every day contact among them.

Even though there is a strong competitiveness among INESCOP's associated enterprises, it has been created a trust relationship among its members by putting them together to reach common interest projects. They believe that this is one of the best characteristics of INESCOP, its privileged position for creating a collaboration atmosphere inside the sector. When interviewed, INESCOP's managers explained the essential importance of this feature for the industrial sector to survive. They stated that the footwear production line is very much subject to fast fashion changes, therefore it needs agile and easy adaptable factories very specialised in specific works, in order to be ready for changes within short periods of time[8].That's it, being specialised and easily adaptable to fashion changes implies some difficulties for investment in large capacity process technology. Thus, enterprises involved in INESCOP's projects behave strategically in collaboration, despite the fact that there is a high degree of competitive relations among them, because the aggregate benefits exceed the costs, and because the costs to exiting and loosing access to innovations are unaffordable. INESCOP carries out its work by supplying technical support that have adequately and successfully adapted to changes in the sector.

Relating to management and organisation structures, we are witnessing how the Assembly is not a proper management body, but rather principal within what has been denominated in some literature as the *governing actor* within the principal-agent relation. With respect to the settings formed by other technological organisations, INESCOP has managed to have salient role within the federation of innovation and technology centres at a national level, FEDIT, in which today it occupies the Vice-

[8] INESCOP's interviewed head directors discussed how in other European Countries, like Portugal, the Government fostered a policy for making macro-factories for elimination of small scale factories, and it was very damaging. Their opinion was that such policy was absolutely destructive for the footwear sector because as a result these countries have high specialization but in short number of low quality shoes models. This way of producing is very powerful in countries with low labour costs.

presidency[9] and before the Presidency. By means of this link, they have a very solid relation with the rest of technological centres in Spain, a relation with a certain degree of leadership. This relation is mostly focused on topics like centres' management, methodology and projects. It also seems to be the case that the political level allows for more flexible and extensive exchanges. INESCOP strategically decide to strengthen this link and invited IMPIVA to be represented in its Governing Council.

On another hand, the future viability of the explained type of international collaboration is far from clear. The EURIS network was born with 50% of their budget financed by EU funds, but nowadays it does not receive those funds anymore. Each country has a different management system and a different accountability way of organisation. That differentiation in organisational models means difficulties when working together in a certain project.

4. Conclusions

INESCOP is an example of a research and technological institution that has greatly benefited from an adequate strategy in technological terms and networking relationships by establishing alliances with actors in political administrations. We find a very dynamic yet high dependency relationship between INESCOP and its associates members where the benefits of association greatly exceeds the cost of disalignment. This centre has been as shown to respond well to the evolution its environment both in terms of technological changes and also external pressures from legal and policy regimes. It has shown provided a unique example in which economies of scale (creation of large factories) has not been necessary to be competitive, innovation and technological development is achieved by aggregation (instead of scale). INESCOP has positioned itself accordingly in the context of its environments especially in economic, technological and political terms.

[9] *Federación Española de Entidades de Innovación y Tecnología* (Spanish Federation of Technology and Innovation Entities).

IAC - Instituto Astrofísico de Canarias.
(Canary Islands Astrophysics Institute)

1. Introduction

The Instituto Astrofísico de Canarias (IAC) is the main support organisation for the Northern European Observatory in the Canary Islands. It represents Spain within a complex international research cooperative system in the areas of astrophysics and astronomy. There are almost twenty telescopes and even more scientific instruments, owned by at least twelve different countries, distributed in two different observatories of the IAC, which is in charge of the overall management and maintenance of the research within this large facility established by multilateral agreements.

IAC is the institution that coordinates the Spanish research community in this field and manages telescope observations both of its own and of other countries. Furthermore, the IAC represents Spain in the International agreements that allow other countries to install their own telescopes in Spanish territory. IAC is in charge of providing common services to all users and, in some cases, international partners contract with the IAC the maintenance and management of their telescopes.

The case of IAC is also relevant not only due to its international role but also because it represents a new type of coordination mechanism of national efforts emerging from different institutions and research actors with a single organisational basis established through a contract among various Spanish institutions. In addition, IAC provides some technical assistance and development services for its international partners. A main function of IAC is to manage a common pool of resources for the Spanish astrophysics community, namely, the observation time.

2. Situation Today

Main Features: Ownership and Mission

The Instituto Astrofísico de Canarias is a Consorcio Público de Gestión (Public Management Consorsium - PMC) formed by the Spanish Central Government, currently represented by the Ministry of Science and Technology, the Regional Government of Canary Islands, the University of La Laguna, and the Higher Council for Scientific Research (CSIC). It was originally established by a 1982 Act (RDL 7/1982).

The IAC mission is to promote research and technology development in the field of astrophysics, and to foster international scientific relations. Management and administration of the international telescopes located in its observatories is also part of IAC's mission. Scientific research is its main focus, while the rest of its activities derive from it.

The Spanish Government created the IAC in its current form[10] in 1982 as an organisational tool for coping with the commitments derived from the 1979 International Agreements for Astrophysics Cooperation between Spain, the UK, Sweden and Denmark, which allowed those countries to set up telescopes in Spanish territory. Since then, several other countries have joined the agreement.

The International Agreements directly influence IAC's work. There is an International Scientific Committee (CCI) that is in charge of decision-making about the uses of telescopes composed by representatives of Spanish and foreign institutions representing third countries. In addition, each foreign owned telescope has to pay the IAC up to 20% of the total amount of observation time, plus 5% of that time for international co-operation programs. This time proportion is administrated by a Time Allocation Committee (CAT).

The IAC facilities are integrated by the Astrophysics Institute located in the University of La Laguna, the Teide Observatory in Tenerife Island, and El Roque de los Muchachos Observatory in La Palma Island. Most of the telescopes and instruments located in these two observatories are foreign owned.

[10] In 1959 a Ministerial Order created the Observatory of El Teide within the University of La Laguna. In 1973 the Astrophysics Institute of the University of La Laguna was created, and two years later it became the Astrophysics Institute of Canary Islands, through an agreement between the University of La Laguna, the High Council for Scientific Research (CSIC), and the former Provincial Inter-islands Council Commonwealth of Santa Cruz de Tenerife (the local Government at the time).

Main Instruments and Ownership at IAC	
Teide Observatory (eight)	
Solar Newton Telescope (VNT)	Germany and Spain
Gregory Coudé Solar Telescope (GCT)	Germany
Reflective Telescope	Belgium
Vacuum Tower Solar Telescope (VTT)	Germany
IAC-80 Telescope	Spain
THEMIS Solar Telescope	France and Italy
Terrestrial Optics Station Telescope-OGS	Spain and International Astrophysics Com.
Carlos Sánchez Infrared Telescope (TCS)	Spain
Other instruments	
Radio-telescopes (microwaves)	Spain and the United Kingdom
Interferometer 33GHz	Spain and the United Kingdom
COSMOSOMAS Experiment	Spain
TOM Millimetres Experiment	Italy
Interferometer Net of 14 antennas (VSA)	United Kingdom
Solar Laboratory	Spain
Spectro-Photometers (at the solar lab.)	
Mark-I	United Kingdom
Iris-T	France
Echo-T	USA
Photometers (at the solar lab.)	
TON	Taiwan
LOI	Spain and ESA
Tachometer GONG	USA
El Roque de los Muchachos Observatory (twelve)	
Meridian Circle Telescope	Denmark, United Kingdom and Spain
DOT Open Solar Telescope	The Netherlands
Swedish Solar Refractor (VRT)	Sweden
Swedish Optic Telescope	Sweden
Jacobus Kapteyn (JKT)	U K, The Netherlands and Ireland
Belgian MERCATOR Telescope	Belgium
Liverpool Telescope (LJMU)	United Kingdom
Isaac Newton Telescope (INT)	The Netherlands and the United Kingdom
Nordic Telescope (NOT)	Denmark, Finland, Norway and Sweden
Galileo National Italian Telescope (TNG)	Italy
William Herschel Telescope (WHT)	The Netherlands and United Kingdom
GRANTECAM Telescope (under construction, first light in 2003)	Spain
Other instruments	
Cosmic Rays Observatory HEGRA	Germany, Spain and Armeny

Figure 1: Main Instruments and Ownership at IAC

Research Outputs, Areas of Capability and Sectors

The IAC varies its activities from basic research to applied research, as well as technical development and diffusion. However, as previously mentioned, it is an outsourcing service provider for observation and instrumentation, which is nested into an international agreement for research cooperation in Astrophysics. PhD training is also a regular research activity.

Astrophysics is its main research area of specialisation that involves scientific and technological capability in natural sciences, engineering and technology. Mathematics and computer sciences are major sub-fields of competence for the institute as well as physical sciences, earth and environmental sciences, electrical engineering and electronics, and other engineering sciences, although these represent minor domains in the IAC's research work. IAC also provides some services for the industry, but this has been a marginal activity. Most technical capabilities are related to specialised services for the astrophysics community in telescope maintenance and construction and on board satellite instruments.

The overall structure of the IAC is organised in four areas: Research, Instrumentation, Training and Teaching, and General Services Administration.

Within the **research area**, the main research fields are: Universe structure and Cosmology; Galaxies structure and their evolution; interstellar material; stars structure and their evolution; the sun; the solar system; atmospheric optics; spatial high resolution; telescopes design and building; optics instrumentation; infrared instrumentation; and astrophysics from space. In year 2000, within these areas there were 40 projects up and running.

Data about IAC scientific production at the beginning of year 2000 show that the Institute is fully integrated in the international research community. The total amount of publications in international journals with referees of IAC authors was 180, while publications in national journals was only 5. A similar pattern is followed in relation to participation in conferences; the amount of communications in international conferences was up to 138 and 16 in nationally organized conferences. Indicators of national research capabilities according to ISI (Philadelphia) assesses a good position of Spanish astrophysics community within the years 1995-99: the shares of world published papers was 4.95 %, which represents more than double of the Spanish average in research production in all fields; the relative impact is within the average with the rest of the World. These data reflect two main facts of IAC: the high level of their research outputs and the international position within the scientific community. Furthermore, astrophysics within the Spanish scientific appears to be one of the leading fields it is fully integrated with the international research community, as witnessed by joint research projects and joint papers.

IAC was created on two main pillars: stars studies and sun studies. Later, the Institute gradually grew and evolved to cover new working lines. As human resources increased, personnel training became more specialised, and new research interests emerged.

Besides the main basic research orientation, certification and standardisation are also activities carried out at the IAC. In 1992 the Canary Islands Regional Government stated the need for a credited laboratory specialised in "electricity and low frequency" as recognised by the ENAC[11], and requested the IAC to take on this task. The Institute set up a specialised laboratory on "electric calibration" with the criteria EN 45001 and ISO 25. It has received the ISO 41000 quality benchmark. Since 1996, the laboratory offers its services performs, on average from 10 to 20 analysis per year.

Users, Audiences and Strategies

IAC has very important political links with national and regional authorities, and also major academic links with the Spanish Astrophysics research community, major international research links, and is closely tied to public sector labs such as CSIC and other astrophysics observatories. IAC also has minor industrial relations and some other links with the European Commission, because of its involvement in competitive programs such as "Human Capital and Mobility" and because it is part of the European R&D facilities and infrastructures, and the European Science Foundation.

There are two different kind of users of IAC as a research centre and as a host institution of facilities of other R&D institutions. On the one hand, users are all the international owners of the observatories' telescopes. The Institute in its present form was formed as a result of the research collaboration among countries. Its very first raison d'être was a support scientific collaboration between a group of countries aiming to develop astrophysical observation while Spain has the best geographical conditions for astrophysics observations in the North Hemisphere near by Europe. In 1979, the International Agreements included: United Kingdom, Sweden, Denmark, and Spain. Germany, France, and Italy joined the community in 1983, 1988, and 1993 respectively. Some other countries are processing their membership and association. Therefore, the main users are those countries, or their research organizations or Councils that have set up their facilities within IAC's territory. Among those we can mention: The associated member [Statens naturvidenskabelige forskningsråd (Denmark), Suomen Akatemia (Finland), Háskóli Íslands (Iceland), Norges forskningsråd (Norway) and Naturvetenskapliga forskningsrådet (Sweden)] of the Nordic Optical Telescope Scientific Association (NOTSA) founded in 1984 to construct and operate a Nordic telescope for observations at optical and infrared

[11] The ***Entidad Nacional de Acreditación*** –ENAC– (National Accreditation Body) is an organisation funded and overseen by the Spanish Ministry of Science and Technology. It was set up under the Industry Act 21/1992 and Royal Decree 2200/95 which approved the Regulation for Infrastructure of Industrial Quality and Safety. ENAC is a private, independent, non-profit agency that runs a national accreditation system. ENAC's organisation and operational procedures abide at all times by the criteria and standards laid down by the European Union (EN45003 and EN45010) and also by the internationally accreditation criteria and guidelines. ENAC accredits bodies that carry out conformity assessment activities, whichever sector they operate in, whatever their size, whether they are private or public organisations and whether they belong to associations, companies, universities or research organisations. Currently these conformity assessment bodies (CAB) are Laboratories, Inspection bodies, Certification bodies, and Environmental verifiers. At a national level ENAC's accreditations are used by the Ministry of Science and Technology and other ministries such as Agriculture, Fishery and Food, Defence, Environment or Health in given areas of their responsibility.

wavelengths; the UK Particle Physics and Astronomy Research Council (PPARC) and the Nederlanse Organisatie voor Wetenschappelijk Onderzoek (NWO), that have entered into collaborative agreements for the operation of and the sharing of observing time on the Isaac Newton Group of Telescopes (ING telescopes); the italian Consorcio Nazionale per l'Astronomia e l'Astrofisica (CNAA) that operated the Telecopio Nazionale Galileo (TNG); the German Institut Kiepenheuer of Solar Physic from Friburg (Germany) (VNT, VTT, etc.) and Gotingen University (GCT), the French CNRS and the Italian CNR with the THEMIS solar telescope; the Mons University (Belgium), or solar instruments from UK, US, France and Taiwan institutions and European Space Agency (ESA), etc. The IAC is in charged of managing and maintaining most of the telescopes (the eight telescopes at the Observatory of El Teide –in Tenerife Island– and the twelve at the Observatory of El Roque de los Muchachos –in La Palma Island- there are 12 telescopes and a cosmic rays observatory).

On the other hand, IAC also has national users, namely, the Spanish astrophysics community. IAC has its own telescopes and instruments, some with foreign institutions and it also administers 20% of the international telescopes' total observation time for use of the Spanish research community (this refers to the royalties paid by those countries that have telescopes located at the IAC facilities) and an additional 5% of that observation time is used for international cooperation purposes. As part of the astrophysics' international community, they are beneficiaries of IAC outputs and outcomes.

Management and Organisational Structures

IAC is structured as a single unified organisation with three different locations in only one region.

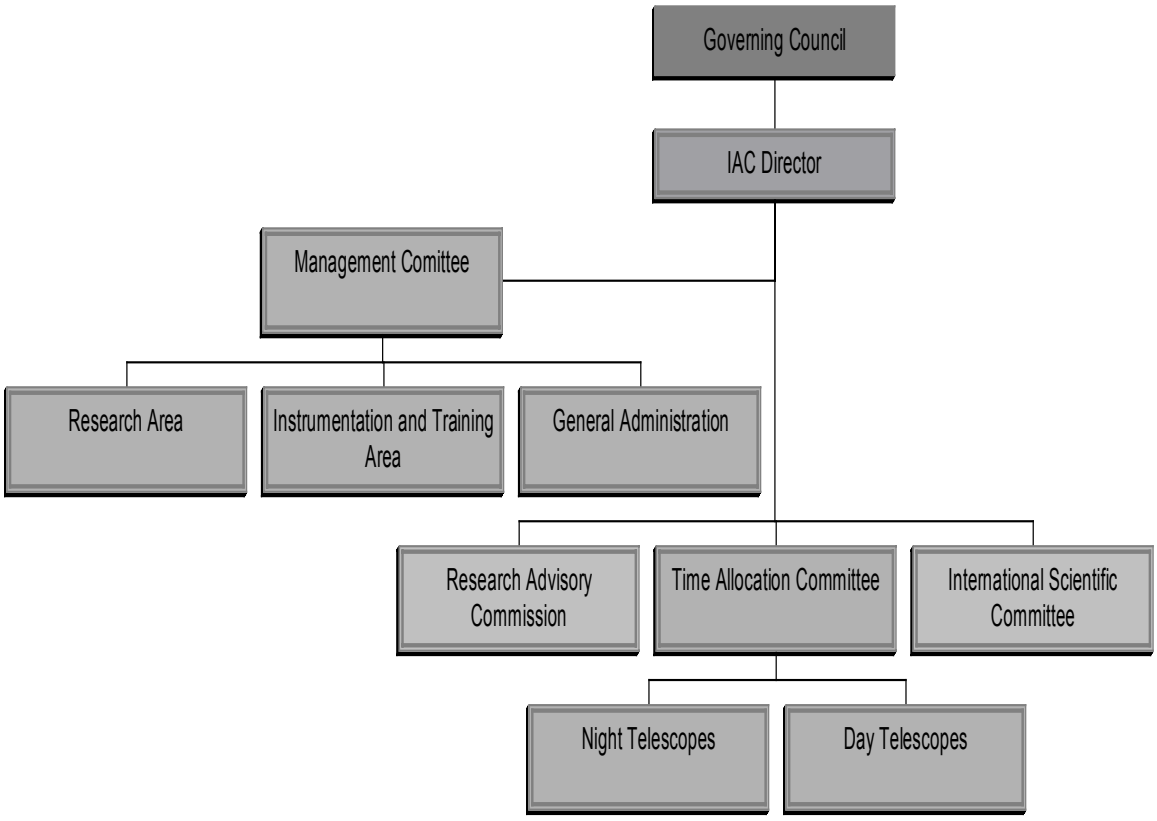

Figure 2: IAC Governing Structure

The present organisational structure was consolidated in by Government Decree in 1989 (795/89 June 23rd). Inside IAC, management and organisation are subject to research needs. The IAC is ruled by two bodies: the Governing Council, and the Director. **The Governing Council** is officially the main decision making body. Its functions are maintenance of the Institute's mission, developing its internal organisation, approving internal management regulations, approving the draft budget before submitting to the Ministry of Finance, approving any expenses of their patrimony, approving the appointment of personnel from other Organisms, and executing any faculty related to the Institute's Governing Council. It formally approves research lines and scientific and technical activities processes proposed by the Advisory Research Commission. It also appoints members for the CAT and regulates its operation. Members of the Council are: the Minister of Science and Technology, a high level official from the central administration, the President of Canary Islands Regional Government, the Chancellor of the University of La Laguna, the President of CSIC, and the IAC's Director.

The Director of IAC is the executive instrument of the Governing Council. Its functions are mainly related to economic, scientific and administrative decisions following the Governing Council's guidelines. Furthermore, it is in charge of any task delegated by the Governing Council. It is the head director of all the Institutes appointed to the IAC, and the executive structure of the IAC. The post has been held by the same person for more than a decade. This degree of stability illustrates the difficulties for radical changes when so many different institutions are involved in the decision-making processes, as in the case of the Consortia.

In order to assist the Director, there is a **Management Committee** composed of the coordinators of the three different areas within the Institute: Research, Instrumentation and Training, plus the IAC General Administrator. Below the Management Committee, there are other working Commissions.

Apart from these governing bodies, there are other ones: the Research Advisory Commission and the Time Allocation Committee (CAT)**. The Research Advisory Commission,** whose members are appointed by the Governing Council among high level scientists, is the consultation and advisory body of the Institute in charge of orientating its research activities, within priorities set by the National R&D Plan. This Commission proposes research lines and monitoring procedures for the Governing Councils.

The **CAT** administers an important resource on astrophysics: observation time. As stated in the Agreements, each foreign telescope gives over 20% of their total observation time to IAC. Following criteria of viability and scientific interest of the proposals, peer-reviewed, the CAT distributes the total amount of time among all the received applications from researchers. This Committee meets every six months under the chairmanship of the IAC's Director. Committee members are outstanding astrophysicists. Membership has a rotary character, almost all the consolidated figures of the Spanish astrophysics community have been a member of the CAT at some point, and they do not remain members for more than four consecutive evaluations, namely, two years. At the end of every meeting there is a vacant, and a new member is designed. Therefore, members are renewed one by one. The CAT examines all the proposals and makes the specific time awards for each of the telescopes. Once the time has been awarded, Spanish scientists are allowed to use all the services and installations of the corresponding telescopes with no cost at all. Observation time applications are always very numerous and exceed enormously the amount of time available. An additional 5% of the total time of observation is compulsorily awarded for international cooperation projects. Multinational specific allowance committees are built ad hoc. It is important to point out that the IAC does not keep absolutely any percentage of that time, and that their astrophysicists have to compete in equal conditions against the rest of the Spanish applications. Thus, the unique allowance criterion are viability and scientific interest of the proposals.

One basic element that should be stated in relation to the authority structure at the IAC is the high degree of freedom of IAC researchers, whom are free to choose what areas they want to promote, and which projects they want to develop. There is no steering emerging from any management body that hinders researchers interests.

Additionally, in order to coordinate the international involvement in the activities of the Institute, there is an **International Scientific Committee** that includes representatives from the different foreign institutions with telescopes and scientific instruments located at IAC facilities.

Sources of Income

The 1999 budget total amount was 10.66 million € income. The expenses amount was 11.15 million €. Most of this funding comes directly or indirectly from basic research money, devoted to astronomy. This figure does not include the investments (that amounts 110 millions €) for building new telescopes such as the GRANTECAN that in 2003 will be the biggest telescope in the Northern hemisphere Even those consignments accounted as "services", serve basic research facilities and keep them running. The same kind of resources comes from a variety of origins: different public administrations –Regional, National, Foreign and International organisations–, larger research institutions, and universities; and resources are both Spanish and foreign. As the Income Table shows below, the Central Spanish Government contribution amounts to 60% of the funds coming from the Consorted Administrations, while the Regional Government provides 21%, the University of La Laguna has a contribution of 10% and the CSIC's is only 9%. These financing rates have been very much stable over time.

IAC Budget		
Regular funds from the consorted administrations:	*7.47 million €*	*70%*
- Central State Administration:	4.45 million €	41.74%
- Regional Government:	1.59 million €	14.91%
- La Laguna University:	0.78 million €	7.31%
- CSIC:	0.65 million €	6.04
Non-regular funding:	*3.19 million €*	*30%*
- State Secretary for Universities, Research and Development	0.61 million €	5.72
- Ministry of Public Administrations	0.03 million €	0.28%
- Autonomous Community	0.05 million €	0.46%
- European Union	0.15 million €	1.5%
- Services Selling	2.28 million €	21.4%
- Other incomes	0.07 million €	0.64%
Total	**10.66 million €**	**100%**

Figure 3: IAC Budget for 1999.

Focusing on non-regular funding, it is important to point out the percentage of services sold (71.48%) compared with all the rest of financing institutions, that all together are only the other 28.52%. Competitive funding sources are –comparatively– a small budget entry. However, private contracts are an essential part of IAC's incomes. Such private contracts are mainly technical work and telescope' maintenance that IAC sells to the owners of the telescopes, because most of them have externally contracted those services with IAC. Apart from these technical services, IAC also has external clients like the Public Hospital Nuestra Señora de la Candelaria, or the Bio-Organic La Laguna University Institute "Antonio González" among others.

Human Resources

There are three basic types of personnel working at the IAC under the supervision of the Director. First, staff belonging to the Consortium, contracted under regular labour relations, for all non research missions. The 1986 Law produced the disappearance of the previous Consortium research personnel, and integrated them within the CSIC. Second, staff belonging to the four consorted administrations and the University; and although these would normally be considered civil servants, while at the IAC they are regarded as affiliated to the Institute. Third, staff from other public or private entities that have a contract or a cooperation agreement with the IAC. The regulations also allow the IAC, for developing research, technical or training activities, to contract under regular labour relations, temporary workers.

The total number of staff working at IAC facilities was 288 in 1999. There are 85 qualified research staff –12 IAC civil servants, 24 IAC temporary research staff, and 49 from different institutions. There are also 39 doctoral students. Only 30.5% of the human resources are IAC's permanent workers, both civil servants and long term contracts. The rest come either from the consorted administrations or are temporary workers. Moreover, while the permanent staff is only 40% of the human resources, the temporary staff is up to 60%, which is a high percentage for a research institution.

IAC Human Resources.

	IAC	IAC Contracted	Temp. Staff	University of La Laguna	CSIC	Resident Astroph.	Other	Total
Astrophysics	12	-	24	22	5	-	22	85
Technicians	1	50	54	-	1	-	5	111
Administratives.	1	24	27	-	-	-	1	53
PhD Students	-	-	-	-		23	16	39
Total	14	74	105	22	6	23	44	288

Figure 4: IAC Human Resources Origins

IAC human resources structure is a combination of different sources. Focusing on the **astrophysics** group, the proportion of non-stable astrophysics is more than the percentage of regular astrophysics (46 out of 85).

The 1986 Law of Science forbids IAC specifically to make their own research staff recruitment directly. There are two ways of recruiting research staff:

– First, any of the Administration members of the Consortium can make bids for jobs in the IAC. They make the announcement, they rule the selection process, and researchers work there although they remain belonging to their home institutions, with the only difference that they develop their labour activity at the IAC.

– Second, the IAC can offer a temporary research job. Selected candidates come to join the Institute's personnel, and therefore they lose their connection with their home institutions. Moreover, the IAC's salaries are lower than the CSIC's and

the University's salaries. Therefore, staff do not prefer this option. The Institute is, then, at the expense of the researchers that each Administration member of the Consortium wants to assign to IAC, and at the expense of the researchers' willingness. They can just offer "working space", but IAC cannot make free calls for astrophysics jobs, due to the fact that its recruitment goes compulsory either through the CSIC or the University.

Focusing on the **technicians**, 53% of them are temporary workers, while only 1 of them is a civil servant and 51 have long term contracts. A similar pattern is followed by the **administrative personnel**, namely, only a 50% of them are long term employees (both civil servants, 1, and long term contracts, 24). Most of this staff is linked by regular contracts instead of civil servants usual positions. These public employees can be either regular public employees, or staff recruited for a certain work. There are two ways to contract regular public employees: workers under collective agreement rules, and workers non under collective agreement rules. Workers under collective agreements rules are all the staff in charged of work related to research activities, namely, administrative personnel and technical support staff. The latter group is staff that perform high level specialisation works, namely, engineers and high level technical staff. Relating to staff recruited for a specific task or service, they are assigned to work within research projects. This labour group is currently a 60% of the total amount of public employees of the IAC. Such group has been developing and taking on more and more responsibilities, and they have ended up being essential for the regular Institute's operation.

PhD students working at the IAC are mostly resident astrophysics, 58.9%, while 41.1% of them are scholarship holders paid by external institutions, such as the National Research Plan, the EU, public Universities, and so on. The resident astrophysics work at the IAC a for four-year training period. This legally regulated contracting way has been changed; at the beginning resident's working period was four years, but afterwards a new legislation established that such period should be only two years. The solution adopted for the IAC was to provide the resident astrophysics with two more years as scholarship holders, in order to complete the four year period.

3. Analysis of Key Dimensions and Changes

Since the early-mid seventies, the Astrophysics Institute of the Canary Islands had existed as a part of the CSIC, and in collaboration with the University of La Laguna and the local Government. When the International Agreements were signed in 1979, and the Institute became the tool for managing such agreements, it was clear from the Central Government point of view that the structure of the Institute was not suitable enough for the international dimension of its new mission. The Institute managing structures were intricate and very slow. The IAC creation Act (1982) improved the management capabilities of the organisation with the creation of a unique administrative figure: the Public Management Consortia (PMC), that consolidated all the interlocking institutions involved in IAC, at the regional, national and international level.

The PMC is a singular management figure, publicly owned, and with the managerial features of an Organismo Autónomo de carácter comercial, which is the organisational form we find in most Spanish public research centres. This is the regular organisational structure to manage the existing facilities and the IAC. However, in order to develop new projects such as the construction of the new metre telescope (GRANTECAN), a public firm has been created: Grantecan S.A. It aims to avoid some of the administrative rigidities inherent to the IAC.

A big change in the management capabilities of the IAC took place with the so-called Law of Science (Ley 13/1986 de 14 de Abril, de Fomento y Coordinación General de la Investigación Científica y Técnica) in 1986 and its development. The Ministry of Education and Science, representing at that time the central government within the Consortia might have wanted to exercise more control over the IAC. However, such an increased control was not easy considering that the Regional Government was part of the Consortia. Eventually, the Law of Science modified the Institute's Governing Council and the Minister of Education and Science was appointed as Governing Council's chairman. Before that Law, the President was elected at the proposal of the institutions involved in the consortium. Due to recent ministerial re-organisations, the current IAC's Governing Council Chairmanship is no longer the Minister of Education but the Minister of Science and Technology.

The Law of Science kept the IAC as a Public Management Consortium, and it did not include it in the Public Research Organisations (OPIs) list. Although in practical terms both administrative figures enjoy the same degree of autonomy to act, however the Law took away the capacity of the IAC to recruit its own research staff directly, its researchers are included under the structure of the CSIC.

Astrophysics research is essentially basic research and the organisation strongly supports the approach. The director of the Research area insisted that IAC researchers need to keep very clear in mind the institute's mission in order to advance knowledge, and avoid temptations of market exploitation of new successfully developments achieved. Basic research is the mainstay of their work; technical capabilities are justified by this research and are subordinated to this principal goal, while technological development by itself does not merit extra effort. Therefore, when any specific output at IAC is developed enough to need marketing management, it is transferred through the Oficina de Transferencia de Resultados de Investigación (OTRI -Office of Transfer of Research Results) to a specialised firm in order to give it a proper development[12]. They do not want to work on such developments and its commercialisation because they want to remain loyal to their basic research mission. This situation is getting more and more common. When research groups advance and new related activities and outputs are generated, they risk absorbing too much energy and resources, and become goals themselves. Therefore, IAC's head directors closely monitor the work to avoid any deviation of the IAC mission[13].

[12] The IAC includes a Technology Transfer Office, OTRI, that seeks clients for its emergent technological outputs.

[13] The Instrumentation Area Head (Carlos Martínez Roger) at the interview illustrated this attitude with an example. A project developed for creating a virtual acoustic space has obvious application for blind people. They have achieved to construct a new perception system through sounds, instead of through light and vision. Users perceive their environment through the noises generated instead of through the

Astrophysics manages big and expensive equipment, and high level specialised knowledge; collaboration is a necessary strategy, with some slight competition. Within the Spanish scientific community the observation time is carefully awarded by the Comité de Asignación de Tiempo (CAT- Observation Time Allocation Committee). On an international level, leading projects are more and more ambitious, and external working linkages are essential for successful efforts. Therefore, collaboration and working groups patterns underpin astrophysics research. Collaborations channels are: common works among institutions framed in the already mentioned international agreements, common research projects, personnel exchange for doing observations in other telescopes, and exchange fellowship.

The current management and organisation structure of IAC is the result of a evolution produced by some changes in its environment. The Spanish Government required a stronger structure to manage the co-operation in astrophysics derived from the signature of the international agreements. Also, the evolution was influenced by the new regulatory environment for the Organismos Públicos de Investigación (OPIs) Public Research Organisations, included in the 1986 Law of Science[14].

Relating sources of income, a comparison among past budgets show us that financing patterns have been very similar year after year. Therefore, the most important source of income within the Consorted Parts has always been the Central Government. This is coherent with the argument that the IAC is, essentially, a Government instrument to implement international agreements in Astrophysics research.

Human resources is one of the main changing points of the IAC. Before the Law of Science was enacted the situation was different. The main implication of the 1986 regulatory changes was that IAC could not have its own researcher staff. IAC used to have its own personnel scales that divided the research staff between the Astrophysics Level and the Assistant Astrophysics Level, but with the Law of Science these levels were eliminated. That new personnel levels was set up in 1982. It followed the same model as the Spanish Universities, namely, the Astrophysics were professors' counterparts, and the Assistant Astrophysics were the tenure teachers' counterparts. The new legal situation aimed to enhance contracting situations in order to set the best possible labour linkages for the very specific working conditions at IAC, and so a new contracting formula needed to be arranged. Nevertheless, such new regulation did not fulfil the target. When interviewed, the Head of the General Services Administration pointed out how much it hinders the research mission not being able to manage the IAC with its own permanent staff.

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light reflected by the objects. In this manner, blind people know where they are and what things are around not by *seeing* it but by *feeling* it through the sounds. These type of research outputs soon became very much demanded within a specific population group, and if commercialised for IAC it would give them high economic incomes, but, again, it is not IAC's mission, and so after developing the first part of basic research and technology development, it is transferred to the proper institution in order to be commercialised.

[14] This law is significant because it has provided the foundations for the organisation of scientific research and development in Spain.

IAC's Director expects this feature to be strongly enhanced, therefore a new regulatory framework has been demanded: "I have to signal that IAC still finds severe administrative troubles to recruit, consolidate and homologue its staff, and it is serious as we all know that, finally, it is the human team the essential of each organisation and the key part to fulfil its goals. (…) I finish by saying my hope that it will soon exist an adequate legal norm to help –and not to hinder– a work as hard as doing science". (Francisco Sánchez, IAC Director, at the Annual Report, 1999).

4. Synthesis and Conclusions

IAC appears to be the main instrument of the Spanish Government for promoting research policy in astrophysics. The research centre hosts the biggest astronomic facilities from different countries in the Northern hemisphere, and at the same time it manages the common pool resources of Spanish research community. IAC is a complex device, composed of four different institutions, Central and regional Governments, University, and Research Centres. It is also in charge of managing international agreements for scientific co-operation in this field. Its main mission is fostering basic research in astrophysics.

It is organised as a unique legal entity, a public consortium. However, the organisation has experienced significant changes in the last two decades. From 1982 to 1986, it was significantly empowered to allow Spain to fulfil its international commitments. Up to 1986, the Institute had its own civil servants research personnel. In the same year, the central government took over the Chairmanship of the Governing Council, subordinating the overall IAC organisational structure to the will of the consorted administrations. The IAC is an instrument of the Central Government for research policy, and illustration of this is that for the construction of a new macro telescope, a new public firm (GRANTECAN) has been created ad hoc.

Although the IAC is mainly concentrated in basic research, it nevertheless provides some technological services both to scientific organisations and, to a lesser extent, to the local industry.

ISCIII – Instituto de Salud Carlos III (Institute of Health Carlos III) & CNIO – Centro Nacional de Investigaciones Oncológicas (the National Centre for Oncology Research)

1. Introduction on Context and History

The following report is comprised of two case studies, which are directly linked to each other. These case studies cover two organisations, the Institute of Health Carlos III (ISCIII) and the National Centre for Oncology Research (CNIO). It was necessary to conduct some background work in order to understand the organisation and structure of the ISCIII. The reasoning for this was that although the CNIO was initially the case study target of our interest, this centre not only forms part of the ISCIII, but it also has a "special" situation as compared to the other national centres within the ISCIII structure.

The report is organized in the following manner: The first part begins with a brief discussion and explanation of the ISCIII. It is important to note that the ISCIII has been undergoing changes very recently, however, we have focused the attention on the structural and functional features it showed at the time the CNIO was created. Next, we focus more of out attention on the CNIO and offer a detailed analysis its organisation, human resources, funding, etc. More fieldwork was carried out in relation to this case. Finally, we end with some final remarks on why the CNIO was created and its unique status within the Spanish public research system.

2. Situation Today: ISCIII

Biomedical and health research in Spain forms part of a complex systemic relationship between regional healthcare services (hospitals), universities and public research centres. However, the main national institution in this field is the Institute of Health Carlos III (ISCIII). This institution is responsible for co-ordination of biomedical and health research at national level, it administers the main public funds for R&D in medicine and health and also has centralised competencies for the control, monitoring and advising for health, food and pharmaceutical issues.

The ISCIII is comprised of several national centres and smaller departments or units which conduct research and development, as well as training and information diffusion. These departments and centres develop research projects, collaborate with hospitals, other public research centres and universities. They include laboratories for testing and monitoring samples involved in the research for assuring public health.
The main centres and units that comprise the ISCIII include:

- National Centre for Epidemiological Research
- National Centre Food Research
- National Centre for Research in Toxic Oil Syndrome
- National Centre for Environmental Health
- National Centre for Microbiology
- National Centre for Fundamental Biology
- Coordination Unit for Health Informatics
- Cooperation Unit and International Health
- Coordination Unit with the Autonomous Communities

The ISCIII also has departments that include:

- Sub Directorate General for Health Research that controls the main public fund for health research (*Fondo de Investigación Sanitaria*, FIS)
- Sub Directorate General for Planning and Training that controls among others the National Library for Health Sciences and the National School of Health, National School for Labor Medicine.
- The Agency for Medical Technology Evaluation

The Institute is responsible for supporting the national healthcare system in areas such as public health, epidemiological monitoring and control, environmental monitoring and control, food safety and security, etc. It also acts as scientific and technical advise to the administration.

The mission of the Institute of Health Carlos III is to "develop and provide scientific and technical services and research of the highest quality in support of national health policies and society as a whole"

The function of the ISCIII is therefore to provide scientific support to the Ministry of Health and to regional healthcare services of the regional governments, and to collaborate with its competencies with other administrative bodies. It is therefore a strategy to guarantee health research at national level[15]. The functions of the ISCIII fall under four main categories: research, monitoring and control, education and training, and promotion and co-ordination.

More specifically, the ISCIII serves as a reference institute at national level in relation to diagnostics, quality control, standards, scientific documentation and information, advise and collaborate with other organisation in biomedical R&D and innovation. It conducts epidemiological studies, develops innovative health education methods, control in the area of medication and drugs, and healthcare related products.

[15] Spain has a decentralized national healthcare service, the largest healthcare provider is INSALUD which currently serves 60% of the population in 10 regions, while the rest of the 7 autonomous regions have competencies in health provision and care, thus have set up their own regional healthcare service. The healthcare policy envisions a gradual transition so that in the near future all regions have competencies in healthcare provision.

Its role in education and training is to develop programs, disseminate information, train young researchers, offer specialized courses for both internal and external researchers, etc.

Finally, it actively promotes and coordinates biomedical research activities with the framework of the Law of Promotion and General coordination of Scientific and Technical Research and the Law of General Health (both passed in 1986 which set the foundation of the current RTD public funded programs and organisation of healthcare services in Spain).

Organisation and Structure

The ISCIII is a public research organisation and thus its decision making structure and human resource management fall under public bodies and organisations legal structures. This implies that, as a publicly funded Institute, many of its staff have civil servant status.

Without going into much detail on the bureaucratic structures and norms that govern the status of Spanish public employees, what mainly frames staffing are public calls or bids that involve specific procedures (interviews, examinations, etc.) before being hired. Once hired as a civil servant these employees have certain benefits and job security privileges, that are unlike normal labor contracts.

The total staff of the ISCIII reaches over 1500 people. About 44% are public servants. Another large portion of the staff have labour contracts that fall under the norms of public contracting (54%) and the rest have grants (scholarships and research fellowships). The national centres range in size, which the largest the National Epidemiological Centre has over 500 people, but most centres run between 150 and 200 total staff. **Figure 1** shows the overall organisational chart.

The ISCIII receives its regular funding for its overall functioning from the Ministry of Health budget appropriations. Its annual budget reached over 78 million Euros. However the research projects are also funded through the competitive sources such as the National R&D Plan, the FIS and Regional R&D Plans, and EU funds from the Framework program. This amounts to 49% of the total R&D funding that takes place in the ISCIII, where the percentage of funds obtained from external competitive sources ranges widely between the various national centres and units of the ISCIII. However, we should mention that "real" percentage of external funds is lower since funds obtained from FIS are considered external (since they are competitive funds) but we should recall that the ISCIII *manages and controls* the FIS fund[16].

Decision making structures of the ISCIII are comprised of the two governing bodies, the Governing Board and the Director of the ISCIII. They are responsible for the overall decision making of the Institute and set the guidelines for functioning and assure that the ISCIII serves its mandate set by the Ministry of Health.

[16] This situation has recently changed since the ISCIII is no longer allowed to compete for the funds of the FIS.

The Governing Board is headed by the Minister of Health, who acts as President, and the board members include Director Generals from other related ministries (Science & Technology, Education, Agriculture, Environment). Seven other Board members are representatives of the regional governments and assigned by the Ministry of Health. The Board Secretariat is the Director of the Institute. The Governing Board is responsible for the establishing the areas and criteria for the activities, the operating budget within the General Budget Appropriations designated by the Government, approve the annual financial report to be present to the National Government, and is responsible for the financial control and management.

The Director of the Institute has the same administrative level as Director General and his responsibilities among others include primarily programming, directing and coordinating the Institute's activities. The general guidelines for the activities developed and strategies followed by the national centres and various departments/units that comprise the ISCIII have specific objectives and research lines which are decided and the directors and governing board level.

Following these general guidelines, each centre director than develops specific lines, depending on the staff and resources available. The majority of the funds come from public budget appropriations for the general operation of the centres and units.

Depending on the mission of the centre, some funding is sought through external through competitive sources. These competitive sources of funding for research and development purposes to carry out projects primarily come from the *Fondo de Investigación Sanitaria* (FIS)[17], the Autonomous Community of Madrid R&D funds, the National R&D Plan, and European Union Framework Program R&D funds.

Newly Created Centres

International studies from the OECD, the European Union, and the World Health Organisation, among others, as well as national level studies in various countries have all recognised the dramatically changing healthcare needs for the future and the challenges these imply. International trends show the aging population directly implies social and economic challenges in order to meet the needs for health prevention, protection and treatment. This in turn requires in-depth research as well as technological development in the fields of biomedicine and health.

Therefore, as part of a national strategy defined in the mid-1990s, a *Strategic Plan of Research*, was developed and it defined priority areas in the fields of cancer, cardiovascular disease and degenerative and neurological disorders. The plan included the creation of three foundations in these high priority research and technological areas.

However, these were to be independent but directly linked foundations that would fall under the umbrella organisation of the ISCIII. They would be partially funded through public funds and but privately managed. Furthermore, these foundations were

[17] The FIS (Health Research Fund) is the national fund for R&D in the areas of biomedicine and health which is controlled by the ISCIII, it is a competitive public fund based on excellence and not through research priorities.

not fall under the same decision making structures and human resources management organisation of the ISCIII. Overall, they are non-profit private foundations that function to serve social and public interest.

The first of these foundations created was the CNIO, the National Centre for Oncology Research which we will address in more detail below. The motivation for creating a National Centre in Cancer lies in the fact that this disease is one of the leading causes of death in the world, but also more specifically Spain traditionally has been strong in the areas of biology, molecular biology and basic biomedical research, which are fields that provide the basis for cancer research.

3. Centro Nacional de Investigaciones Oncológicas Carlos III

Description and Organisation

The *Centro Nacional de Investigaciones Oncológicas Carlos III*, CNIO (National Centre for Oncology Research) was created as a private non-profit foundation directly associated to the ISCIII. But, like previously mentioned, although it is a national centre (like others belonging to the ISCIII) it does function completely within the ISCIII organisational structure or decision making system.

The CNIO was founded in March 1998 with the establishment of its statutes. At this point is did not have its permanent facilities and was placed temporary on other premises[18].

The mission of CNIO is to foster oncology research by promoting, supporting and improving of scientific and medical advancements in the field of oncology.

This mission is operationalised through a series of specific duties that include:

- To collaborate with other centres of oncology research.
- Let the advancements achieved to have repercussions on the health system and thus on the patients welfare.
- To prepare and develop teaching activity programs.
- To coordinate oncology research in Spain.
- All of the activities on oncology research that can contribute to improve citizens life-quality broadly, and of the affected people particularly.
- Special addition is given to the goal of providing publicity of its objectives and activities, as well as to the periodical diffusion of its achievements.

The CNIO is currently temporarily located 20km from Madrid on a campus of the ISCIII. Within the next year, the CNIO will move to its permanent site, a new building located in the other campus of ISCIII in downtown Madrid. This new building is an old Victoria Eugenia Hospital, which is being completely renovated and a new wing currently under construction.

[18] The permanent facilities are going to be renovated and sometime in 2001 all the activities will be carried out there.

The skills and capabilities of CNIO are directly related to medical research and biotechnology, with a specific focus, of course, to oncology. The CNIO is still currently being established but it is expected to have five departments, two in basic science (Molecular Pathology and Experimental Therapies), two in applied research (Molecular Oncology and Cancer Genetics) and one department which comprises a series of support units that will include: SPF Animal Facility, Transgenic Unit, Bioinformatics, Structural Biology, Genomics, DNA Sequencing, Cytogenetics, Histology and Immunohistochemistry, Confocal Microscopy, Protein Expression, Antibody Production, and Proteomics.

The CNIO will also complement its areas of research with the creation of a network of collaborators in the Departments of Anatomic Pathology and Oncology of major Spanish hospitals. Also there recently created in collaboration with hospitals, the ISCIII a tumor bank. The creation of a tumor bank and implementation of the state-of-the art technologies for genetic analysis using DNA Biochips and DNA Arrays have been recent advancements.

The CNIO's strategic plan is aimed at bringing together the major discoveries made over the last thirty years in the field of Molecular Oncology (oncogenes, suppressor genes, signal transduction pathways, etc.) and Cancer Genetics (human genome, genomic instability, modifying genes, etc.) with the overall aim to improve the diagnosis and treatment of Spanish cancer patients.

Human Resources and Decision Making Structures

One of the main challenges in creating new R&D centres is guaranteeing reputation and well as excellence. So following the definition of its statues, the first mission of the CNIO was to select a director. This person was to have solid skills as a high ranked scientist and should also be recognized world wide. Dr. Mariano Barbacid was that selected person, a leading Spanish scientist who had been working outside of Spain for over 30 years.

Mariano Barbacid developed his professional career in the United States. Along with his research career, he has also a reputation in the creation and management of research groups and private laboratories. He was appointed through a private five-year contract to direct CNIO and from that point he was directly in charge of the construction and definition of the Centre as well as the recruitment process for the first group of scientists to form part of the centre.

Currently directed by Mariano Barbacid, the Centre, the CNIO has been conceived as a *centre of excellence.* There are just over 70 people working at the present, although the total staff should reach by the end of 2003 over 350 people.

During the recruitment process for obtaining human resources the goal was to attract *excellent* staff. Incentives in CNIO depend on results and performance. As one interviewer stated "there is no other way to stimulate people than by focusing on resource provision according to one's performance."

Senior staff have been and are currently being recruited though a special process where the CNIO is open to offers. Interested researchers in directing a research group in any one of the areas send their curriculum vitae that should include not only a description of their current research program but also a proposal for lines of research. The philosophy lies in the underlying basis that only through excellence provided through experience and top performance of those who make up the CNIO.

Hiring for junior and technicians has been and will continue to be done directly by the Group Directors once they have joined the CNIO. Meanwhile, visiting research staff from other centres (national or international) are encouraged, as well as medical residents interested in applied pre-clinical research.

All employees of CNIO have a five-year contracts. These are renewable contracts following an evaluation of performance. Salaries are stated to be lower than those equivalent working in private industry, but higher than those of the public administration or university.

During the whole recruitment process Dr. Barbacid has been directly involved. The idea is that although the general lines and mission of the centre have been determined, based on the skills, experience and capabilities of the human resources that make up the centre it will determine the type of specific research lines and activities that will be carried out. This is reasoning on why senior staff are asked to provide proposals for what they have to offer in terms of lines of research and ideas for new opportunities.

These staff also are permitted to come with other junior staff.

In reality the recruitment process is structured as means of hiring "teams" as opposed to individuals with specific profiles. This bottom – up decision making process puts greater responsibility on researcher staff, but also gives them a sense of "belonging" since it is they who decide what activities are important and (as mentioned previously) they are responsible for finding funding for their research activities.

The Centre, in its temporary location has already started working in three of those areas, Molecular Oncology and Pathology, and Biotechnology. Full operation should begin soon after the final recruitment process is complete and the Centre has transferred to its permanent facilities.

Financial Resources and Research Funding

All the funding for the construction and equipping of the building that will house the CNIO will be provided by Ministry of Health. The CNIO's annual operating budget, once staffing has been completed (around 2003), is estimated to be about 30 million Euros. Half of this amount will be provided by the Ministry of Health, which accounts for just 0.05% of the Ministry's total budget.

The remaining funds will be obtained through research projects, contracts with the pharmaceutical industry, and sponsorships by institutions and private individuals. Of this remaining amount it is estimates that around 6 million € are expected to come

from competitive funds, and 9 million € from private sources –private sponsoring, including individual donations, and contracts with pharmaceuticals about services and products of high added value.

All activities of the CNIO are regulated by the Board of Trustees of the Foundation. The economic activities of the CNIO are regularly audited by an independent external consulting firm and then submitted to the Foundation's Protectorate and then sent to the official auditing organisation of the Ministry of the Treasury.

The scientific activities of the CNIO are evaluated by a Scientific Advisory Committee formed by eleven scientists of the highest international prestige who are well acquainted with biomedical research in Spain.

A large part of CNIO's expected support relies in private donations: this is new in Spain where the private sponsoring of scientific research is not fully developed.

In an interview with CNIO Manager, he stated that the ideal situation is to have a good balance between "*hard money*" and "*soft money*". Hard money refers to overhead and related expenditures (what comes primarily from the allocated budget by the ISCIII) and is the responsibility of what the CNIO should obtain. Meanwhile soft money refers to the funds that are obtained from competitive sources (European, national and regional funding programs, among others), which go directly to fund the research activities undertaken at the CNIO and the researchers themselves are responsible for obtaining.

Relations with the Environment and Research Outputs

The CNIO also has two agreements with local high schools to send for *vocational training* courses on laboratory skills, thus promoting early on interest in science and technology fields.

Expected outputs of the Centre are both high quality research papers and publications, as a means of contributing to increasing the knowledge in the fields related to cancer. These research outputs also include permanent collaborations with hospitals, for example for residencies for the training of young doctors and services provides to the pharmaceutical industry.

Currently, the CNIO has promoted a tumor bank that is a complex organisation and networking between the Centre and various hospitals. The current design is not of a centralized tumor bank, but rather a cooperative and coordinated network of hospital banks, based on simple, homogeneous and optimal tissue treatment protocols.

This network is promoted by the CNIO, which thereby undertakes the work of coordinating the network, using and maintaining the database, and carrying out quality control. In this way, each centre's tissue remains in the hospital itself, thereby playing a key role in the development of the welfare, teaching and research activities

within the hospital. However, at the same time, it represents a tool for the encouragement of multi-hospital cancer research and of cooperation between basic and clinical researchers, as it is constitutes an important meeting point between different biomedical disciplines.

Statutes define the beneficiaries of the CNIO explicitly as the scientific community and the users of Spanish public health system. However, CNIO does not treat patients, that is, it is not involved with clinical treatment. Its activities include *basic* and *applied* research. It policy is to collaborate in research with all other centres working on cancer, as well as hospitals and universities, both national and regional and in Spain and abroad.

The CNIO has minor relations with patient associations, for example the Spanish Association Against Cancer. In general, however, unlike in other countries like the UK, patient associations are not very active in terms of promoting or funding R&D. The fact is that in many cases these associations do not have very much funds available for research, and direct most of the efforts for information dissemination and support. In the future, however, the CNIO hopes that this will change and is open to increase collaboration with patient groups.
Figure 1 shows the organisation of the various research programs currently being carried out at the CNIO. In Figure 2, the organisational chart of human resources and recruitment process is given.

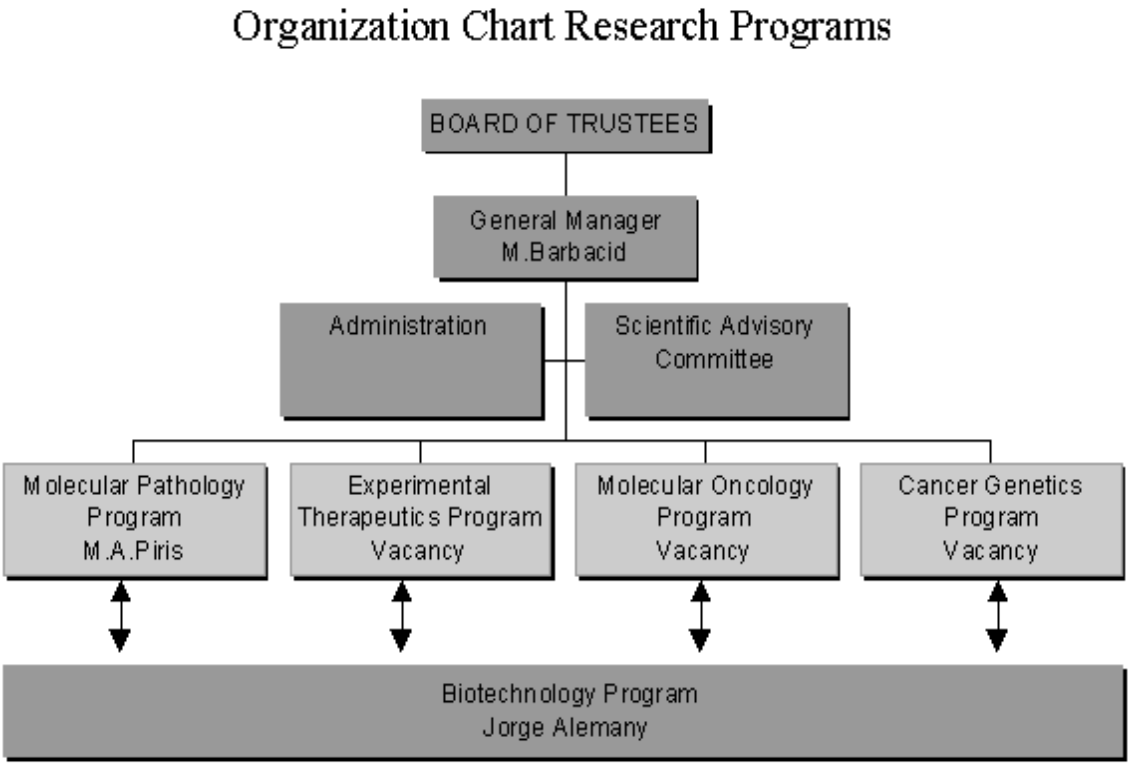


Figure 1: CNIO Organization Chart Research Programs

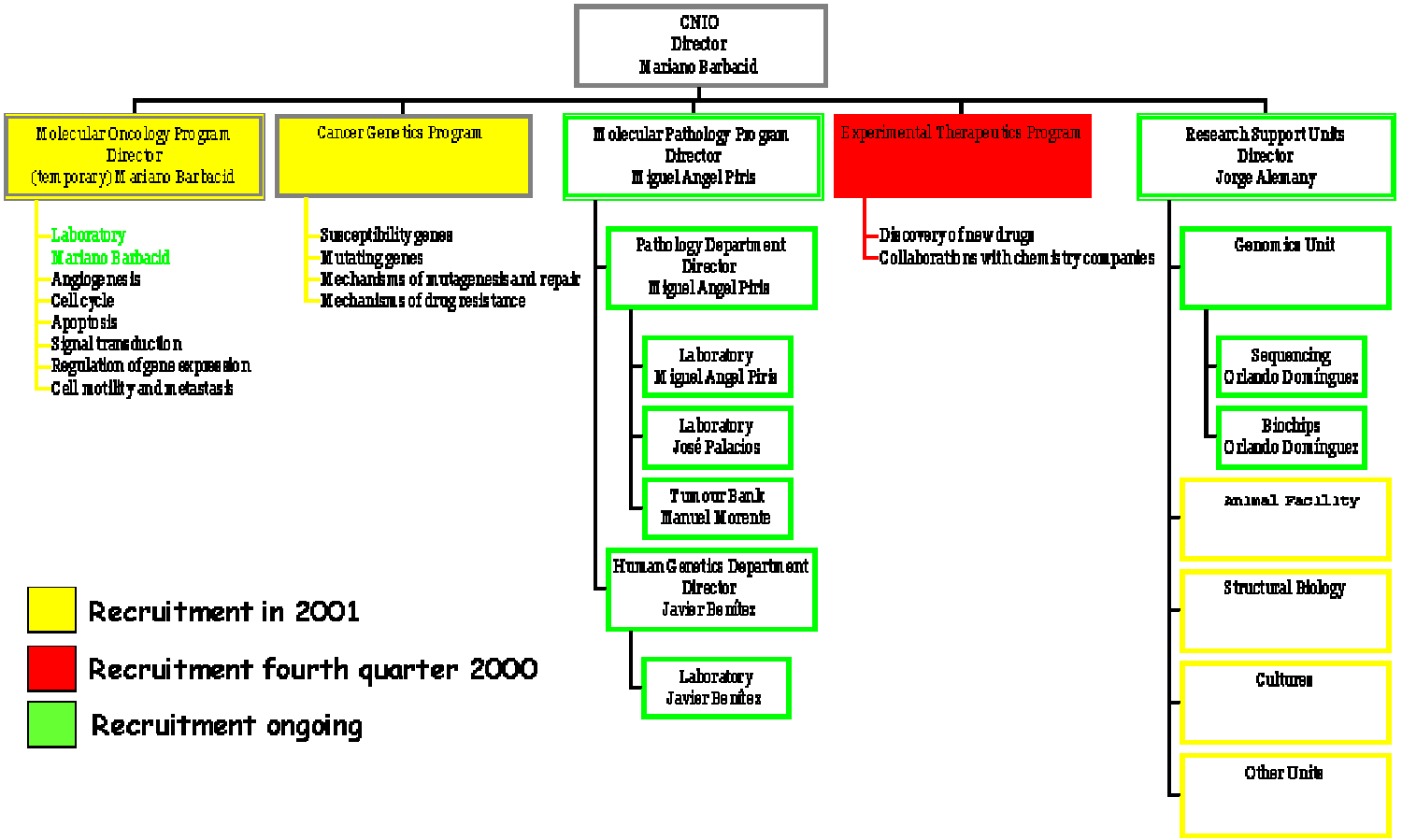


Figure 2: CNIO Organisational Chart

4. Analysis of Key Dimensions and Trends: CNIO and ISCIII

First of all what comes to our attention is that although the ISCIII is comprised of several national research centres, the CNIO as a national centre dedicated to cancer research was created separately (although linked) as a foundation.

The CNIO was created within the ISCIII, however, it was only included within the institutional arrangements, and not the organisational structure of the ISCIII. What we must try to understand is the reasoning behind this and why it was done in this manner. Furthermore the question we pose is what was the CNIO a solution for? That is, what the justification for its creation and the form in which it is managed and organised?

If we take into consideration the essential elements for the functioning of a research centre, we come up two factors: how financial resources are obtained and the recruitment process for human resources.

To recall briefly, the ISCIII is a public research centre that is governed within the norms of public administration. The ISCIII is funded by public budget appropriations from the Ministry of Health and almost half the staff are civil servants. In addition it has a top-down decision making structure that serves specific mandates of the Ministry of Health. This can be considered somewhat rigid because of the bureaucratic procedures required by public administration. The CNIO has much greater political independence from the administration, as compared to the ISCIII.

The fundamental reasoning therefore were these two factors, the decision making structures, especially for funding and recruitment process for human resources.

Respondents interviewed insisted that CNIO is *not* a public institution, thus it is free to contract or to do commercial operations; and, furthermore, it has much more flexibility in terms of contracting personnel.

Also, its funding is a balance or a mix between public and private funding. Here the CNIO has the freedom to contract its services, set up contracts, and establish collaborations with outside organisations, including private firms.

With respect to human resources, there are incentive mechanisms established as well as means of disregarding (eliminating) those who do not perform good research and do not meet the objectives.

The recruitment process offers a unique arrangement where the top level scientists offer their skills and competencies as well as proposals for research activities. This is a more bottom-up approach for the decision making structures in terms of defining research lines. Each group or unit develops its strategies and research lines, and must seek funding for its activities from competitive sources.

In addition, the research staff are also more autonomous than their counterparts in corresponding ISCIII national centres, especially in terms of their research activities because of the bottom up decision making structures of the CNIO and recruitment process for human resources that has been carried out.

5. Conclusions

We can conclude that the CNIO has increased flexibility for operating and completing its mission, in terms of research activities and its relations with others, although we cannot ignore the benefits it has from public support through the ISCIII.

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

1. Introduction on Context and History

INIA has been a quite stable research centre in terms of its mission, that nevertheless suffered a huge organisational transformation resulting from its regional division in 1984. Since then, it has functioned as national co-ordinator of Spanish food and agricultural research, but it also has kept research centres of its own. In this regards, and despite changes in the political and institutional environment, empirical evidence has shown a significant degree of internal organisational inertia.

INIA, as other Public Research Centres (PRCs), has shared the same economic context characterised by cuts in public spending and stagnant evolution in the number of public employees. However, in contrast with other centres in its same organisational field, INIA has shown a much lower degree of initiative to search for external funding, or innovative forms of collaboration and co-operation, and even fewer attempts have been made to escape from legal administrative restrictions.

Its significant activism in terms of international co-operation is mainly explained by INIA's traditional role of co-ordinator for the Spanish government in agricultural and food technologies research.

INIA, was created in 1971 by the Ministry of Agriculture as a result of the merge of several centres, as the Instituto Nacional de Investigación Agraria – (Institute for Agricultural Research). In 1984, competencies in agriculture where transferred to the regional governments, and thus an agreement was established to distribute by territory INIA's facilities and research centres . The central administration kept about a third of the Institute's personnel and facilities, all located in Madrid, and gave the Regions all the facilities located in its territories. It also kept half of its funding with the objective of playing the role of a research council for the regional centres. Currently, INIA has two main functions: it is a *funding agency* that allocates funds to the former INIA's centres (the aggregate is known as the *INIA System*), and it undertakes research through centres of its own, that administratively belong to the Vice-directorate for Research and Technology.

Since agricultural research is closely tied to territorial aspects, and to its specific industries, the INIA intensely suffered political changes in its environment through the regional distribution, which in fact is the only PRC that has witnessed this type of restructuring. Nevertheless, its organisation remains stable although its evolution has been slow.

Regional governments have followed different models to cope with agricultural research. While some have remained as units or departments of the Regional Government, others have been rearranged as non-profit foundations, and some were transformed into public companies or even private firms owned by the regional government. To compare the dynamics of these changes with INIA we have also selected another agricultural research centre, one that regrouped in Catalonia (IRTA) former INIA facilities. IRTA (Institute for Food and Agricultural Research and Technology) was first established under a different name as a unit within the Department of Agriculture of the Catalonian Government. Upon request by its directors for restructuring, the regional Parliament passed a law in 1985 that changed it into a public firm.

The restructuring of the former INIA has created institutional and organisational diversity among the different organisations. IRTA in Catalonia represents a case of the interwoven processes of growth of the public system, privatisation (at least in management) and *regionalisation* and it is the object of another case study.

2. Situation Today

Main Features: Ownership and Mission

INIA has historically been the sectoral research institution owned and controlled by the Ministry of Agriculture, Fisheries and Food (MAPA), however the INIA was transferred along with other PRCs under the new Ministry of Science and Technology, created in April 2000. Although INIA is one of the *Public Research Organisations* included in the Science Act of 1986, at this point it has changed its legal Statute to include wider spectrum of research and technology in both highly related fields of food and agriculture.[19] However, INIA retained links with its former parent Ministry because its mission included agricultural and food policy objectives and within its Governing Council there are some representatives of the MAPA (Second Vice-president of INIA is a General Director of MAPA).

As for other PRC, the Minister of Science and Technology appoints by a government decree the institute's General Director and the President of the INIA and its Governing Council is the State Secretary (Vice-minister) of Science and Technology Policy. INIA is an autonomous entity that has its own assets and patrimony, it has to follow the rules of the Public Administration in what relates to contracts with public and private counterparts, or even in human resources policy.

INIA's main mission is to manage and implement all the Government's scientific research and technological innovation competencies in the area of agriculture and food; to promote national and international co-operation; and to elaborate, co-ordinate and to manage the Strategic Actions included in the National Plan for Scientific

[19] Royal Decree 1951/2000 of December 1st, 2000 where the Statute is approved for the National Institute for Research and Technology in Food and Agriculture.

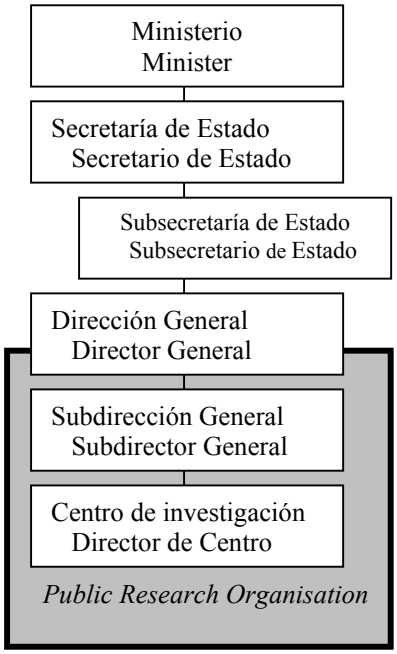
Research, Technological Development and Innovation. Furthermore, not only does it undergo its own research, it manages some programmes or strategic actions, that have been commissioned by regional authorities. All this implies planning research priorities –and the studies conductive to this prioritisation–, the co-elaboration of the directives, and the co-ordination and management of funding activities. It also implies the monitoring of the funded projects and activities, under the supervision of the Sub-Secretariat for Science Policy. Additionally, the centre has incorporated the *Spanish Office of Vegetables Varieties*, a service unit for the Ministry of Agriculture in charge of administrating files of seed varieties and its genetic records.

INIA's direction clearly recognises the double edge of its mission, and the need to keep apart the funding agency aspects from the research implementing ones: "One side is for the co-ordination and management of a research programme along with the autonomous Communities (and its relationship with the CICYT), and the other is to implement research". INIA's staff also underlines the different mission of the recently added Office of Vegetables Varieties.

Management and Organisational Structures

INIA is a *research organisation* that also performs the role of a *funding agency in the area of agriculture and food activities*[20]. However, from an organisation point of view the agricultural funding activities are developed in a Sub-directorate of INIA. Most of the Spanish *public research organisations* are placed, in the structure of the Government, as a third or fourth level within the administration schema, *Direcciones Generales*. Its head is always a Director General (see Figure) appointed by the Minister. Above him or her, the President of the Institute –and President of the Governing Council– is the State Secretary for Science and Technology Policy Head of the Division of Department, *Secretario de Estado*.

Figure 1: Public Research Centres' Common Hierarchy



The Vice-President of INIA is the General Secretary of Science Policy –who is at the third level within the Ministry. The Minister of Science and Technology appoints most of the members of the Governing Council, more than 20, including representatives of the Ministries of Science and Technology and of Agriculture, Fisheries and Food and some others from ministries that make research; farming syndicates; related industrial sectors –food and forestry products transformation–; researchers and Sub-directors of the INIA. The Governing Council draws the main policy lines of INIA. It chooses the institute own research lines and the overall strategic planning for the funds it distributes. INIA's Governing Structure is drawn in the Figure.

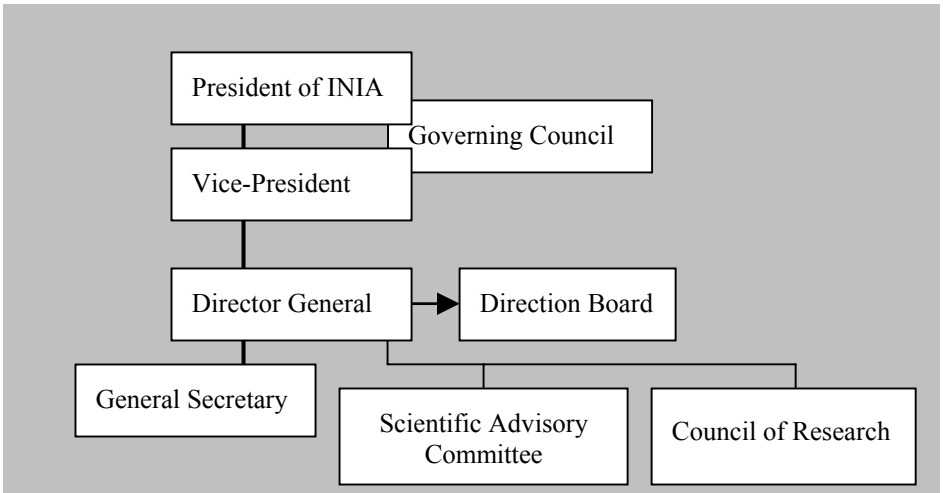


Figure 2: INIA Governing Structure

The Director General is backed up by a *Direction Board*, composed of the heads of the four divisions, and is assessed by both a *Scientific Advisory Committee*, composed by several researchers from the institute's staff and from outside, and by a

[20] The *Carlos III Health Institute*, ISCIII, is also exceptional in the same way.

Advisory Council for Research[21] that is assembled by the heads of the Sub-directorates, departments and Units within INIA's centres.

Below INIA's Director General there are four divisions (Sub-directorates, *Subdirecciones Generales*) represented in Figure "**INIA's Functional Structure**". The first one is General Secretariat of the INIA (that acts as Deputy Director) that has the responsibilities of financial maters, normative, contracts and human resources. The second one is the Subdirectorate for *Foresight and Programmes Co-ordination*

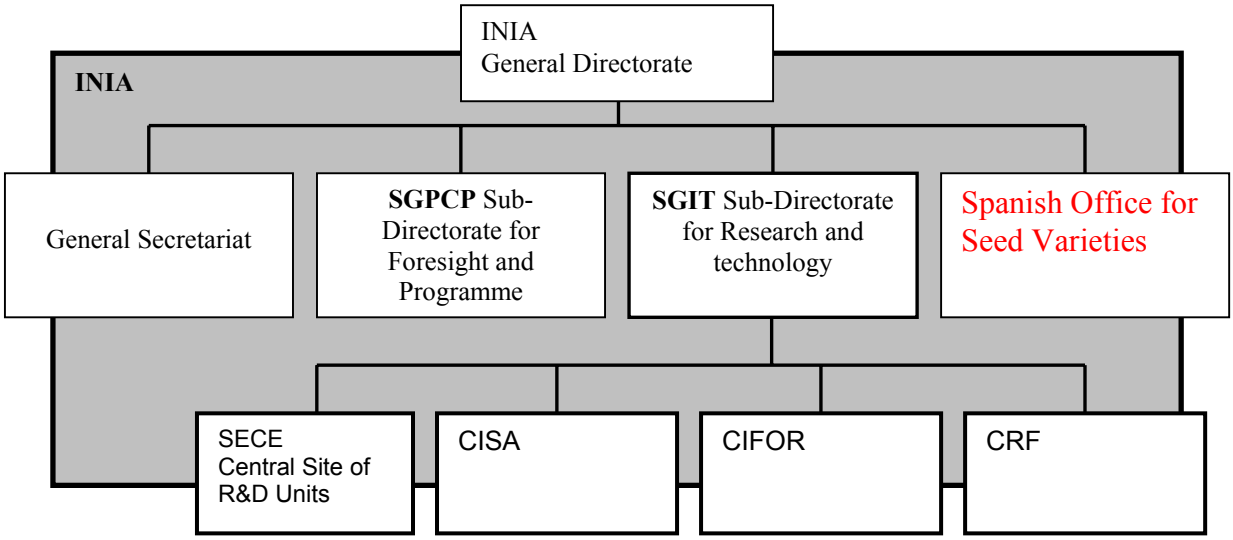


Figure 3: INIA Functional Structure

(SGPCP), that manages the mission of *funding agency* in agriculture and food technology. The third is the Subdirectorate of Research and Technology (SGIT) which has the responsibilities of managing the INIA's own research centres and other support units. Present research centres are three: CISA, working on livestock and animal health, the CIFOR devoted to research on forestry, and the CRF, researching on crops and plant genetic resources. Additionally there is a unit (SECE *central site of research and technology units*) that groups previously unrelated departments, works on food transformation and in different new areas of research –biotechnology, for instance. The fourth sub-directorate of INIA is the *Spanish Office of Seed Varieties*, that works in the context of the EU Office.

Both the Sub-directorates on "Programme Co-ordination" and "Research and Technology" (SGIT) are the largest ones in terms of personnel and budget. When the Research Centres under the SGIT compete for funding distributed from the SGPCP they manage to keep them apart, where norms are strictly followed to avoid conflict of interests. Each project is evaluated by external panels and by the ANEP, whether it comes from the Regional centres or from the INIA centres. From the SGIT Research centres' point of view, all competitive funding is "external", similar to the one provided by the CICYT or any Regional Government funding agency.

However, some INIA's researchers were asked –aside with external consultants– to co-operate in the preparatory works of the National Plan, including the strategic actions on agriculture and food technologies, and they even participated in representing Spain in some programmes of the Framework Programme within their areas of competence.

[21] We translate *consejo de investigación* as *advisory council for research.*.

Under the administrative rule the budget is managed in a centralised way and all the contracts and procurement are done by the administrative units, however research groups manage most of its projects income, decide on expenses and small procurement up to limited amounts. Each project has a research leader who is responsible of its management.

Research Outputs, Areas of Capabilities and Sectors

Describing the scientific and technological competencies of the INIA, this section will only explain the work of direct research implemented by the research centres of the INIA (SGIT). Additional information on the areas it funds and the outputs of this funding will be described at the section *Research at the Regions and the "INIA System*".

Since its original activities of technological development, assessment and diffusion, INIA widened its interests in the eighties to also include applied and basic research. Currently less efforts are made in the areas of diagnosis, testing and regular analysis that can be done by ordinary laboratories. It has moved also from the research in agriculture, forestry and livestock, to include research in food. Capabilities had also diversified at this time from the core agricultural and forestry engineering, and veterinary field, towards to biology and genetic sciences.

The INIA has adapted its capabilities to the evolution of its sectoral environment and to the opportunities opened by the development of new areas of research associated to food. The overall productive sectors structure did change slowly. Agriculture, forestry and livestock changed to an export market oriented production. INIA then included research on food and forestry products transformation among its capabilities. From the beginning, the INIA had been very much interested on transferability of results. Based on the main research centres of the SGIT, details on some of the capabilities and research outputs will be described.

The work of the **Research and Technology Centre**, known as **CIT** (former SECE) is mixed as reflected by its different departments. This centre represents more than 60 per cent of the researcher staff of INIA (73 researchers and a staff of 256 people). It works on plants protection against plagues diseases and weeds, development of diagnosis methods and evaluation of pesticides and its impact on the environment. It does research in genetics and biotechnology, and genetic improvement of commercial species. Another department works in animal reproduction –*in vivo* and *in vitro* embryos production–. A newer department researches on environmentalist issues, ecology of natural and artificial ecosystems, ecotoxicology, sustainable agriculture, and impact assessments of chemical on the environment. The department of food technology works on the characterisation and improvement of Spanish products with *denominación de origen* (authenticity of origin and quality), in particular with cheese products and olive oil, and also on the development of new industrial food products and processes, especially cheeses, for Spanish industry.

The **Research Centre on Animal Health**, **CISA**, does research mainly on animal infectious diseases, and on animal epidemics (epizootics). The department dedicated to the study of infectious diseases develops diagnosis and treatment methods –vaccines–, works in immunology, and it works also on the impact of pollution on livestock and, vice versa, the impact of exploitations on the environment. A second department is specialised in high risk and exotic diseases –diagnosis and treatment–, and in epizootics. A third department is a service that manages the laboratories of

biological safety –five of *level 3* and two more of the highest *level 4*[22]–. Those laboratories are available to all INIA's departments researchers, and can be rented by external public and private laboratories.

The **Research Centre in Forestry**, **CIFOR**, is one of the INIA's older components, with 108 total staff. CIFOR works on forestry and forest natural ecosystems, and also on forest products and the related industries. The first side does research in forestry of Mediterranean forests, forest ecology, models of growth and reforestation, and prevention of forests fires. The industrial side of the centre works on the characterisation, chemistry, production and pathology of wood, cork and cellulose and the related technologies. It also deals with pollution produced by the transformation industry (especially paper manufactures), and on studies of fire prevention and distant detection of forests' health conditions. A part of its work is dedicated to wood dating and historical wood identification.

The **Centre for Phytogenetic Resources and Sustainable Agriculture**, **CRF,** is dedicated to the improvement of seeds and plants crops, as well as energetic, industrial and ornamental species. It is not as large compared with the other units, with 33 people. Although it does little research, it carries out essays and works on mathematical models of profitable and sustainable modes of cultivation. Most of its labour is to identify and collect seeds to preserve the genetic diversity of indigenous and rare species, varieties and ecotypes. A *service of genetic preservation* collects a long term seed bank, and a medium term one that offers seeds to users and exchanges genetic material with other centres. A service of development prepares a database of information about the seed collection, and it prospects and recollects indigenous samples of plants.

All of the centres' departments and services publish their results both in scientific journals and other publications (some of them edited by the centre). They also present papers at conferences, congresses, courses and lectures. Significant INIA's output is human capital, young researchers developing dissertations, with the help of a quite significant "training program through research".

INIA's SGIT Output: Comparison Among Centres

	CRF	CISA	CIFOR	SECE	*Total SGIT*
Research Articles	18	38	34	105	195
Popularisation and Extension Arts.	1	11	10	22	44
Books (mainly popul. and ext.)		1	13	53	67
Congresses Contributions	17	32	31	168	248
Ph D		2	4	14	20
Total	36	84	92	362	574

Figure 4: Scientific Outputs of INIA's Research Centres

From its beginning, INIA has been also a service provider: an important part of its output are contracted services (known as *convenios*). Most of the laboratories makes

[22] The lab levels refer to necessary safety requirements, the higher the number the more precaution needed.

analyses of chemicals or food products –evaluation and quality control of products, phytosanitarian or forestry products and its components–, characterisation of commercial species or pests, and the like. As we have already mentioned, some laboratories that provide high biological safety facilities are rented out to public or private institutions. Laboratories and individual researchers' services are sometimes required as legal experts.

Sources of Income

Main Figures at the Budget of INIA 1998		
Sectorial Programme	9,255,586 €	29.71%
- Proportion of the Programme Driven to Research Projects	6,700,684 €	21.51%
- Proportion of the Programme Driven to Scholarships	1,881,168 €	6.03%
National Programme on Apiculture	240,405 €	0.77%
National Programme on Phytogenetic Resources Use and Preservation	756,073 €	2.42%
EU Programme on Olive Oil Improvement	1,638,960 €	5.26%
Competitive Funds at SGIT from the SGPCP	1,572,849 €	5.04%
Competitive Funds at SGIT from the SGPCP, Sectorial Programme	1,293,378 €	4.15%
Competitive Funds at SGIT from the SGPCP, Other Programmes	279,471 €	0.89%
Total	**31,150,167 €**	**100%**

Figure 5: INIA Budget 1998

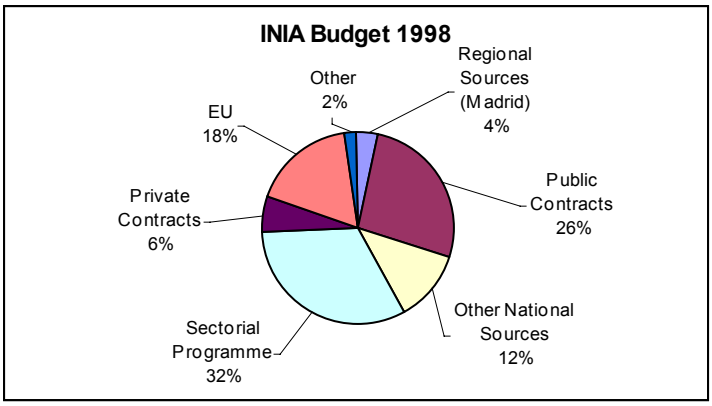


Figure 6: INIA Budget 1998

INIA's budget includes a significant amount that is not spent by INIA itself. The whole 1998 budget amount was 31.15 millions €, from which the Sectorial Programme summed 9.25 millions €. The preservation of phytogenetic resources programme sums

up to 0.75 million €, that on apiculture 0.24 million €, and the EU programme on olive oil, 1.63 millions €. The main budget has not increased since 1985, in constant terms[23]. The funding that comes from industry is small and has barely changed since the seventies; However, the proportion of *external* funds has increased –competitive funds with different administrations, and contracts with them.

General figures of INIA's budget distorts the real meaning of its breakdown –as it happens also with its staff figures. As far as it funds other institutions' research, a part of its expenditure is *administrative*, or unrelated with R&D Plan.

SGIT research centres received 5.26 millions € in 1998 from competitive sources, some of then external. From the directors' point of view, "external" includes also those competitive funds coming from *the other part* of INIA, SGPCP, it all sums up to 1.66 millions €, or 18% of the *Programme*. 0.65 million € more come from the National Fund and other national government's sources (long term contracts with different public administrations add 1.38 million € to the public sources figure). Regional authorities, the Autonomous Community of Madrid, funds research with 0.19 million €. Most external sources of funding, 74% are public. 18% comes from the EU, and just 0.32 million €, or 6% of all external sources comes from private contracts.

In the last years we detect a slight pattern of increasing funding coming from competitive sources (EU, National R&D Plan) This trend has influenced researchers' behaviour because it provides them with more autonomy.

Human Resources

The evolution of INIA's human resources has been stagnant and even decreasing for the last ten years. INIA personnel is formed by: A) civil servants personnel, including researchers; B) Contracted staff under regular labour relations either temporary or permanent; C) contracted research staff for the implementation of particular research programmes under the Science Act provisions.

In 1998 INIA's personnel comprised 705 individuals. 298 of them, 42%, were civil servants, of which 201 worked in R&D activities. Those figures include different functions and different kind of contracts. Long-term public employees summed up to 149, short-term employees, 80, while 30 people were under apprentice contracts.

SGIT personnel amounts to 532, of which 61 are employed for administrative matters of the SGIT itself. The number of permanent research staff is 111, 21%, and belong only to three of the centres, CISA (14), CIFOR (24) and SECE (73). Most of the *apprentice contracts*, 26, are young researchers. That kind of contracts is considered by the head directors as a transitional step towards a long-term research contract or even a civil servant position; there is a new short-term contract possibility also. Finally, a hundred people have different scholarships (pre- and post doctoral, mainly). Next Table summarises SGIT proportions:

[23] 1985 budget was 5,074 million of constant 1998 pesetas. 1998 budget was 5,183 million pesetas. INIA's budget reached a maximum in 1992, 6,910 million of constant 1998 pesetas, and has decreased since.

Staff of SGIT-INIA

	Long Term and Public Servants	Short Term
Researchers	111	26
Technicians	28	57
Technical Support	25	22
Administration	62	
Scholarships	...	100

*Practice Contracts

Figure 7: INIA Staff

Personnel incentives are not remarkable. They relate mainly to relative research autonomy provided by the external funding. For permanent civil servant researchers there is a discretional productivity complement paid in addition to regular salaries, that used to be distributed after evaluation of research performance, but this changed recently and now the productivity complement pertains the job and not the researcher.

Users, Audiences and Strategy

INIA serves the policy of the Ministry of Agriculture, Fisheries and Food. This covers the whole farming and forestry productive sectors, and its related industries as well. It focuses mainly on applied research and technology development. Other users and beneficiaries could collectively influence INIA's activities through contracts and through its *governing council.*

The Institute has been changing slowly from its main core of agriculture, forestry and livestock to food and wood industries. However, those former sectors have also changed to an intensive commercial and export production, and demand new technologies related with plagues control, genetically modified seeds, artificial fertilisation, and the like.

Industry and union representatives are involved in INIA. The most important representation is that of FIAB, a federation that groups together all of the different food and drink associations and, thus, most of the industry. Larger professional and some industrial associations work together with the Institute doing research: this is a way to influence its activities. Moreover, about 6% of INIA's income comes from direct research contracts with the industry (*convenios*). An example is the work for *regulating councils on authenticity of origin*: analysis on products origin and quality and also research to improve products' specific properties and to enhance productivity. Those contracts are expected to grow: the Institute has prepared a *strategic plan* for four years, 2000-2003, which aim is to increase the external participation funding by reaching external clients.

The departments that have a direct voice in the *governing council* are the Ministry of Agriculture, Fisheries and Food, and the Ministry of Science and

Technology; Ministry of Environment and Ministry of Defence. All of them have also long term contracts with the institution that keep it oriented and devoted to applied research.

INIA as a *funding agency* fosters competition among all the members of the *INIA system* and fosters collaboration among them. Regional governments are partners in this system. International scientific collaboration is fostered by INIA's interest in co-operation: the Institute is member of different organisations devoted to, funds and works along with institutions that do research in other developing countries. They feel themselves one of the roots of the so called *green revolution* in these countries. They carry out other international collaborations within the EU, the USA and other countries. As a result, INIA's research outputs enjoy wide audiences.

3. Analysis of Key Dimensions and Changes

Agriculture research in Spain appears to be good compared with other countries. The Spanish production represents 4.41% of the world scientific production in the area, between 1995-1999, while the average Spanish contribution to the world output is 2.63%[24]. Its relative impact is consistently higher than the average.

From 1992, INIA's public funding has been stagnant in accordance with a general pattern of real terms decrease in public spending for science. To give an idea of the impact, if taking into account the regional centres INIA finances, from 1984 to1985 its budget fell from 5,160 million pesetas to half this figure, 2,680 million pesetas, in just one year[25]. During this year, INIA transferred two thirds of its personnel and facilities to the autonomous communities, but retained half of the funds. The aim was to create and manage a new research fund for agriculture, livestock, forestry and food research –a tool for steering and co-ordination of the national research in those fields. The *Sectorial Programme for Agriculture and Food Research and Development* came right from the National Government budget, and funded research both in national centres and in universities and regional research institutions. It was conceived mainly to fund all the former INIA's centres, the *INIA System*. In 1988, a National R&D Plan was created with the same purpose which was served by the National Fund and a general funding agency, CICYT, but managed also by INIA. However, the former Sectorial Programme remained aside on the hands of the Institute. Nevertheless, in the last version of the National R&D Plan (2000-2003), all funding activities from INIA have been included as strategic actions.

After it was created in the seventies, INIA has slightly changed its research personnel profile. Most of the researchers were part of the Ministry of Agriculture technical staff, and thus they were farming and forestry engineers, veterinarians, and other professionals related to food technologies. The profile has been slowly changing since the eighties, and biologists have been entering the staff. Interviewees think that this is an important change as far as, traditionally in Spain, engineers and engineer's schools are less oriented towards basic research than biologists are; thus, they expect some reorientation of INIA's work in the long term.

[24] Institute for Scientific Information "What's hot in research" Internet service: http://www.isinet.com/isi/hot/research/200012/331041/index.html 2001-03-16.
[25] Current pesetas.

The overall human resource policy for permanent staff has been very stable because is centrally controlled by the Ministry. Except for the *training contracts*, most of the staff is composed of long-term employees and civil servants, both on research and on auxiliary positions. However, some long-term contracts have been recently changed into civil servant positions.

A new legal regulation on researchers and technical personnel rating levels has been approved[26]. There will be a single scale for rating levels of *researchers* in the public research organisations –except for that of the CSIC. The law refers to technical researchers in INIA, CIEMAT, (energy and environmental research), IEO (an oceanographic institute), and IGME (on mining and geology), but technical researchers from CSIC can also enter the new rating levels upon request. The aim of the law is to unify the research career in the public centres and interviewees wait it to be extended to other public centres.

It is interesting to note that INIA in the last years has had a very stable position due to the strong co-operative links with agricultural research, but also because after its division among the *Regional Governments*, INIA did not developed new centres, foundations, enterprises nor *spin off firms*, even though the 1986 Law of Science allows the PRC to create them in order to enhance flexibility. Over time, adaptive behaviour of the organisation in the face of decreasing central financing seems to be based on the aggregation of individual researchers responses towards the search for external sources of funding (mainly through competitive programmes), whose proportion is however low in aggregate terms. Two factors explain this dynamic. On the one hand, because of the nature of agricultural research, researchers are less dependent on the equipment and other collective organisational resources than in other areas, and thus have more autonomy to participate in programmes on an individual basis. On the other hand, the lack of clear incentive schemes associated external funds raising might explain partially the modest dimension of the proportion of these type of sources, compared to other public research centres.

4. Synthesis and Conclusions

INIA's structure was changed in the eighties due to a large change in its political environment: *regionalisation*. It was first divided among the Regions. From then on it has two functions: it is a *funding agency* and also a *research institute*. Simultaneously, its main clients transformed: primary sector went even more commercially oriented and had to cope with the increment in salary costs, and thus demanded technology to enhance productivity and quality; the industrial sector related to food and wood transformation also grew and became a major client of research. INIA –that was dedicated from its very beginning to applied research– adapted its capabilities to cope with the new demands. The recent involvement of potential clients as members of the governing council was a tool to cope with those changes; another tool is the new *strategic plan* to look for research clients. An important change in the context of the public research institutions in Spain has been the stagnation of science public spending,

[26] The Law of Fiscal, Administrative and Social Measures, known as "the accompaniment law of the Budget", was published in December the 30th, 2000; the Budget Law for 2001 was published the day before.

which might have enhanced the search for alternative funding sources. This, however, have been modest in the case of INIA. European programmes funding has increase as a proportion, though, and this has resulted in an increased researchers' autonomy.

Overall, INIA has not appeared to have developed a collective adaptive response to those changes in its environment. INIA has not used the legal capabilities set up the new regulatory framework of 1986, and it has not experimented with non-for profit foundations, co-operative centres, or creation of firms nor has it searched for ways to increase management flexibility. With regards to human resources, it has had similar constraints as other PRCs. Its staff have limited economic incentives and, until very recently, no opportunities for mobility and developing a research career. The new legislation, however, on public research centres' personnel (that includes INIA's) may produce important changes in this respect.

IRTA – Institut de Recerca i Tecnologia Agroalimentàies (Catalonian Agrofood research and technology institute)

1. *Introduction on Context and History*

Research in Regions and the "INIA System"

In the mid-eighties a large proportion of INIA was distributed among the Autonomous Communities. However, the Constitution granted the central administration the power to co-ordinate the whole system. A portion of the resources were kept, while the rest are re-distributed through a Sectorial Programme to regional research centres; the funding programme is limited to the various regional centres – regardless of their type of organisational structure or their relationship to the regional government. However, not all the Autonomous Communities obtained facilities from the old INIA –the allocation was not proportional,– but indeed it developed its own system. Most of the regions supplemented the received centres and facilities. We have informally called the whole outcome as *INIA System*, as attributed as such by those we interviewed. In this section we will describe the system. The regional centres started as branches of regional governments and not as independent. Some became *independent public organisations* (IVIA in Valencia, and ICIA in the Canaries); some others became *public* (IRTA in Catalonia) or *non--profit foundations* under private law (AZTI in the Basque Country); but most of them remained as plain *branches of their regional governments*. Many laboratories also changed their organisational structures, have grown in size and most have diversified their scope and line of research. The map included here shows the resultant system; dark grey illustrates those regions that include centres that changed into independent organisations, the pale grey areas are where those that became *firms* or *non- -profit foundations*, and the light grey areas show those Regions that kept the centres as *branches of government*.

INIA management estimates that a third of the total Spanish agro-food researchers have some relation to INIA –about one thousand out of three thousand. As a *funding agency* (SGPCP), INIA distributes the *Sectorial Programme of Agrarian and Food Research and Development* among the regional centres. It also allocates a smaller Sub-programme on forestry –research, and extension actions. Priority lines of those programmes are decided by the Governing Council of INIA; however, since the Ministry of Agriculture is well represented its policies are priorities. Regional governments have less power to directly influence the priority lines established.

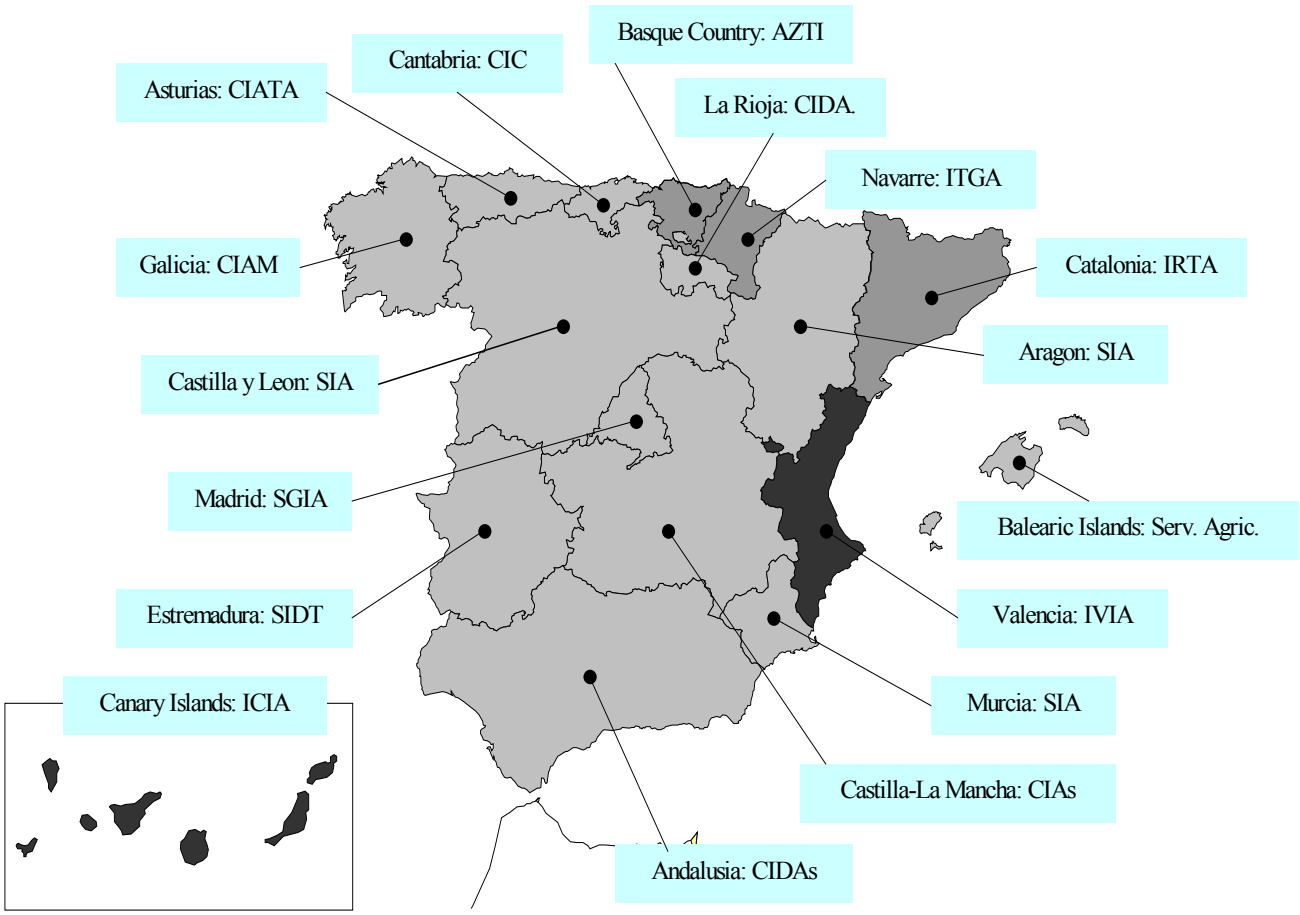


Figure 1: The *INIA System*

The funds allocated by the programmes is relatively proportional to the centres' size. The rest of centres' funding comes from regional governments' direct allocations, regional competitive programmes, the National R&D Program, and various EU programmes on research and infrastructure –FEDER, for instance. This variety of funding permits the centres to spread their lines of investigation, and thus develop research related directly to the Region's interests.

The next case of study focuses in one centre of the *INIA system*: IRTA, in Catalonia. It is a public firm whose evolution illustrates deepest changes within the Spanish public system of research, along with the changes in all the public system variables. As a point of departure, Catalonia received very few facilities from INIA, and despite this fact, IRTA has evolved of the most active and developed research centres within its area at regional level. The Figure shows the relative size of IRTA and some other regional centres in 1998 and 1999, compared with INIA. Now IRTA budget is about a 40% of INIA.

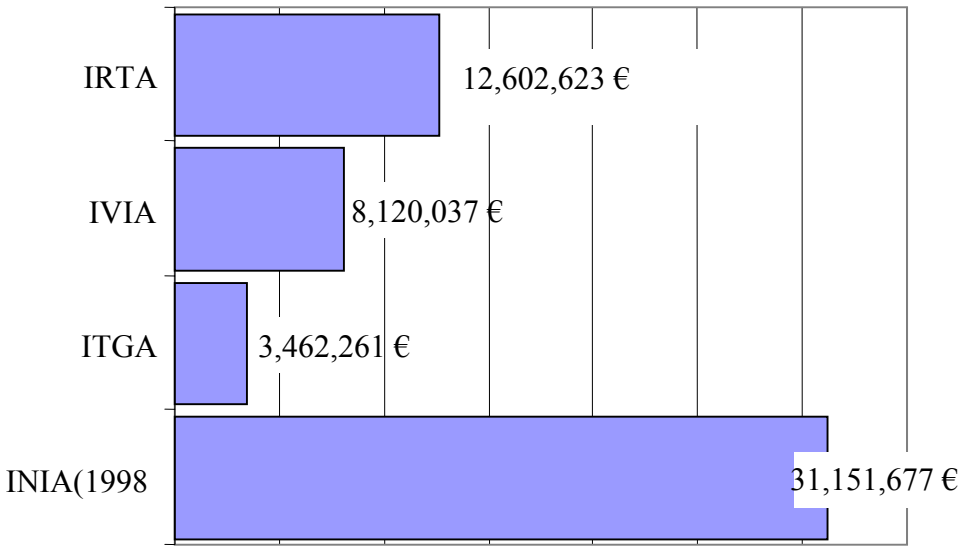


Figure 2: Budget Comparison among INIA and some centres of *INIA System*

Figure 3: The *INIA System*

Public Centres of Agrarian, Livestock and Food Research in the Autonomous Communities Linked with INIA (INIA System)

Name of the Centre	Acronym	Autonomous Community	Parent Organisation	Governance/ Accountability
Centro de Investigaciones Agrarias de Mabegondo (Agrarian Research Centre in Mabegondo)	CIAM	Galicia	Dirección General de Estructuras y Desarrollo Agrario de la Consellería de Agricultura, Ganadería y Montes, Government (Xunta) of Galicia	Branch of government
Centro de Investigación Aplicada y Tecnología Agroalimentaria (Centre for Food Applied Research and Technology)	CIATA	Principado de Asturias	Dirección Regional de Ganadería y Agricultura, Consejería de Agricultura, Government of the Principality of Asturias	Branch of government
Centro de Investigación y Coordinación (Research and Coordination Centre)	CIC	Cantabria	Servicio de Extensión y Formación Agrarias, Dirección General de Agricultura, Consejería de Ganadería, Agricultura y Pesca, Government of Cantabria	Branch of government
Instituto Tecnológico Pesquero y Alimentario (Technological Institute for Fishing and Food)	AZTI	Basque Country	Fundación AZTI -non-for-profit foundation under the private law-	Accountanle to foundation or regulator
Centro de Investigación y Desarrollo Agrario (Centre for Agrarian Research and Development)	CIDA	La Rioja	Dirección General de Investigación y Asistencia Agraria, Consejería de Agricultura y Alimentación, Government of La Rioja	Branch of government
Instituto Técnico y de Gestión Agrícola (Institute of Agriculture Technology and Management)	ITGA S.A.	Navarre	...	Accountable to shareholders
Servicio de Investigación Agraria (Agrarian Research Service)	SIA	Castilla y León	Dirección General de Industrias Agrarias y Desarrollo Rural, Consejería de Agricultura y Ganadería, Government (Junta) of Castilla y León	Branch of government
Servicio de Investigación Agraria (Agrarian Research Service)	SIA	Aragón	Departamento de Agricultura, Ganadería y Montes, Government (Diputación General) of Aragon	Branch of government
Institut de Recerca i Tecnologia Agroalimentàries (Institute for Food and Agricultural Research and Technology)	IRTA	Catalonia	Departament d'agricultura, Ramaeria I Pesca, Government of Catalonia.	Public firm -under the private law-
Servicio de Investigación y Desarrollo Tecnológico (Agrarian Research Service)	SIDT*	Estremadura	Dirección General de Producción, Investigación y Formación Agraria, Consejería de Agricultura y Medio Ambiente, Government (Junta) of Estremadura	Branch of government
Subdirección General de Investigación Agraria	SGIA	Madrid	Dirección General de Agricultura y Alimentación, Consejería de Economía y Empleo, Government of Madrid	Branch of government
Centros de Investigación Agraria (Centres of Agrrian Research)	CIA**	Castilla - La Mancha	Consejería de Agricultura y Medio Ambiente, Government of Castilla - La Mancha	Branch of government
Instituto Valenciano de Investigaciones Agrarias (Institute of Agrarian Research of Valencia)	IVIA	Valencia	Consellería de Agricultura, Pesca y Alimentación	Independent Public Organisation
Servicio de Agricultura (Service of Agriculture)	...	Balearic Islands	Dirección General de Agricultura, Consejería de Agricultura, Comercio e Industria	Branch of government
Centros de Investigación y Desarrollo Agrario (Centres of Agrarian Research and Development)	CIDA***	Andalusia	Dirección General de Investigación Agraria, Consejería de Agricultura y Pesca, Government (Junta) of Andalusia	Branch of government
Centro de Investigación y Desarrollo Agrario (Centre for Agrarian Research and Development)	CIDA	Murcia	Dirección General de Investigación y Transferencia Tecnológica, Consejería de Medio Ambiente, Agricultura y Agua, Government of Murcia	Branch of government
Instituto Canario de Investigaciones Agrarias (Institute of Agriculture Research of the Canary Islands)	ICIA	Canary Islands	Consejería de Agricultura, Pesca y Alimentación, Government of Canarias	Independent Public Organisation

* The name has changed in 1999. ** Different centres under the Consejería de Agricultura y Medio Ambiente (Department of Agriculture and Environment). *** 5 centres under the Consejería de Agricultura y Pesca

IRTA

IRTA was chosen because it is one of the most successful components of the INIA system and because it illustrates some of the most important processes of change in the Spanish System of Innovation, namely, *regionalisation*, the introduction of new managerial ideas in the public scene, changes in a whole productive sector, and growth in the public system of research. Its evolution illustrates how, in spite of belonging to the same organisational field and sector, public research centres might opt for divergent management and development patterns. In contrast with many other public research centres, IRTA has adopted a strategy of management flexibility and decentralised co-operation with other organisations, including the private sector and universities, and it has managed to untie itself from some of the bureaucratic rigidities inherent to public administration. This has provided the organisation with the means to adapt to its economic environment and to its organisational field, that of the research centres. IRTA has evolved from being a branch of the regional government into a public firm, to finally transform itself into an organisation with similarities to the British formula of executive agencies, by which a contract is signed between the regional government and the institute, that establishes the objectives, the instruments, the financial arrangements and the performance indicators to be developed and achieved within a certain period of time. Over time IRTA has expanded organisationally, and has created a large conglomerate of co-owned centres, non-profit foundations, and small firms.

2. Main Features: Ownership and Mission

IRTA, Institut de Recerca i Tecnologia Agroalimentàries, was created as a public firm ruled by private law in 1985.[27] Until then, this legal formula had not been used for research centres. Traditionally in Spain, R&D public centres have been managed through bureaucratic forms (government services or independent public organisations) typical within the Spanish Public Administration. IRTA's creation was approved just five months before passing of the 1986 Science Act, and its formula is very different from the one that has been applied to public research centres, as for instance, CSIC, whose based upon that legislation. As we have mentioned, the origins of IRTA started earlier in the democratic period, in 1980, as a branch of the new Catalonian Autonomous Government –called *Generalitat*– which created it as soon as it had competencies on agriculture policy. It was first created as a service of the Generalitat's *Department of Agriculture, Livestock and Fisheries* –under the name of Agrarian Research Service– and it was then transformed into a public firm. In 1985, the Regional Government received from INIA a small centre specialised in horticulture, consisting of seven people at the time, and that was IRTA's point of departure. Thus the origins of IRTA can be attributed to the combination of the region's already existing service derived from the transfer of agricultural policy transfers in the early eighties, and the addition, in the mid-eighties, of that small centre coming from INIA. From this

[27] Ley 23/1985 de 28 de noviembre [Novermber 28th 1985], Parlament de Catalunya. The name is not written in Spanish, but in Catalan.

point on, it has grown sharply from its 30 employees to the 303 today, and added 7 own

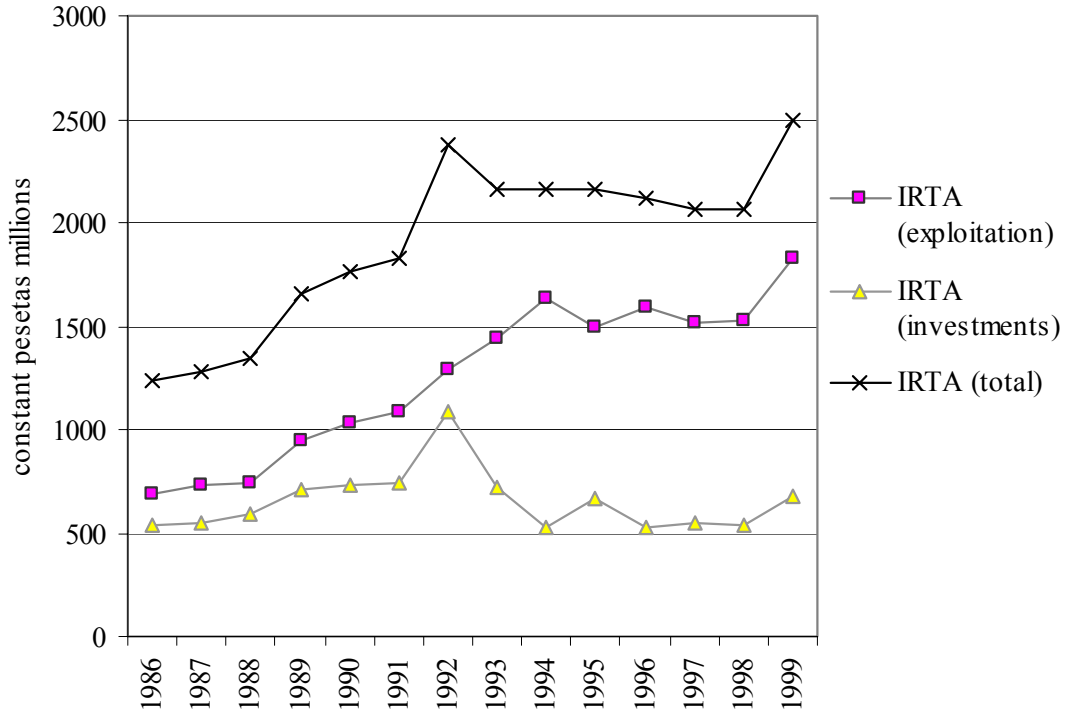


Figure 4: IRTA Growth in Constant (1999) Terms Since 1986

centres and *experimental stations*, and some as *consortia*. The owner of IRTA is the Government of Catalonia.

Its mission is, explicitly, "*to promote research and technological development in the agro-food sector; to assess scientific advances and to facilitate their application, and to co-ordinate the efforts of the public and private sectors as efficiently as possible*". Its mission has not changed substantially, but IRTA has extended its functions and the areas it covers. Main *functions* are applied research and development, technological transfer –through specialised and general publications, and patents and transfer contracts–, research under contract, and technical assistance and specialised training. IRTA serves the specific productive sectors of Catalonia, traditionally familiar to *commercially oriented* production.

Research Outputs, Areas of Capabilities and Sectors

It is not easy to classify IRTA's work as merely basic or applied research, or developmental. Its research is mainly driven by objectives. Its Director calls it "*mission oriented research*", and basic research is done as far as it is needed for a specific problem. Research is oriented to clients and potential clients and, thus, to specific crops or farm production; it also depends on the location of the different laboratories and extension stations. Now the institute covers most of the Region's productive sectors –on farming– and does research on agriculture –all kind of Mediterranean crops–, livestock and aquaculture, forestry, post-harvest processes, and food industries –especially meat. Twelve research *programmes* –divided in four main areas– are closely related with these sectors.

The first research area, *Vegetal Production*, is comprised of five programs: Horticulture, Mediterranean Fruit Crops, Field Crops –mainly cereals–, Plant Protection, and Vegetal Biotechnology. All are focused on productivity increase –by the use of new technologies, protection against pests, and the selection or modification techniques. Research also focuses on traditional crops of Catalonia–that includes ornamental plants which is an important sector in the Region–, and on the adaptation and adoption of foreign crops.

The Animal Production Area works both on production and genetics, selection and improvement of productive breeds, *Animal Nutrition*, that includes fodder production technologies, and *Animal Health*. Following the Catalonian industrial needs, the centre focuses on pig, rabbit and poultry –of which it tries to recover indigenous varieties. A large part of the program is done under contracts or in collaboration with firms..

The Food Technology Area focuses on two aspects, *Meat Industries*, a program on meat quality assessment and improvement, development of manufacturing technologies, and improvement of final products quality –nutrition, hygiene and sanitation –, and *Post-Harvest Processes*, which devotes itself to preservation technologies and pathologies, and to physiology and biochemistry of harvests. Another program, *Other Alimentary Activities*, works on different sciences and technologies related with food –including consumer studies.

The last oriented program – is *Aquaculture*; it also represents a new field among the interests of IRTA. It works on fish and seafood breeding –specifically on evaluation of offshore sites for fish cage aquaculture.

A different program, *Other Activities*, includes several minor research actions, or those specially focused ones –management of cow and sheep farms, forestry production, vineyards, etc.

Research activities and capabilities have evolved following the needs of IRTA's clients, both the Government and the firms –or agricultural co-operatives.

Management and Organisational Structures

Ten years after IRTA was created, Josep Tarragó, one of the main actors of this process and IRTA's General Director, wrote a brief article explaining the reasons that lead to the transformation of the former *Agrarian Research Service* into a public commercial firm.[28] The main reason was the bureaucratic limitations for a centre to do applied research: "(…) *after a time we saw that we could not go further with that system. Legal-administrative limitations and obstacles impeded an efficient management –or at least made it very difficult. Consequently, they produced a lowering of productivity in terms of the projection of its work and its results in society* (…)" (Tarragó 1995:55). He assessed four further reasons that underlined the specific limitations: *personnel management*, being a firm it is easier to evaluate both research and auxiliary work and to organise incentives and promotion schemas; it is flexible enough to *negotiate and contract with private parts*, in their own terms; it is also possible *to create and to participate in commercial societies*, related with its mission; and plain *management* is more flexible from current expenditures to large contracts and purchases. IRTA enjoys "*more decision power and managerial autonomy*" than a public centre, and these are tools to develop its institutional objectives.

[28] Tarragó, Josep. 1995. "IRTA. Una fórmula distinta en la gestión de I+D". *Política Científica*¸43:54-57. ("IRTA. A Different Formula on R&D Management")

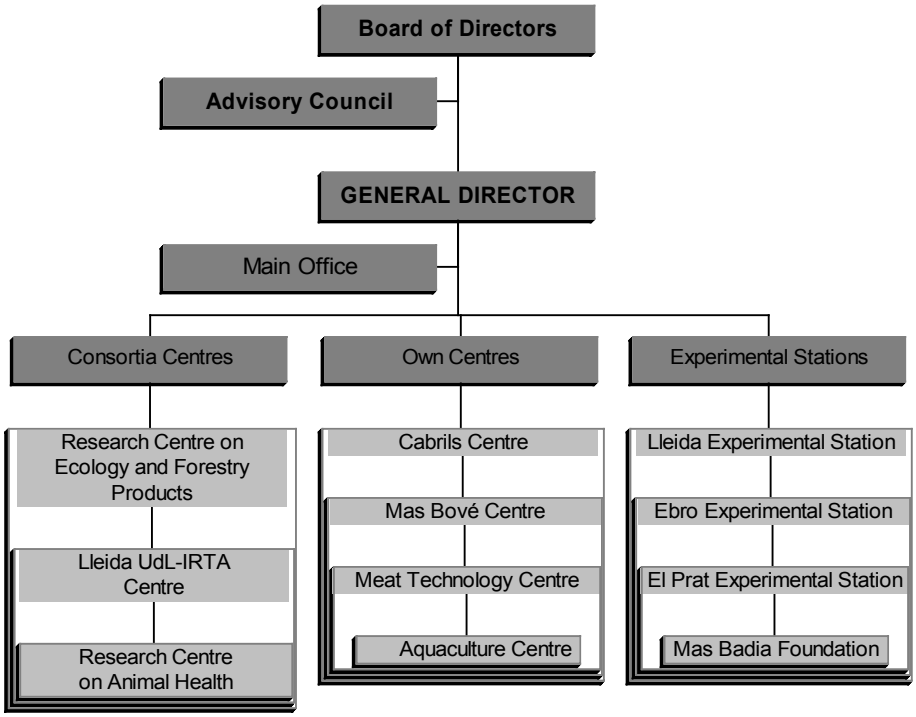


Figure 5: IRTA Governing Structure

The model has worked and some other research institutions in Catalonia are adopting it. After its creation IRTA has changed, not only in its size and areas covered; but also with respect to its relationship with the public administration. From 1999, this relationship has formalised through a contract-program that clearly specifies mutual duties –that we will explain later (section "Sources of Income"). Another internal change is a *management integrated system*. It involves a change to an integrated *management by processes*, specific-client oriented, and the automation of the whole procedure. It is related also with the demand of a quality control and an ISO 9000 certification.

As a public firm, IRTA governance structure is influenced by its political parent organisation. The *Director General* is the institute's staff head, and is appointed by the Government of Catalonia. He or she leads the firm and makes main decisions in terms of daily issues but issues more related to research are distributed among the *centres*, and among the *departments*, *units* or *areas* within the centres. A *Board of Directors* is composed by a *President*, who is the Counsellor [post equivalent to *Minister* in Regional level] of the Department of Agriculture, Livestock and Fisheries, a *Vice-President*, the head of the Office for Catalonian Universities, the *Director General* of IRTA, appointed by the Catalonian Government, and thirteen other members. Most of them act for different Departments of the Regional Government: four act for the Department of Agriculture (two of them are elected by the head of the department but are not necessarily members of it), two act for the department of Economy and Finance, one for the new Department of Universities and Research,[29] one for Health, and one for

[29] Formerly it was the head of the Office of Universities and Research [Comissionat per a Universitats i Recerca] or his or her delegate.

Industry; four members represent the local governments of the Catalan provinces, and one more is a representative of personnel.

A large *Advisory Council* helps to decide the institute's lines of research. It is composed by the President of the Board of Directors and the Director General, four representatives from the departments of Agriculture and Research, and fourteen or more representatives of professional associations, agriculture labour unions, associations and savings banks, universities, industry, the chambers of commerce, trade unions, and of the Catalan Studies Institute (IEC, a public non-for-profit foundation), and also three prestigious scientists in IRTA's fields.

Both IRTA's *Advisory Council* and *Board of Directors* represent the distribution of interests on agriculture research in the Catalonian Government and Society. IRTA's activities are thus oriented to both the policies of the Government and the needs of the productive sectors regarding these areas – as we will explain more detailed in further section. Any changes in these factors thus sharply influence the institute's work.

IRTA's activities, especially in agriculture, are directly related with the territory and thus with the different landscapes of Catalonia; facilities of the institute are therefore spread over the region. Other reasons for this distribution are administrative concerns (for the main site), the location of the institutions with which IRTA has a long term agreements or consortium, and the nature of these institutions. The map below shows the geographical distribution in Catalonia (Northeast of Spain) which comprises different climates and crops, and the different types of centres.

The Institute's *Main Office* is at Barcelona ("Serveis Centrals" in the map) the site of

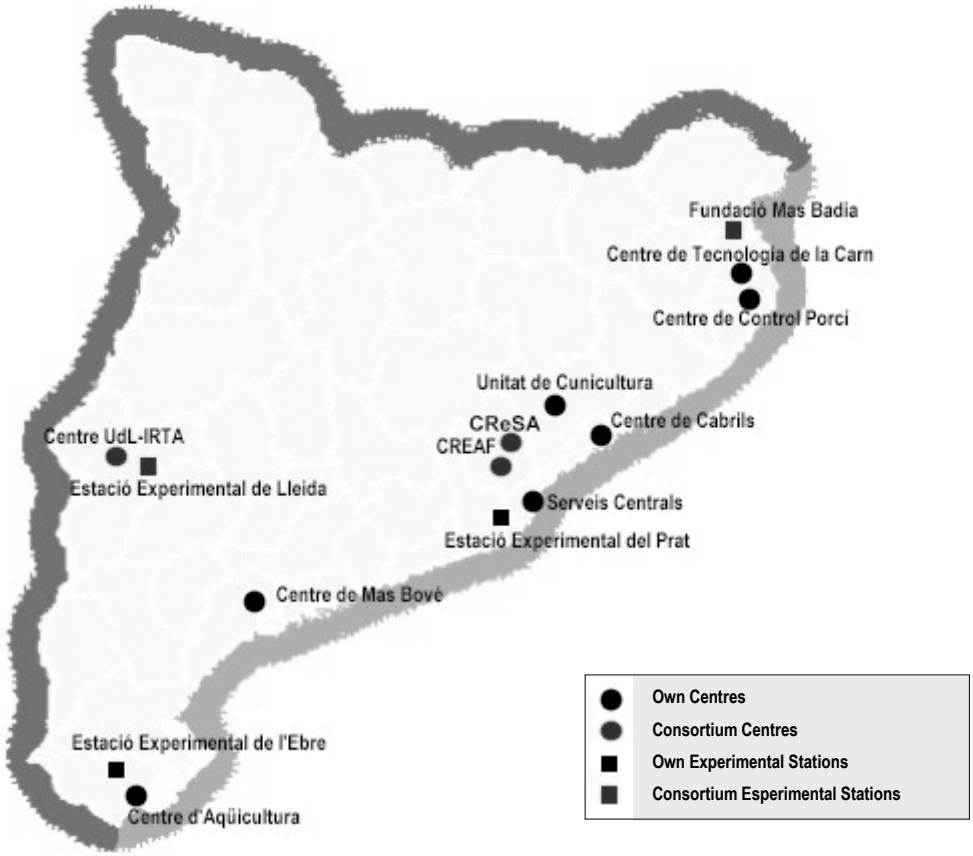


Figure 6: IRTA's Locations in Catalonia
Source: IRTA's Web Page: http://www.irta.es/en/ (March 2001) (Ttranslated box)

the Government of Catalonia which concentrates on basic and applied research not related with a specific territory. *Own Centres* are four, Cabrils, Mas Bové, Meat

Technology and Aquaculture. There are two more own *Units* placed within other institutions' sites, those of Animal Health and *Cunicultura* (rabbit breeding).

Over time, some of the most important changes in IRTA are related to management, and more specifically, to the adoption of co-operation formulas with private firms, universities, other research centres, or public institutions. Consortia, non-profit foundations and participated firms are some of those formulas. It is important to note that IRTA's management autonomy and decision-making power in relation to creating or participating firms is remarkably high if compared with traditional public research centres. In IRTA's case, a decision made by the Board of Directors in enough.

Consortia Centres are three, and there is another added *Consortium Unit*. The *Centre UdL-IRTA of Lleida* is a consortium with the University of Lleida and has the legal form of *University Institute*; this centre –and the attached *experimental stations* of *Lleida* and *Les Garrigues*– devotes mainly to cereal crops natural to the area of Lleida. *CREAF*, *Research Centre on Ecology and Forestry Products*, was created jointly with two of the Barcelona Universities, the already mentioned IEC, and some other departments of the Catalonia Government; it works on forestry, ecology and environmental issues. *CReSA*, *Research Centre on Animal Health*, was recently built up as a private non- profit foundation with the Autonomous University of Barcelona, and it works mainly on animal health. The *Consortium Unit* on Vegetal Genetics and Biotechnology was created with the CSIC and has two sites, in Cabrils and in Barcelona.

Experimental stations are tied to a specific territory, and work on applied research, demonstration works, and diffusion. There are four of them, each one tries to serve local problems: *Estació Experimental de l'Ebre*, *Estació Experimental de Lleida* (created within an agreement with the University of Lleida and Fundació La Caixa, a private non- profit foundation, and also the *Experimental Unit of Les Garrigues*), *Estació Experimental del Prat*, and *Fundación Mas Badia* a non-profit foundation created by the Girona provincial government, the Polytechnic University of Barcelona, an Association of Agricultural Co-operatives of Girona, and the Catalonian Government Department of Agriculture.

Daily management of the centres and experimental stations is decentralised, as they are partly independent of the Main Office. Autonomy is very broad in *consortia* and they were created with this purpose and to have their own budget. IRTA's staff denotes this as a *co-operative system of research* and it fosters the co-ordination of all research done in these fields in Catalonia.

Until 1998 IRTA participated in three firms: INORSA, a private and public consortia that made research on ornamental plants, CIV S.A., participated mainly by private firms and undertakes research on animal pharmaceutics, and Nova Genetica S.A., that specialises in pig genetics. After 1999 IRTA retained the participation only in this last one, with 25% of its capital.

Therefore, over time and in order to match long-term agreements with both private and public or semi-public parts IRTA has created new semi-autonomous centres under the form of *firms* or *foundations*. IRTA was created as a public firm in order to be able to make those agreements –as Tarragó explained in op.cit. (see first pages of this section). This choice was presented by interviewees as a way to improve *management*, not of IRTA itself but of its agreements; the aim was to foster the institute's long-term objectives. The resulting system is the output of choices made at different moments for *private contracts* with industry, for the creation of *experimental stations* related to a particular territory –or for co-operation agreements with some local public administration. The alternative option of centralisation was rejected: "*In a solitary,*

unique location, management could have been easier and cheaper, but IRTA would not be what it is today; it would have been by now one among many *institutes in the Catalan and Spanish landscape of agro-food research,* but just one more".

Sources of income

Almost half of IRTA's income (46,8% in 1999) is obtained from competitive sources or private contracts.

Main Figures at IRTA Budget 1999		
Regional Government	8,006,082 €	53.22%
Public Contracts	2,215,931 €	14.72%
European Union	523,481 €	3.47%
Public Subventions	1,494,116 €	9.93%
Private Subventions	126,814 €	0.85%
Contratos y servicios privados	2,144,411 €	14.25%
Otros	536,102 €	3.56%
Total	**15,046,939 €**	**100%**

Figure 7: IRTA Budget 1999

IRTA's total income was 15,046,939 € in 1999. This does not include IRTA's *consortia*, which are fully independent entities with regards to budget. The core funding, that comes from two departments of the Government of Catalonia was 8,006,082 €, 53% in 1999. This figure is important not only in quantitative terms. This source funds 90% of IRTA's payroll for permanent personnel. More specifically, the funding institutions were the Office for Universities and Research (1,202,024 €), now in the new Department of Universities, Research and Information Society, and the Department of Agriculture, Livestock and Fisheries, that contributed 6,804,058 €, through a four year contract-program. IRTA's direction staff assess that this explicit contract makes the institution much more independent on the short term, from direct political pressure: it reduces uncertainty, demands are made explicit, within a closed term –four years–, and outputs are evaluated by means of a set of performance indicators. "Public contracts and competitive funds amounted to 2,215,931 €, of which 496,436 € were from the competitive programmes of the Research Funding Agency of Catalonia, CIRIT; the rest is mostly from INIA, whose contribution is 8%. EU programmes summed up to 523,481 €. Donations from private sources amounted 126,814 €, most of this figure comes from a single source –a savings bank.

Private contracts and services represent a 14.72% of the whole (2,144,411 €, of which 1,862,537 € are contracts), and this proportion has been growing in the last years. As a rough figure of this evolution, IRTA signed 200 contracts with private parts in 1995, and 356 in 1999, a 75% increase. Last year, in the year 2000, the proportion of funding from contract sources passed 50%, an increment supported mainly by the rise in private contracts. Directors take private contracts as an indirect measure of the fulfilment of IRTA's institutional objectives, the technical support of the sectors addressed.

IRTA's financial accounts and personnel have grown sharply from the starting point, but the figures we have shown underestimate the whole expansion, since they do

not reflect the increment of the co-operative system promoted by the institution –which aggregates the *Consortia* we described earlier, and the participating firms. Members of this system are *IRTA* itself, the *UdL-IRTA Centre* of Lleida with its *experimental stations* of *Lleida* and *Les Garrigues*, *CREAF*, *Research Centre on Ecology and Forestry Products*, and the *Fundació Mas Badia*. IRTA created all these centres in collaboration with other public institutions and Universities, it has partial ownership it contributes permanently with staff –along with that of the partner institutions.

Human Resources Policies

Human resources management is an integral part of IRTA's strategy and the area in which the differences that its status of public firm ruled by private law implications became more evident. IRTA's personnel management is ruled by regular labour relations legislation and not by the Public Administration one. This has important effects in terms of organisational capabilities to recruit, evaluate, promote and incentivate staff. Human resources were portrayed by the directors as the most important input for a research organisation. It is, thus, one of the reasons for its structure and organisation: a public firm was seen to allow a better human resources management. Tarragó (op.cit.:55-56) cited different aspects in which it improved this, private contracting of staff, evaluation of individual and collective work and related incentive systems and promotion levels, and even the possibility to cease the contract relationship. A researcher should *see* her or his whole career prospects related with work and quality criteria and should be able to evolve.

IRTA's researchers have systems of evaluation and promotion based on explicit criteria and reliable procedures. Main criteria are publications and collaboration with clients –including public ones. Criteria details are written and public. The evaluation procedure starts with a panel that meets up several times per year and is composed of some delegates of personnel and head staff, and some external evaluators (accepted by the works committee). A system of incentives () is also applied to change research lines of individual researchers –as far as they do not fully decide its field of work which is dependent on objectives, as we will explain below.

The new contract-program with the Regional Government also sets some criteria for direct economic incentives; if the contract-program objectives have been accomplished a part of the firm profit is divided among the staff following criteria of productivity –in 1999 it amounted a 3% of total salaries. The agreement sets the limits to permanent personnel of the institute. Human resources policies aim to not extend the situation of short term contracts for more than 3 to 6 years : if he or she is going to stay longer a long term contract is established. Otherwise the short-term relationship finishes as soon as a task is fulfilled, and further contracts with the same worker, if any, are long-term. This policy is clear-cut, especially concerning post-doctoral contracts.
There are 37 civil servants in IRTA –a remaining of when it was a branch of government. Direction staff preferences is for this category to disappear in the long term, as individual employees retire. The policy is the same to this group as to the others, both in salaries and in incentives issues; they do have a different *collective agreement* than the civil servants in other bodies of the Regional Government.

At December 31st, 1999, IRTA's personnel was made of 303 people. 114 was research personnel of six different categories, and 76 were doctors. 263 enjoyed long term contracts or were civil servants. The number of doctorate students was 13. Personnel of the *co-operative system* reaches 414 people, (39 at the UdL-IRTA Centre, 59 at CREAF and 13 at Mas Badia,); the whole number of doctors is 127. Most of *consortia* research personnel work part time because they are also University lecturers or professors (this is one of the reasons for the creation of *consortia* or non- profit institutions. These figures enable the organisation to implement long term agreements with universities, and avoid personnel-related bureaucratic problems); *consortia* research personnel *from IRTA* work full time.

Users, Audiences and Strategy

IRTA's environment comprises both public administrations and productive actors. All of them are considered as clients. IRTA's user-oriented strategy has had an influence on its organisation, its management and its personnel policy, the evolution of its capabilities, and the way it has grown and expanded its structure (even its territorial distribution). We have mentioned that the search for 'external' clients (out of the clearly cut relationships with the Government) is a measure of its success also in light of Government's performance indicators: the new contract-program underlines the importance stressed by the administration on the mission to apply and not only to create knowledge.

Clients or users are the primary sector, the *agro-food* industry, Catalan or Spanish, associated or not, and structured or not within commercial firms. Clients are also public administrations, both of Catalonia or other regions, and even other research institutes –ITGA, for instance. The agricultural productive sector is generally highly fragmented and very little organised and does not have the capabilities to promote research itself. Moreover, agriculture or forestry production is different in the various climates and territories of Catalonia, though the most important is greenhouse commercial agriculture, Mediterranean products, and wine –a long time tradition. Livestock relies mainly on the pig farms, chicken and rabbits. Main industry is sausage producers, but it is varied and includes even pharmaceutics and chemistry.

Users other than the government are **also** represented in the *Advisory Council* which has about 6 institutional representatives –among 20 more or less– of the agricultural co-operatives and labour unions, of industry, and of the chambers of commerce. Contact with its clients is mainly through commercial relationships . Chief Head of departments or individual researchers are almost fully authorised to firm contracts with private sides –following INIA's example; limits are that a service cannot be sold below its price (carefully estimated) and that a service cannot mean a direct grant or subsidy.

IRTA's direction tries to keep an equilibrium among basic and applied production whose audiences are universities and other research centres, and commercially oriented development and technical services: both goals are part of staff's evaluation. The first aspect tries to keep alive personnel capabilities: "*It is essential to produce scientific quality*". Since this aspect keeps the centre aware of advances and of *what is going on* in research, it is fully complementary with the other aspect:

opportunity to gain private clients and to ask for public competitive funds. Main changes on research lines are compelled for by the direction: "*Researchers have freedom to propose but, and it could sound hard, not freedom of research*". Main lines are explicitly drawn in an *strategic plan* of each department, 6, 8 or even 10 years ahead; specific decisions are in the hands of the Director General or the Board of Directors.

Collaboration is fostered as a way to compete for funds within the international context, although IRTA competes against other research centres in its field of interests; recently it has some competition from the universities in Catalonia –"*unfair competition*", directors assess, as far as they set prices below the cost.[30] IRTA enjoys a good position among its colleagues and thus it has research agreements with most of the largest Spanish centres –a permanent centre with CSIC, for instance– and with important foreign laboratories –French INRA, or the University of California among others. International collaboration depend partly on the area covered ant its products; it is related to the climate regions of its collaborators.

4. Conclusions

IRTA was created primarily to accomplish the Government of Catalonia's policies on agriculture research, and to manage that which transferred to the region by INIA; it is in some way a piece of the history of INIA's recent change. Its own history started as a branch of government that felt the bureaucratic limitations of public administration. The decision to create IRTA as a public firm ruled by private law responded to the belief that research in general but especially in those organisations devoted to applied research and technical assistance to the productive sector should be managed as to allow flexibility, autonomy and co-operation with third parts. The form adopted by the organisation was especially flexible in relation to contracts and to personnel management.

Measured by its size, the proportion of external funding and the growing proportion of private contracts in aggregate terms, illustrate the evolution of an organisation that has been able to adapt to changes and has spread both its capabilities and the sectors attached in order to share risks. Recent changes on its relationship with the institute's political parent organisation reinforced autonomy against short-term political pressure at the cost of a more specific agreement on objectives and procedures of evaluation; the new *contract-program* is seen by the staff to make "*more professional*" the relationship by the formal obligation of both parts. Despite its evolution in finance, its dependence on public money is still significant. The most relevant changes has been on the nature of the relationship with the regional government, in which we detect some of the features characteristic of the agency-type research centre.

[30] Universities laboratories income do not depend on competition and cost adjustment; and its personnel salaries do not depend on external private contracts.

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