2D6

OVERVIEW OF PORTUGUESE R&D

○Luisa Lino, Tamio Yoshioka (Tokai University)

Abstract-Portugal was some five centuries ago a leading country in the world, not only by its discoveries of new worlds and new sea routes, but a leader in science and research organization, contributing then, somehow, to Europe's dominant position in the world. With the need to protect its frontiers , Portugal has gradually lost its leading position, and with the advent the new industrialized world, was left behind. Being still remarkable in some areas, its leadership is lost. Internationally recognized for its individual researchers, Portugal has since 1986-88 tried to give the Portuguese R&D the help and support it needs. The challenge its taking place right now, and positive results have already been felt, not only in the country but also by the research teams in which Portugal is taking an active part. Portugal is improving significantly not only its internal R&D system and bases but also its international R&D relations in a world wide area.

1-Introduction- A country of contrasts, Portugal now finds itself confronted with rapid historical change presenting a series of challenges. About five centuries ago the Institute of Astronomical, Cartographic and Naval Research , set up in Sagres by Henry the Navigator in 1419, made an essential contribution to the development of Europe and its dominance in the world. According to the words of Mendelsshon - for whom Henry the Navigator "must rank as one of the most outstanding of all scientific organizers"(...)" and, one may consider Portugal as the pioneer of scientific research organization". Portugal has been an independent state since the 12th century. The republic proclaimed in 1910 was overturned by a military putsh in 1926/28 and then by the Estado Novo 1928-1974. It was the second world war which because of difficulties in obtaining supplies that somewhat paradoxically resulted in the take off of industrialization in Portugal. Two major changes were made to the system during the 1950s to give economic growth new stimulus and direction : the introduction of economic planning in 1953 and accession to the European Free Trade Association (EFTA) in 1959. Membership of EFTA) brought about a salutatory opening up, of the corporatist state to the outside world: foreign investment , which had started in the 19th century, but had subsequently fallen to less than 1 per cent of grossed fixed capital formation in 1959, rose to 27% of GFCF in 1970. The benefits of relaxed corporatist controls, better allocation of investment through planning and the opening up of the country to the outside world, soon made themselves felt; in the last decade of the old regime , Portugal recorded one of the highest growth rates for per capita income (7.1 per cent) in the world: it was surpassed only by certain oil-exporting countries, Japan (8.7 per cent) and Korea (7.5 per cent). There was another major turning point in 1961 the war against liberation movements in African territories (Angola, Mozambique, Guine-Bissau), ate up as much as 40 per cent of the metropolitan budget and up to 50 per cent of the total resources of the "common Portuguese area" which brought about its downfall. The revolution of 25th of April 1974 tackled the colonial problem and the economic reforms. The granting of independence to the former " overseas territories" caused major upheavals with

serious consequences for the Portuguese economy. The period 1974-76 was marked by abrupt changes in economic policy, while at the same time the productive system became thoroughly disorganised. Since 1977 there has been a return to norma, with the economy overtaking its pre-revolution level of activity.

2- State coordinated R&D-In Portugal we have several National R&D institutions, those institutions being directly dependant from the ministry they belong to. To coordinate plan and to take responsibility for Portuguese R&D there is a National Board for Scientific and Technological Research, JNICT, that was set up in the 11 of July 1967. Although by law JNICT depends upon the office of the Prime Minister in fact has been directly related, and depending somehow from other government departments. In 1983 it was again placed directly under the Deputy Prime Minister and is the direct responsibility of the Minister of State. Its main function is to plan, coordinate, and promote scientific and technological research in Portugal. The Junta has also other responsibilities like administration of certain programs to promote the development of R&D in Portugal, to be the secretariat for several commissions with responsibilities for international scientific relations and interdisciplinary fields., standing committed for NATO, Scientific and Technological Research , standing committee for Scientific and Technical Co-operation with European Community and OECD, Standing Committee for Outer Space Research, Committee for Urban and Regional Research. Though it has no special committees for this purpose the JNICT is also responsible for keeping abreast of the activities of the scientific agencies of other international organizations like the United Nations ad UNESCO.

The public sector finances 63% of total R&D expenditure, but it is also far and away the largest performer of R&D scientific research. In 1986 the government was devoting 46% of its intramural R&D expenditure to applied research which was much higher than it was in 1976 (35%) , with just over 40 % going to experimental development and about 10% to basic research. First in the scientific disciplines comes engineering (29%), followed by Agricultural sciences (28.8) The exact and natural science account for more than 10%. 24.4% of all scientific and technical personnel are scientists and engineers, (against over a half in Higher education), and 43% have a University qualification. Although some laboratories (medicine marine biology, public health, tropical research and so on were created at the end of the 19th century or at the beginning of the 20th century, the first important research institutes were only set up in 1936 and subsequent years. Being often reorganized after 1974. Before research was still very isolated and dispersed in as much as the institutes, centres, laboratories, and testing stations were attached to different general directorates within the responsible ministries and engaged in quite separate activities. The purpose of the mergers between 1974 (INIA) and 1979 (reorganization of LNEC and LNICT) was to improve the central co-ordination of sectorial scientific and technological activities.

3- The R&D budget- Authorities intended to make JNICT the central body in the country's science and technology system, while the past results may seem negative, JNICT always have had problems with the size of its budget, as being inadequately small for the needs of the system.(see fig 1 and 2) In figure 2 we can see how low is Portuguese expenditure in R&D in 1986, compared to the other countries of the EEC. Namely the % of the GNP spent in R&D. Still Portugal R&D has 63% of its budget coming from the state with only 26.8 from

companies and 8.7 from other sources. See fig 3 and table 1.

4- R&D in Higher Education-University & research have a 700 hundred year history in Portugal. The Estudo Geral established in Lisbon in 1290, was transferred to Coimbra in 1308 and repatriated to Lisbon 30 years later. A major act in 1911 tried to revitalize the University. In 1924 a new proposal to improve the University was proposed with the creation of the Educational Guidance Council, but was changed again in 1929 by the new established Estado Novo with its substitution by the National Education Council, renamed Higher Institute of Culture in 1936 and completely Overhauled in 1952.The 1960s were an agitated period in the Universities and the teachers themselves were increasingly critical. The most highly reputed of the Portuguese magazines made the subject of all its issues in 1968 "The University and the Portuguese life" Its diagnosis was particularly severe : there was no peer control of the quality of teaching, careers often depended on arbitrary decision, assistants and students had no part in University life, courses were uniform and there was no competition; salaries were to low, thus inducing teachers to take on outside employment, teaching was divorced from research and so on. In 1968 Marcelo Caetano stated at his very first Council of Ministers that the reform of education had to take absolute priority over other problems., in 1970 Veiga Simao became the Minister of Education to pursue the needed the reforms. In 1973 new projects and reforms were planned, with the 25th of April the reforms were postponed by the momentum instability, with the new system inheriting a poor . The education system in a "dilapidated" State.

5-The present situation -In 1976 The INIC was established to substitute the former Higher Institute of Culture, being the INIC itself dissolved in 1991 being the functions performed until then by INIC performed now by JNICT. The Universities in Portugal accounted for 27 % of human resources and 20.6 % of financial resources devoted to R&D activities. The number of Universities has increased very fast recently with an increasing number of people devoted to research. We assist recently to a greater autonomy of Universities each of them trying to find its own way, on research fields, and in finding new ways to cooperate with the society, to get new forms of financing, and improve the output of the young generation of professionals graduating from the University, with a high level of education, knowledge and still full of energy, ideas and creative power. To support this new strategies and the effort of Portuguese researchers and teachers, that have been often recognized by their individual quality, and if until recently these young researchers were invited to do research outside and work abroad, now they are coming back taking part in the plan of a younger scientific community, to improve the quality and number of research and researchers in Portugal. To give support to this movements refreshing attitudes and ideas of the Portuguese R&D community , from 1986 Portugal has tried to improve the conditions to permit a better R&D in the country. With the participation of Portugal in the EEC two favourable conditions got together the new National strength and energy coming from all this new researchers, and the will of the community to bring Portuguese R&D level to the high level of R&D in certain parts of the community. We can see in table 2 and 3 how the actual situation is, with Portuguese universities and government laboratories, participating in a significant number of projects together with other countries of the community.

6-R&D activities in Industry-Until 1986 the state of R&D activities in the industrial sector is certainly a big deficiency of the Portuguese Science and Technology System: This

sector accounted for only 31.2% of total resources for R&D. In 1982 Portuguese enterprises spent 2 billion Esc. and employed nearly 1900 scientific and Technical Staff. R&D activities are highly concentrated in Lisbon, Oporto, Setubal and Braga, which contribute 70% of industrial output, together account for 85% of all R&D expenditure and 81% of scientific and technical staff .Given the persistent weakness of the R&D effort in Industry the government decided to include research activities in the Integrated system of Investment Incentives (SIII) a very general system of fiscal and financial incentives to assist enterprises with investment projects in fisheries, mining and quarrying and manufacturing sectors.

7- Portugal R&D characteristics-Portugal has Internationally recognized labs such as the LNEC, LNETI, Gulbenkian Research Centres and the Tropical Sciences Institute, and a Portuguese Professor, Egas Moniz, received too a Nobel Prize of Medicine.Portuguese Scientific achievements have been disperse and can rather be considered as a part of a National Policy. That gap is recently being taken care of by the new Portuguese R&D Policy with new priority areas defined recently: Information and telecommunications technologies, production and energy technologies, new materials science and technology, health sciences and technologies, bio-technology and fine chemistry, technologies of the sea. A few programs are being used to promote Portuguese R&D; from those we'll refer: CIENCIA, STRIDE, PEDIP, and PEDAP,PRODEP, PIDAC, and COST, Portugal also takes part in a number of other EEC programs like ESPRIT,JOULE, STEP, and others, (see table) that gathering efforts and competencies in several domains, have being giving support to a considerable number of actions. The Program CIENCIA (creation of National Science, Research, and Development Infrastructures, a program entirely devoted to the strengthening of R&D activities in a long term range , proposed by Portugal whose structure and concept were considered very promising and deserving to be supported.). Program CIENCIA has already produced significant changes in the Portuguese scientific and technology community. Its target is to create the needed conditions for the National scientific and technology development of the 90s , going over existing deficiencies, at human and structure levels, getting in this process an improvement of the institutional activities of R&D, stimulating the creation of critical positions contributing simultaneously to correcting the still existing regional asymmetries. Just like other programs financed by EEC funds, the CIENCIA does not cover the entire action of the state in its action. It is oriented to the interventions that by its strategic value, as well as by advantage in simultaneous realization, might better benefit from the concentration of these funds. CIENCIA uses both community and National funds., the last one through the use of two structural funds (FEDER and FSE) in a total of 304 MECU's, being the community contribution of 162 MECU's., being the JNICT the entity responsible for the execution of the several measures defined for it, CIENCIA is aimed at developing the scientific and technology activities with a pre-competitive character, that will allow when possible, and simultaneously permit: a) The creation of solid scientific and technology bases in areas that are important for the diversification of the production system and for the domain of new technologies that may give a contribution in the modernization of the National economical and social system as well in acquiring a better knowledge and a better use of the Portuguese natural resources ; b) widen the future participation of Portuguese institutions in the activities defined in the EEC strategic program for R&D; c) to develop the international cooperation activities with countries not belonging to the EEC and with whom Portugal has a long and traditional relation, namely those

in the tropics. CIENCIA will contribute to amplify and diversify the R&D capacities of the four regions less favoured in this field- Alentejo, Algarve, Azores, and Madeira- always with the perspective to develop there poles of excellence and not mere extensions of other regions. CIENCIA will also support : Agriculture and biology sciences, Sea sciences, as well as technology programs associated with national natural resources, represent very promising fields. The areas of intervention of the CIENCIA are : a) The strengthening of infrastructures -creation or strengthening of research centres in selected scientific and technological fields, including buildings and equipment, -installation or amplification of scientific and technology infrastructures of common use (big equipment, calculus devices, computer networks, libraries etc.) ,-R&D infrastructures, in two science and technology parks, allowing to articulate several institutions and R&D centres to be created, - installation or renovation of infrastructures for divulgation, namely the creation of a museum of science and technology and support of existing museums. b) Human resources education of researchers and technicians, through scholarships for studies in the country and abroad to get enough education to pursue R&D, Education of technicians to support R&D activities, through scholarships for studies in the country and abroad with the objective of obtaining knowledge to support R&D and the use of its equipment, - education of specialists in complementary areas by educating resources in science and technology management, and divulgation of science and technology. CIENCIA program plans to provide education to some 2600 new technical staff for R&D activities and others. CIENCIA prioritary domains are: Information and telecommunications technologies, production and energy technologies, new materials science and technology, health sciences and technologies, bio-technology and fine chemistry, technologies of the sea, CIENCIA aims at stimulating concentration of efforts, development of multidisciplinarity and exploration of synergies between R&D activities situated in different areas of R&D but complementary, namely by the creation of R&D centres by exploration of its resources together, and by starting R&D projects together too. In parallel it aims at stimulating innovation through several ways. This program CIENCIA was planned to be integrated with the other community programs to support the country in its effort to develop its R&D structures. So it is articulated with programs like PRODEP, PEDIP, and PEDAP. CIENCIA program by assuring the development of competencies in basic sciences and in advanced domains of research related to these areas, will permit to maintain in the future the activities of applied research and the transfer of technology with a desirable intensity and quality. But CIENCIA has still other scientific areas under its responsibility like health sciences and technologies, sea sciences and sea technologies, agriculture sciences and technologies, exact sciences and engineering, sciences of the earth and management and economy sciences.

8- International Relations-Portugal has had for a long time traditional Scientific relations with the United States of America, being the number of researchers in that country considerable, Scientific relations with Europe are also traditional, with a considerable number of researchers in the United Kingdom. R&D relations with PALOP (African countries whose official language is Portuguese); as Portugal has been traditionally enrolled in tropical R&D, whose research quality has been internationally recognized (namely for its research on coffee plants). Portugal has been an important centre of education for these countries technicians, as well as in providing the visit of Portuguese specialists to these countries with the aim of together, pursuing research and finding solutions for specific situations. Other areas in which Portugal is collaborating with this countries is in the education of promising youngsters, as

well as in providing education in electronics and information systems. Until now Portugal has collaborated with the 5 Portuguese speaking African countries (Angola, Cabo verde, (Cape Green Islands), Guine Bissau, Mocambique and S.Tome e Principe. The new Portuguese R&D policy seeks to maintain traditional relations in R&D fields, as well as develop and increase its scientific relations with PALOP countries, Brazil, and the Orient.

9-The future- The policy for the 90s is to overcome the actual deficiencies, with the support of the above referred CIENCIA program, another aspect of the policy for the 90s is the increase of collaboration between Universities and the productive sector, and also the transfer of promising staff to companies to stimulate innovation and also to stimulate the scientific community to do research and innovative work that can directly support and be of economic advantage for the productive sector. The budget in R&D that has been growing since 1986 have had an increase of 26% in real terms in 1991. As a result of the new policy and of the new breath in the Portuguese R&D community there are already institutions with a very promising structure whose output is also very exciting. As an example we'll refer two Portuguese institutions internationally recognized. They are the INESC and the LNETI. INESC was recently the theme of an article in the financial times with the title "Portugal's pioneering approach to product research pays off" and as sub-title: "An unusual alliance between academics and industry has won praise from the Community (EEC)". Portuguese R&D capabilities are expected to increase sharply, as well as its output, in the next decade. Its new researchers together with their senior but still young researchers are giving signals of a new life and energy in the Portuguese R&D, together to its increasing relations and positive contributions to the society, (private, public, university sector and others).

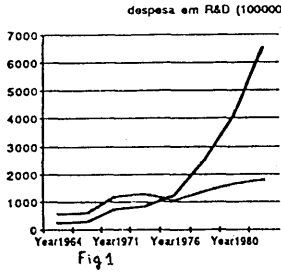

Fig 1

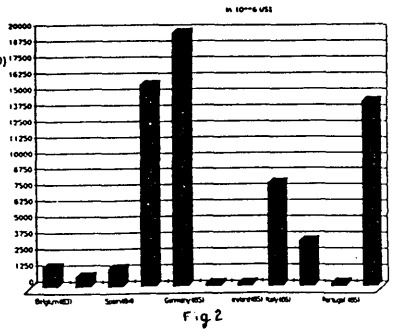
Fig 2

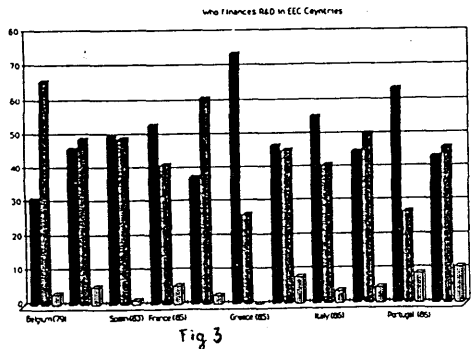
Fig 3

Who finances R& State	Companies	Others	
Belgium (79)	31	65.8	3.2
Denmark (85)	46	48.9	5.1
Spain (83)	49.6	49.1	1.3
France (85)	53	41.4	5.6
Germany (85)	37.6	60.9	2.6
Greece (85)	73.7	26.3	0
Ireland (85)	46.7	45.4	7.9
Italy (86)	55.3	41	3.7
Netherlands (85)	45	50.2	4.8
Portugal (86)	63.5	26.8	8.7
United Kingdom (85)	43.4	46.1	10.5

table 1

New programs started in 1989
DOSES
BRITE/EURAM
MAST
AIM
DRIVE
DELTA
AERONAUTICA
JOULE
Big instalations
raw materials & recycling
BRIDGE
ECLAIR
FLAIR
SCIENCE

table 2

Program	no of aproved projects
Environment & climatology	13
Agriculture research	6
Biotechnologies	7
BRITE	36
raw mateerials & advanced materials	23
non-nuclear energies	22
controled termo-nuclear fusion	1
radio-protection	4
ESPRIT	47
RACE	17
Estimulation	17
EUROTRA	1
FAST	2
research for development	8
Innovation and technology transfer	22
	226