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Deliverable 1.3a: *EULANEST COUNTRY REPORT: BRAZIL*

Report

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Summary

During the 6th Research and Development Framework Programme (FP6) the European Commission launched a programme aiming to coordinate Member-States' policies on a predetermined theme, as a contribution to construction of the European Research Area. The Eulanest project was built up in 2006, as part of that overall scheme, to increase harmony between European countries' bilateral Science and Technology (S&T) cooperation policies with Latin America. The project focuses especially on Argentina, Brazil, Chile and Mexico. The participant countries are Germany, Spain, France, Portugal and Norway. Its core short-term objective is to issue a joint call for S&T cooperation projects involving the countries concerned as closely as possible.

The first stage of the project is a diagnosis of the current situation, to as great a depth as possible. That consists of a comparative analysis of the instruments European countries use to set up their cooperation schemes with the Latin-American countries. It continues with the study of the characteristics of the science and technology sectors of each of these countries that might influence the decisive factors of the future joint call for proposals.

This report carries a compilation and interpretation of the existing information in the specific case of Brazil. The first part focuses on the Brazilian research system, by means of an investigation of its organization and the consequent way it operates. It then sets out indices applicable for estimating the investment in resources and its productive performance. The second part is a detailed analysis of current scientific priorities in Brazil, as laid out in the National Action Plan for 2007-2010. These parts together form a status report on Brazil's research and innovation potential and a description of the organizational structure of the corresponding solutions. The reader can gain an insight into the trends emerging under the effect of government choices for harnessing science, technology and innovation for the benefit of national development.

An interpretation of all the data collected for this project, intended to identify lines for the joint call for proposals to follow, concludes the report. Thus, the study of different instruments applied to bilateral S&T cooperation brings out the common points in Member-States' policies for cooperation with the Latin-American partner and helps identify good practice in this field. Moreover, the sound knowledge acquired of Brazil's research and innovation system must open the way not only to reasoned choices concerning institutional partners but also to ways of targeting the areas of excellence in Brazilian science, to favour more competitive cooperation. In addition, detailed examination of Brazil's scientific priorities brings into relief the sectors for which the federal political authorities wish explicitly to call for international S&T cooperation. Additional fields are also highlighted where the objectives fixed by the National Action Plan, in the light of the research system status report, conjure the thought that an external input is necessary where European cooperation could become involved to advantage.

The production of this special report on Brazil falls within the framework of the European project Euranest. It will have given the rare opportunity to bring together and compare different types of information and data (description of the national system of research, S&T indicators, inventory of the cooperation instruments, identification of national scientific priorities). At the time when the European Union is setting up a whole set of instruments destined to organize and improve its research and innovation cooperation with third-party countries, documents of this type could be valuable tools for supporting and stimulating discussion between the specialists concerned on either side of the Atlantic.

INTRODUCTION

Part of work package n°1, the Eulanest project provides for a report to be drawn up (deliverable 1.3) on the way research systems operate in the target Latin-American countries and the analysis of these countries' needs in science and technology (S&T) cooperation. The objective is to reinforce cooperation between the two regions (on the *joint call* basis) and make it more pertinent for the real needs of the target countries.

This work, as set out in the description of work (DoW), consists of an overview of the architecture of national systems of research of the Latin-American countries concerned, of their national R&D priorities and their specific needs in terms of cooperation with European countries. This overall report answers this remit by dealing with each country in a separate chapter, organized in three parts : a) description of the national research system; b) identification of national R&D priorities and c) needs in terms of cooperation with European countries.

This document is the "Brazil" chapter of the overall report in question.

The description of the Brazilian system of research, the subject of the first part, is founded completely on the "*fiche Curie+ Brazil*" compiled in June 2007 by the scientific officials of the French Embassy in Brasilia. Written under the supervision of Jean-Pierre Courtiat, science and technology attaché, it incorporates S&T indicators provided by OST (Observatoire des Sciences et des Techniquees).

The text has nevertheless been reworked and summarized, to concentrate essentially on the architecture of the system, its performances (strengths and weaknesses) and on its working mechanisms. A flow chart of the system has been established, as a highpoint of the first part, in order to facilitate comparison with the other countries.

The core of the identification of Brazil's scientific priorities is based on examination of the Action Plan "The 2007-2010 Action Plan for Science, Technology and Innovation for National development" published by the Brazilian government in August 2007. At this stage of production of the Eulanest project it is essential to take into account the general framework of the priorities of partner countries, to set them out clearly and itemize them with regard to the specificities of the country in question (such as strengths and weaknesses of the National Research and Innovation System, the character and trends in the productive sector, or historical socio-cultural aspects).

The objective in essence is to distinguish the priority "Lines of Action" that are really expressed, while defining the arguments that justify these choices, the corresponding means that it is proposed to harness and the methods of implementation envisaged.

The final part, entitled general lines for cooperation with the European countries, puts in perspective the scientific priorities of Brazil with what is known about the policy and the instruments applied for European bilateral and multilateral S&T cooperation, all situated in the context of the specificities and performances of the Brazilian National Resarch System.

This exercise is aimed at identifying organizational methods and possible alterations, both in terms of structure and research themes, that could adapt what European S&T cooperation can provide to Brazil's true necessities. It is a question of extracting the necessary elements to build a preliminary picture of the terms of reference for the joint call for proposals, even if this step needs to be complemented by the taking into account of priorities on the European side and of the results of an identical analysis for the other Latin-American countries targeted by the project.

As had been envisaged at the design stage of the Eulanest project, the results presented in this study must be used to feed the discussion of an international meeting – in Latin America – with the members of the consortium, the scientific directors and political decision-makers responsible for cooperation programmes from the two regions. A collective grasp of these elements of information should facilitate the launching of a bi-regional dialogue on the cooperation priorities for science and technology, a dialogue which could subsequently be taken up at the level of the scientific experts.

I. The Brazilian Research System

International scientific and technological cooperation demands good knowledge of the overall system and potential of research in the partner country, a strong factor for the accurate targeting of actions. The contacts forged between researchers tend to be born of circumstance, yet it is important that conscious choices of partner be made at the level of those who manage the cooperation. To this end, having at hand a wide view on the participants in research in the country and their interactions can be highly valuable. The first part of this section provides an insight into the architecture of the Brazilian Research System.

Such an extensive overview can by no means be exclusively qualitative. Ideally, the strengths and weaknesses of science in the partner countries must also be dealt with such as to define the themes that could be taken up by a cooperation scheme and justify them according to the policy (whether governed by competition, aid for development, or other approaches) being pursued. The science, technology and innovation (ST&I) indicators allow this aspect to be tackled at a highly global level, both by providing figures on the science and technology production of the Brazilian system of research and also on the means that the nation devotes to it. That is the subject of the second part of this section.

I.1. Organization and operation[1]

It is convenient to adopt a functional interpretation framework in order to present the architecture of a system of research. As well as the actual performance of the research, distinction is made between a programming-financing function and one of steering and orientation. The analysis finishes with examination of the assessment function which allows effective completion of the research process. Each of the functions is assigned to a different institution. The core of the Brazilian research system is run by the operators, i.e. the institutions that conduct the research : these will be presented first. Steering of public sector research, however, falls to ministerial departments. The description of the system ends with intermediary structures responsible for programming and assessment.

However, Brazil's federal organization means that there are two levels of political and operational decision-making : federal and federate. These two levels appear to have the intention of acting according to a principle of rationality tending towards an increasingly strong partnership between the country's different active science and technology research actors, whether they be the supervisory, financing, steering or assessment bodies.

I.1.1. The research operators

Research in Brazil is predominantly a public-sector activity, conducted in laboratories located in specifically-geared establishments (the public research bodies) or in establishments of higher education and research (the universities). The latter are the main contributors, but there exist also some private universities, especially confessional ones, which contribute to the national research results.

a) The universities

The assessment system of the Federal Agency for Support and Evaluation of Higher Education (*Coordinação de Aperfeiçoamento de Pessoal de Nível Superior* – CAPES) allows a classification of the country's best universities. The federal universities are often in the leading positions. Table 1 sets out the best 20 Brazilian universities.[2]

[1] This part draws extensively from the 'Curie+ Recherche Leaflet', written under the chief editorship of Jean-Pierre Courtiat and produced by the French embassy in Brazil in June 2007.
[2] The CAPES notes date from the latest triennial assessment (2004-2007).

Table 1 : The top Brazilian universities by the CAPES classification

University	Status	Internet address	Total number of masters and/or PhD programmes and/or professional training	Number of courses according assessment mark of between 5 and 7	Courses awarded the mark of 7 by CAPES (international-level excellence)
Universidade de São Paulo USP	State	www.usp.br	134	87	Astronomy Life Sciences (biochemistry) Food Sciences Physics Geosciences (geochemistry and geotectonics) Social history Immunology Linguistics Odontology (pathology) Experimental psychology Sociology
Universidade Federal do Rio de Janeiro UFRJ	Federal	www.ufrj.br	86	37	Social anthropology Chemical engineering Physics Biological chemistry
Universidade Estadual de Campinas Unicamp	State	www.unicamp.br	59	42	Food Sciences Food engineering Physics Biological and molecular genetics History Mathematics Chemistry
Universidade Federal do Rio Grande do Sul UFRGS	Federal	www.ufrgs.br	79	46	Life Sciences (biochemistry) Physics Geosciences
Universidade Federal de Minas Gerais UFMG	Federal	www.ufmg.br	69	35	Biochemistry and immunology Animal sciences (doctorate only) Life Sciences (physiology and pharmacology) Metallurgy and mining Literature Physics
Universidade Estadual Paulista Julio de Mesquita Filho UNESP	State	www.unesp.br	105	34	Zootechnics
Universidade Federal de Santa Catarina UFSC	Federal	www.ufsc.br	56	25	
Pontifícia Universidade Católica do Rio de Janeiro PUC-RJ	Private	www.puc-rio.br	28	19	Civil engineering Computer science
Universidade Federal de Viçosa UFV	Federal	www.ufv.br	30	16	Genetics Zootechnics
Universidade de Brasilia UnB	Federal	www.unb.br	63	19	Anthropology
Universidade Federal do Pernambuco UFPE	Federal	www.ufpe.br	58	20	Physics

Universidade Federal Fluminense UFF	Federal	www.uff.br	42	11	History
Universidade Federal de São Carlos UFSCar	Federal	www.ufscar.br	22	11	Materials science and engineering Chemistry
Universidade Federal do Paraná UFPR	Federal	www.ufpr.br	37	3	
Pontifícia Universidade Católica de São Paulo PUC-SP	Private	www.pucsp.br	26	13	
Pontifícia Universidade Católica do Rio Grande do Sul PUC-RS	Private	www.pucrs.br	25	9	
Universidade Federal da Bahia UFBA	Federal	www.ufba.br	51	11	
Universidade Estadual do Rio de Janeiro UERJ	State	www.uerj.br	42	10	
Universidade Federal do Ceará UFC	Federal	www.ufc.br	51	9	
Universidade Federal de Santa Maria UFSM	Federal	www.ufsm.br	31	6	

b) The public-sector research organizations

The greatest number of public research organizations is found at federal level and they are also the largest. Each of them is attached to a ministry. Several technical ministries thus take part in the Brazilian system of research by means of one or more partner(s). This is the case for example of the Ministry of the Environment (*Ministério do Meio Ambiente* – MMA), through the Brazilian Institute for Environment and Renewable Natural Resources (*Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis – IBAMA*) or again the Ministry of Mines and Energy (*Ministério das Minas e da Energia – MME*), with, among other establishments the Company for Mineral Research (*Companhia de Pesquisas Minerais - CPRM*).

As for the Ministry of Science and Technology (*Ministério da Ciência e da Tecnologia* – MCT), through the intermediary of its undersecretariat for the coordination of research units (*Subsecretaria de Coordinação das Unidades de Pesquisa* – SCUP), it manages over 20 units of scientific, technological and innovation research (Table 2). These cover Brazil's highest-priority fields of knowledge.

Public research organizations also exist that are overseen by the country's various States. Some of these, mainly those located in São Paulo State, enjoy considerable renown, such as the following (in São Paulo State) :

- Institute of Technology Research of the State of São Paulo (*Instituto de Pesquisas Tecnológicas do Estado de São Paulo – IPT*);
- Butantan Institute for Biomedical Research;
- Institute of Food Technology (*Instituto de Tecnologia de Alimentos – Ital*);
- Campinas Institute of Agronomy (*Instituto Agronômico de Campinas – IAC*);

In other States of the Federation :

- The Science and Technology Foundation (*Fundação de Ciência e Tecnologia – Cientec*), in the State of Rio Grande do Sul;
- Paraná Institute of Technology (*Instituto de Tecnologia do Paraná - Tecpar*);
- Minas Gerais Technological Centre Foundation (*Fundação Centro Tecnológico de Minas Gerais – Cetec*).

Table 2 : Principal federal research bodies in Brazil

Status	Name	Internet address	Number of affiliated laboratories	Priorities
Public sector institution under the Ministry of Agriculture	Brazilian Agricultural Research Corporation *(Empresa brasileira de pesquisa agropecuária – EMBRAPA)*	http://www.embrapa.br	41	Sustainable agricultural production, generation and processing of food in tropical climates.
Public sector institution under the Ministry of Health	Oswaldo Cruz Foundation (*Fundação Oswaldo Cruz – FIOCRUZ*)	http://www.fiocruz.br	15	Health, medicine in relation with the environment, ecology, education, epidemiology, microbiology, parasitology, clinical research, virology, anthropology and sociology.
Public sector institutions under the Central Administration of the Ministry of Science and Technology (MCT)	Brazilian Centre for Physics Research (*Centro Brasileiro de Pesquisas Físicas – CBPF*)	http://www.cbpf.br	17	Nanosciences, nanotechnologies, information technology, nuclear energy.
	Renato Archer Research Centre (*Centro de Pesquisa Renato Archer –* CenPRA)	http://www.cenpra.gov.br	12	Information technology and innovation.
	Centre for Mineral Technology (*Centro de Technologia Mineral – CETEM*)	http://www.cetem.gov.br	10	Environmental and recycling technology, industrial minerals and rocks, sustainable management of mining resources.
	Brazilian Institute of Science and Technology Information (*Instituto Brasileiro de Informação em Ciência e Tecnologia – IBICT*)	http://www.ibict.br		Relations between information, science, technology, culture and society.
	National Institute for Research on the Amazon Region (*Instituto Nacional de Pesquisas da Amazônia – INPA*)	http://www.inpa.gov.br	6	Technologies for the development of the Amazon.
	National Institute for Space Research (*Instituto Nacional de Pesquisas Espaciais – INPE*)	http://www.inpe.br	5	Space science, atmosphere, meteorology, space technology.
	National Institute for Semi-Arid Environments (*Instituto Nacional do Semi-Arido – INSA*)	http://www.insa.gov.br		New technologies for development of semi-arid environments.
	National Institute of Technology (*Instituto Nacional de Tecnologia – INT*)	http://www.int.gov.br	23	Work with the private sector to develop research in the fields of chemistry, materials technology, industrial engineering, energy and environment.
	National Observatory (*Observatório Nacional – ON*)	http://www.on.br	10	Astronomy, astrophysics, geophysics.

	Museum of Astronomy and Related Sciences (*Museu de Astronomia e Ciências Afins* – MAST)	http://www.mast.br	2	History of science and scientific education.
	Pará Emilio Goeldi Museum (*Museu Paraense Emilio Goeldi – MPEG*)	http://www.museu-goeldi.br	3	Generation and dissemination of knowledge on the natural and socio-cultural systems of the Amazon Basin.
	National Astrophysics Laboratory (*Laboratório Nacional de Astrofísica – LNA*)	http://www.lna.br	4	Development of competitive and innovatory tools.
	National Laboratory for Scientific Computing (*Laboratório Nacional de Computação Científica – LNCC*)	http://www.lncc.br	8	Biosystems, bioinformatics.
	Brazilian Synchrotron Light Laboratory (*Associação brasileira de tecnologia Luz Síncroton – LNLS*)	http://www.lnls.br	7	Synchrotron light, micro and nanotechnology, molecular biology.
Private-sector Social Organizations under supervision of the MCT	Mamirauá Institute for Sustainable Development (*Instituto de Desenvolvimento Sustentável Mamirauá – IDSM*)	http://www.mamiraua.org.br	12	Biodiversity, fisheries, agriculture.
	National Institute of Pure and Applied Mathematics (*Instituto de Matemática Pura e Aplicada – IMPA*)	http://www.impa.br	5	Algebra, fluid dynamics, mathematical economics, probability.
	National Research and Education Network (*Rede Nacional de Ensino e Pesquisa – RNP*)	http://www.rnp.br		Advanced networks.
	Nuclear Technology Development Centre (*Centro de Desenvolvimento da Tecnologia Nuclear – CDTN*)			Scientific and technological research in the nuclear field.
Units of the National Commission for Nuclear Energy (*Comissão Nacional de Energia Nuclear – CNEN*)	Regional Centre of Nuclear Sciences (*Centro Regional de Ciências Nucleares – CRCN*)			Bring the benefits of nuclear energy to the Nord and Nordeste regions.
	Institute of Nuclear Energy (*Instituto de Engenharia Nuclear – IEN*)			Scientific and technological research and development in the nuclear field.
	Institute for Energy and Nuclear Research (*Instituto de Pesquisa Energéticas e Nucleares – IPEN*)			Scientific and technological research and development in the nuclear field
	Institute of Radioprotection and Dosimetry (*Instituto de Radioproteção e Dosimetria – IRD*)			Monitoring services for the use of ionising radiations and nuclear technology

I.1.2. The supervisory bodies

The supervisory bodies are government structures in charge of steering public research. It is pertinent to distinguish the federal level from the federate level.

a) The federal level

The Ministry of Science and Technology (*Ministério de Ciência e Tecnologia* - MCT) is the main player in the promotion of research and technology in Brazil. The ministry is in particular responsible for defining and implementing the national science, technology and innovation (policy *Política Nacional de Ciência, Tecnologia e Inovação* - PNCTI). Its jurisdiction ranges from the scientific and technological heritage and its development to the policy on cooperation and exchange in relation to this heritage, by way of the coordination of sector-oriented policies, the national R&D policy and the production and application of new high-technology materials and services.

The PNCTI was defined by the government of President Luis Lula da Silva. The MCT drives the implementation of this policy, but it was devised jointly with the Ministry of Education (*Ministério da Educação* - MEC), the Ministry of Development, Industry and International Trade (*Ministério do Desenvolvimento, da Indústria e do Comercio Exterior* - MDIC), the Ministry of Health (*Ministério da Saúde* - MS), the Ministry of Agriculture, Fisheries and Supply (*Ministério da Agricultura, da Pesca e do Abastecimento* - MAPA), the Ministry of Mines and Energy (*Ministério das Minas e Energia* - MME), the Ministry of Defence (*Ministério da Defesa* - MD), the Ministry of National Integration (*Ministério da Integração Nacional* - MIN), the Ministry of Planning (*Ministério do Planejamento* - MP), the Ministry of Finance (*Ministério da Fazenda* - MF) and the President of the Republic's *Casa Civil* (Civil House).

The Ministry of Education participates by means of its Higher Education Secretariat (*Secretaria de Educação Superior* - SESU) and its Evaluation agency, the CAPES. These two bodies manage the lecturer-researchers in the various university departments, who make up the predominant core of leaders in Brazilian research.

The Ministry of Development, Industry and International Trade (MDIC) is involved in defining the Policy for Industry, Technology and International Commerce (*Política Industrial, Tecnológica e de Comercio Exterior* - PITCE) which aims to increase the effectiveness of the productive structure, the Brazilian companies' capacity for innovation and exports.

Certain technically-oriented ministries also take part in the national effort for research in science, technology and innovation. This they do by creating their own research institutions, within their sphere of operation. Among these, the Ministry of Health has the Oswaldo Cruz Foundation (*Fundação Osawaldo Cruz* - FIOCRUZ) whose purpose is to promote health and social development, and the Ministry of Agriculture is the supervisory body for the Brazilian Agriciultural Research Corporation (*Empresa Brasileira de Pesquisa Agropecuária* - EMBRAPA).

b) The federate level

Every State government in Brazil has a State Secretariat for Science and Technology. These secretariats are brought together in the National Council of State Secretaries for Scientific and Technological Affairs and Innovation (*Conselho Nacional de Secretários Estaduais de Assuntos de Ciência, Tecnologia e Inovação* - CONSECTI). This body's principal objective is to consolidate a national system of science and technology that is unifying, yet decentralized and efficient. The CONSECTI and the national bodies, first among which is the MCT, are devoted to working jointly to devise the research policies. In 2005, the CONSECTI and the MCT signed a cooperation protocol aiming for better integration of the federal and federate levels of operation. This protocol suggests that in the long term the State secretariats for science and technology, represented by the Council, should execute the national policy for the science and technology fields.

I.1.3. The intermediary structures

As for the supervisory bodies, there are two distinct political levels of operation for the intermediary structures, which include the theme-based coordination agencies (for programming and/or financing), structures geared to valorization (innovation agencies) and the assessment bodies.

a) The theme-based coordination agencies

The main source of finance for science and technology managed by MCT is the National Fund for Scientific and Technological Development (*Fundo Nacional de Desenvolvimento Científico e Tecnológico* - FNDCT), which is fed largely by the sector-oriented funds. Re-established in 1991, the FNDCT gives financial support to priority programmes and for the country's scientific and technological development. The sector-oriented funds are the only stable option for funding.

At federal level

The MCT has five agencies at hand to pursue its objectives. Two of these are geared to the financing of research : the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* - CNPq) and the Studies and Projects Financing Agency (*Financiadora de Estudos e Projetos* - FINEP).

The CNPq is the oldest Brazilian research funding agency. It promotes and stimulates the scientific and technological development of the country and contributes to the formulation of national policies for science, technology and innovation. This Council has been running for 55 years and has supported the training of 88 000 masters graduates and 30 000 PhDs in Brazil and abroad. In 2006, it backed over 65 000 grant holders through its various programmes, which represents a 45 % increase in 4 years.

The agency has two instruments available to enable it to fulfil its mission : on the one hand, training grants; on the other, financial resource provision for researchers, groups, even institutions for project implementation or management, for financing scientific research. These instruments are applied using three mechanisms**,** set up in the context of pre-defined programmes :

- annual calendar for permanent activities (grants, organization of scientific events);
- calls for proposals for specific activities (occasional grants or financial packages);
- agreements and partnerships in support of specific actions carried out by the CNPq itself or by third-parties.

The CNPq budget has received considerable increases over recent years. In 2006 it reached a total of 850 million reais (about 340 million €[3]) (compared with 600 million in 2002), 60 % of which were allocated for human resources training (grants).

The FINEP is another MCT agency. Its purpose is to promote and finance innovation and scientific and technological research in both public and private scientific and technological companies and institutions.

This agency has three financing methods at its disposal :

- subsidies attributed, following calls for proposals, to actions conducted in fields predetermined by the sector funding coordination and management committees, on the resources for sector funds;
- re-payable advances intended for companies;
- investments made with own resources or coming from sector funds for specific actions and as backing for innovatory companies.

In parallel with these traditional actions, FINEP has developed a programme for the modernization of the infrastructure of scientific and technological institutions (*Programa de Modernização da Infra-estrutura das ICTs* - Proinfra). In 2006, this programme invested about 80 million € in support of projects, maintenance and modernization of research infrastructure.

[3] One euro is equivalent to about 2.5 reais, according to the June 2008 rate.

FINEP's budget for 2006 was around 770 million €, a record budget for this agency, given that the 2005 budget was about 490 million €. More than half these funds go for non-reimbursable finance schemes.
Finally, FINEP also has the role of executive secretariat of the FNDCT and, consequently, for the sector funds (*Fundos Setoriais*).

Sector Funds for Science and Technology[4]

> The Sector Funds, set up in 1999, are financing instruments to support research, development and innovation. Sixteen sector funds exist : 14 specific to particular sectors and 2 transverse cross-sector ones. The 14 specific sector funds are : aeronautics, agriculture, Amazon Basin, biotechnology, energy, space, computer science, minerals, oil, water resources, health, telecommunications, maritime transport, transport. The two cross-sector funds are : Green-Yellow Fund (*Fundo Verde-Amarelo*), for interaction between universities and industry, and Infrastructure.
> The revenue for the funds comes from contributions paid on the operational profits from exploitation of natural resources belonging to the Union, from parts of the tax on the manufactured products of certain sectors and from the economic domain intervention contributions (*Contribuição de Intervenção no Domínio Econômico* – CIDE).
> Each fund is managed by a management committee chaired by an MCT representative and made up of representatives from connected ministries, regulation agencies, members from the academic and private sectors, from CAPES and the CNPq.
> In 2006, the sector funds provided an investment of around 462 million € in science and technology projects.

At federate level
The constitutions of most of the federate States provide for the redistribution of a percentage of the State's fiscal revenue towards science and technology research. These resources are managed by research support foundations (*Fundação de Amparo à Pesquisa* - FAP). The FAPs are generally linked to the State secretariats for science and technology. They act by allocating grants, research support arrangements, scientific exchanges and the dissemination of science and technology.

The São Paulo Research Support Foundation (FAPESP)

> Set up in 1962, the FAPESP is the country's longest-established FAP. It is currently still the largest and most effective, for the following three reasons :
> 1/ The FAPESP is the only FAP to receive from the State of São Paulo the entire amount of resources constitutionally allocated to it, i.e. 1 % of São Paulo State's tax receipts;
> 2/ It enjoys a capital amounting to two years of budget, which ensures its independence of operation and a possibility for mid-term planning;
> 3/ It has a substantial budget at hand, the largest of all FAPs (about 200 million € in 2006), which is divided and allocated as follows : 58 million € for grants, 86 million € for research projects and 57 million € for technological innovation.

The research-support foundations, like the State secretariats for science and technology, are also brought together in a council, the National Council of State Research Support Foundations (*Conselho Nacional das Fundações Estaduais de Amparo à Pesquisa* - CONFAP).
For many years, the federal and federate-level institutions have been operating in increasingly closely tied partnerships. For example the CNPq and FAPs have built four joint programmes :

[4] More information on the FINEP Internet site.

- National support Programme for Centres of Excellence (*Programa de Apoio a Núcleos de Excelência* - PRONEX);
- an emerging researcher programme providing first-project support (*Programa Primeiros Projetos* - PPP) aiming for the integration of young PhDs into the world of research;
- Regional Scientific and Technological Development Programme (*Programa Desenvolvimento Científico e Tecnológico Regional* - DCR). This programme is devoted to the development of research in the North, Northeast and Central-West regions;
- young scientist programme (*Iniciação Científica Júnior*) intended for secondary education students of public-sector schools.

In the same way, the FINEP and the FAPs set up the Research Support in Enterprises Programme (*Programa de Apoio à Pesquisa em Empresas* - PAPPE), which finances the development of innovatory products and processes initiated by researchers in or in cooperation with small businesses.

b) The research optimization structures

The research optimization structures in Brazil take the form of innovation agencies. The Law on Innovation, passed in December 2004 and in force since October 2005, made it compulsory for all the universities and research laboratories to set up such agencies.

Law on Innovation of December 2004

> The Law on Innovation, also called the “du Bien” law, is greatly inspired by the French law on innovation of July 1999. It provides for three main Lines of action :
> a) creation of conditions facilitating partnership building between universities, technological institutes and businesses. The private sector has since been able to use public laboratories and facilities for their research;
> b) promotion of participation in technological innovation. Civil-service researchers can negotiate contracts and licences for their research work conducted with the private sector. The research institutes and universities are obliged to set up innovation agencies;
> c) offering the private sector incentives for creating innovation to by means of financial support measures.
> Moreover, this law enabled the public-sector funding bodies to subsidize R&D projects undertaken by private industry.

All the institutions have indeed equipped themselves with optimization organs, yet such structures are still at the embryonic stage. Currently, the most substantial and dynamic is the INOVA agency, attached to the University of Campinas (Unicamp), followed closely by that of the University of São Paulo (USP) which has unified its different units within a single agency (USP Innovation Agency). The *Pontifícal Universidade Católica de Rio Grande do Sul* (PUC-RS) is also doted with an agency, the TecnoPuc, at the interface between the university and industrial companies. In 2005 these innovation agencies decided to group together in a network: the FORTEC network.

c) The assessment organizations

Generally, there is confusion of roles between the research financing and policy steering bodies and the assessment organizations.

At federal level

High quality scientific research is the fruit of top quality higher education. This quality is assessed by two distinct bodies : one to examine courses and programmes, the other concerned with the lecturer-researchers.

Course and programme assessment falls to CAPES**,** which in 1976 set up a postgraduate (*pós-graduação*) assessment system in order to develop this level of studies and also scientific and technological research. This system consists of an assessment of the present *pós-graduação* programmes and of proposed new courses *:*

- the assessment of *pós-graduação* programmes entails an annual period of accompaniment and a triennial assessment. This process leads to marks awarded on the scale of 1 to 7 (7 being the best mark) for each course and programme,
- the assessment of the new courses on offer looks at the proposed course's compatibility with the quality criteria.

The assessment of the research personnel in Brazil is the responsibility of the CNPq**,** in line with its function as a funding agency for researchers. Research staffs are evaluated by an assessment committee. Funding is attributed (amount and duration) according to a scale taking into account a personnel category chart drawn up by the agency and an assessment of level attained.

Staff are categorized according to the following terms or situations : a) research productivity, b) productivity in terms of technological development and extension of innovation, c) visiting research personnel, d) junior post-docs - *pós-doutorado*, e) senior post-docs - *pós-doutorado*, f) sandwich doctorate, g) *pós-doutorado* in industry, h) sandwich doctorate in industry, i) regional scientific and technological development.

A classification and assessment of work level are added on to that categorization. The researchers belong to one of the following three grades : a) senior researcher (15 years in service), b) researcher 1 (five years), c) researcher 2 (two years). The levels of attainment concern essentially grade 1 researchers : they are indicated by letters (A, B, C and D; A being the highest level). Each step corresponds to criteria concerning publications and supervision over a given period (number of articles in international journals, number of communications presented in conferences, numbers of students supervised at masters or doctorate level etc.).

As the amount of the research productivity grant, which also includes a salary supplement, varies according to the attained level, it is a system that strongly encourages the lecturer-researchers to get involved in research.

The CNPq has in addition set up an online interface system (a database) where researchers can publish their curriculum vitæ : the Lattes[5] Platform. It is in practice obligatory to keep feeding and updating this interface, because only those researchers registered on it are eligible to reply to a call for proposals. Apart from that, the data available on the Lattes Platform constitute the very basis of researcher assessment. This system makes it possible to follow the progress and trends of the country's scientific base. The interface currently holds over one million CVs, including around 30 % of Masters and PhDs and 38 % of students.

At federate level

The FAPs are assessment bodies that operate at federate State level. The procedures adopted vary widely between different FAPs, in line with the great disparities between their situations (the States' financial resources, level of technological development, degree of political interest their governments apply to science and technology, and so on).

I.1.4. Organization flow chart

The elaboration of an organization flowchart (see Flowchart 1) provides a graphic picture of Brazil's national system of research. Such a chart clarifies the interactions at work between the different institutions concerned. It also aims to facilitate international comparisons.

The chart is designed to highlight the three elements in research organization - steering, funding and execution - which have been used to describe in turn all the structures of the system. The ties between the different establishments (universities and organizations) and their supervisory bodies are depicted. Particularly noticeable are the large research organizations, such as FIOCRUZ or EMBRAPA, located in the funding part of the process, because at directorate-general level they play a role in programming in parallel with the agencies, by way of recurrent finance packages allocated by the supervising ministries.

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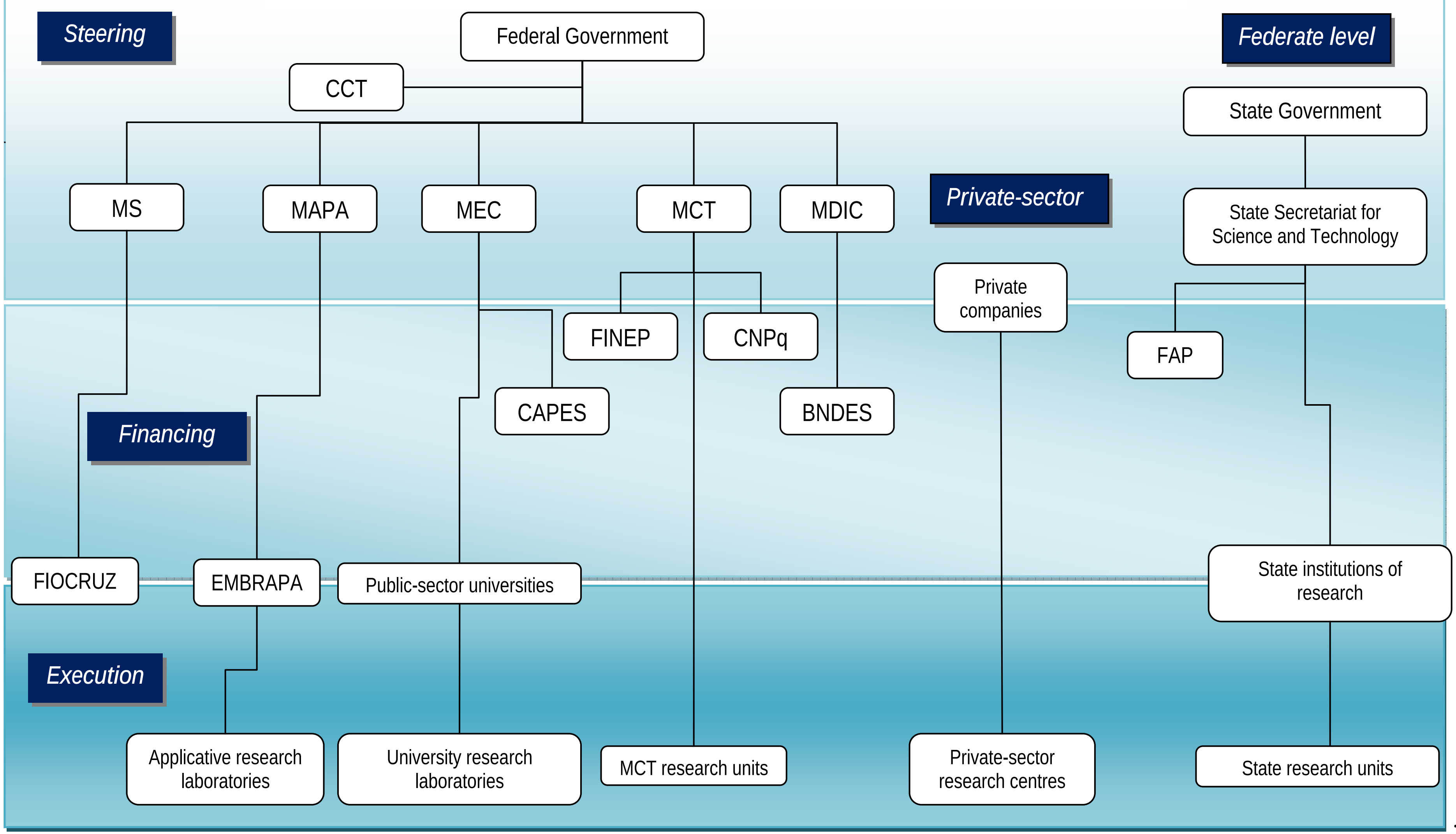
5 http://lattes.cnpq.br

Flow chart 1 : Overview of the Brazilian system of research and innovation



The federate level is also represented on the same diagram, with a State's Secretariat for science and technology taking a role equivalent to that played by the MCT at national level and with the FAP as coordination agency. At this level, the research institutions are evidently smaller and more localized than their federal counterparts.

I.2. Benchmarking

Indicators are essential in order to proceed with benchmarking. They provide an estimation of the scale and scope of the Brazilian system of research in its many different dimensions, as it is impossible to conduct a complete inventory at the level of every laboratory in the country. There are essentially two categories of parameter that can be appreciated overall : the input data– in other words the means devoted to research – and the output, which gives an idea of the performance achieved by the system. These categories are dealt with under the two subheadings of this section.

I.2.1. The means

The means signify in essence the financial resources and the human resources in terms of personnel employed in research.

a) Financial resources

Figures supplied by MCT indicate that Brazil devoted an overall sum exceeding 9.5 G€ to research and development expenditure, a little over 1 % of its GDP (see Table 3). Variation in this factor was not pronounced over the period 2000-2006 in terms of GERD/GDP, yet it doubled when expressed in reais.

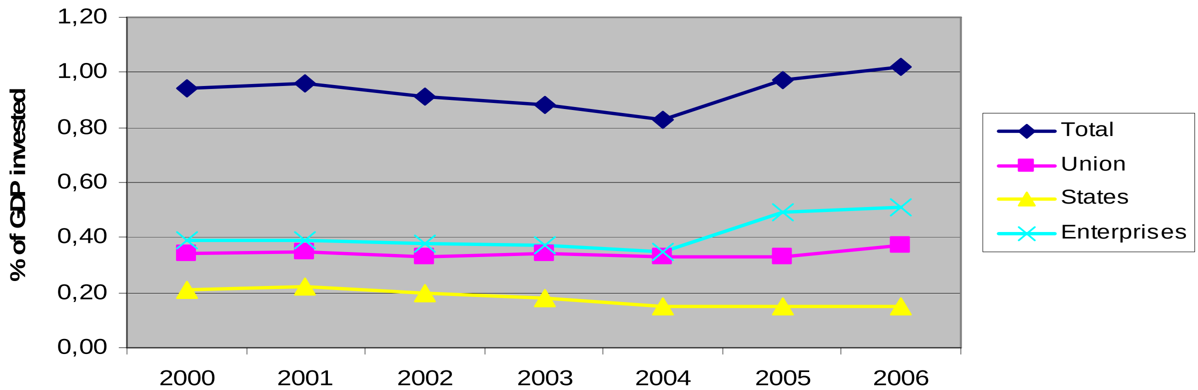
Table 3 - Brazil : national-level R&D investments, by sector (2000-2006)

	Values expressed in percentage of GDP						
Sector	2000	2001	2002	2003	2004	2005	2006
Total	0.94	0.96	0.91	0.88	0.83	0.97	1.02
Union	0.34	0.35	0.33	0.34	0.33	0.33	0.37
States	0.21	0.22	0.20	0.18	0.15	0.15	0.15
Industry	0.39	0.39	0.38	0.37	0.35	0.49	0.51

Source : IBGE + Serpro *Processed by MCT-2007*

Analysis of the distribution of these R&D investments by sector of origin (Figure 1) shows that it is a recent rise in the proportion contributed by private industry (50 % in 2006) that explains the vigorous rise in the total curve for the last two years available. The federate level contribution, although quite stable, remained low at below 15 % and even tended to decrease.

Figure 1: R&D investments (2000-2006)



Source : IBGE + Serpro *Processed by MCT-2007*

b) Human resources

Also found on the MCT web site is an estimate of personnel numbers employed in research, whether at researcher level or support staff. Table 4 sets out the corresponding figures for 2004, the latest year available (as full-time equivalents, FTE). R&D employs a total of almost 158 000 people in Brazil, of whom around 54 % are researchers.

Table 4 - Brazil : R&D researchers and support staff, in FTE, 2004

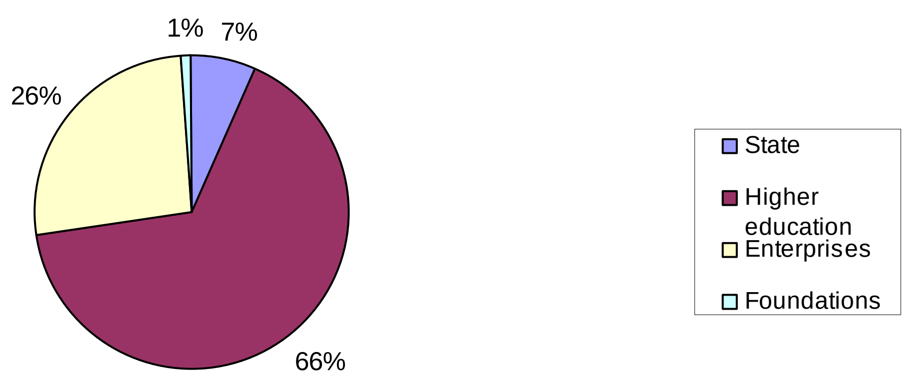
	Sectors				
Category	State	Higher. educn	Industry	Foundations	Total
Researchers	5 625	56 008	22 355	991	84 979
Support staff	4 854	52 174	15 187	401	72 616
Total	10 479	108 182	37 542	1 392	157 595

Source : CAPES + CNPq + Pintec-IBGE *Processed by MCT-2007*

Analysis by sector brought out some striking points (Figure 2). It shows that the dominant sector is higher education (the universities), especially regarding researchers. There are practically ten times more researchers (FTE) in the universities (PhD students included) than in the public research organizations (State, federal and federate levels taken together), which accounts for the considerable weight of the theme coordination agencies in Brazil.

As for the private sector, the proportion of researcher amounts to about one-quarter of the total, seemingly low especially seeing that the slice in terms of investment reaches 50 %. This finding carries the fear that the data collection methods (in part by way of the Lattes system for the public sector and through the national enquiry on innovation for the private sector) might have skewed the results.

Figure 2 : Distribution of researchers by sector in 2004



Source : CAPES + CNPq + Pintec-IBGE *Processing by MCT-2007*

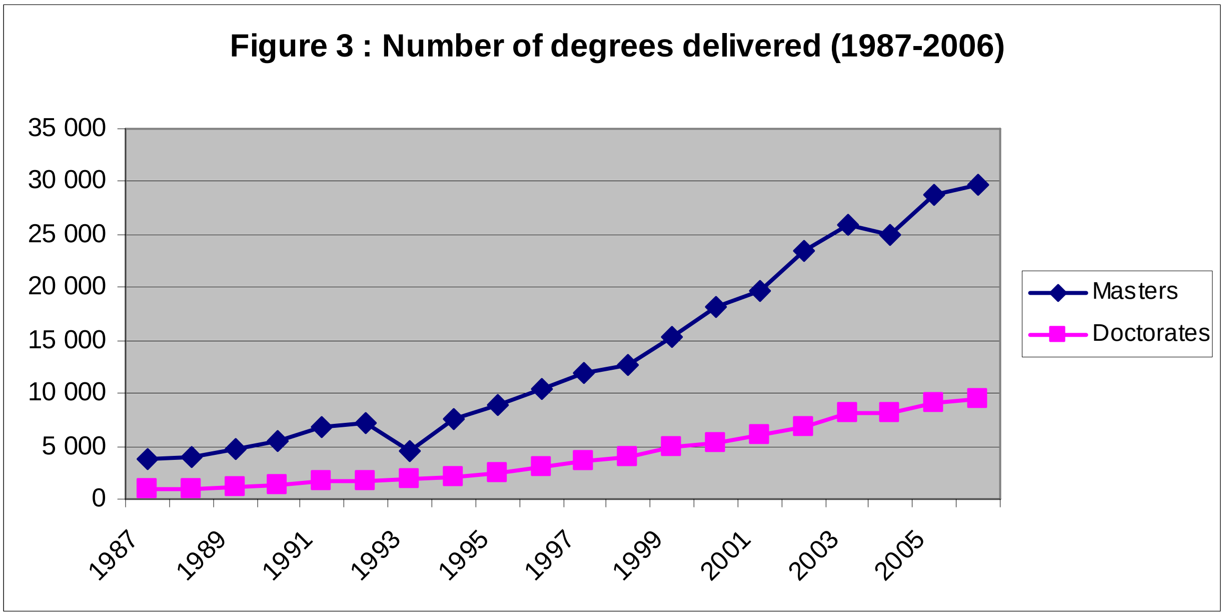
Analysis of the flow of students in higher education indirectly gives an idea of the dynamics of the system. Table 5 traces the trends in the number of degrees delivered.

Table 5 - Brazil : Number of masters degrees and PhDs delivered (1987-2006)

Degree	1987	1990	1995	2000	2005	2006
Masters	3 865	5 579	8 982	18 140	28 675	29 761
Doctorates	1 005	1 410	2 497	5 344	8 991	9 366

Source : CAPES-MEC *Processing MCT-2007*

A striking observation is that for the period analysed, 1987-2006, the number of doctorates awarded by the Brazilian universities grew from 1 000 to over 9 000 and the figure for masters degrees generally rose by the same proportion (Figure 3).
In 2006, over 2 500 professional masters – a qualification created in 1999 – came in addition to the 30 000 or so research masters awarded.



Source : CAPES-MEC *Processing by MCT-2007*

There again, this surge in strength of higher education in Brazil is an expression of the strong intervention of the major Brazilian funding agencies, whether federal (CAPES, CNPq) or State bodies like the FAPESP. Table 6, which displays the trends between 2000 and 2006 in the number of doctoral grants awarded by the federal agencies alone, in fact translates a sustained growth, of around 40 % in six years, reaching nearly 19 000 doctoral grants in 2006.

Table 6 - Brazil : doctoral grants attributed by the federal agencies (2000-2006)

Agencies	2000	2001	2002	2003	2004	2005	2006
Total	13 457	13 984	14 232	14 623	15 190	17 794	18 956
CAPES	7 839	8 144	8 493	8 687	8 859	10 932	11 530
CNPq	5 618	5 839	5 739	5 935	6 331	6 862	7 426

Source : CAPES-MEC + CNPq *Processing by MCT-2007*

I.2.2. Performances

ST&I indicators are also employed to provide an estimate of the performances achieved by the Brazilian research and innovation system, as much in terms of new knowledge production as in the generation of new technologies. The large international scientific publication and patent databases were used to make this assessment.
The database Web of Science®, by Thomson Reuters, provide the indicators selected both by MCT (by using the product *National Science Indicators*) and the Observatoire des Sciences and Techniques (OST-Paris), from whom a complete consistent set of ST&I indicators for all the Eulanest project's target Latin American countries was commissioned.
This section sets out the main results.

a) Calibration data

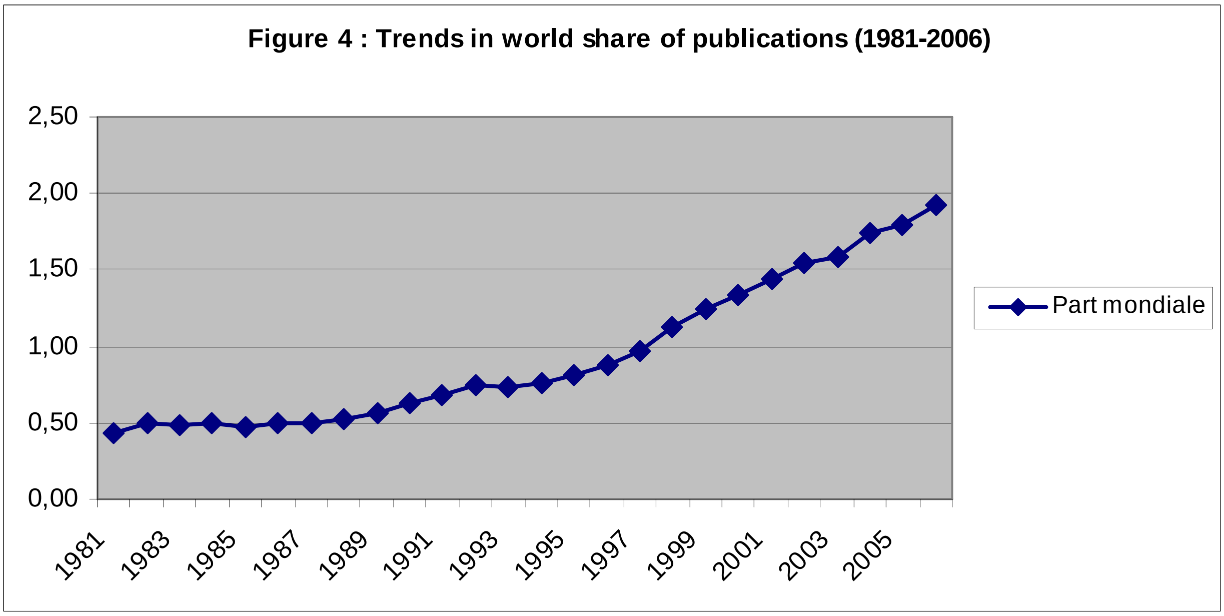
For a preliminary overall approach, analysis can be made of the number of scientific articles published in the international journals (indexed in the database) and attributed to Brazil over the available observation period (since 1981) and compared with world scientific production during the same period (Table 7). It emerges that Brazil's share in 2006 represented about 1.9 % of world scientific production and as much as 49 % of that of the whole of Latin America, according to the figures announced by the MCT.

Table 7 - Brazil : number of scientific articles 1981-2006, international comparison

Nbr articles	1981	1985	1990	1995	2000	2005	2006
Brazil	1 884	2 300	3 539	5 410	9 563	15 796	16 872
Latin America	5 641	6 905	9 604	14 240	22 706	33 831	34 552
World	432 059	484 997	558 087	665 924	718 466	883 508	879 011

Source : National Science Indicators *Processing by MCT-2007*

The trends in the world share for the known period are shown in Figure 4. The curve indicates a constant advance, from 0.44 % in 1981 up to 1.92 % reached in 2006. A change in slope also emerges, indicating a marked acceleration in production level from 1995 onwards, the year of creation of a Ministry of Science and Technology in Brazil and when the whole system was reorganized.



Source : National Science Indicators *Processing by MCT-2007*

For a deeper analysis of Brazil's scientific production it was judged preferable to turn to indicators supplied by the OST, which yield comparable values for the four Latin American countries concerned (Argentina, Brazil, Chile and Mexico). Nevertheless, the figures they give are noticeably different from those issued by the official national body, owing to a certain number of choices and conventions OST always adopts (see note on methodology in Appendix). They concern essentially the "perimeter" (the set of journals selected), the way of counting articles (by fraction or whole number, depending on what is measured – the country's contribution or participation – regarding world production) and the smoothing of values over three consecutive years to remove short-lived fluctuations that confuse interpretations.
These conventions considered, it becomes possible to give indicators on activity, visibility, specialization and even on partnerships.

b) Activity indicators

The world share figure obtained from a fractional count of publications is the least questionable of the comparative indicators of scientific production. It is applicable to the whole corpus of

scientific articles and by discipline, after breakdown into eight large traditional academic disciplines (OST nomenclature).
Table 8 sets out the results obtained for Brazil, compared internationally with Argentina, Chile and Mexico, for 2004. Brazil's dominant position in the region stands out. The other three countries made up[6] only 1.21 % of the world share of publications whereas Brazil on its own attained 1.41 %.

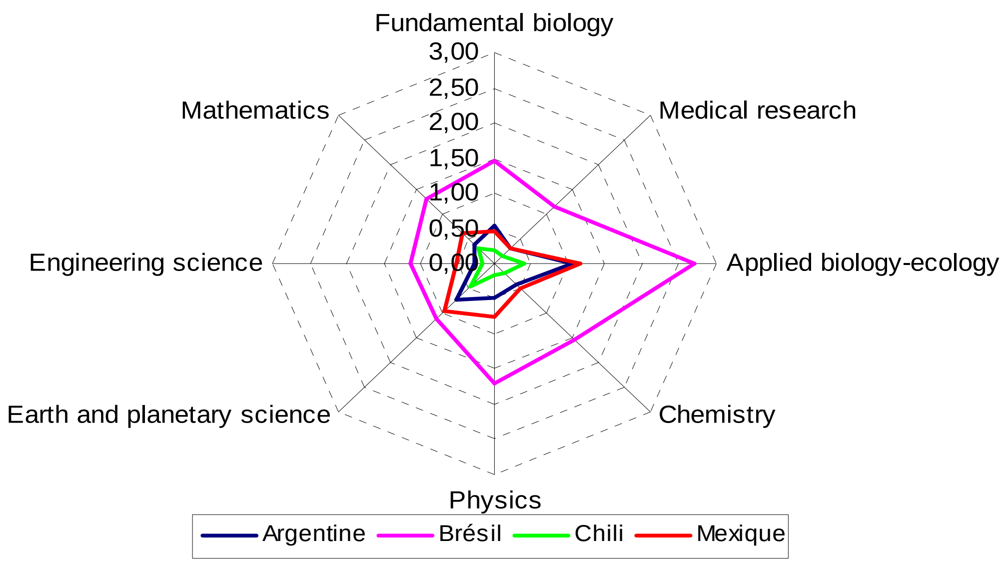
Table 8 – Brazil : world shares by discipline in 2004, international comparison

	World shares of scientific publications (%)			
Discipline	Argentina	Brazil	Chile	Mexico
Fundamental biology	0.53	1.47	0.18	0.46
Medical research	0.31	1.13	0.16	0.32
Applied biology– ecology	1.06	2.71	0.40	1.16
Chemistry	0.44	1.54	0.20	0.48
Physics	0.49	1.69	0.15	0.77
Earth and planetary sciences	0.74	1.12	0.46	0.95
Engineering sciences	0.28	1.13	0.17	0.52
Mathematics	0.37	1.29	0.32	0.59
All disciplines	0.46	1.41	0.21	0.54

Source : Thomson Reuters *OST –2007*

The comparative performance of different countries can be visualized by plotting on a spider chart (Figure 5), with rates by discipline. Applied biology-ecology is – unsurprisingly – the region's field *par excellence*, with a cumulated world share of scientific publications of 5.33 %. Conversely, the weakest fields are medical research (1.92 %) and engineering sciences (2.10 %).

Figure 5 : World share of scientific publications, 2004



Source : Thomson Reuters *OST –2007*

c) Visibility indicators

The Web of Science® gives for each publication the number of citations received during a given period (two years in this case). This is an informative indicator about the impact of the article

[6] In the fractional counting method, world shares can be added up.

cited, which adds a qualitative aspect to the scientific production data. The relative impact factor of a country, defined as the ratio between its share in citations collected and its share in attributed publications, is the visibility indicator, used as a measure of the interest the international community accords to that country's science.
Table 9 shows the relative impact factor calculated for Brazil over the period 2001-2004. At 0.46 – all disciplines included – it is quite low and no real change was shown over that period. The wide differences between disciplines can scarcely be interpreted, because they reflect differences in approach to publications practised in each of those disciplines.

Table 9 – Brazil : relative impact factor for two years of scientific publications

Discipline	2001	2002	2003	2004
Fundamental biology	0.29	0.31	0.34	0.35
Medical research	0.42	0.43	0.44	0.43
Applied biology- ecology	0.34	0.36	0.38	0.37
Chemistry	0.60	0.64	0.60	0.60
Physics	0.72	0.72	0.71	0.71
Earth and planetary sciences	0.59	0.57	0.54	0.51
Engineering ciences	0.66	0.66	0.69	0.66
Mathematics	0.89	0.82	0.79	0.74
All disciplines	0.44	0.46	0.46	0.46

Source : Thomson Reuters *OST –2007*

d) Specialization indicators

The specialization index measures the discipline profile of Brazil compared with that of publications worldwide. It is calculated as the ratio between the world share of publications from Brazil in a discipline and its world share in all disciplines put together. Table 10 sets out the trends in this index between 2001 and 2004.

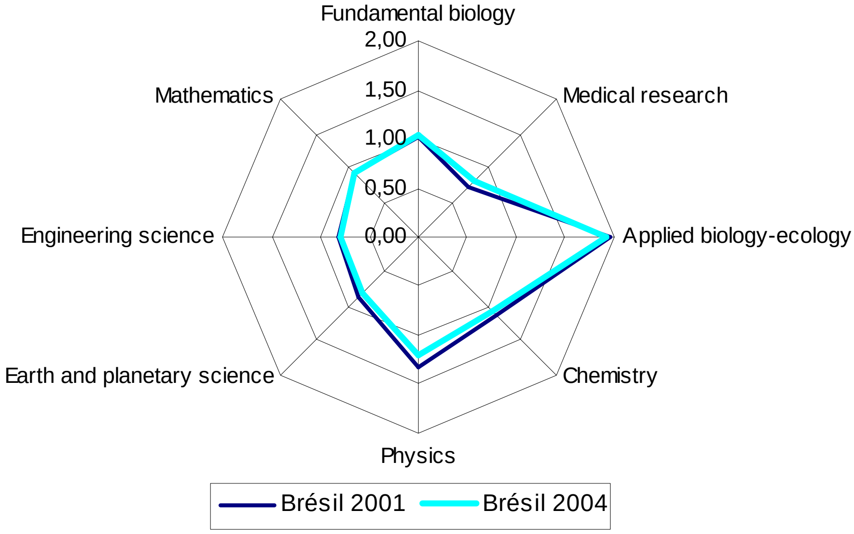
Table 10 - Brazil : specialization index by scientific discipline (2001-2004)

Discipline	2001	2002	2003	2004
Fundamental biology	1.02	1.03	1.05	1.04
Medical research	0.73	0.74	0.77	0.80
Applied biology - ecology	1.95	1.87	1.87	1.92
Chemistry	1.12	1.14	1.15	1.09
Physics	1.33	1.30	1.24	1.20
Earth and planetary sciences	0.85	0.85	0.81	0.79
Engineering ciences	0.81	0.79	0.76	0.80
Mathematics	0.91	0.90	0.91	0.92
All disciplines	1.00	1.00	1.00	1.00

Source : Thomson Reuters *OST –2007*

The strongest specialization Brazilian science is found in applied biology-ecology (agriculture, biodiversity and so on). There are nearly twice as many publications in these fields as in the all the disciplines. Then come physics and chemistry. The weak areas are the earth and planetary sciences, engineering sciences and medical research.
Figure 6 illustrates this specialization and the corresponding trends. It effectively confirms that the specialization in applied biology-ecology persisted over the observation period, whereas for the other strong points of Brazilian science (chemistry, physics) a readjustment occurred to the benefit of the weak areas.

Figure 6 : Specialization index for publications 2001, 2004



Source : Thomson Reuters *OST –2007*

e) Technological production indicators

The international patent databases carry an indication of a country's technological production, in that a patent is accorded to the country of the inventor's address. Processing techniques are possible that are analogous to those used for scientific publications. The OST has information related to European patent applications filed with the European Patent Office (EPO). Patents benefit from a precisely ordered classification, used universally to describe the state of the art in the technological field : this is the International Patent Classification (IPC). The OST has used this international classification to build a nomenclature in seven technological fields.

Table 11 displays the world shares of European patent applications attributed for 2004 (smoothed year) to Brazil, in international comparison with Argentina, Chile and Mexico.

The values are expressed in ‰ in the Table : they are quite low for all four countries concerned. There again the proportion for Brazil (1.58 ‰) is higher than that for all the other three countries put together (1.26 ‰).

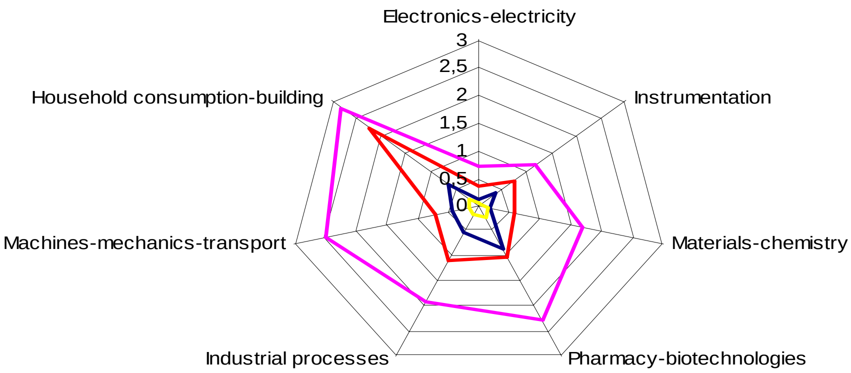
Table 11 - Brazil : world shares of European patent applications, 2004

	World shares (‰)			
Field	Argentina	Brazil	Chile	Mexico
Electronics-electricity	0.11	0.7	0.07	0.35
Instrumentation	0.37	1.15	0.03	0.7
Materials-chemistry	0.17	1.67	0.16	0.6
Pharmacy-biotechnologies	0.85	2.3	0.23	1.03
Industrial processes	0.54	1.92	0.19	1.09
Machines-mechanics-transport	0.43	2.48	0.15	0.72
Household consumption-building and construction	0.59	2.8	0.19	2.19
Total	0.37	1.58	0.12	0.77

Source : EPO and Inpi *OST-2007*

The values obtained in 2004 for the different technological fields have been plotted on Figure 7, which gives a curve for each of the countries concerned. There are some similarities among these. For example the most frequent applications for European patents – filed by these Latin American countries – belong to the field "household consumption-building and construction", not particularly high-technology areas. However, a relative degree of specialization of the four countries in pharmacy-biotechnologies is observed.

Figure 7 : World shares of European patent applications , 2004



Source : EPO and Inpi *OST-2007*

f) Partnership indicators

The indicators OST provides also allow quantitative assessment of Brazil's scientific and technological partnerships with the European countries. Three parameters give this kind of indication : Brazilian participation in European Union R&D Framework Programmes (FP's), the number of Brazilian students enrolled in European universities, and vice-versa; scientific co-publications between Brazilian laboratories and laboratories of European countries.

Analysis of these parameters, and their trends with time, yields indications as to the intensity of S&T cooperation existing between Latin American and European countries.

Participation in FP's

Table 12 shows the data relating to projects of the 5th and 6th FP (partial for the latter, because figures were taken only up to February 2006) in which the Latin American countries took part. Three distinct indicators are proposed : the share of projects, calculated from the number projects in which the country is involved, divided by the total number of projects; the share of participations, calculated from the number of participations in all the projects for which the country is involved and the share of coordinations, calculated from the number of projects coordinated by participants from the country.

Worthy of note is the participation of third-party countries (neither members of the EU, nor associated with it) which began to increase only very recently, such that for the period furthest back in time, values were too low to be really significant. They will nevertheless serve as a reference base for analysing the impact of the Liaison Bureau (B.Bice), set up in Brasília in September 2005, and also the effects of projects like Eulanest and Eularinet on bi-regional scientific and technological cooperation.

Table 12 - Share of projects, participations and coordinations of FPs. International comparison

	5e FP			6e FP (partial figures)		
Pays	Participations	Projects	Coordinations	Participations	Projects	Coordinations
Argentina	0,07	0,30	0,00	0,10	0,93	0,04
Brazil	0,11	0,41	0,00	0,16	1,19	0,04
Chile	0,03	0,14	0,01	0,09	0,86	0,00
Mexico	0,05	0,20	0,00	0,03	0,33	0,00

Source : Cordis *OST-2007*

Student mobility

The mobility of higher education students, found from the OECD database "*Education at a glance*", gives another indication of the S&T relations between different countries. The indicator is made up from the number of higher education students (ISCED levels 5 and 6 of the OECD nomenclature) expatriated in 2003 and enrolled in other countries. Table 13 thus gives the number of students of each country of the European consortium enrolled in a higher education establishment of one of the Latin American countries concerned by the Eulanest project. These numbers are only known for Brazil and Chile. They are very low, especially when compared with the number of European students enrolled in United States universities.

Table 13 : European students enrolled in the Latin American universities

	Number of students from the European consortium hosted in a Latin American country (2003)					
Host country	Germany	Spain	France	Norway	Portugal	United States
Argentina	na	na	na	na	na	Na
Brazil	15	8	13	na	24	8
Chile	186	138	156	22	2	1111
Mexico	na	na	na	na	na	830
United States	9302	3633	7223	1568	881	_

Source : OECD - Education at a glance *OST-2007*

Conversely, Table 14 shows the number of students from each of the target Latin American countries enrolled in 2004 in a higher education establishment of one of the Eulanest countries consortium. United States figures are included as a reference.

Table 14 : Number of Latin American students enrolled in European universities

	Number of students from Latino-American countries Hosted in countries of the European consortium (2004)				
Host country	Argentina	Brazil	Chile	Mexico	United States
Germany	519	1801	624	977	3419
Spain	2750	1699	1569	2652	753
France	838	1759	512	1452	2687
Norway	15	47	72	34	314
Portugal	21	1842	5	17	216
United States	3644	8388	1723	12801	_

Source : OECD - Education at a glance *OST-2007*

The strongest interactions are forged with Spain, especially for hosting Argentinian or Mexican students, Chilians to a lesser extent : the language of these counties clearly is a large factor in the choice – by the students themselves – of the European countries where they are to pursue their studies. For Brazil, which most concerns this analysis, the amount of influence is almost identical between Germany, France and Portugal, the latter with an evident linguistic advantage.

It also emerges that the total number of students hosted in the five European countries concerned is greater than the number who study in the United States for Argentina and Chile, but below that for Brazil and especially Mexico. That gives an idea of the possible room for growth, certainly greater in the last two cases.

Scientific copublications

The copublication indices of a country reflect the amount of joint projects between its research teams and teams from other countries. When a scientific article is co-written by one or more Brazilian laboratories and a laboratory from another country, it is an international copublication for Brazil (and indeed for the other country). Thus one could look at the proportion of

copublications with one or more given country, in the international copublications of a particular country.
These indices are calculated as world shares, all disciplines put together. Contrary to the other indicators, the indices for partnerships forged through scientific copublications are based on a count by whole number (integer count).
Table 15 sets out the world shares, in the European countries' international copublications, of copublications produced with Latin American countries, for 2004. They are quite low, expressed as a percentage as in the Table, except for the share of copublications with Brazil in Portugal's international copublications (6.8 %) and, to a lesser extent, in those from France. It also comes out that Brazil is more significant as a partner than the other Latin American countries for all the European countries, except Spain, and for the United States. As a counterpart, Argentina and Mexico are important partners for Spain.

Table 15 : European countries' world shares of copublications with Latin American countries

	2004					
with	Germany	Spain	France	Norway	Portugal	United States
Argentina	0.7	3.7	1.0	0.2	1.1	1.0
Brazil	1.7	2.6	2.7	1.4	6.8	2.6
Chile	0.7	2.1	0.9	0.3	0.6	0.8
Mexico	0.7	3.6	1.2	0.5	0.6	1.7
United States	29.4	26.2	24.7	29.1	19.1	-

Source : Thomson Reuters *OST -2007*

Also for 2004, Table 16 shows the world shares – in Latin American countries' international copublications – of co-publications produced with European countries. The values are strikingly more substantial, around 10-15 % rather than the 2 % of the previous Table. Strong involvement of three countries in particular stands out : Germany, Spain and France. Portugal is much less present, Norway even less so. And whereas Germany and France give a similar profile, more involved in Chile and Brazil than in Argentina or Mexico, Spain has a strong attraction for Argentina.

Table 16 : Latin American countries' world shares of copublications with European countries

	2004					
with	Germany	Spain	France	Norway	Portugal	United States
Argentina	10.6	18.6	11.4	0.3	1.3	32.3
Brazil	10.9	5.6	13.2	0.8	3.5	37.8
Chile	14.8	15.0	15.4	0.5	1.0	36.9
Mexico	7.7	13.6	10.4	0.5	0.5	42.5
United States	13.3	3.9	8.3	1.2	0.7	

Source : Thomson Reuters *OST -2007*

The same information is given in Table 17 as in the preceding one, but this time concerning 2001[7]. These two tables can be compared in order to trace the recent trends in such cooperation. The intensity of joint operations in S&T thus hardly varied over three years, at least for the three large countries, and consequently correspond to practices well rooted in time. However, whereas there has been a growth in co-publications with Latin America for Germany and Spain, this aspect of cooperation has been losing ground for France.

[7] Bear in mind that the figures are values smoothed over three years, for 1999, 2000 and 2001.

Table 17 : Latin American countries' world shares of copublications with European countries

	2001					
with	Germany	Spain	France	Norway	Portugal	United States
Argentina	10.5	18.2	11.8	0.4	0.7	32.7
Brazil	10.5	6.5	13.7	1.2	3.1	37.4
Chile	14.1	14.3	15.0	0.3	1.0	35.7
Mexico	7.4	11.8	11.9	0.3	0.7	41.2
United States	13.6	3.7	8.7	1.1	0.6	

Source : Thomson Reuters *OST -2007*

Focusing specifically on the nationality of laboratories that coproduce scientific articles co-written with at least one Brazilian laboratory brings into relief the main partner countries of Brazilian research teams. Table 18 thus lists the ten most significant partners for Brazil, in 2001 and 2004.

Table 18 : All-disciplines shares (%) of Brazil's copublications with the ten most important partner countries, over the total of its international copublications, (integer count, 2001 and 2004)

	Shares of international copublications for Brazil			
	2001		2004	
Position	Country	Share (%)	Country	Share (%)
1	United States	37.4	United States	37.8
2	France	13.7	France	13.2
3	United Kingdom	12.1	United Kingdom	11.5
4	Germany	10.5	Germany	10.9
5	Italy	6.8	Italy	7.1
6	Spain	6.5	Canada	6.0
7	Argentina	5.7	Spain	5.6
8	Canada	5.6	Argentina	5.4
9	Russian Federation	4.4	Japan	4.0
10	Japan	3.4	Russian Federation	3.6

Source : Thomson Reuters, processed by OST *OST-2006*

The Table makes clear that Germany and France are among Brazil's top five partners, in an order that stayed unchanged over the period considered. France is in second position, just after the United States, whereas the United Kingdom comes in just before Germany. Spain slipped one place in 2004, becoming only 7th partner, behind Italy and Canada. Argentina was first among Brazil's countries Latin American partners, in 8th position. Portugal did not figure in the top ten partner countries of Brazil, but with 3.5 % share of publications was not far behind.

II. Brazil's scientific priorities

There has long been great debate in Brazilian civil society on national priorities for science and technology, as demonstrated in the audience of meetings of the Brazilian Society for the Advancement of Science (SBPC), which celebrates its 60th anniversary in 2008. However, the strongest impulse was the 1st National Conference on Science, Technology and Innovation, held country-wide in 2001, that stimulated a substantial shared effort to think strategically about the challenges and issues of scientific progress for the development of Brazilian society.

Consequently, even given that the CNPq was able to devise and manage a foundation plan for scientific and technological development between 1975 and 1985, the Science, Technology and Innovation Action Plan 2007-2010 for furthering national development is an initiative unprecedented at Federal Government policy level. It aims to give research a decisive role in the sustainable development of the country.

Such a document provides a convenient frame of reference for leaders in S&T cooperation from Brazil's partner countries. It is an aid to enable them to coincide the bilateral actions undertaken with government-declared priorities and with a four-year running time. It takes on a quite different significance for European Union projects designed for coordination of Member States' scientific policies. It is desirable to make systematic use of this document, with a view to detecting subject areas for which the Brazilian government authorities intend to harness the efforts of the scientific community in the short term and which therefore represent many opportunities for focalizing bi-regional cooperation.

II.1. Science, Technology and Innovation Action Plan 2007-2010

On 20 November 2007, the Brazilian Minister of science and technology unveiled the Science, Technology and Innovation (ST&I) Action Plan 2007-2010 for national development, at the Presidential palace in Brasília. With this plan, subtitled "*Invest and innovate for growth*", the Brazilian government hopes to create the conditions for a new model of growth for the Brazilian economy, founded on the generation, assimilation and harnessing of scientific and technological knowledge.

The basic idea is that alongside investments in infrastructure − which is the target of the accelerated growth programme (PAC) launched by President Lula in January 2007 − investments in non-material assets, like research and development or science and technology education, are also of fundamental importance for the country's economic growth. The Action Plan thus aims to enable Brazilian enterprises to accelerate substantially the generation and appropriation of technological innovations, so as to enhance their competitiveness and expand their presence on both domestic and international markets. The objective is therefore to intensify interactions between the different parties involved in the system, with a dual aim : a broadening of the national scientific base, consolidation of excellence in the various fields of knowledge as well as enhancement of the technological potential of industry by the creation and acquisition of knowledge and its transformation into innovations.

With federal financial resources of about 41 billion reais, equivalent to 16 G€[8] over four years, the Action Plan is nurturing great ambitions. It shows well the importance now accorded to ST&I for the country's development. Domestic R&D expenditure should then rise to 1.5 % in 2010, including 0.64 % of federal public investments, 0.21 % in contribution from federate States and 0.65 % coming from the private sector.

This plan is part and parcel of the federal government's economic policy and falls in line with its other components, in particular the Industry, Technology and Foreign Trade Policy (PITCE). Four major strategic priorities are hence defined :

[8] All based on the June 2008 exchange rate of 2.5 R$ per euro.

a) Extend, integrate, modernize and consolidate the national system of science, technology and innovation, in particular by means of a link-up with federate State governments, such as to strengthen and enlarge the national science and technology base.
b) Accelerate the implementation of an environment favourable for innovation in industrial companies, particularly by reinforcing the federal government's industry, technology and foreign trade policy.
c) Prioritize research and innovation activities in fields that are strategic for the country's sovereignty, such as energy, aerospace, public safety, national defence and the Amazon Region.
d) Promote the popularization of science subjects and teaching in schools and the spread of technologies, in order to make the benefits brought by scientific progress accessible for all and improve the Brazilian people's living standards.

These four strategic priorities are translated into complementary interlinked objectives, that might be achieved by means of the actions defined in the common thread of the 87 programmes or initiatives identified, themselves classed according to 21 Lines of action (see Flow chart 2).

All these programmes are described in the Action Plan sensibly according to the same model, including the title, the purpose, a fairly detailed description with objectives that set out the overall aim of the programme. Moreover, the operators involved in implementation and the theme-based coordination agencies responsible for financing – including the annual budget allocation calendar – are systematically cited for each programme.

For the latter reason, it is clear that it is indeed at the level of the programme entity that analysis of Brazilian ST&I priorities must be conducted, at least for the partner countries' decision-makers concerned with international cooperation policy. In fact, although the 21 Lines of action provide a convenient interpretation frame, being homogeneous, quite clear and evidently in line with the hierarchy of four major strategic priorities of the Action Plan, it is only at the level of the 87 programmes that the European players can mount a scientific and technological cooperation with Brazil. Indeed, once they have determined the programme(s) they are interested in, they can find not only the concrete objectives and the right partners, but also the appropriate sources of finance and the institutional and human means rallied by the Brazilian side.

That is the level of detail that the discussion of bi-regional cooperation should therefore reach. For this reason the four strategic priorities of the Action Plan are broken down in terms of programmes, which are examined in turn in the following sections of Part II[9] of this country report.

II.2. Expansion and consolidation of the national ST&I system

The 1st strategic priority requires that two main objectives are met : improvement of the institutions, the management and governance of the ST&I policy; expansion of the science and technology research capacity. The latter objective presumes an increase in the financial support for science and technology in general, but also for training and maintaining human resources.

Consequently more than 20 % of the ST&I Action Plan resources are devoted to this strategic priority, for which three Lines of action have been decided :

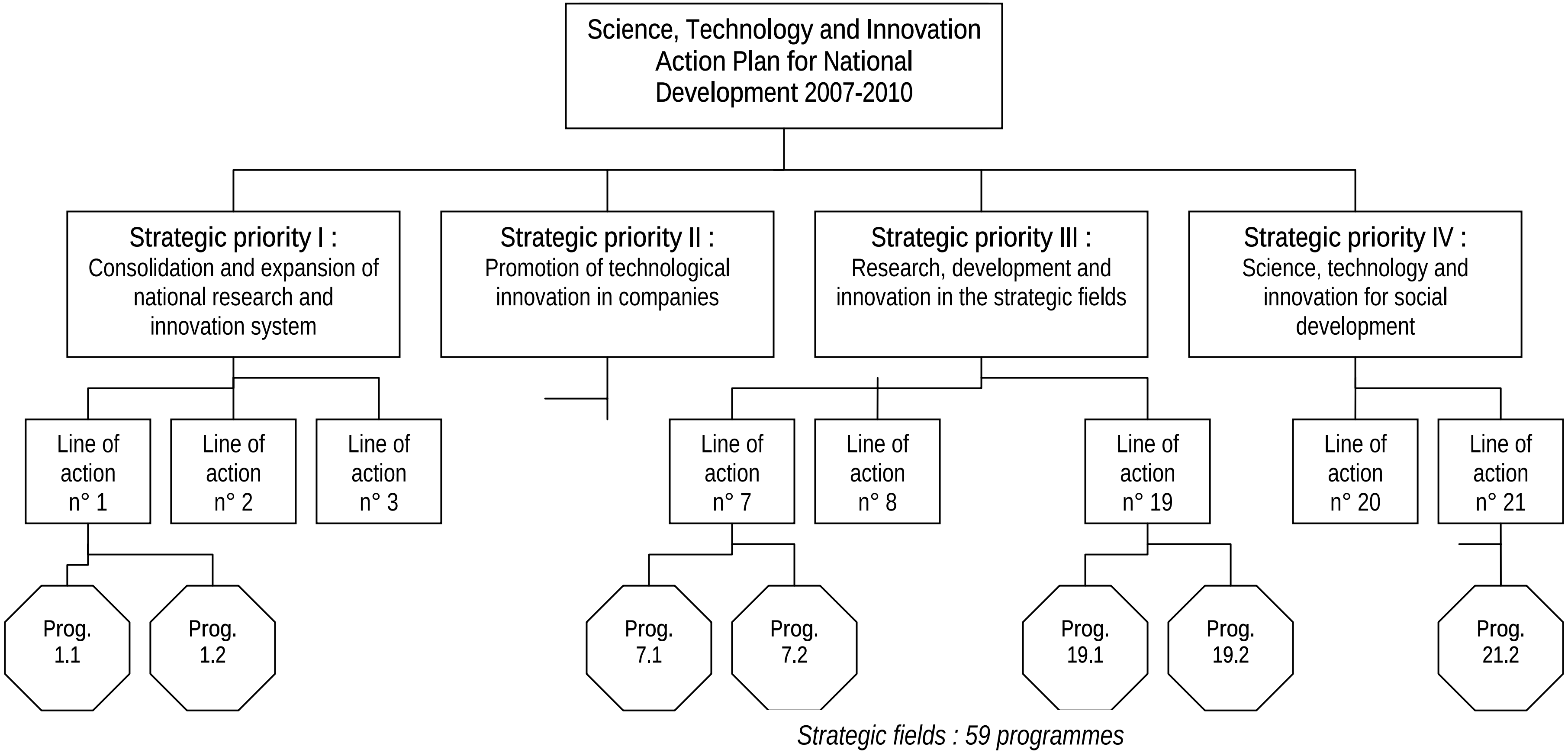
1) institutional consolidation of the national ST&I system,
2) training and qualification of ST&I human resources,
3) infrastructure and financing of scientific and technological research.

II.2.1. (1) Institutional consolidation of the national ST&I system

Programme 1.1 aims to optimize the legal framework, the management and financing instruments and also the institutional partnerships (including those with the private sector and the federate States) of the national science, technology and innovation system.

[9] Details for each programme are available on the website of ministry, www.mct.gov.br.

Flow chart 2 : Hierarchical structure of the Brazilian ST&I Action Plan



In total, 87 programmes for the 21 lines of action and the four strategic priorities of the Action Plan 2007-2010 of ST&I

As for Programme 1.2, it specifically targets international cooperation. Its purpose is to give impulse to the corresponding instruments, extend and diversify strategic partnerships, enlarge the scope of bilateral and multilateral cooperation schemes, particularly in South America and Portuguese-speaking African countries. It is mainly ministerial departments that are involved in its execution, alongside funding agencies (CNPq, FINEP and so on).

II.2.2. (2) Training and qualification of ST&I human resources

Programme 2.1 "Training, qualification and maintaining of human resources for ST&I" has the task of reaching one of the Brazilian government's priority objectives, that of training 16 000 PhDs from 2010. Over 2.5 G€ must be devoted to this over four years, mainly by way of the CAPES and the CNPq. The disciplines belonging to strategic fields are especially favoured and the programme aims also to encourage settlement of researchers in the less well-endowed regions, and their incorporation into industry.

II.2.3. (3) Infrastructure and funding of scientific and technological research

Four programmes coincide to support Line of action 3. Programme 3.1 concerns the funding of infrastructure : just over 500 M€ are to be assigned to it over four years.

Programme 3.2 is geared to priority research work and knowledge creation, both in fundamental research and for targeted applications. The funding for the corresponding CNPq and FINEP instruments is included.

Programme 3.3 pursues the intention to expand and enlarge the national education and research network (RNP), which links up all the units involved in this field by broadband Internet access (whether federal or federate).

Finally, Programme 3.4 finances the research units attached to the MCT, giving them the means to bring regional institutions into association. The objective is to reinforce these units' role as coordinators of motivational projects and consolidate their position at the head of the national thematic network, in ST&I fields that are strategic for the country's development.

II.3. Promotion of technological innovation in industrial companies

A second priority objective of the Action Plan is to bring research investments of Brazilian businesses up to an average 1 % of their turnover by 2010, whereas the current figure is an estimated 0.8 %. Nearly 40 % of the resources generated by the Action Plan are earmarked for this 2nd strategic priority. The public budget devoted to stimulation of innovation in industrial companies will be increased substantially over the coming years in order to sustain this effort. This will be implemented by means of the existing instruments. Other measures will also be adopted (incubators, technological parks, etc.), including establishment of a skills network capable of raising the technological potential of Brazilian industry, especially concerning the smallest firms. Thus, the proportion of researchers in the private sector in Brazil should by 2010 be boosted from the current rate of 26.3 % to 33.5 % of the estimated total of 120 000 active researchers in Brazil.

In the light of these aims, three more Lines of action have been defined :

4) support for technological innovation in industrial companies,
5) technology for innovation in industrial companies,
6) support for creation and consolidation of innovatory companies.

II.3.1. (4) Support for technological innovation in industrial companies

Line of action 4 consists of a set of diverse measures, implemented by five distinct programmes. Programme 4.1 supports companies' research, technological development and innovation projects, in order to boost their competitiveness, the wealth created and employment. The instruments used are those set up by the recent Law on Innovation : they consist of aid packages, repayable or not. With more than 5 G€ over four years, it is one of the most strongly backed programmes of the plan.

Programme 4.2 finances the cooperation projects between industry and scientific and technological institutions.
The national innovation initiative, Pró-Inova, constitutes Programme 4.3. This aims to build awareness in the productive sector of the importance of innovation as a tool for furthering competitiveness and lasting economic growth and to stimulate consequent action.
Programme 4.4 focuses on training for innovation, targeted a) on small companies, b) on innovatory firms and c) on priority fields defined in the industrial policy (PITCE).
Finally, the creation of over 300 company-based centres for research, development and innovation throughout the country is the core purpose of Programme 4.5, endowed with almost 500 M€ over 4 years.

II.3.2. (5) Technology for innovation in industrial companies

Line of action 5 and Programme 5.1 coincide as one element to set up the Brazilian system of technology (SIBRATEC), an organized network of both public and private centres of technological research, covering the whole national territory and intended to offer all types of technological services to aid the development of industrial enterprises.

II.3.3. (6) Support for creation and consolidation of innovatory companies

Three distinct programmes make up Line of action 6. Programme 6.1 gives financial support for setting up business incubators and technological parks.
Programme 6.2 sets up a series of lines of credit – in particular the INOVAR funds of the FINEP and CRIATEC of the BNDES – to generate and grow venture capital and the financing of innovatory companies. Public money provides a lever effect, and the process is to generate 2 G€ of funds over four years which can be drawn on to further innovation in industry.
Finally, there is Programme 6.3 with its major aim to make full use of public-commissioned orders to stimulate the technological development of national-level technology companies, within the legal limits of possibility for free competition.

II.4. Research and innovation in the strategic fields

Certain sectors of high technology are more fruitful than others in terms of innovation opportunities. They grow more rapidly, create jobs and have a beneficial impact on other productive sectors. The Action Plan makes a special priority of these sectors essential for the growth and development of the Brazilian economy.
Research, development and innovation in the most sensitive fields for national sovereignty and security are also considered, given the absolute necessity for the nation to be master over its own specificities, resources and technologies. Particularly concerned are the sectors that are sensitive in international relations, like space, nuclear technology and national control over the biodiversity or water resources, on the one hand, and those for which new knowledge and technology applied to Brazil's particular needs must be acquired and developed, on the other.
The Action Plan moreover aims to contribute to the reduction of regional and social inequalities, especially in the Central-Western, North and North-East regions, in the ST&I field. The reinforcement of regional and local systems of innovation, through actions and programmes geared to developing the specific economic potential of these highly diverse regions, is therefore a priority objective.
Efficient handling of the potentialities and the reasoned use of natural resources should henceforth enable Brazil to engage in development that reconciles economic growth, poverty reduction and conservation of the environment.
Thirteen Lines of action have consequently been selected in the context of this strategic priority, together drawing on just over one-third of the total investments of the Action Plan :

7) key fields for the future, biotechnology and nanotechnology,
8) information and communication technology,
9) health care products and services,

10) biofuels,
11) electrical energy, hydrogen and renewable energies,
12) oil, gas and coal,
13) agriculture and food industries and their derivatives,
14) biodiversity and natural resources,
15) Amazon Basin and Semi-arid environments,
16) meteorology and climate change,
17) the space programme,
18) the nuclear programme,
19) national defence and public security.

This set of Lines of action breaks down into 59 programmes, described briefly in what follows, covering each line of action in turn.

II.4.1. (7) Key fields for the future : biotechnology and nanotechnology

The objectives for these fields are to find better ways of identifying the opportunities and major challenges that present themselves before the country, establish priorities and enhance national companies' competitiveness by incorporating biotechnology, nanosciences and nanotechnology in the development of new products and processes. This Line of action entails two separate programmes.

a) Competitiveness in biotechnology (7.1)

This programme supports technological development and innovation in the strategic sectors of genomics, proteomics or bio-informatics applications. Fields that could benefit include agriculture, human and animal health, the environment and industry. The programme has to operate in symbiosis with the biotechnology development policy, put in place by the federal government in 2007. Allocated 80 M€ over four years, it comprises a variety of activities. These range from the funding of technology platforms, including the installation in 2008 of the Amazonia Biotechnology Centre (CBA,) to legal and regulatory measures for creating a favourable framework for private initiative in biotechnology. A partnership with Argentina has indeed been forged concerning this theme.

b) Science, technology and innovation for nanotechnology (7.2)

With the intention that national industry should become competitive in this field, this programme encourages technological innovation by improving coordination between the public- and private-sector players, supporting training and encouraging settlement of specialized human resources and stimulating international cooperation. Several of the country's economically important sectors should be affected by nanotechnologies, such as food production, biotechnology, electronics, aerospace, textiles, mechanics or energy (including oil and natural gas), all considered as priority areas.

The programme provides for assessment of the BrasilNano network of nanotechnology laboratories and its strategic priorities in 2008 and 2010 and envisages a broadening of Brazil's international partnerships in this field.

II.4.2. (8) Information and communication technologies (ICT)

The three programmes under this Line of action are oriented respectively to the electronics industry (8.1), software and services (8.2) and digital technologies for networks, media and communication (8.3). The setting-up of the Centre for Research and Development of Digital Information and Communication Technologies, a network of centres for integrated circuit projects and of the Centre of Excellence in Advanced Electronics Technology of Porto Alegre (CEITEC) figure among the main activities planned in these programmes. Altogether they will receive around 900 M€ for the four years of the Action Plan.

a) Technological development of the electronics and semi-conductor industries (8.1)

This programme, allocated 150 M€ of federal money over four years, supports the installation and development in Brazil of businesses in electronic component design, prototyping, final development and manufacture, particularly involving integrated circuits. Methods deployed include ST&I actions, training of human resources and tax incentive measures.
The programme gives continuity to a previous national microelectronics programme, launched in 2002, by reinforcing the network of integrated-circuit project centres founded under that initiative. It is hoped to establish international technology cooperation schemes in such fields as microelectronics, nanoelectronics and optoelectronics.

b) Stimulation programme for the software and services sector (8.2)

The ambition is for Brazil to become one of the international references in this sector. This programme's goal is an enhanced competitiveness and market share of national firms producing software and offering related services. The methods planned include training for specialized human resources, promotion of good software engineering practices, specific support for emerging market segments like wireless communication or television, and funding of research projects in complex fields.

c) Digital technologies for communication, media and networks (8.3)

This is one of the Action Plan's best funded programmes, attributed 600 M€. More than half the credits come from the sector fund for technological development of telecommunications (Funttel), administrated by the Ministry for Communications. It signals the ambition to give technological autonomy to the Brazilian digital communication and networks industry. This includes the application of recent digital radio and television technologies or techniques for working jointly through computer networks.
The corresponding public-sector support favours joint ventures between public laboratories and private, in wireless communication, IP connectivity, digital television, and advanced network technologies (Giga project).

II.4.3. (9) Health care products and services

The idea of this Line of action is to encourage the development of processes and products in the strategic fields defined by the Ministry of Health. The means include the development of appropriate technology platforms and service chains, with an intention to expand the Brazilian pharmaceutical industry on the international market. In concrete terms, the priorities defined are the ones in force in the policy for biotechnology development and the PITCE.
The Ministry of Health coordinates the five programmes of this Line of action and mobilizes a global 300 M€ for this over the duration of the Action Plan.

a) Pharmaceutical products and medicines (9.1)

Research, development and technology transfer are supported by this programme, which also gives impulse to quality control in medicine production in Brazilian bio-industrial firms. The setting-up of appropriate technology platforms (for production of monoclonal antibodies, toxicological tests, screening of natural products and so on.), operating under a system of service provision, will be especially encouraged.
The programme targets the development of compounds against neglected diseases (such as Chagas' disease, leishmaniasis and malaria.), degenerative diseases and transplant rejection. Concerning another aspect, ad-hoc legislation to regulate access to the genetic heritage was set in place at the start of the Action Plan.

b) Medical products and biomaterials (9.2)

The product manufacture sector for medicine, hospitals and dentistry represents a substantial economic market in Brazil. Generating over 35 000 direct jobs, it has a significant export capacity, notably to the United States. It characteristically receives a strong contribution from federal-capital backed industry and is highly fragmented and specialized. Competition is based largely on product differentiation.

This programme helps modernize manufacturing processes for medical products such as orthopaedic implants, haemodialysis equipment, or diagnostic equipment. It aims also to set up technology development centres for medical products and biomaterials, to support technology transfer between universities and industry, advanced training and the linking of teams in this field into a network.

c) Diagnostic kits (9.3)

As its priority, this programme deals with national production of diagnostic agents for enzymatic assays, molecular assays or rapid tests suitable for neglected diseases and others that have a strong economic impact on the public health system (Aids, for example), with the objective of substantially cutting related imports.

At the current state of development, the first aim is to build the sector into a structured national complex. The most accessible niches for the Brazilian industry are for diagnostic kits for such diseases as leptospirosis, malaria, dengue, leishmaniasis, toxoplasmosis or rubella. Specific financial support mechanisms are to be mounted and the development of ST&I platforms for national production of kits will be favoured.

d) Blood derivatives (9.4)

Blood derivatives are biological medicines obtained by industrial purification of human plasma proteins. Currently, only albumin is produced in Brazil, and this in insufficient quantities for national consumption. This programme therefore encourages the national production of these derivatives with the desire to meet public health demands and lessen the risk of shortage and the country's dependence on imports in this area.

The operational launch of the Brazilian Company of Hemoderivatives and Biotechnology, Hemobrás, founded in 2004, and which should start producing from 2010, is the priority. In this context, international cooperation projects are planned with a view to absorption of appropriate technologies.

e) Vaccines (9.5)

Modern biotechnology is causing great changes and developments in the vaccines field. This segment represents an opportunity for the country to reduce its dependence on imports of immunobiological products. At present, the Butantan Institute and FIOCRUZ are Brazil's two principal laboratories that could together produce a vaccine line. It is a field where research takes a long time and investments are risky and therefore requires substantial public investment and effort. This materialized in the form of a national competitiveness programme for vaccines (INOVACINA).

The objectives sought in terms of vaccine production include satisfaction not only of nationwide public health needs, but also of the demand of developing countries, by taking advantage of international funding mechanisms.

II.4.4. (10) Biofuels

This Line of action gives the opportunity to reassert a major priority objectif : Brazil's ambition to become the world leader in biofuel technology. The R&D on renewable energy sources and clean and efficient energy technology, in particular biodiesel and ethanol, gives rise to two programmes together attributed 120 M€ of federal credits over the four-year period.

a) Biodiesel technology development programme (10.1)

This programme supports scientific research, technological development and innovation applied to the production and usage of biodiesel fuel, along six main themes : 1) agriculture, 2) production plant technology, 3) residues and by-products, 4) technological services infrastructure, 5) stability and storage and 6) engine and vehicle tests. It is implemented by the Brazilian Biodiesel Technology Network (RBTB), organized to link up all the many players operating in this field (EMBRAPA, PETROBRAS, private companies, producers' associations, etc.).

Scientific and technological cooperation schemes with countries that master the technologies of this field are planned.

b) Ethanol science, technology and innovation programme (10.2)

Brazil is currently the world's main producer and user of fuel based on alcohol extracted from sugar cane. The country is the first exporter of this biofuel and of the corresponding technology.
In order to maintain this position, the programme continues and expands the R&D efforts made in several directions : a) biotechnology, for the production of higher-performance cultivars for agriculture, b) enzymatic hydrolysis, to optimize the processing of ligneous and cellulosic materials into alcohol, c) sector-based technologies (mechanization of cane cultivation, alcohol production in small plantations, use of straw, etc.), d) development of new sources of fertilizing materials and nutrients for agro-energy and e) creation of a world centre of reference for ethanol technology. There again, scientific and technological cooperation schemes are envisaged with countries mastering the technologies in this field.

II.4.5. (11) Electrical energy, hydrogen and renewable energies

This Line of action entails programmes devoted to ST&I development in electrical energy and hydrogen and renewable energies. The objectives are to develop new technologies for electrical energy generation, transmission, distribution and end-usage, such that the country will be able to use hydrogen commercially as a fuel in less than 20 years' time and exploit the potential sources of renewable energy (hydraulic, biomass, biogas, wind and solar energy), other than biodiesel and ethanol. About 200 M€ will be devoted to this during the Action Plan.

a) Education and research in electrical energy (11.1)

This programme sets up operational infrastructure facilities and resources in the research and higher education institutions. These include laboratories and human resources necessary for scientific and technical knowledge creation concerning the generation, transmission, distribution and utilization of electrical energy.

b) Electrical energy technology development programme (11.2)

The programme supports the Electrical Energy Research Centre's laboratories to enable them to meet the new challenges faced by the Brazilian electricity system. This mixed hydraulic and thermal complex, of continental-scale proportions, is diversifying by harnessing renewable energy sources. It must be geared so as to optimize the different distribution systems. The programme is essentially a scheme for strengthening the corresponding research laboratories.

c) ST&I programme for long distance electric power transmission (11.3)

Electricity transmission grids account for a large slice of the cost of extending the country's distribution system. This justifies a specific programme, for perfecting materials and equipment or design new transmission line systems, and also to prolong their useful life, reduce power line losses and solve other problems.

d) ST&I programme for optimization of electric power system assets (11.4)

The main themes for optimization and extension of the electric power installations and equipment include maintenance, real-time surveillance, corrosion control measures, assessment of the structural integrity of power stations and development of new superconductor and insulation materials.

e) ST&I in planning and operational models of electric energy networks (11.5)

This programme finances projects of development and improvement of mathematical models and IT tools for planning and operation of the national electrical energy supply and distribution system.
For instance, a software platform devoted to the integration of local automation functions of substations will be elaborated and validated.

f) ST&I for energy quality and efficiency improvement (11.6)
The target activity of this programme is the development of technologies geared to improving the quality of the electric energy produced and the efficiency of the generation, transmission and distribution network.

g) ST&I programme for the economy of hydrogen (11.7)
The programme backs R&D actions in the area of hydrogen production, as a new energy alternative, or as a contibution to the country's integration in the hydrogen economy. The methods used are the network building of research teams in this field, training of specialized human resources and support for laboratory and technological services centre infrastructure.

h) ST&I programme for renewable energies (11.8)
Covered by this programme are forms of energy that show the highest potential for the country (such as solar energy, wind energy, hydroelectric micro power stations, biomass), other than biodiesel and ethanol which are dealt with under their own separate programmes. The aim is to diversify the energy source base, reduce contributions to the greenhouse effect and global warming, while steering the country to a position of competitive producer in this field.
The operations run are intended to give structure to the research community in these fields, by such means as advanced training, networking of specialists, funding for laboratory facilities and equipment plus fostering of link-ups between industrial companies and the universities.

II.4.6. (12) Oil, gas and coal
Expansion and modernization of the ST&I infrastructure in oil and natural gas exploration, production and transport, and also for refining, constitute the core themes of this Line of action. Its objectives also encompass mineral coal production and clean usage.
The nine constituent programmes mobilize a package of federal funds (mainly from the Ministry of Mines and Energy, MME, and Petrobras) of around 2.4 G€, over the Action Plan's running period.

a) Education and research on oil, natural gas, energy and the environment (12.1)
The aim of this programme, conducted according to contractual agreements between Petrobras and research and education higher institutions, is to expand and modernize ST&I laboratory facilities in all scientific fields linked to the oil, natural gas, energy and environmental sectors.

b) Technological development for oil, natural gas, energy and environmental sectors (12.2)
This programme works towards the extension and modernization of the Petrobras Research Centre in Rio de Janeiro, CENPES, in the field of renewable energy sources.

c) Refining research and technological development (12.3)
The focus of this programme is funding for technological improvement of heavy-oil refining processes, lubricant production and new fuels, including biofuels.

d) Research and technological development for oil and natural gas exploration (12.4)
Geosciences R&D with potential for furthering the discovery of new oil-bearing deposits and exploration of natural gas accumulations is the focus of support from this programme. It helps with the development of physical and numerical simulation methods concerning geological processes in sedimentary basins, with a view to optimizing exploration.

e) Research and technological development for oil and natural gas production (12.5)
The programme invests in R&D on oil and natural gas production, especially from heavy crude oils and offshore deposits, in deep marine waters.

f) Research and technological development for oil and natural gas transport (12.6)
This is an R&D programme on oil and natural gas transportation systems. Its objective is the optimization of oil and gas pipeline networks and terminals, operating-cost reduction, an improved durability and reduction to a minimum of risks of leakage and environmental impact.

It also finances higher education and research in naval construction.

g) Research and technological development for natural gas operations (12.7)

This programme provides ST&I investments in the areas of natural gas storage and on-board transport.

h) Sustainable development measures in the oil and natural gas sectors (12.8)

The focus of this programme is ST&I investment to find technological solutions that reduce to a minimum the impact of oil and natural gas related activities on water resources, ecosystems and global climate change. In particular, this entails funding for pilot projects for the separation, capture and geological storage of CO_2.

i) Research and technological development for coal production and utilization (12.9)

Brazil's energy plan, which entailed a prospective study up to the 2023 horizon, provides for the tripling of coal's input to the national energy complex and the construction of new coal-fired power stations. The ST&I programme consequently aims to develop a clean production chain for coal, be it for electricity generation, iron and steel production or coal conversion, and the development of land restoration technologies for repairing environmental damage in worked coal mining areas.

II.4.7. (13) Agriculture and food industries and their derivatives

This Line of action, consisting of five distinct programmes, is coordinated by the Ministry of Agriculture, Livestock and Supply, MAPA, with the Brazilian Agricultural Research Corporation, EMBRAPA, as principal operator. Over 500 M€ are allocated for ST&I in this field, for the period 2007 to 2010.

The objective of actions in this field is to exploit the new fronts opened by food technology. However, a technico-economic approach is adopted, and special attention is paid to small-scale producers.

a) Food industry research, development and innovation (13.1)

This programme invests in ST&I in the interests of food security. The approach includes the development of high-quality foods, bioactive ingredients for disease prevention, vitamin-enriched foods, antioxidants, carotenoids, etc.

It is implemented by means of multidisciplinary, multi-institutional RDI projects.

b) Agricultural automation in smallholdings (13.2)

The development of methods, equipment and systems of automation is backed by this prgramme. The purpose is to improve the quality of produce from family-based smallholdings and raise the income and living standards of small-scale producers, in order to further sustainable socio-economic development of Brazilian agriculture.

c) Innovatory systems of agricultural production (13.3)

This programme promotes innovation in agriculture by means of new agricultural production systems which draw on advances in research on such aspects as soil and water conservation, insect control, fertilizers, genetic improvement, rehabilitation of degraded land.

d) International links for ST&I advances in agriculture (13.4)

This programme finances EMBRAPA's international cooperation actions, in partnership with countries at the forefront in production of food, fibres and bioenergy, aimed at technology transfer towards developing countries.

e) Integration of the agriculture research institutions from federate States (13.5)

The agriculture and food sector contributes nearly 40 % of Brazil's gross national product, and hence fully justifies the strengthening of efforts in agricultural research. The objective of this programme is therefore to reconstruct the national system of agricultural research, by bringing 17 regional research institutions back into the system, especially those focused on livestock, fruit growing and coffee, which have suffered from severe budget restrictions imposed in the early 2000s.

II.4.8. (14) Biodiversity and natural resources

For this Line of action, one objective is to develop and improve the products, processes and services derived from the resources provided by the country's biodiversity. Another is to optimize the instruments for conservation of this biodiversity and the *savoir-faire* appropriate for using it.
The six programmes concerned mobilize about 190 M€ during the term of the Action Plan.

a) ST&I applied to biodiversity and natural resources (14.1)

The programme invests in the creation of a fund of scientific and technological knowledge that allows conservation and rational, sustainable use of Brazil's natural resources, whether terrestrial, water or marine. The method used is the setting-up of theme-based ST&I networks for advanced development of products, processes or services derived from the country's biodiversity and natural resources.

b) ST&I for exploitation of marine resources (14.2)

The purpose of this programme is to finance ST&I concerning marine ecosystems and oceanographic processes, including interaction with the atmosphere and exploitation of natural marine resources. The programme provides for the acquisition and fitting-out of an oceanographic research vessel in order to accomplish campaigns further offshore in search of new bio-active substances from the ocean.

c) Fisheries and aquaculture RD&I (14.3)

Fishing is a vital sector in Brazil owing to its socio-economic importance. The country also stands out because of its aquaculture activities which have high potential for expansion. In order better to develop these capacities, the programme supports ST&I initiatives to make available information, technologies and systems leading to improvement of national fish production and make Brazilian fisheries competitive and sustainable. It operates essentially by building up research and development networks for specialized technologies.

d) ST&I in the Antarctic (14.4)

Brazil is developing an international research programme in the Antarctic, aiming to gain understanding of associated environmental phenomena and their global impacts, especially concerning Brazil's territory.
A particular area of focus for this programme's funding is biotechnological prospection of the region's marine and terrestrial organisms, intended to identify genetic material with economic potential.

e) ST&I for water resources (14.5)

Application of scientific and technological knowledge on water resources is essential for Brazil, owing to the great variety of landscapes, climatic conditions and ecosystems on the one hand and a steep growth in water consumption, on the other. The water resources ST&I programme works to develop specialized advanced training, supports research laboratories and popularization initiatives and finances research projects into the rational use of water resources.

f) Technological development and innovation for mineral resources (14.6)

This sector is highly significant for the national economy (4.7 % of GDP and directly involving one million jobs) and plays a large role in reducing regional inequalities. These factors justify the elaboration of this programme. The objective is to finance higher education, scientific and technological research, technological development and innovation in geology and mining technology.

II.4.9. (15) Amazonia and Semi-arid region

Line of action 15 adopts a sustainable-development strategy for these two zones and involves a scientific and methodological input. The approach includes training and fixation of human resources, which can enable local institutions to face the challenges, current and future, of socio-economic development and living standards.
Just over 100 M€ of federal resources have been allocated for the duration of the Action Plan.

a) ST&I for conservation and sustainable development of the Amazon region (15.1)

This integrated ST&I programme for the conservation and sustainable development of Brazil's Amazon Basin coordinates actions of research institutions operating in the region oriented towards land use, biodiversity and climate. It also supports training and fixation of human resources. Its overriding objective is to promote the sustainable use of natural resources for a harmonious socio-economic development.
A forum for management of this programme, involving several different sections of society, public authorities and private initiative must be set up and linked up with the different Amazonian countries.

b) ST&I for sustainable development of the Semi-arid region (15.2)

The programme finances the development and consolidation of thematic research networks and provides support to local ST&I infrastructure, with the aim of improving the organization of productive systems and the quality of life in the semi-arid region of *Nordeste*. One of the programme's outstanding measures is the formation of the National Institute of Semi-arid Environments (INSA) and of the Rio São Francisco regional Observatory, also strongly geared to the training and fixation of Masters and PhD graduates on the region's problems.

II.4.10. (16) Meteorology and climatic change

Line of action 16 targets studies on the causes and effects of global climate change, research intended to guide public policy on adaptations to changes and reductions of greenhouse gas emissions. It also embraces weather and air quality forecasting, and climate prediction. Funds for the two constituent programmes amount to 170 M€.

a) National programme on climate change (16.1)

Brazil's economy is strongly based on natural resources, which makes it vulnerable to any extreme weather or climate events that the rise in average land surface temperature is reckoned to cause. An investment programme to extend related scientific and technological knowledge is therefore crucial. Standing out among the planned actions is the formation of a centre for terrestrial sciences at the INPE and of a Brazilian network of climate change research.

b) Weather and climate forecasting (16.2)

The programme funds research infrastructure with the aim of expanding and integrating national capacity in weather and air quality forecasting and climate prediction. The hope is to develop applications to agriculture, water resources, energy, transport, civil defence, health, tourism and leisure. In particular, the network of federate States meteorological centres will be consolidated.

II.4.11. (17) Space programme

The objective of the space activities section of the ST&I Action Plan 2007-2010 is to equip the country with the capability to develop and use space technologies in the interests of Brazilian society. The Line of action entails developing an infrastructure of launching, rocket and satellite centres. The six component programmes account for over 940 M€ of the Union budget over the four years of the Action Plan.

a) Alcantara Space Centre programme (17.1)

This programme funds the setting-up of the Alcantara Centre, as a new hub of scientific and technological development devoted to the commercialization of rocket and satellite launches, both for national projects and in line with international agreements.

b) Satellite Launch Vehicle (VLS) programme (17.2)
The second programme of this Line of Action provides the necessary means for final development and industrialization of the VLS-1B rocket, designed to launch satellites of maximum payload of 600 kg to reach an orbit up to 800 km, including types geared for multi-mission platform technology.

c) Multi Mission Platform for earth observation satellites (17.3)
The multi-mission platform (PMM), designed at the INPE and built by national industry, is a satellite services module capable of coupling up different types of payload, for earth observation missions, meteorology projects or scientific experiments. This programme's remit is to complete the PMM to be ready to launch the first satellite (Amazonia-1, monitoring of deforestation in the region) from 2010.

d) China-Brazil Earth Resources Satellite (CBERS) Programme (17.4)
The CBERS programme finances the development, manufacture, testing and operation of remote-sensing satellites in partnership with China, for monitoring the environment and natural resources. It comprises five satellites, the last two being due for launch in 2010 and 2013. The images they yield are issued free-of-charge. International agreements are planned for the installation abroad of new CBERS image reception and distribution stations.

e) Alcantara Cyclone Space (ACS) Programme – bi-national joint venture (17.5)
This entails establishment and operational commissioning of the Ukraine-Brazil joint-venture Alcantara Cyclone Space (ACS) to commercialize a satellite launch service based at Alcantara, using the Ukrainian carrier rocket Cyclone-4. The long-term objective is to achieve six launches of medium -sized satellites (like CBERS) per year. The first is planned for 2011.

f) Human resources training in the aerospace sector (17.6)
The last programme of this Line of action supports advanced training and research to meet demand from the aerospace sector. It is run in close collaboration with companies in the industry who will also take part. In particular, a space engineering course will be established at the ITA (*Instituto Tecnologico de Aeronautica*).

II.4.12. (18) Nuclear programme
Intervention in the Brazilian nuclear programme aims to develop the manufacture of components for nuclear plants and to further advances in prospection and the uranium enrichment plan. The Line of action also provides for the development of a national nuclear waste policy and the design of a nuclear research reactor.
The seven programmes making up this line of action are endowed with an overall total of a little over 400 M€ of federal funding for the duration of the Action Plan.

a) Consolidation of the legal framework governing the nuclear field (18.1)
The objective of this programme is to reorganize the bases of the legislation governing the nuclear field. Laws and legal provisions in force are to be harmonized and the structure of the sector adjusted to the present political realities, both national and international. A prominent feature will be the formulation of a national policy for radioactive waste management.

b) Extension of the nuclear fuel cycle in Brazilian nuclear industries (18.2)
This programme finances the realization of inventories and prospection with a view to identifying exploitable uranium reserves and invests in ST&I for uranium enrichment necessary for nuclear fuel production.

c) Completion of the Aramar pilot UF_5 production (conversion) scheme (18.3)
The operational finalization of the pilot uranium-to-gas plant at Aramar, which will complete the cycle of national experimental nuclear fuel production, fixed for 2010, is the focus of this programme's investment.

d) Modernization of NUCLEP for nuclear power station component manufacture (18.4)

Brazil's nuclear programme provides for the construction of eight new nuclear power stations from the present up to 2022. This funding programme aims to support recovery operations and modernization of the manufacturing structure NUCLEP, set up in 1970 in line with the nuclear power agreement with Germany.

e) Implementation of the Brazilian radioactive waste management policy (18.5)

This programme gives support to Brazil's policy for management and reliable storage of radioactive waste produced within the country. This entails the formation of a State company, independent from the CNEN. Finance is also provided for the development of a prototype storage cell for spent nuclear fuel.

f) Brazilian federal radiopharmacy company, EBR (18.6)

The major aim of this programme is to finance a federal enterprise to produce radioactive medical products (radioisotopes and other radiotherapy agents). It also supports a project for an experimental research reactor capable of enhancing radioisotope production.

g) ST&I actions and training for a revival of the Brazilian nuclear programme (18.7)

This programme has to guarantee the development of professional training and technological R&D for the Brazilian nuclear programme. Brazil's participation in international initiatives to develop novel nuclear technology, especially for new-generation fission reactors, requires a special effort in this field.

II.4.13. (19) National defence and public security

The last Line of action among these strategic scientific priorities focuses on national defence policy and priorities for public security. The corresponding actions favour support for infrastructure developments for research, advanced education and training and innovation in national companies involved in this field.
The two programmes of this Line of action are attributed 120 M€ over four years.

a) ST&I for national defence (19.1)

The role of this programme is to promote R&D in all fields concerning the country's security, by encouraging synergy between public– and private–sector players. This is to be achieved through mobilizing schemes and innovatory projects. The Ministry of Defence takes a predominant role. Moreover, particular effort is made to attract foreign researchers and scientists for spearhead fields with national defence applications.

b) ST&I for public security (19.2)

This programme works in support of linkages between public security institutions and national operators in research and technology, the objective being to incorporate modern crime control techniques. It is run in partnership with the Ministry of Justice.

II.5. ST&I in the service of social development

Communication of the message of the importance of the generation, appropriation and advantageous use of scientific and technological knowledge to the whole of civil society is vital if the Action Plan is to succeed. This is especially so in its aim to harness S&T to serve the well-being and social progress of the Brazilian people. Consequently another objective of the Action Plan is to spread and instil a culture of science, technology and innovation in Brazil's society. The last two Lines of action have been devised to meet this goal :

20) popularization of ST&I and improvement of science education,
21) technologies for societal development.

An overall sum of de 600 M€ is allocated to this final strategic priority of the ST&I Action Plan 2007-2010.

II.5.1. (20) Popularization of ST&I and improvement of science education

The first of these two Lines of action concentrates on the communication measures and is divided into four distinct programmes. Programme 20.1 supports the production of any promotional or educational event within the country on science, technology and innovation by appropriate organizations. Featuring among these is "National Science and Technology Week" which should involve 90 % more communities, making 700 Brazilian towns and cities, in 2010.

The formation and development of centres and museums of science, technology and innovation are financed by programme 20.2, with an important task of achieving better regional distribution.

In 20.3, the Brazilian Mathematical Olympiad for State Schools (OBMEP), which allows at the same time improvement of the quality of basic education and identification of young talent, should reach 21 million pupils in 2010, compared with 17 million competitors in 2007.

Programme 20.4 concerns the production multimedia content for scientific education and popularization of ST&I by way of Internet. It provides for the design of specialized web sites and portals, as well as the integration of a range of media (Internet, TV, radio).

II.5.2. (21) Technologies for societal development

Eight programmes with relatively modest budget make up the last Line of action, devoted to the application of ST&I knowledge as an instrument for the country's socio-economic and regional development. Programme 21.1 sets up and modernizes the technological vocational centres (CVT), which are units of education and professionalization dedicated to the spread of basic knowledge in science and technology. The programme is to support the construction of 300 CVTs by 2010.

The national Digital Inclusion Programme (PBID, 21.2) is intended for the most deprived sections of society. Its objective is to give these people access to new information and communication technologies, as a key to opportunities on the job market.

Programme 21.3 funds research, innovation and technological diffusion projects devoted to participatory schemes for solving social problems (concerning family-based agriculture, housing, sanitation and so on).

The community programme for technology and citizenship (21.4), focusing on cotton production by traditional communities of the country's semi-arid region, is a means of furthering social insertion and sustainable development. It gives impulse to research and technology transfer activities that might make viable an integrated system of small-scale agro-industrial production.

Science and technology for regional development is the concern of programme 21.5. Founded on the principle of local production clusters (APL), it finances innovations that enhance the competitiveness of such projects to stimulate locally-based economies.

Support for research and development applied to food and nutritional security falls to programme 2.6. A salient element is the development of agro-ecological production processes and social technologies for food security in areas at risk or for specific populations. Its purpose is to reduce social inequality by guaranteeing communities permanent regular access to sufficient quantities of good quality food.

Programme 2.7 covers agriculture and agro-industrial development research to further social integration. It targets certains sections of the population – rural workers and communities involved in extractivism – to date excluded from the national development process. It operates mainly by funding specific agroecology projects.

Finally, programme 2.8 attends to the strengthening of skills and knowledge of the scientific and technological community regarding ST&I applied to social development. Actions planned under the programme include promotion of the incorporation into academic research agendas of themes directly linked to development and awareness building among organized social-movements of the ability of ST&I to help solve the social problems that concern them.

III. General lines of approach for EU-Brazil cooperation

Compared with previous experiences, preparation of this country report on Brazil has benefited from a particularly favourable context in many respects, thanks to the availability of several recent documents. The production of a "*fiche Curie+ Recherche*" by the French Embassy in Brasília in June 2007 provides an extensive analysis of the structure of the Brazilian system of research. The service commissioned from the French *Observatoire des sciences et des techniques* for the Eulanest project yields some original performance indicators, which are a good supplement to those available from MCT. The recent four-year Government Action Plan for Science, Technology and Innovation in Brazil sets out the national priorities. In addition, the comparative analysis of the European instruments of bilateral ST&I cooperation conducted in the framework of this Era-Net Project gives a picture of the bi-regional ways of arranging joint schemes.

It is therefore advisable to make maximum use of this body of information, by examining in turn what can be deduced from each study to indicate ways of improving scientific and technological cooperation with Brazil.

What results is an original document, a model useful as an aid towards identifying common priorities, which should be the basis for the dialogue – in terms of ST&I cooperation – between the two parties.

III.1. Cooperation needs deduced from analysis of Brazilian priorities

Analysis of the Brazilian government's Action Plan 2007-2010 "Invest and innovate for growth" was conducted using the second part of this country chapter. Among the 59 programmes under Priority III "Research, development and innovation in the strategic fields" it reveals a certain number of themes for which the Brazilian scientific community might particularly interest international cooperation.

This interest is sometimes expressed explicitly, without however specifically indicating a potential partner in most cases. For other themes the context can imply that international cooperation would be welcome for consolidating Brazilian national effort.

These two aspects are covered in turn in this section. They provide a preliminary platform for discussion of the choice of subject areas to take into consideration in science and technology cooperation with Brazil.

III.1.1. Explicitly expressed needs

In the framework of programme 7.2 "*Science, technology and innovation for nanotechnology*", Action Plan 2007-2010 intends to stimulate and broaden international cooperation. This could materialize in the form of training of human resources, in order to increase the knowledge and skills available in the country in nanosciences and nanotechnology and/or of implementation of innovation projects in fields of nanotechnology considered as strategic for Brazil, involving both research laboratories and industrial companies.

Programme 8.1 "*Support for the technological development of the electronics and semiconductor industries*" envisages the establishment of an international technology cooperation scheme with institutions of excellence in microelectronics, nanoelectronics, optoelectronics, photonics, micro-electromechanical system (MEMS) organic electronic devices and solar cells.

The Line of action relating to the *pharmaceutical industry* indicates that Brazil's priorities lie in the production of medicines and biomaterials, diagnostic kits, blood derivatives and vaccines, aiming simultaneously to satisfy domestic demand for public health purposes and cut down dependence on imports and to supply developing countries by means of international funding. Neglected diseases such as Chagas' disease, leishmaniasis or malaria are especially targeted. In this perspective, international cooperation projects are planned with a view to the incorporation of the technologies taken on board.

Brazil is currently the world's leading player in the production and use of bio-fuels. In order to conserve its lead, Brazil encourages scientific and technological cooperation with countries dominant in the bio-diesel and ethanol production-line technologies, with the aim of developing second-generation biofuels. The project for founding a world reference centre for ethanol in Brazil could serve as a basis for such international cooperation.

Programme 13.4, which concerns the scientific and technological advances in the *food and agriculture sector*, provides for reinforcement of the international cooperation practised by EMBRAPA for technology transfer focused on food independence (production of food, fibres and bio-energy) and the sustainable development of the least advanced countries of Africa.

The operational approach of the integrated programme "*Science, technology and innovation for conservation and sustainable development of the Amazon region*" (15.1), designed to support research dealing with the growing social and environmental pressures that bear on Amazonia, envisages action coordinated with that of other countries concerned with the region, like the European Union by way of French Guiana. Special emphasis will be given to the reduction of intra-regional imbalances in water and mineral resources, bio-energy and alternative energies, Amazonian agriculture systems, biodiversity and cultural heritage.

The hopes for international cooperation the Brazilian government expresses for line of action 17, "*Space*", concern the commercial exploitation of Alcantara space centre for rocket and satellite launches and the installation abroad (in Australia, North America and Europe) of satellite-image reception and distribution stations produced by the China-Brazil Earth Observation Satellite (CBERS).

In the *nuclear field*, the objectives of Brazil's national programme bring to the forefront the need for training of sufficient human resources to guarantee the country's international participation in the development of the latest generation of nuclear fission reactors, as in ITER (*International Thermonuclear Experimental Reactor*).

III.1.2. Needs detected through arising opportunities

In the preceding subsection an attempt was made to draw up an inventory of themes for which the Brazilian Action Plan effectively referred to a desire for international cooperation. The exercise reported in what follows is decidedly more subjective, because it is based on the detection of subjects for which it is considered that Brazil might call for, owing to the context and taking account of the priority expressed.

Programme 2.1 "*Training, qualification and fixation of human resources for ST&I*" provides a first opportunity. To cite only the objectives in terms of new Brazilian PhDs trained annually, their number should rise from less than 9 400 in 2006 (see Table 5) to 16 000 in 2010. This represents considerable effort and will undoubtedly require calling on the traditional partner countries by sandwich PhD arrangements, founded on CNPq and CAPES grants and in the framework of bilateral cooperation instruments, all the more so since the intention is to favour fields linked to national strategic priorities. On this particular point, the EU's multilatéral Marie Curie Actions programme could probably play a major role in attracting young Brazilian researchers to European laboratories of excellence. However, it would also be judicious to think about the ways and means of guaranteeing better reciprocity. Indeed, for each European student hosted in a Brazilian university, there are between ten and twelve Brazilian students in a European university (see Tables 13 and 14).

Strategic Line of action III "*Promotion of technological innovation in industrial companies*", one of the Brazilian government's high priorities, offers considerable opportunities for international cooperation through projects linking up research centres and innovatory firms on the two sides of the Atlantic. It nevertheless entails projects that are particularly difficult to build, as economic interests and private initiative are involved. European participation for the setting-up of business incubators as part of programme 6.1, or for raising venture capital (programme 6.2 INOVAR) could probably be a starting point and the means for detecting opportunities.

Brazil nurtures great ambitions in the software and computer services sector, a field where Brazilian industry is certainly competitive, but is still too strongly oriented to its internal market. The desire to invest in emerging segments of this field, such as wireless communication, digital television, video games and so on could probably lead to the forging of European partnerships, in the sphere of higher education and training but also in research projects, particularly in software engineering.
The Brazilian federal government intends to promote the use of alternative energy sources having a strong potential in the country, such as hydropower, biomass, biogas, wind or solar power, with the objective of diversifying its energy system and reducing greenhouse gas production. Programme 11.8 "*ST&I for renewable energies*" provides the means for doing this. The corresponding developments will entail the construction of prototypes, pilot and demonstration projects. Technology-based international cooperation schemes can be envisaged for these fields , considered as high-priority for furthering sustainable development.

III.2. Observations from analysis of the Brazilian system of research

The study of the Brazilian system of research evidently brings a better knowledge of the prospective partner and the various players concerned. A research system is often a complex institutional edifice, which is not always easy to decipher, and even more so if the investigator does not have an appropriate formula for interpreting its characteristics.
In the presentation, the separation (see Part I) of the structural aspects from those related to means and performances allows clear distinction of the comments that can be deduced about the architecture of the Brazilian research system from conclusions drawn from analysis of quantitative results obtained by this system.

III.2.1. System architecture

The organizational structure of the Brazilian system of research responds overall to a model in which federalism weighs strongly on governance, financing by project predominates at the programming level and the public-sector execution of research is mostly undertaken in universities.
The country's federal organization leads to a public-sector research system that partly duplicates the system set in place by the Union at the level of each State. However, the substantial size of national-level investments put in confers a role of leadership, or head of network, on research institutions operating under the federal government in general, and the MCT in particular. The recurrent financing (Table 3) granted by federate States – less substantial and primarily short-term (except São Paulo) – to the research structures they administer, make the latter more precarious and dependent on their federal equivalents. In consequence, European cooperation must favour the federal structures.
Brazil traditionally sustains some large financing agencies, which have gone from strength to strength in the course of time, including those of federate States (FAPESP especially). The important role played by the FINEP-administered sector-based funds further accentuates the weight of finance on projects compared with the recurrent funding the ministries attribute to the organizations they supervise. The European programmes of international cooperation therefore easily find counterparts to deal with (of the agency type) in this country and, in any case, Brazilian researchers and teacher-researchers are well used to the system of calls for research proposals and the constitution of ad-hoc project-oriented teams.
The dominant place occupied by academic research is linked to the country's good organization of its funding-by-project arrangements. The teacher-researchers are especially active in research in that the system of research productivity-related grants gives them strong incentives. In the context of international cooperation the European researchers must therefore pay attention to the requirements their Brazilian partners have to meet, whether it be to satisfy their assessment criteria and enable them to obtain or keep hold of their CNPq grants, or to comply with the

compulsory registration procedures of the Lattes platform and other research support tools in operation in Brazil.

III.2.2. System performance

Study of the indicators produced by OST to characterize the performances of the Brazilian system of research and innovation brings pointers as to means of assessing the pertinence of partnership with this country. Overall, with a world share of publications reaching 1.4 % in 2004, Brazil is in equal 15th place, along with Sweden and Taiwan. Using this same indicator, only China, South Korea and Turkey will have shown stronger progress than Brazil over the last five years known (OST 2006).

Analysis by broad scientific discipline (Table 10) shows that Brazil has its strongest specialization in applied biology-ecology, indeed like the whole of the Latin American region (Table 8). The figures give a cumulative world share of above 5 % for the four countries studied in this field, more than half of which is attributed to Brazil. Therefore it is in these disciplines (agricultural sciences, biodiversity, natural resources) that ST&I cooperation with Brazil presents the most interest, going by the strict logic of scientific competition. The subsequent fields of specialization (physics, chemistry) are not sufficiently significant (around 1.5 % of world share of scientific publication), or indeed original, for the corresponding competitive aspect to be taken into account in the formulation of a science and technology cooperation policy. Finally, and still on the basis of the scientific competition factor, it can be said that Brazil is not the most competitive partner in earth and planetary sciences, engineering sciences or medical research.

In the technological domain, and given Brazilian performances concerning European patent applications (about 1.6 ‰ of world share, all fields taken together), cooperation organized by the European countries does not stand out as a necessity. Moreover, the 1st specialization occurs in "Domestic/household consumption – building and construction" (Table 11), which does not involve particularly high technology. Brazil's 3rd field of specialization considering European patent applications is "Pharmacy – biotechnology". If a cooperation agreement were to be made, it could involve this field, account taken for example of the prior existence of Argentina-Brazil partnerships. However, cooperation schemes concerning technological development also respond to other criteria, notably those governed by market-based logic.

III.3. Recommendations from review of current cooperation situation

In the course of this first work module, *Work package 1*, the Eulanest project has resulted in an inventory and a comparative analysis of science and technology cooperation programmes, practised by the European member-countries of the consortium for Latin American countries in general, and Brazil in particular. Around 20 programmes originating from the five countries concerned were then described and analysed, in the dual objective of comparing these programmes according to different aspects and making use of the accumulated experience to identify the best applicable practices of cooperation between the two regions.

III.3.1. Intensity of cooperation

This study resulted in the observation that bilateral cooperation has been well rooted for a long time (certain programmes have been in force for over 30 years) and has reached a good degree of maturity. Three large European countries stand out in terms of the intensity of cooperation, Germany, France, Spain, as the partnership indicators confirm (Table 16).

Moreover, it can be regretted that the rule about voluntary services in European projects deprives the Eulanest project consortium of the presence of the United Kingdom, whereas this European country is still a major partner in Latin America. It is noteworthy that while the character of cooperation effort arranged by Germany and France is practically identical, in that both favour Brazil and Chile, Spain's is distinct. Not only does that country undertake relatively less cooperation with Brazil, but it also particularly strongly oriented towards Argentina. Similarly, Portugal's partnerships with Brazil are rising to the level of the larger European countries, at least in hosting agreements for Brazilian students (Table 14).

III.3.2. Instruments

The Era-Net model of which the Eulanest project is a part has led to a prior exclusion from the inventory of S&T cooperation programmes with Latin America a practice that does not involve the establishment of programmes and consequent opening up of competition for projects. There exists in fact a form of cooperation currently applied by public research organizations, consisting in spotting abroad the laboratories with which they would like to maintain a joint venture and putting it in place with their own means, including sometimes going as far as setting up mixed international laboratories with expatriate researchers. Such methods of cooperation indeed provide excellent results, a relationships are forged directly between the two laboratories concerned, with no need for calls for proposals procedures requiring liaison and coordination between two countries. However, it is then more difficult to "regularize" the situation with the governance bodies of the host country.
Account taken of the costs generated, this practice can evidently not be applied to research operators (the universities, for example) which have no recurrent funding dedicated to research. However, it is common in the large organizations like CSIC in Spain and the CNRS in France, which are in a way both financing agency and research operators. The extreme case is that of French public organizations like CIRAD[10] or the IRD[11], which have specific means for sending and keeping their researchers in postings abroad for several years. These cooperation schemes have in addition a significant impact for networks of relations woven between the two countries. In counterpart, they generate a large amount of confusion in institutional relations, because the organizations concerned are then drawn to sign asymmetric contractual agreements with the Brazilian objectives agencies (CNPq, FAPESP, etc.). They also have to keep up their own representations in the countries concerned, alongside diplomatic representations, as soon as their expatriate personnel start to reach substantial numbers.

III.3.3. Policies

The typology devised in the *benchmarking* report on the basis of the principal strategic orientation of the different programmes led to the distinction of several classes, representative of varied policies of international ST&I cooperation.
On first examination, two basic systems of criteria can be distinguished, even contrasted : a logic of competitiveness and another one, more philanthropic, of aid for development.
In order to be comprehensive, it should perhaps be added that there is also a logic of economic interest and international competition which materializes in the form of limitation to cooperation in fields of advanced technology, in particular the sectors related to defence like the nuclear field, aeronautics, space and so on. Unfortunately, this aspect is still mainly dealt with in an implicit form, even in the most successful bilateral partnerships.

- Logic of competitiveness

The *logic of competitiveness* is itself the most common among the European partners, in the form of programmes devoted to financing bilateral research projects. The five countries concerned have this type of instrument at their disposal. It aims to create and consolidate the links for joint scientific collaboration between national teams research and their Latin American counterparts, in a healthy spirit of world scientific competition. For the European research teams involved, the essential purpose of these projects is to ally with Latin American research teams working on the same subject, with the intention of sharing the mutual scientific advances and willing to fortify each other.

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[10] Centre de coopération internationale en recherche agronomique pour le développement (French Agricultural Research Centre for International Development).
[11] Institut de recherche pour le développement (Research institute for development)..

Besides this, there is a variant consisting in the will to give an innovatory component to this cooperation, even to arrive at joint development of new technological products, by means of public-private partnerships. The idea entails the involvement, alongside the two partner research laboratories working on a scientific advice with potential for a commercial application, of private companies from both sides, in order to continue the venture further and as far as the exploitation of this discovery on the commercial market. This exercise, which requires the overcoming of many obstacles – particularly cultural – is implemented in only rare cases, in the context of traditional binational and particularly solid partnerships.

- Logic of aid for development

The *logic of aid for development* is less well represented in cooperation schemes between Europe and Latin America. In the case of the large emerging countries like Brazil, it appears in any case as an echo of the past of bilateral cooperation practised by old European partners, France above all. This policy of aid for development shows up in reality under diverse aspects, depending on the mode of action chosen.

Thus, still restricting ourselves to instruments just from the scientific sphere, one could classify under this category all the programmes that aim to train Latin American PhD students in research by research, including those that support the emergence of research teams in association with a European team (such as Essor-France), but also all those which take on the objective of furthering regional integration by means of setting up networks of research teams of different Latin American countries.

Naturally, even if the logic behind all the programmes of this category lies basically on philanthropic principles, in no way is it devoid of interest for the European donor countries, even if only in the framework of a policy of international influence. In addition, the training programmes contribute much in concrete terms to the creation of a tissue of bilateral relations in science and technology as well as a breeding ground for Latin American researchers who, throughout their careers, will be inclined to favour scientific ties with the European countries that hosted them for carrying out their thesis work. As for network-building or *mentorship* programmes of young research teams, they act directly on the partnerships.

Furthermore, it cannot be excluded that all international cooperation programmes have an indeniable impact in terms of *brain gain,* more or less intentional ones. The intention can in fact be gauged much more by the will or absence of will to correct the effects.

Finally, one point should be emphasized : all the programmes recorded in the context of the Eulanest project inventory arrive at a state of more-or-less symbiosis of the two logics. The bilateral research programmes for example often highlight the interest of training of Latin American PhD students, whereas despite everything development aid programmes use criteria of scientific excellence in the selection process for projects to be funded.

Conclusion

In the science and technology fields, international cooperation is above all a necessity, an indispensable mode of exchange and collective construction of knowledge. However, today it is also a complex historical construction, largely inherited from the past of relations between the countries concerned and where there is a great intermingling of the results of geopolitical orientations, the strategies of manifold scientific institutions and a whole range of individual initiatives – especially of researchers.

The decision-makers involved in financing this cooperation, attached to ministerial departments, specialized agencies or scientific departments of diplomatic representations, sometimes seek to exert their weight on this construction with the aim of rationalizing or turning it towards subjects deemed to be the most relevant and the most effective in terms of impact (on science, or on development). They then have recourse to expertise, to produce and make available information, indicators, analyses, and so on., in the hope of guiding the parties involved towards cooperation that is ever more fruitful, owing to a backed with better, more easily available information.

The process undertaken by the European Union since the Era-Net programme of the 6th FP, and which is continuing and expanding with the Inconet and Bilat programmes, is by far the most successful example in this domain. On the subject of relations with Latin America regarding science, technology and innovation (ST&I), the Eulanest project provides both the opportunity and the means to explore all the information that might guide such cooperation with that region. In addition, it offers a concrete short-term objective, consisting of the preparation and issuing of a joint call for proposals between the present and 2010.

Clearly, a country-by-country study is necessary : this Brazil chapter has therefore used all the sources that appear pertinent for analysing ST&I cooperation with Brazil and providing paths to pursue to give it new directions, for example by means of the Eulanest joint call. The procedure adopted was in compliance with the one that had been planned at the project design stage, in other words 1) descriptive analysis of the Brazilian system of research, 2) study of national scientific priorities and 3) identification of needs in S&T cooperation with the European Union.

Description of Brazil's research and innovation system is almost routine work in the embassies in Brasília. It must frequently be updated, because any research system is permanently in a state of change. Its organizational structure and its mode of operating bear a number of major characteristics (federalism, great importance of funding by project, weight of academic research, special modes of monitoring and assessment and so on) highlighted in the report in order to be taken into account by the players involved.

A study by the Paris *Observatoire des Sciences et des Techniques* was called upon in order to gain a full appreciation of the performances of this system. The indicators supplied unambiguously point to applied biology-ecology (agricultural sciences, natural resources, biodiversity and so on), as a field in which Brazilian science is strongly specialized : it is therefore a strong candidate to be a thematic base for a joint call, all the more so seeing that this specialization is as widespread in other parts of Latin America.

The indicators of available means (financial resources, human resources), calculated by the Brazilian federal authorities, are also drawn upon in this report, in order to gauge the scale of the system of research. They are also extremely useful for evaluating the realism of government ambitions, which are to reach 1.5 % from 2010 for the GERD/GDP ratio which measures the country's investment effort made on research or to train a total of over 16 000 PhDs per year, from the same year.

Brazil's scientific priorities, set out in the national Action Plan 2007-2010, have been examined in detail, that is up to programme level sufficient to provide concrete information (means, players, designated objectives) and situated at the limit of possible involvement of political players (as against the scientific ones). This exercise gives a wealth of information and makes it possible to detect fields where international cooperation in ST&I is needed, as expressed by the Brazilian side : biofuels, biotechnology, animal health, nanotechnology, space, nuclear technology, development of Amazonia, biodiversity protection and global climate change. A bolder interpretation of Brazilian priorities suggests that our cooperation efforts should aim to contribute to programmes for training Brazilian PhD students, to build bi-regional public-private partnerships linking centres of research and innovatory companies or to propose projects in the fields of software engineering and renewable energy (especially wind and solar power).

However, the Eulanest project has also entailed a stage of inventory compilation and comparative analysis of ST&I cooperation programmes between the EU and Latin America. Conclusions were drawn from these that could be useful in this new task. The intensity of the partnerships already dating quite far back with Latin American countries in general, and Brazil in particular, is conveyed by the fact that four member-States of the EU are in the top five scientific partners, behind the United States, even if two of them – the United Kingdom and Italy – are unfortunately not members of the consortium.

As far as instruments of cooperation are concerned, two distinct approaches co-exist. The *bottom-up* method, dear to some research operators that have sufficient resources of their own, contrasts with the *top-down* logic of agencies which operate with a competition-oriented approach using calls for projects. Although the format imposed by the Era-Net scheme precludes the first approach straight away, it is difficult to see how the EU could continue any longer without debating the doctrine behind this subject in its coordination of international ST&I cooperation policies of member-countries, when this is an area where national ways of doing things are so strongly expressed.

In terms of logic of cooperation it has been observed that not all the programmes covered by the Eulanest project inventory obeyed the logic of scientific competitiveness advocated by the European Commisssion (DG Research). Not only do some of them openly proclaim to follow the approach of aid for development, reinforcement of scientific capabilities or for regional integration in the partner countries, but also it must be recognized that the borders between the two approaches are far from being rigidly defined. In this way, doesn't the training of PhD students of Latin American countries, recommended as part of bilateral programmes governed by the sole criterion of scientific excellence in the name of aid for consolidation of an elite, also hide an implicit brain drain?

The promoters of the Eulanest project joint call will certainly have to take these aspects into consideration when they define the ways in which it will operate. For example in the extension of the case mentioned previously, involving a programme open to research projects between European and Latin American laboratories, the recommendation to include PhD students should concern people from both regions, to comply with the strict symmetry that a well balanced partnership should show.

(Patrick Séchet, version 1.3, 11/02/2009)

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Appendix

Flow chart 1: Illustrated overview of the Brazilian system of science, technology and innovation
Flow chart 2 : Hierarchical structure of the Brazilian ST&I Action Plan
S&T Indicators for the Eulanest project, Methodological documentation, Observatoire des Sciences et Technologies, November 2007
S&T Indicators for the Eulanest project, Methodological documentation, Observatoire des Sciences et Technologies, November 2007

S&T indicators for EULANEST

Methodological documentation

November 2007

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Summary

IV. Indicators based on scientific publications

IV.1. Database used

The bibliographic database used by the OST is the Web of Science, produced by Thomson Scientific. It is considered as a reference tool for the production of indicators worldwide. Knowing the characteristics of this database is very important to understand since they have a consequence on most of the international statistics on scientific publications. In general, the statistical quality of this database – created as a documentary source and not as a source to be used to build indicators – is due to its large but non exhaustive survey of the best scientific journals throughout the world.

The choice of the Web of Science as a reference tool for the production of bibliometric indicators relies on its characteristics. It covers several thousands of scientific journals (about 8 000 in 2004), selected as having well known editorial management, a good scientific level, and a good international visibility level, which relies particularly on the average number of citations received by articles in those different journals. Nevertheless this journal selection is not necessarily a guaranty of a well-balanced representativeness between disciplines and sub-disciplines. Note that the database has recently included more conference proceedings and electronic journals.

The representativeness of Web of Science is generally accepted in the most internationalised fields, such as physical sciences or fundamental biology. The situation can be less accurate for scientific fields with a strong national specificity, those using dissemination other than "scientific articles", those with a high degree of application, and for small size fields.

Social sciences and humanities are excluded from the bibliometric indicators presented in our report, because the corresponding databases produced by Thomson Scientific (Social Science Citation Index – SSCI, Arts & Humanities Citation Index – A&HCI) have potentially very important biases depending on the discipline and country considered.

IV.2. From data to indicators

IV.2.1. Gathering of journals within disciplines

The journals of the Web of Science are assigned to eight major traditional academic disciplines, as defined from the subject category assigned to the journals by Thomson Scientific (see annex 1). The OST assigns each subject category to only one major discipline: for example immunology is assigned to the "medical research" discipline. Besides the eight disciplines a ninth field incorporates the "multidisciplinary" section, which is very heterogeneous but which includes some very prestigious general journals (*Nature, Science, PNAS, …*). This section is not isolated in the tables but contributes to the "all disciplines" totals.

In this way, journals can be attributed to different subject categories (up to 6). With fractional counts, the multi-attributed articles from these journals are fractioned among subject categories.

On the other hand, using a distinct integer count each article is integrally counted in each category to which it belongs to.

IV.2.2. The counting principle on scientific publications

The statistics by types of actors (country, region) are not calculated from the nationality of the authors but from the address of the laboratories and signing institutions. In other words, an Egyptian scientist working in UK will be counted as a UK scientist if he does not sign the address of his home institution.

The scientific articles are often co-signed by many actors belonging to several laboratories and institutions. Different ways of counting such articles can be used: in particular the fractional count and the integer count. Using contribution type logic to world science, the laboratories' contributions to each article are fractioned in order to get a total of 100% on the whole group of laboratories. It is the same principle applied to the possible affectation of a scientific journal in several subject categories. This type of count, called "fractional", where each article has a unitary weight, is additional in every scale and well adapted to macro-analysis (at country level, for instance). Extended to the relative impact indexes, this type of count is preferable for international visibility comparisons.

The other logic, the "participation" in world science, relies on "distinct integer" or "full integer" counts: each actor is credited with a unitary participation as long as he is present in a publication, and this logic is also extended to disciplinary affiliations of the journals. The summed data related to participations is necessarily superior to that of the contributions. For example, France can be present in about 8% of the world publications but contributes to less than 5% when the fractional count is applied. Because of multiple counts, the integer count produces sums of actors' participations that are superior to 100% and the data vary with the scale changes. Despite this inconvenient, the "integer distinct count" is well adapted to micro-analysis (at institutional level, for example) and is easier to interpret for co-publications.

Fractional counts are used for all the bibliometric indicators for the Eulanest project, except for co-publication indicators where integer counts are preferred. The number of publications for each Latin American country (LAC) is also presented in integer counts.

In order to produce more stable bibliometric indicators, the OST indicators are smoothed on a three years basis. The last year being used to date the indicator: for instance, 2004 is used as the date for the three year basis 2002 to 2004 (2002+2003+2004/3).

In our report, the most up-to-date indicators are proposed, given that OST bibliometric database is updated annually. At the time of writing, the most recent year for publications is the smoothed year 2004 and, due to the data delivery dates of Thomson Scientific, the OST database was slightly incomplete for those articles which were published in the year 2004. Methodologically, this choice doesn't significantly impact on the value of the resulting Eulanest indicators because they are calculated as a ratio between the country under study and the world (world share, impact index = share of citations divided by share of publications …) at the macro level (for countries and/or for large disciplines)..

IV.3. Definition of indicators

One should be careful when interpreting indicators for small entities (small countries, small disciplines), which could be statistically sensitive, the variation of those indicators being potentially important.

IV.3.1. World share of publications

The world share of publications is defined as the number of publications of an actor (a country, a region, an institution, …) divided by the number of worldwide publications, expressed as a percentage (%). It is the easiest comparable production indicator.

$$\text{Country world share (\%) in discipline "i"} = \frac{\text{Number of publications in discipline "i" of a country}}{\text{Total number of worldwide publications in discipline "i"}} \times 100$$

where discipline "i" is one of the eight standard disciplines or all disciplines

The higher the value of this share (between 0 and 100%), the more active is the country in world scientific production.

IV.3.2. Specialisation index

The specialisation index of an actor is the ratio of its world share of publications in one particular discipline to its world share of publications for all disciplines.

$$\text{Specialisation index in discipline "i"} = \frac{\text{Publication world share of the country in discipline "i"}}{\text{Publication world share of the country for all disciplines}}$$

A specialisation index of 1 in discipline "i" implies that the actor's world share for that discipline corresponds to his world share all disciplines combined. This is a neutral situation. When the specialisation index is greater than 1, the country is said to be specialised in discipline "i", at the expense of those disciplines for which the specialisation index is less than 1.

IV.3.3. Relative impact index

The relative impact index for an actor in the world is defined as the ratio of the world share of citations for that actor to his world share of publications. The window used is that used for the calculation of the world share of citations.

$$\text{Relative impact index in discipline "i"} = \frac{\text{Citation world share of a country in discipline "i"}}{\text{Publication world share of a country in discipline "i"}}$$

A relative impact index of 1 in discipline "i" implies that the visibility of the country's publications is equal to the average visibility of worldwide publications in that discipline. When the relative impact index is greater than 1, the country's visibility is better that world average. When the relative impact index is less than 1 the country's visibility hasn't reached world average visibility in discipline "i".

IV.3.4. Share of international co-publications

From a general point of view, the scientific community is strongly interconnected. A part of this cooperation takes the form of co-authored articles (co-publications). The co-publication indicators are calculated using integer distinct counts, which is more “intuitive” regarding the notion of collaboration. Co-authoring an article means the existence of a "link" between the signing authors, independently of the other signing authors.

The share of co-publications of a country A, under study, with country B is defined as the number of co-publications between these two countries divided by the total number of international co-publications of country A under study. The indicator is expressed in percent, and in our report the ten first scientific partners of country A are presented.

$$\text{Share of co-publications of country A with country B (\%)} = \frac{\text{Number of co-publications of country A with country B}}{\text{Total number of international co-publications of country A}} \times 100$$

The higher the share of co-publications of country A with country B (comprised between 0 and 100%) is, the more the country B can be considered as a scientific partner of country A.

V. Indicators based on patents

V.1. Indicators based on European patent applications

V.1.1. Database used

The OST uses those patent applications published by the European Patent Office (EPO) as well as those published by the World Intellectual Property Organisation (WIPO), the so-called Patent Cooperation treaty (PCT) or international patent applications. These two types of published patent applications are combined (taking care to exclude double counts) in the OST patent database in order to calculate indicators on technological activity in Europe. An international patent application is first published as a PCT application, then possibly re-published as an European publication if it enters into the European regional system. In the OST patent database, only first publications are kept in the indicator calculation process.

V.1.2. "Nationality" of a European patent application

The statistics by types of technological actors (country, region) can be calculated from two types of "nationalities": that of the inventor, given by his (or her) personal address, or that of the applicant, given by the address of the firm or institution where the inventor works.

For the Eulanest project, the inventor information was used to build technology indicators as the inventor's address is considered as providing better information about the geographical localisation of the research that was undertaken in an institution or firm. In general, and of course at country level, the inventor doesn't work far from his home. The address of applicants generally gives the headquarters of the firm or institution filled for a patent, and this address isn't relevant for the localisation of the research.

The OST reworks the raw European patent application addresses obtained from the EPO so as to harmonize the addresses and to affiliate each patent application to a particular geographical classification (country, region, …).

V.2. Indicators based on granted American patents

V.2.1. Database used

Besides the European patent database, OST also uses data on patents granted by the US Patent and Trademark Office (USPTO). Information about these patents has been provided by the American firm IpIQ.

V.2.2. "Nationality" of a granted American patent

In the OST database, only inventor information is available for granted American patents. Due to American patent law, this is the most important information for that patent system.

In the Eulanest project, inventor data was used to build technology indicators.

V.3. The technological classification

A very precise and detailed way of classifying patents into technological domains is used worldwide. This classification is the International Patent Classification (IPC). It is structured in 8 sections, 118 classes, 630 sub-classes and about 70 000 groups and sub-groups. Unfortunately, the sections of the IPC are not relevant of the modern industrial production. For that reason the OST has built, from the IPC codes, another classification into seven technological domains, more appropriate to technological strategies of today firms (see annex 2).

V.4. The counting principle on patents

Often more than one inventor figures in patent applications or in patent notices. Different ways of counting such patents can be used: in particular the fractional count and the integer count. Using contribution type logic to world technology, the inventor's contributions to each patent are fractioned in order to get a total of 100% on the whole group of inventors. This principle is also applied to the possible affectation of IPC codes in several domains. This type of count, called "fractional", where each patent has a unitary weight, is additional in every scale and well adapted to macro-analysis.

The other logic, the "participation" in world technology, relies on "distinct integer" or "full integer" counts: each inventor is credited with a unitary participation as long as he is present in a patent notice or application, and this logic is also extended to IPC code affiliations to domains. The summed data related to participations is necessarily superior to that of the contributions. Because of multiple counts, the integer count produces sums of inventors' participations that are superior to 100% and the data vary with the scale changes.

For the Eulanest project, fractional counts are used for most technological indicators. The number of European patent applications is also presented in integer counts. For American granted patents only fractional counts are available.

In order to produce more stable technological indicators, the OST indicators are smoothed on a three years basis: the last year being used to date the indicator. For instance, 2004 is used as the date for the three year basis 2002 to 2004.

V.5. Definition of indicators

Technological production indicators, also called technological activity indicators, are calculated for all domains and for each of the seven technological domains. In the following paragraphs the word "patent" is used as general term to cover either European patent applications or granted American patents.

V.5.1. World share of patents

The world share of patents is defined as the number of patents of an actor (a country, a region, an institution …) divided by the number of worldwide patents (for a given patent system), expressed as a percentage (%).

$$\text{Country world share (\%) in domain "i"} = \frac{\text{Number of patents (in a given patent system) in domain "i" of a country}}{\text{Total number of worldwide patents (in a given patent system) in domain "i"}} \times 100$$

where the domain "i" is one of the seven technological domains.

The higher the value of this share of patents (between 0 and 100%), the more active is the country in world technological production.

V.5.2. Specialisation index

The specialisation index of an actor is the ratio of its world share of patents in one particular domain to its world share of patents for all domains.

$$\text{Specialisation index in domain "i"} = \frac{\text{Patent world share of the country in domain "i"}}{\text{Patent world share of the country for all domains}}$$

A specialisation index of 1 in the domain "i" implies that the actor's world share for that domain corresponds to his world share all domains combined. This is a neutral situation. When the specialisation index is greater than 1, the country is said to be specialised in domain "i", at the expense of those domains for which the index is less than 1.

VI. Indicators based on foreign student mobility

VI.1. Database used

Indicators are based on the number of students in higher education (ISCED 5 and 6 levels according to OECD nomenclature) hosted and expatriated for the years 2003 and 2004, according to the availability of the source data (source: OECD/Eurostat).

The mobility of students in the higher education is calculated from the OECD database on education “Education at a glance” (www.oecd.org). The definition of “Tertiary education”, established by UNESCO/UIS, the OECD, and Eurostat comes from the classification established by ISCED-97 (International Standard Classification of Education), an updated version of ISCED-76. The education programs are still the basic unit of the classification. ISCED-97 evaluates the process of education in 7 levels, from ISCED 0 to ISCED 6. For our study, the data used correspond to the “tertiary education” part, which is composed of both levels ISCED 5 and ISCED 6.

ISCED 5: first stage tertiary education. This level makes a distinction with very undefined limits between two forms of education; one is more considered as theory-based education, the other as practice-based. The level 5 programs have to show a theoretical approach of a minimum of 2 years but don’t have to end up with a qualification linked to advanced research. Because the organisational structures of the “tertiary education” vary from one country to another, there is no unique criterion to define the precise limits between the two levels of ISCED 5.

ISCED 6: second stage tertiary education. This level has to be an access to a qualification of advanced research. To be considered in this level, a program has to be linked to the writing of a thesis or a publishable essay as the result of an original work and as an important contribution to knowledge – not limited to the only elements of the course taken. It has to prepare a student for a university position in institutions that propose ISCED 5 level courses, but also for a position in research, at a governmental level or in industry.

VI.2. Definition of indicators

The indicator used for the Eulanest project is the number of students of a particular country who are hosted in another country. The two groups of countries considered are the group of European consortium countries and the group of Latin American countries.

Two matrices are produced. The first contains the number of students of the European consortium countries who are hosted in the Latin American countries. The second matrix contains the number of students of the Latin American countries who are hosted in the European consortium countries.

VII. Indicators based on Framework programs of the European Commission

VII.1. Database used

The Community Research & Development Information Service (Cordis) of the European Commission provides the OST with data about all the research projects of the different framework programs (FP) of the Commission. These framework programs are used by the European Commission to contribute to the development of the European Research via the funding of projects. The FP's are divided into programs, sub-programs and actions for which there are calls for tenders published in the European Commission official journal.

For the Eulanest project, the data used for the 5^{th} and the 6^{th} FP is that which was available in the Cordis database on the 20^{th} of February 2006. In the OST database, all projects of the FP are considered, except for the "Marie Curie" actions that are really very specific and hardly comparable with the other projects of the FP.

Some differences exist between the structure and the finality of the 5^{th} and the 6^{th} FP. The 5^{th} FP is divided into two distinct parts: the European Union program with RDT Community actions (four thematic programs and three transversal programs) plus the Euratom program (research in nuclear sector). The 6^{th} FP is structured into three specific programs with the addition of Euratom program.

The OST does additional work on geographical classification from the initial data. The Observatory also classifies the different programs into twelve thematic domains.

VII.2. Definition of indicators

Logically, compared with European countries, Latin American countries are not very present in the European framework programs. As such indicators are only provided globally at the level of the FP without the detail of the different thematic domains that make it up.

VII.2.1. Share of projects

The denomination "project" signifies that a team of several partners has been constituted for a given period of time to bid for a tender in order to reach the objective mentioned in the call. The team receives funds from the Commission to do the work specified in the call.

The country's share of projects (in the 5^{th} or 6^{th} FP) is defined as the number of projects (in the 5^{th} or 6^{th} FP) in which the country is involved divided by the total number of projects of 5^{th} or 6^{th} FP. It is expressed as a percentage (%).

$$\text{Country's share (\%) of projects in a given FP} = \frac{\text{Number of projects of a country in a given FP}}{\text{Total number of projects in a given FP}} \times 100$$

The higher the value of this share (between 0 and 100%), the more involved the country is in the projects in the 5^{th} or 6^{th} framework program.

VII.2.2. Share of participations

The participation in a project of the 5th or 6th FP by a laboratory, an institution, a region etc of a country implies the involvement of that laboratory etc in the research programs. The number of participants of a FP corresponds to the number of institutions or teams involved in all the different consortia that participate in projects within the FP considered.

The country's share of participations in the projects (in the 5th or 6th FP) is defined as the number of participations in all the projects (in the 5th or 6th FP) in which the country is involved divided by the total number of participations in all the projects of 5th or 6th FP. It is expressed as a percentage (%).

$$\text{Country's share (\%) of participations in a given FP} = \frac{\text{Number of participations to the projects of a country in a given FP}}{\text{Total number of participations to the projects in a given FP}} \times 100$$

The higher the value of this share (between 0 and 100%), the more participating the country is involved in the 5th or 6th framework program.

VII.2.3. Share of coordination

Amongst all the participants of a consortium, there is one who assumes a special role: this partner scientifically and administratively leads the consortium and is responsible to the Commission for the project. This partner is called the coordinator of the project. As there is only one coordinator per project, the number of coordinators is the same as the number of projects.

The country's share of coordination (in the 5th or 6th FP) is defined as the number of projects (in the 5th or 6th FP) coordinated by the country divided by the total number of projects of 5th or 6th FP. It is expressed as a percentage (%).

$$\text{Country's share (\%) of coordinations in a given FP} = \frac{\text{Number of coordinated projects of a country in a given FP}}{\text{Total number of projects in a given FP}} \times 100$$

The higher the value of this share (between 0 and 100%), the more the country is involved in leading the research in the 5th or 6th framework program.

Annex 1. Definition of the eight standard scientific disciplines

The scientific disciplines taken into account for the calculation of indicators are the 8 standard disciplines of the OST. They have been defined as an aggregation of the about 180 subject categories implemented by Thomson Scientific for the natural sciences in the Web of Science®. The following table provides the correspondence between a discipline and the subject categories that it covers.

FUNDAMENTAL BIOLOGY
ANATOMIE, MORPHOLOGIE
BIOCHIMIE, BIOLOGIE MOLÉCULAIRE
BIOINGENIERIE
BIOLOGIE CELLULAIRE, HISTOLOGIE
BIOLOGIE MOLÉCULAIRE ET CELLULAIRE
BIOMATÉRIAUX
BIOMÉTHODES
BIOPHYSIQUE
BIOTECHNOLOGIE ET MICROBIOLOGIE APPLIQUÉE
EMBRYOLOGIE
GÉNÉTIQUE, HÉRÉDITÉ
GÉNIE BIOMÉDICAL
MICROBIOLOGIE
MICROSCOPIE
NEURO-IMAGERIE
NEUROSCIENCES
NUTRITION, DIÉTÉTIQUE
PARASITOLOGIE
PHYSIOLOGIE
PSYCHOLOGIE
SCIENCES COMPORTEMENTALES
SYSTEMES REPRODUCTEURS
TECHNIQUES DU LABORATOIRE
VIROLOGIE

APPILED BIOLOGY - ECOLOGY
AGRICULTURE
AGRICULTURE, MULTIDISCIPLINAIRE
AGRONOMIE GÉNÉRALE
BIODIVERSITÉ, CONSERVATION
BIOLOGIE GÉNÉRALE
BIOLOGIE, AUTRES
BOIS ET TEXTILES
BOTANIQUE, BIOLOGIE VÉGÉTALE
ÉCOLOGIE
ENTOMOLOGIE
HORTICULTURE
MYCOLOGIE
ORNITHOLOGIE
SCIENCES DES PRODUCTIONS ANIMALES
SCIENCES ET TECHNIQUES AGRO-ALIMENTAIRES
SCIENCES ET TECHNIQUES DES PECHES
STATIONS AGRICOLES EXPÉRIMENTALES
SYLVICULTURE
ZOOLOGIE GÉNÉRALE

MEDICAL RESEARCH
ALLERGOLOGIE
ANDROLOGIE
ANESTHÉSIOLOGIE
CANCÉROLOGIE
CHIMIE, CLINIQUE ET MÉDECINE
CHIRURGIE
SOINS INTENSIFS
DERMATOLOGIE, VÉNÉROLOGIE
ENDOCRINOLOGIE
GASTROENTÉROLOGIE
GÉRONTOLOGIE
GYNÉCOLOGIE, OBSTÉTRIQUE
HÉMATOLOGIE
IMMUNOLOGIE
MÉDECINE INTÉGRATIVE ET COMPLÉMENT
MALADIES INFECTIEUSES
MÉDECINE CARDIOVASCULAIRE
MÉDECINE CARDIOVASCULAIRE 2
MÉDECINE CLINIQUE, AUTRES
MÉDECINE D'URGENCE
MÉDECINE DE LA DÉPENDANCE
MÉDECINE DU SPORT
MÉDECINE EXPÉRIMENTALE
MÉDECINE INTERNE GÉNÉRALE
MÉDECINE LÉGALE
MÉDECINE TROPICALE
MÉDECINE VÉTÉRINAIRE
SANTÉ PUBLIQUE 2
ÉTHIQUE MÉDICALE
NEUROLOGIE CLINIQUE
ODONTOLOGIE
OPHTALMOLOGIE
ORTHOPÉDIE
OTORHINOLARYNGOLOGIE
PATHOLOGIE
PÉDIATRIE
PHARMACOLOGIE-PHARMACIE
PNEUMOLOGIE
PSYCHIATRIE
RADIOLOGIE, MÉDECINE NUCLÉAIRE
RÉHABILITATION
RHUMATOLOGIE
SANTÉ PUBLIQUE
TOXICOLOGIE
TRANSPLANTATIONS
UROLOGIE-NÉPHROLOGIE
SOINS INFIRMIERS

Annex 2 (continued): Definition of the eight scientific disciplines

CHEMISTRY
CHIMIE ANALYTIQUE
CHIMIE APPLIQUÉE
CHIMIE GÉNÉRALE
CHIMIE MINÉRALE ET NUCLÉAIRE
CHIMIE ORGANIQUE
CHIMIE PHYSIQUE
CRISTALLOGRAPHIE
ÉLECTROCHIMIE
MATÉRIAUX COMPOSITES
MATÉRIAUX/ANALYSE
SCIENCE DES MATÉRIAUX
SCIENCE DES MATÉRIAUX - BOIS, PAPIER
SCIENCE DES MATÉRIAUX - CÉRAMIQUES
SCIENCE DES POLYMÈRES
TRAITEMENTS DE SURFACE

PHYSICS
ACOUSTIQUE
INSTRUMENTATION
OPTIQUE
PHYSICO-CHIMIE
PHYSIQUE APPLIQUÉE
PHYSIQUE DES FLUIDES ET PLASMAS
PHYSIQUE DES PARTICULES
PHYSIQUE DU SOLIDE
PHYSIQUE GÉNÉRALE
PHYSIQUE MATHÉMATIQUE
PHYSIQUE NUCLÉAIRE
PHYSIQUE, AUTRES
SPECTROSCOPIE

ASTRO and GEO-SCIENCES
ASTRONOMIE ET ASTROPHYSIQUE
BIOLOGIE MARINE - HYDROBIOLOGIE
DIV. GÉOPHYSIQUE-GÉOCHIMIE
GÉOGRAPHIE
GÉOLOGIE
GÉOSCIENCES
GÉOTECHNIQUE
LIMNOLOGIE
MÉTÉOROLOGIE
MINÉRALOGIE
OCÉANOGRAPHIE
PALÉONTOLOGIE
RESSOURCES EN EAU
SCIENCES DE L'ENVIRONNEMENT
TECHNOLOGIES DE L'ENVIRONNEMENT

MULTIDISCIPLINAIRE

ENGINEERING
BIOCYBERNÉTIQUE
COMPOSANTS
REVUES DE SYNTÈSE EN INFORMATIQUE
CONTRÔLE
CONTRÔLE 2
ÉNERGIE ET CARBURANTS
GÉNIE MARITIME
GÉNIE AÉROSPATIAL
GÉNIE CHIMIQUE
GÉNIE CHIMIQUE ET THERMODYNAMIQUE
GÉNIE CIVIL
GÉNIE DE LA CONSTRUCTION
GÉNIE ÉLECTRIQUE ET ÉLECTRONIQUE
GÉNIE INDUSTRIEL
GÉNIE MÉCANIQUE
GÉNIE MÉTALLURGIQUE ET MINIER
GÉNIE MINIER
GÉNIE PÉTROLIER
INFORMATIQUE
INFORMATIQUE (DIVERS)
INFORMATIQUE ET CHIMIE
INFORMATIQUE ET ROBOTIQUE
INFORMATIQUE/APPLICATIONS
INFORMATIQUE/DIVERS 2
INFORMATIQUE/IMAGERIE
INFORMATIQUE/THÉORIE ET SYSTÈMES
INGÉNIERIE/SYSTÈMES
INTELLIGENCE ARTIFICIELLE
MÉCANIQUE
MÉTALLURGIE
PHOTOGRAPHIE, IMAGERIE
RECHERCHE OPÉRATIONNELLE
ROBOTIQUE
SCIENCE - TECHNOLOGIE NUCLÉAIRE
SCIENCES DE L'INFORMATION
SYSTÉMIQUE
TECHNOLOGIES MARINES
TÉLÉCOMMUNICATIONS
TÉLÉDECTION ET TÉLÉCONTROLE
SCIENCES ET TECHNIQUES DES TRANSPORTS

MATHEMATICS
MATHÉMATIQUES
MATHÉMATIQUES APPLIQUÉES
MATHÉMATIQUES GÉNÉRALES
MATHÉMATIQUES THÉORIQUES
MATHÉMATIQUES, AUTRES
MÉTHODES MATHÉMATIQUES (BIOLOGIE ET MÉDECINE)
MÉTHODES MATHÉMATIQUES (SCIENCES PHYSIQUES)
MÉTHODES MATHÉMATIQUES (SCIENCES SOCIALES)
STATISTIQUE ET PROBABILITÉS

N.B. The term “multidisciplinary” refers to the multidisciplinary journals of the Web of Science for which Thomson Scientific has not affected a specific subject category.

Annex 2. Definition of seven technological domains

A very precise and detailed way of classifying patents into technological domains is used worldwide. This classification is the International Patent Classification (IPC). It is structured in 8 sections, 118 classes, 630 sub-classes and about 70 000 groups and sub-groups. Unfortunately, the sections of the IPC are not relevant of the modern industrial production. For that reason the OST has built, from the IPC codes, another classification into seven technological domains, more appropriate to technological strategies of today firms.

The following table provides the correspondence between a technological domain and the IPC codes (at the sub-class level) that it covers.

Technological domain	IPC Codes
1. Electronics - electricity	
	F21 ; G05F ; H01B,C,F,G,H,J,K,M,R,T ; H02 ; H05B,C,F,K
	G09F,G ; G11B ; H03F,G,J ; H04N,R,S
	G08C ; H01P,Q ; H03B,C,D,H,K,L,M ; H04B,H,J,K,L,M,Q
	G06 ; G11C ; G10L
	H01L ; B81
2. Instrumentation	
	G02 ; G03B,C,D,F,G,H ; H01S
	G01B,C,D,F,G,H,J,K,L,M,N,P,R,S,V,W ; G04 ; G05B,D ; G07; G08B,G ; G09B,C,D ; G12
	A61B,C,D,F,G,H,J,L,M,N
	G01T ; G21 ; H05G,H
3. Chemistry – materials	
	C07D,F,G,H,J
	C08B,F,G,H,,K,L ; C09D,J
	A01N ; C05 ; C07B ; C08C ; C09B,C,F,G,H,K ; C10B,C,F,G,H,J, K,L,M ; C11B,C,D
	B05C,D ; B32 ; C23 ; C25 ; C30
	C01 ; C03C ; C04 ; C21 ; C22 ; B22 ; B82
4. Pharmacy - biotechnologies	
	C07K ; C12M,N,P,Q,S
	A61K,P
	A01H ; A21D ; A23B,C,D,F,G,J,K,L C12C,F,G,H,J ;C13D,F,J,K
5. Industrial procedures	
	B01 ; B02C ; B03 ; B04 ; B05B ; B06 ; B07 ; B08 ; F25J ; F26
	B25J ; B41 ; B65B,C,D,F,G,H ; B66, B67
	A41H ; A43D ; A46D ; B28, B29 ; B31 ; C03B ; C08J ;C14; D01 ; D02 ; D03, D04B,C,G,H ; D06B,C,G,H,J,L,M,P,Q ; D21
	A62D ; B09 ; C02 ; F01N ; F23G,J
	A01B,C,D,F,G,J,K,L,M ; A21B,C ; A22 ; A23N,P ; B02B ; C12L ; C13C,G,H
6. Machines – mechanics - transports	
	B21 ; B23 ; B24 ; B26D,F ; B27 ; B30
	F01 (sauf F01N) ; F02 ; F03 ; F04 ; F23R
	F22 ; F23B,C,D,H,K,L,M,N,Q ; F24 ; F25B,C ; F27 ; F28
	F15 ; F16 ; F17 ; G05G
	B60 ; B61 ; B62 ; B63B,C,H,J ; B64B,C,D,F
	B63G ; B64G ; C06 ; F41 ; F42
7. –Consumer goods - Construction	
	A24 ; A41B,C,D,F,G ; A42 ; A43B,C ; A44 ; A45 ; A46B ; A47 ; A62B,C ; A63 ; B25B,C,D,F,G,H ; B26B ; B42 ; B43 ; B44 ; B68 ; D04D ; D06F,N ; D07 ; F25D ; G10B,C,D,F,G,H,K
	E01 ; E02 ; E03 ; E04 ; E05 ; E06 ; E21

S&T indicators

for the EULANEST project

November 2007

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Summary

Part I: The tables of indicators

The Eulanest (*European – Latin American Network for Science and Technology*) European project began on September 1st, 2006 for a period of four years. Eulanest aims to coordinate scientific and technological (S&T) cooperation policies between Member States of the European Union and Latin America. It falls within the so-called Era-net category projects. Concretely, the project consortium is made up of members from five European Union countries (Germany, Spain - coordinating country, - France, Norway and Portugal) and also targets five Latin American countries: Argentina, Brazil, Chile, Mexico and Uruguay.

The first eighteen month module of the project (WP1) is placed under the responsibility of the IRD, a French member of the consortium, together with the MAEE and the MESR. It aims to provide a description of the current state of bilateral scientific and technological (S&T) cooperation between the two world sub-regions, as well as to describe and appreciate the global performances of the national research and innovation systems of the five Latin American countries. This last point corresponds to a type of Country Report similar to those that were produced in conjunction between the MAE and the OST. To produce such Reports, the proposed methodology is based on bibliographic searches and on Internet data, also obtaining normalised indicators conceived by the OST and by carrying out expert in field missions, supported locally by the French diplomatic forces in place.

This document describes the construction, by the OST, of quantitative indicators of science and technology according to three large categories: scientific production, technological production and international cooperation.

VIII. Indicators based on scientific publications

Indicators of scientific publications (world share, specialisation indexes and relative impact indexes) are produced for Argentina, Brazil, Chile, Mexico and Uruguay, for the years 2001 to 2004 (three year smoothed results) inclusive (source: Thomson Scientific).

VIII.1. Indicators of scientific activity

VIII.1.1. World share of publications

Table 1.1: Argentina – world share of publications, by discipline, in fractional count (from 2001 to 2004)

	Argentina: World shares (%) of scientific publications			
Discipline	2001	2002	2003	2004
Fundamental biology	0,52	0,55	0,55	0,53
Medical research	0,33	0,34	0,32	0,31
Applied biology-ecology	0,97	1,04	1,06	1,06
Chemistry	0,50	0,50	0,46	0,44
Physics	0,54	0,55	0,53	0,49
Astro and Geo- sciences	0,65	0,68	0,71	0,74
Engineering	0,28	0,29	0,30	0,28
Mathematics	0,34	0,36	0,36	0,37
Total	0,47	0,48	0,47	0,46

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*

Table 1.2: Brazil - world share of publications, by discipline, in fractional count (from 2001 to 2004)

	Brazil: World shares (%) of scientific publications			
Discipline	2001	2002	2003	2004
Fundamental biology	1,19	1,30	1,40	1,47
Medical research	0,85	0,94	1,03	1,13
Applied biology-ecology	2,29	2,36	2,48	2,71
Chemistry	1,31	1,43	1,52	1,54
Physics	1,55	1,63	1,65	1,69
Astro and Geo- sciences	1,00	1,07	1,07	1,12
Engineering	0,95	0,99	1,01	1,13
Mathematics	1,07	1,13	1,21	1,29
Total	1,17	1,26	1,33	1,41

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*

Table 1.3: Chile - world share of publications, by discipline, in fractional count (from 2001 to 2004)

	Chile: World shares (%) of scientific publications			
Discipline	2001	2002	2003	2004
Fundamental biology	0,16	0,16	0,17	0,18
Medical research	0,17	0,17	0,17	0,16
Applied biology-ecology	0,35	0,37	0,39	0,40
Chemistry	0,18	0,19	0,20	0,20
Physics	0,11	0,14	0,14	0,15
Astro and Geo- sciences	0,39	0,41	0,44	0,46
Engineering	0,11	0,13	0,15	0,17
Mathematics	0,23	0,26	0,30	0,32
Total	0,18	0,19	0,21	0,21

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*

Table 1.4: Mexico - world share of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Mexico: World shares (%) of scientific publications			
	2001	2002	2003	2004
Fundamental biology	0,39	0,41	0,44	0,46
Medical research	0,30	0,31	0,31	0,32
Applied biology-ecology	0,99	0,99	1,09	1,16
Chemistry	0,42	0,43	0,46	0,48
Physics	0,74	0,76	0,79	0,77
Astro and Geo- sciences	0,85	0,88	0,90	0,95
Engineering	0,40	0,43	0,46	0,52
Mathematics	0,55	0,58	0,59	0,59
Total	0,48	0,50	0,53	0,54

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*

Table 1.5: Uruguay - world share of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Uruguay: World shares (%) of scientific publications			
	2001	2002	2003	2004
Fundamental biology	0,04	0,04	0,04	0,05
Medical research	0,02	0,02	0,02	0,02
Applied biology-ecology	0,05	0,05	0,06	0,07
Chemistry	0,02	0,02	0,01	0,01
Physics	0,03	0,03	0,03	0,03
Astro and Geo- sciences	0,03	0,03	0,04	0,04
Engineering	0,01	0,02	0,02	0,01
Mathematics	0,03	0,04	0,04	0,04
Total	0,03	0,03	0,03	0,03

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *Given the low number of publications per discipline, the indicators must be interpreted with special caution*

VIII.1.2. World specialisation index of publications

Table 2.1: Argentina – world specialisation index of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Argentina: World specialisation index			
	2001	2002	2003	2004
Fundamental biology	1,12	1,14	1,16	1,17
Medical research	0,71	0,70	0,68	0,67
Applied biology-ecology	2,08	2,15	2,24	2,31
Chemistry	1,08	1,03	0,98	0,96
Physics	1,16	1,15	1,12	1,08
Astro and Geo- sciences	1,39	1,41	1,49	1,61
Engineering	0,60	0,61	0,62	0,61
Mathematics	0,72	0,75	0,75	0,80
Total	1,00	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the discipline at the expense of those disciplines for which the index is less than 1.*

Table 2.2: Brazil – world specialisation index of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Brazil: World specialisation index			
	2001	2002	2003	2004
Fundamental biology	1,02	1,03	1,05	1,04
Medical research	0,73	0,74	0,77	0,80
Applied biology-ecology	1,95	1,87	1,87	1,92
Chemistry	1,12	1,14	1,15	1,09
Physics	1,33	1,30	1,24	1,20
Astro and Geo- sciences	0,85	0,85	0,81	0,79
Engineering	0,81	0,79	0,76	0,80
Mathematics	0,91	0,90	0,91	0,92
Total	1,00	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the discipline at the expense of those disciplines for which the index is less than 1.*

Table 2.3: Chile – world specialisation index of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Chile: World specialisation index			
	2001	2002	2003	2004
Fundamental biology	0,89	0,84	0,83	0,85
Medical research	0,91	0,88	0,84	0,78
Applied biology-ecology	1,92	1,92	1,89	1,92
Chemistry	1,00	0,98	0,99	0,95
Physics	0,62	0,71	0,70	0,73
Astro and Geo- sciences	2,13	2,10	2,13	2,20
Engineering	0,62	0,66	0,74	0,82
Mathematics	1,24	1,36	1,44	1,56
Total	1,00	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*

- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the discipline at the expense of those disciplines for which the index is less than 1.*

Table 2.4.: Mexico – world specialisation index of publications, by discipline, in fractional count (from 2001 to 2004)

	Mexico: World specialisation index			
Discipline	2001	2002	2003	2004
Fundamental biology	0,80	0,82	0,84	0,85
Medical research	0,63	0,63	0,60	0,58
Applied biology-ecology	2,06	1,99	2,07	2,12
Chemistry	0,88	0,86	0,88	0,89
Physics	1,54	1,52	1,50	1,42
Astro and Geo- sciences	1,77	1,76	1,72	1,75
Engineering	0,83	0,86	0,88	0,96
Mathematics	1,15	1,16	1,12	1,08
Total	1,00	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the discipline at the expense of those disciplines for which the index is less than 1.*

Table 2.5: Uruguay – world specialisation index of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Uruguay: World specialisation index			
	2001	2002	2003	2004
Fundamental biology	1,46	1,58	1,64	1,62
Medical research	0,76	0,73	0,69	0,73
Applied biology-ecology	1,86	2,05	2,19	2,45
Chemistry	0,78	0,65	0,52	0,52
Physics	1,05	0,96	0,97	0,90
Astro and Geo- sciences	1,29	1,24	1,33	1,30
Engineering	0,56	0,60	0,58	0,51
Mathematics	1,17	1,37	1,54	1,41
Total	1,00	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the discipline at the expense of those disciplines for which the index is less than 1.*
- *Given the low number of publications per discipline, the indicators must be interpreted with special caution*

VIII.2. relative impact index

Table 3.1: Argentina – world relative impact index over 2 years of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Argentina: 2 year relative impact index			
	2001	2002	2003	2004
Fundamental biology	0,34	0,35	0,35	0,38
Medical research	0,50	0,50	0,53	0,57
Applied biology-ecology	0,57	0,62	0,61	0,62
Chemistry	0,53	0,56	0,61	0,64
Physics	0,78	0,78	0,77	0,74
Astro and Geo- sciences	0,52	0,56	0,56	0,53
Engineering	0,84	0,77	0,70	0,71
Mathematics	0,70	0,80	0,76	0,73
Total	0,50	0,51	0,52	0,53

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *A relative impact index of 1 implies that the visibility of the country's publications is equal to that of worldwide publications in the discipline. When the index is greater (respectively less) than 1, then the country has a better (respectively worse) visibility then the world average of the discipline*

Table 3.2: Brazil – world relative impact index over 2 years of publications, by discipline, in fractional count (from 2001 to 2004)

	Brazil: 2 year relative impact index			
Discipline	2001	2002	2003	2004
Fundamental biology	0,29	0,31	0,34	0,35
Medical research	0,42	0,43	0,44	0,43
Applied biology-ecology	0,34	0,36	0,38	0,37
Chemistry	0,60	0,64	0,60	0,60
Physics	0,72	0,72	0,71	0,71
Astro and Geo- sciences	0,59	0,57	0,54	0,51
Engineering	0,66	0,66	0,69	0,66
Mathematics	0,89	0,82	0,79	0,74
Total	0,44	0,46	0,46	0,46

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *A relative impact index of 1 implies that the visibility of the country's publications is equal to that of worldwide publications in the discipline. When the index is greater (respectively less) than 1, then the country has a better (respectively worse) visibility then the world average of the discipline*

Table 3.3: Chile – world relative impact index over 2 years of publications by discipline, in fractional count (from 2001 to 2004)

	Chile: 2 year relative impact index			
Discipline	2001	2002	2003	2004
Fundamental biology	0,50	0,52	0,55	0,54
Medical research	0,41	0,42	0,42	0,45
Applied biology-ecology	0,59	0,69	0,69	0,70
Chemistry	0,52	0,57	0,56	0,60
Physics	0,71	0,69	0,75	0,76
Astro and Geo- sciences	1,08	1,19	1,29	1,31
Engineering	1,02	0,94	0,93	0,87
Mathematics	1,01	1,16	1,09	0,95
Total	0,55	0,58	0,61	0,63

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *A relative impact index of 1 implies that the visibility of the country's publications is equal to that of worldwide publications in the discipline. When the index is greater (respectively less) than 1, then the country has a better (respectively worse) visibility then the world average of the discipline*

Table 3.4: Mexico – world relative impact index over 2 years of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Mexico: 2 year relative impact index			
	2001	2002	2003	2004
Fundamental biology	0,41	0,41	0,42	0,42
Medical research	0,46	0,46	0,47	0,47
Applied biology-ecology	0,44	0,44	0,49	0,51
Chemistry	0,49	0,49	0,51	0,49
Physics	0,56	0,56	0,53	0,54
Astro and Geo- sciences	0,63	0,62	0,58	0,53
Engineering	0,72	0,74	0,80	0,71
Mathematics	0,72	0,73	0,79	0,83
Total	0,45	0,46	0,46	0,45

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *A relative impact index of 1 implies that the visibility of the country's publications is equal to that of worldwide publications in the discipline. When the index is greater (respectively less) than 1, then the country has a better (respectively worse) visibility then the world average of the discipline*

Table 3.5: Uruguay – world relative impact index over 2 years of publications, by discipline, in fractional count (from 2001 to 2004)

Discipline	Uruguay: 2 year relative impact index			
	2001	2002	2003	2004
Fundamental biology	0,58	0,54	0,55	0,56
Medical research	0,81	0,69	0,64	0,54
Applied biology-ecology	0,53	0,49	0,46	0,45
Chemistry	0,51	0,46	0,54	0,49
Physics	0,95	1,08	1,23	1,15
Astro and Geo- sciences	0,32	0,52	0,61	0,75
Engineering	0,30	0,41	0,43	0,78
Mathematics	0,49	0,46	0,68	0,85
Total	0,67	0,63	0,65	0,64

Thomson Scientific data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide publications*
- *A relative impact index of 1 implies that the visibility of the country's publications is equal to that of worldwide publications in the discipline. When the index is greater (respectively less) than 1, then the country has a better (respectively worse) visibility then the world average of the discipline*
- *Given the low number of publications per discipline, the indicators must be interpreted with special caution*

VIII.3. Indicators of international cooperation according to scientific co-publications

Co-publications between the five European countries (plus the USA) and the five Latin American countries (plus the USA) are presented, for the years 2001 to 2004 (three year smoothed results) inclusive (source: Thomson Scientific).

Two co-publication shares can be calculated:

- The ratio of the number of co-publications between a European country and a Latin American country to the number of international co-publications of the European country
- The ratio of the number of co-publications between a European country and a Latin American country to the number of international co-publications of the Latin American country

VIII.3.1. Matrix N° 1, refers to EU countries

The 1st matrix (Table 4.1.): 6 x 6 presents in the cell (i,j) the share of international co-publications a European country (column i) that are co-authored by a Latin American country (row j). This share is the ratio of the number of co-publications between a European country and a Latin American country to the number of international co-publications of the European country.

Table 4.1.: share of co-publications between the five European countries (plus the USA) and the five Latin American countries (plus the USA) in the total number of international co-publications of the European countries, all disciplines combined (2001 and 2004)

	Co-publications of European countries (and United States) with Latine American countries as shares (%) of international co-publications of European partnairs											
	2 001						2 004					
with	Germany	Spain	France	Norway	Portugal	United States	Germany	Spain	France	Norway	Portugal	United States
Argentina	0,7	3,7	1,0	0,3	0,6	1,0	0,7	3,7	1,0	0,2	1,1	1,0
Brazil	1,5	3,1	2,6	1,9	6,9	2,5	1,7	2,6	2,7	1,4	6,8	2,6
Chile	0,5	1,8	0,8	0,1	0,6	0,6	0,7	2,1	0,9	0,3	0,6	0,8
Mexico	0,6	3,2	1,3	0,3	0,9	1,6	0,7	3,6	1,2	0,5	0,6	1,7
Uruguay	0,0	0,4	0,1	0,0	0,1	0,1	0,0	0,3	0,1	0,1	0,1	0,1
United States	29,2	25,7	24,7	27,0	20,1	-	29,4	26,2	24,7	29,1	19,1	-

Thomson Scientific data, OST computing *OST - 2007*

- *The co-publication indicators are calculated using an entire or integer count,*
- *The share of co-publications of country 1 (column) with country 2 (row) is calculated by dividing the number of co-publications between country 1 and country 2 by the number of international co-publications of country 1*
- *To read the table: for 2001, 0,7 % of Germany's international co-publications are in collaboration with research laboratories from Argentina and 1,5 % Germany's international co-publications are in collaboration with research laboratories from Brazil. Similarly, 3,7 % of Spain's international co-publications are in collaboration with research laboratories from Argentina*

VIII.3.2. Matrix N° 2 refers to LAC countries

The 2nd matrix (Table 4.2.): 6 x 6 presents in the cell (i,j) the share of international co-publications a Latin American country (row i) that are co-authored by a European country (column j). This share is the ratio of the number of co-publications between a European country and a Latin American country to the number of international co-publications of the Latin American country.

Table 4.2.: share of co-publications between the five European countries (plus the USA) and the five Latin American countries (plus the USA) in the total number of international co-publications of the Latin American countries, all disciplines combined (2001 and 2004)

	Co-publications of Latine American countries (and United States) with European countries as shares (%) of international co-publications of Latine American partnairs											
	2 001						2 004					
with	Germany	Spain	France	Norway	Portugal	United States	Germany	Spain	France	Norway	Portugal	United States
Argentina	10,5	18,2	11,8	0,4	0,7	32,7	10,6	18,6	11,4	0,3	1,3	32,3
Brazil	10,5	6,5	13,7	1,2	3,1	37,4	10,9	5,6	13,2	0,8	3,5	37,8
Chile	14,1	14,3	15,0	0,3	1,0	35,7	14,8	15,0	15,4	0,5	1,0	36,9
Mexico	7,4	11,8	11,9	0,3	0,7	41,2	7,7	13,6	10,4	0,5	0,5	42,5
Uruguay	4,3	15,1	11,3	0,2	1,0	27,0	4,4	14,4	11,3	0,6	0,8	26,6
United States	13,6	3,7	8,7	1,1	0,6	-	13,3	3,9	8,3	1,2	0,7	-

Thomson Scientific data, OST computing *OST - 2007*

- *The co-publication indicators are calculated using an entire or integer count*
- *The share of co-publications of country 1 (column) with country 2 (row) is calculated by dividing the number of co-publications between country 1 and country 2 by the number of international co-publications of country 2*
- *To read the table: for 2001, 10,5 % of Argentina's international co-publications are in collaboration with research laboratories from Germany and 10,5 % Brazil's international co-publications are in collaboration with research laboratories from Germany. Similarly, 18,2 % of Argentina's international co-publications are in collaboration with research laboratories from Spain*

IX. Indicators based on patents

IX.1. Indicators of technological activity according to the European patent system

Indicators based on European patent applications (according to the inventor country) are presented for Argentina, Brazil, Chile, Mexico Uruguay, for the years 2001 to 2004 (three year smoothed results) inclusive (source European patent Office, OEB).

IX.1.1. World share of European patent applications

Table 5.1: Argentina – world share of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

	Argentina: World share (‰) of European applications			
Domain	2001	2002	2003	2004
Electronics-electricity	0,13	0,12	0,13	0,11
Instrumentation	0,53	0,48	0,31	0,37
Materials-chemistry	0,21	0,27	0,24	0,17
Pharmacy-biotechnologies	0,98	0,95	0,85	0,85
Industrial procedures	0,29	0,40	0,50	0,54
Machines-mechanics-transports	0,43	0,45	0,45	0,43
Consumer goods-construction	0,55	0,60	0,65	0,59
Total	0,39	0,40	0,37	0,37

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *The world share is given in parts per thousand*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*

Table 5.2: Brazil – world share of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Brazil: World share (‰) of of European applications			
	2001	2002	2003	2004
Electronics-electricity	0,70	0,70	0,71	0,70
Instrumentation	1,17	1,22	1,09	1,15
Materials-chemistry	1,49	1,49	1,26	1,67
Pharmacy-biotechnologies	1,71	1,82	2,19	2,30
Industrial procedures	1,99	1,88	1,92	1,92
Machines-mechanics-transports	2,70	2,68	2,48	2,48
Consumer goods-construction	2,33	2,40	2,39	2,80
Total	1,54	1,53	1,49	1,58

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *The world share is given in parts per thousand*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*

Table 5.3: Chile – world share of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Chile: World share (‰) of European applications			
	2001	2002	2003	2004
Electronics-electricity	0,03	0,04	0,05	0,07
Instrumentation	0,03	0,01	0,02	0,03
Materials-chemistry	0,19	0,16	0,14	0,16
Pharmacy-biotechnologies	0,11	0,14	0,23	0,23
Industrial procedures	0,17	0,15	0,10	0,19
Machines-mechanics-transports	0,04	0,06	0,09	0,15
Consumer goods-construction	0,13	0,17	0,25	0,19
Total	0,08	0,08	0,10	0,12

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *The world share is given in parts per thousand*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*

Table 5.4: Mexico – world share of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Mexico: World share (‰) of European applications			
	2001	2002	2003	2004
Electronics-electricity	0,39	0,44	0,37	0,35
Instrumentation	0,38	0,38	0,63	0,70
Materials-chemistry	0,94	0,80	0,72	0,60
Pharmacy-biotechnologies	0,66	0,66	0,81	1,03
Industrial procedures	1,10	1,29	1,24	1,09
Machines-mechanics-transports	0,59	0,63	0,64	0,72
Consumer goods-construction	1,26	1,58	1,98	2,19
Total	0,66	0,70	0,74	0,77

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *The world share is given in parts per thousand*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*

The number of European patent applications for Uruguay is too low to calculate this indicator. The number of European patent applications for Uruguay is provided in the annex.

IX.1.2. World specialisation index of European patent applications

Table 6.1: Argentina – world specialisation index of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Argentina: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,33	0,29	0,36	0,31
Instrumentation	1,36	1,22	0,84	1,00
Materials-chemistry	0,54	0,69	0,64	0,47
Pharmacy-biotechnologies	2,56	2,40	2,28	2,32
Industrial procedures	0,74	1,01	1,33	1,46
Machines-mechanics-transports	1,11	1,13	1,21	1,18
Consumer goods-construction	1,43	1,52	1,74	1,61
Total	1,00	1,00	1,00	1,00

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Table 6.2: Brazil – world specialisation index of European patent applications by technological domain in fractional count (from 2001 to 2004)

Domain	Brazil: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,46	0,46	0,48	0,44
Instrumentation	0,76	0,80	0,73	0,73
Materials-chemistry	0,97	0,97	0,85	1,05
Pharmacy-biotechnologies	1,11	1,19	1,47	1,46
Industrial procedures	1,29	1,23	1,29	1,22
Machines-mechanics-transports	1,75	1,76	1,66	1,52
Consumer goods-construction	1,51	1,57	1,60	1,77
Total	1,00	1,00	1,00	1,00

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Table 6.3: Chile – world specialisation index of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Chile: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,33	0,43	0,49	0,55
Instrumentation	0,38	0,09	0,22	0,27
Materials-chemistry	2,31	1,91	1,42	1,28
Pharmacy-biotechnologies	1,31	1,66	2,27	1,87
Industrial procedures	2,11	1,82	1,03	1,51
Machines-mechanics-transports	0,44	0,75	0,86	1,23
Consumer goods-construction	1,64	2,09	2,51	1,58
Total	1,00	1,00	1,00	1,00

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Table 6.4: Mexico – world specialisation index of European patent applications, by technological domain, in fractional count (from 2001 to 2004)

Domain	Mexico: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,60	0,64	0,50	0,45
Instrumentation	0,58	0,55	0,85	0,91
Materials-chemistry	1,42	1,15	0,97	0,78
Pharmacy-biotechnologies	0,99	0,94	1,09	1,33
Industrial procedures	1,67	1,85	1,67	1,41
Machines-mechanics-transports	0,89	0,90	0,86	0,93
Consumer goods-construction	1,91	2,26	2,67	2,84
Total	1,00	1,00	1,00	1,00

EPO and INPI data, OST computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide European patent applications*
- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

The number of European patent applications for Uruguay is too low to calculate this indicator. The number of European patent applications for Uruguay is provided in the annex.

IX.2. Indicators of technological activity according to the American patent system

Indicators based on granted American patents (according to the inventor country) are presented for Argentina, Brazil, Chile, Mexico Uruguay, for the years 2001 to 2004 (three year smoothed results) inclusive (source ipIQ).

IX.2.1. World share of granted American patents

Table 7.1: Argentina – world share of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

	Argentina: World share (‰) of US patents			
Domain	2001	2002	2003	2004
Electronics-electricity	0,08	0,08	0,06	0,04
Instrumentation	0,67	0,61	0,61	0,59
Materials-chemistry	0,20	0,23	0,24	0,24
Pharmacy-biotechnologies	0,52	0,63	0,78	0,95
Industrial procedures	0,44	0,39	0,45	0,44
Machines-mechanics-transports	0,59	0,60	0,56	0,52
Consumer goods-construction	0,52	0,64	0,64	0,69
Total	0,35	0,36	0,36	0,35

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *The world share is given in parts per thousand*
- *Granted American patents are geographically attributed according to the inventor's address*

Table 7.2: Brazil – world share of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

	Brazsil: World share (‰) of of US patents			
Domain	2001	2002	2003	2004
Electronics-electricity	0,19	0,19	0,23	0,22
Instrumentation	0,68	0,68	0,71	0,54
Materials-chemistry	0,77	0,80	0,87	0,91
Pharmacy-biotechnologies	0,71	0,85	0,97	1,15
Industrial procedures	1,08	0,93	0,89	1,07
Machines-mechanics-transports	1,35	1,20	1,42	1,64
Consumer goods-construction	1,85	1,94	1,82	1,39
Total	0,73	0,70	0,75	0,73

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *The world share is given in parts per thousand*
- *Granted American patents are geographically attributed according to the inventor's address*

Table 7.3: Chile – world share of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

Domain	Chile: World share (‰) of US patents			
	2001	2002	2003	2004
Electronics-electricity	0,01	0,02	0,02	0,04
Instrumentation	0,05	0,03	0,01	0,02
Materials-chemistry	0,12	0,14	0,17	0,24
Pharmacy-biotechnologies	0,13	0,20	0,25	0,16
Industrial procedures	0,25	0,27	0,19	0,15
Machines-mechanics-transports	0,07	0,03	0,05	0,05
Consumer goods-construction	0,15	0,11	0,04	0,16
Total	0,08	0,08	0,07	0,08

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *The world share is given in parts per thousand*
- *Granted American patents are geographically attributed according to the inventor's address*

Table 7.4: Mexico – world share of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

Domain	Mexico: World share (‰) of US patents			
	2001	2002	2003	2004
Electronics-electricity	0,20	0,23	0,25	0,27
Instrumentation	0,30	0,32	0,45	0,55
Materials-chemistry	0,98	0,85	0,78	0,77
Pharmacy-biotechnologies	0,63	0,64	0,63	0,64
Industrial procedures	0,88	1,08	1,19	1,23
Machines-mechanics-transports	0,84	0,85	0,84	0,78
Consumer goods-construction	1,53	1,95	1,84	1,66
Total	0,58	0,62	0,63	0,63

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *The world share is given in parts per thousand*
- *Granted American patents are geographically attributed according to the inventor's address*

Uruguay is not present in the data base of American patents.

IX.2.2. World specialisation index of granted American patents

Table 8.1: Argentina – world specialisation index of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

Domain	Argentina: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,23	0,23	0,17	0,12
Instrumentation	1,90	1,71	1,70	1,71
Materials-chemistry	0,55	0,65	0,66	0,70
Pharmacy-biotechnologies	1,47	1,77	2,18	2,76
Industrial procedures	1,24	1,10	1,27	1,28
Machines-mechanics-transports	1,67	1,67	1,57	1,50
Consumer goods-construction	1,48	1,79	1,78	1,99
Total	1,00	1,00	1,00	1,00

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *Granted American patents are geographically attributed according to the inventor's address*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the domain at the expense of other domains for which the index is less than 1*

Table 8.2: Brazil – world specialisation index of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

Domain	Brazil: World specialisation index			
	2001	2002	2003	2004
Electronics-electricity	0,26	0,27	0,31	0,30
Instrumentation	0,94	0,96	0,95	0,73
Materials-chemistry	1,05	1,13	1,16	1,25
Pharmacy-biotechnologies	0,97	1,20	1,30	1,58
Industrial procedures	1,49	1,32	1,20	1,47
Machines-mechanics-transports	1,86	1,71	1,90	2,25
Consumer goods-construction	2,54	2,75	2,43	1,90
Total	1,00	1,00	1,00	1,00

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *Granted American patents are geographically attributed according to the inventor's address*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Table 8.3: Chile – world specialisation index of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

	Chile: World specialisation index			
Domain	2001	2002	2003	2004
Electronics-electricity	0,17	0,27	0,32	0,43
Instrumentation	0,62	0,37	0,18	0,28
Materials-chemistry	1,52	1,73	2,33	2,95
Pharmacy-biotechnologies	1,63	2,57	3,46	1,90
Industrial procedures	3,05	3,35	2,61	1,88
Machines-mechanics-transports	0,84	0,41	0,67	0,61
Consumer goods-construction	1,81	1,37	0,50	1,94
Total	1,00	1,00	1,00	1,00

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *Granted American patents are geographically attributed according to the inventor's address*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Table 8.4: Mexico – world specialisation index of granted American patents, by technological domain, in fractional count (from 2001 to 2004)

	Mexico: World specialisation index			
Domain	2001	2002	2003	2004
Electronics-electricity	0,34	0,37	0,39	0,43
Instrumentation	0,51	0,52	0,71	0,88
Materials-chemistry	1,69	1,37	1,23	1,22
Pharmacy-biotechnologies	1,09	1,02	0,99	1,01
Industrial procedures	1,51	1,74	1,88	1,96
Machines-mechanics-transports	1,45	1,37	1,33	1,24
Consumer goods-construction	2,65	3,13	2,92	2,64
Total	1,00	1,00	1,00	1,00

USPTO data, OST and ipIQ computing *OST - 2007*

- *These indicators, based on a fractional count, reflect the contribution of the country to worldwide granted American patents*
- *Granted American patents are geographically attributed according to the inventor's address*
- *The neutral value of the specialisation index is 1; an index greater than 1 implies a particular specialisation in the technological domain at the expense those domains for which the index is less than 1*

Uruguay is not present in the data base of American patents.

X. Indicators based on foreign student mobility

Indicators are based on the number of students in higher education (ISCED 5 and 6 levels according to OECD nomenclature) hosted and expatriated for the years 2003 and 2004, according to the availability of the source data (source: OECD/Eurostat).

The OST provides two matrices of indicators, one on the number of students hosted and one on the number of expatriated students.

The 1st matrix (Table 9.1.): 6 x 6 presents in the cell (i,j) the number of students of the European consortium countries or the USA (column i) who are hosted by a Latin American country or the USA (row j).

N.B. The OST can not guarantee to provide this matrix in its complete form because of the uncertainty associated with the availability of these data.

Table 9.1: Higher education students of European consortium countries or the USA hosted by a Latin American country or the USA (2003)

	Number of students of consortium country hosted in Latin America country (total tertiary education)(2003)					
Host country	Germany	Spain	France	Norvway	Portugal	United States
Argentina	na	na	na	na	na	na
Brazil	15	8	13	na	24	8
Chile	186	138	156	22	2	1 111
Mexico**	na	na	na	na	na	830
Uruguay	na	na	na	na	na	na
United States	9 302	3 633	7 223	1 568	881	-

OECD Education at a Glace data *OST - 2007*

- *The data correspond to ISCED5 (one to five years of higher education) and ISCED6 (six or more years of higher education) levels of the international nomenclature. They cover higher education including the Doctorate level and enrolment in specialised sections like paramedical, architecture, management…*
- *na: data not available*
- *** data for the year 2002*

The 2nd matrix (Table 9.2.): 6 x 6 presents in the cell (i,j) the number of students of the Latin American countries or the USA (column i) who are hosted by a European consortium country or the USA (row j).

N.B. The OST can not guarantee to provide this matrix in its complete form because of the uncertainty associated with the availability of these data.

Table 9.2: Higher education students of Latin American countries or the USA hosted by a European consortium country or the USA (2004)

Host country	Number of students of Latin America country hosted in consortium country (total tertiary education) (2004)					
	Argentina	Brazil	Chile	Mexico	Uruguay	United States
Germany	519	1 801	624	977	na	3 419
Spain	2 750	1 699	1 569	2 652	na	753
France	838	1 759	512	1 452	na	2 687
Norvway	15	47	72	34	na	314
Portugal	21	1 842	5	17	na	216
United States*	3 644	8 388	1 723	12 801	na	-

OECD Education at a Glace data *OST - 2007*

- *The data correspond to ISCED5 (one to five years of higher education) and ISCED6 (six or more years of higher education) levels of the international nomenclature. They cover higher education including the Doctorate level and enrolment in specialised sections like paramedical, architecture, management…*
- *na: data not available*
- ** data for the year 2003*

XI. Indicators of international cooperation according to participation in the 5th and 6th FP

Indicators of the participation of Argentina, Brazil, Chile, Mexico and Uruguay in the 5th and 6th FP (source: Cordis service of the European Commission).

Table 10: Argentina, Brazil, Chile, Mexico et Uruguay – share of projects, participations and coordinations in the 5th and 6th FP

Country	5th FP			6th FP		
	Share (%) of participations	Share (%) of projects	Share (%) of coordinations	Share (%) of participations	Share (%) of projects	Share (%) of coordinations
Argentina	0,07	0,30	0,00	0,10	0,93	0,04
Brazil	0,11	0,41	0,00	0,16	1,19	0,04
Chile	0,03	0,14	0,01	0,09	0,86	0,00
Mexico	0,05	0,20	0,00	0,03	0,33	0,00
Uruguay	0,01	0,06	0,00	0,01	0,15	0,00

Cordis data, OST computing

- *The 6th FP indicators are based on data available in the database of the Cordis service of the European Commission in February 2006*
- *All projects of the FP are considered except "Marie Curie" specific actions.*

Part II: Annexes

XII. Annex 1. Descriptive elements

Table A.1: Argentina – number of publications, by discipline, in integer counts (from 2001 to 2004)

	Uruguay: Number of scientific publications (integer counts)			
Discipline	2001	2002	2003	2004
Fundamental biology	945	1 007	1 038	1 015
Medical research	1 074	1 112	1 107	1 046
Applied biology-ecology	735	801	835	812
Chemistry	808	832	827	808
Physics	728	754	740	692
Astro and Geo- sciences	456	497	552	564
Engineering	379	410	440	431
Mathematics	109	127	131	132
Total	4 321	4 571	4 663	4 515

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 data are provisional*
- *These indicators, based on a integer count, cannot be summed over the different disciplines*

Table A.2: Brazil – number of publications, by discipline, in integer counts (from 2001 to 2004)

	Uruguay: Number of scientific publications (integer counts)			
Discipline	2001	2002	2003	2004
Fundamental biology	2 247	2 467	2 671	2 779
Medical research	2 952	3 244	3 603	3 821
Applied biology-ecology	1 778	1 880	2 005	2 100
Chemistry	1 974	2 219	2 429	2 462
Physics	2 011	2 162	2 238	2 269
Astro and Geo- sciences	736	829	879	920
Engineering	1 211	1 331	1 421	1 596
Mathematics	370	414	467	504
Total	10 631	11 627	12 524	13 140

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 data are provisional*
- *These indicators, based on a integer count, cannot be summed over the different disciplines*

Table A.3: Chile – number of publications, by discipline, in integer counts (from 2001 to 2004)

Discipline	Uruguay: Number of scientific publications (integer counts)			
	2001	2002	2003	2004
Fundamental biology	326	334	350	360
Medical research	510	532	555	523
Applied biology-ecology	281	295	321	330
Chemistry	295	315	349	345
Physics	168	198	210	220
Astro and Geo- sciences	397	448	522	540
Engineering	156	179	220	249
Mathematics	85	105	122	133
Total	1 904	2 084	2 302	2 338

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 data are provisional*
- *These indicators, based on a integer count, cannot be summed over the different disciplines*

Table A.4: Mexico – number of publications, by discipline, in integer counts (from 2001 to 2004)

Discipline	Uruguay: Number of scientific publications (integer counts)			
	2001	2002	2003	2004
Fundamental biology	730	787	853	882
Medical research	952	1 012	1 048	1 046
Applied biology-ecology	789	823	923	949
Chemistry	751	789	868	911
Physics	987	1 049	1 099	1 073
Astro and Geo- sciences	693	741	791	817
Engineering	545	609	691	770
Mathematics	193	219	234	237
Total	4 722	5 007	5 403	5 541

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 results are provisional*
- *These indicators, based on a integer count, cannot be summed over the different disciplines*

Table A.5: Uruguay – number of publications, by discipline, in integer counts (from 2001 to 2004)

Discipline	Uruguay: Number of scientific publications (integer counts)			
	2001	2002	2003	2004
Fundamental biology	95	100	102	101
Medical research	91	89	85	83
Applied biology-ecology	53	59	65	71
Chemistry	44	40	37	37
Physics	39	40	42	42
Astro and Geo- sciences	29	30	34	35
Engineering	21	22	23	22
Mathematics	13	14	17	16
Total	312	321	335	343

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 data are provisional*
- *These indicators, based on a integer count, cannot be summed over the different disciplines*

Table A.6: number of co-publications between the five European countries (plus the USA) and the five Latin American countries (plus the USA), all disciplines combined (2001 and 2004)

	Number of co-publications of European countries (and United States) with Latin American countries													
	2 001							2 004						
with	Germany	Spain	France	Norway	Portugal	United States	Latin American country international co-publications	Germany	Spain	France	Norway	Portugal	United States	Latin American country international co-publications
Argentina	161	280	181	6	10	502	1 536	193	340	208	6	24	591	1 831
Brazil	366	228	480	40	109	1 305	3 490	457	238	555	35	145	1 590	4 210
Chile	131	133	140	2	9	331	928	185	187	192	6	13	461	1 251
Mexico	149	238	240	7	14	832	2 020	185	327	250	11	13	1 020	2 397
Uruguay	9	31	23	0	2	55	203	10	32	25	1	2	59	221
United States	7 132	1 921	4 558	564	316	107 216	52 419	8 079	2 385	5 023	727	407	116 123	60 581
European country international co-publications	24 434	7 462	18 489	2 090	1 573	52 419	-	27 491	9 101	20 306	2 498	2 131	60 581	-

Thomson Scientific data, OST computing *OST - 2007*

- *The 2004 data are provisional*
- *The number of co-publication indicators are based on a integer count*

Table A.7: Argentina – number of European patent applications, by technological domain, in integer count (from 2001 to 2004)

	Argentina: Number of European applications (integer counts)			
Domain	2001	2002	2003	2004
Electronics-electricity	6	6	7	7
Instrumentation	12	14	10	13
Materials-chemistry	7	7	6	6
Pharmacy-biotechnologies	18	19	18	19
Industrial procedures	7	8	9	13
Machines-mechanics-transports	10	10	10	12
Consumer goods-construction	7	7	9	8
Total	58	63	63	68

EPO and INPI data, OST computing *OST - 2007*

- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *These indicators, based on a integer count, cannot be summed over the different domains*

Table A.8.: Brazil – number of European patent applications, by technological domain, in integer count (from 2001 to 2004)

Domain	Brazil: Number of of European applications (integer counts) 2001	2002	2003	2004
Electronics-electricity	30	33	35	35
Instrumentation	29	32	32	32
Materials-chemistry	46	42	29	29
Pharmacy-biotechnologies	33	35	44	44
Industrial procedures	35	34	35	35
Machines-mechanics-transports	58	63	59	59
Consumer goods-construction	29	30	29	29
Total	231	241	234	234

EPO and INPI data, OST computing *OST - 2007*

- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *These indicators, based on a integer count, cannot be summed over the different domains*

Table A.9: Chile – number of European patent applications, by technological domain, in integer count (from 2001 to 2004)

Domain	Chile: Number of European applications (interger counts) 2001	2002	2003	2004
Electronics-electricity	2	2	3	3
Instrumentation	1	1	1	1
Materials-chemistry	4	4	3	4
Pharmacy-biotechnologies	3	4	5	5
Industrial procedures	3	3	2	4
Machines-mechanics-transports	1	1	2	4
Consumer goods-construction	2	3	4	3
Total	13	14	17	20

EPO and INPI data, OST computing *OST - 2007*

- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *These indicators, based on a integer count, cannot be summed over the different domains*

Table A.10: Mexico – number of European patent applications, by technological domain, in integer count (from 2001 to 2004)

Domain	Mexico: Number of European applications (integer counts)			
	2001	2002	2003	2004
Electronics-electricity	18	23	22	20
Instrumentation	10	11	18	22
Materials-chemistry	21	18	16	14
Pharmacy-biotechnologies	17	16	18	23
Industrial procedures	23	24	23	22
Machines-mechanics-transports	14	15	17	20
Consumer goods-construction	16	18	23	27
Total	101	111	120	127

EPO and INPI data, OST computing *OST - 2007*

- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *These indicators, based on a integer count, cannot be summed over the different domains*

Table A.11: Uruguay – number of European patent applications, by technological domain, in integer count (from 2001 to 2004)

Domain	Uruguay: Number of European applications (interger counts)			
	2001	2002	2003	2004
Electronics-electricity	2	3	3	4
Instrumentation	2	3	2	2
Materials-chemistry	0	0	1	1
Pharmacy-biotechnologies	0	1	1	2
Industrial procedures	0	0	0	1
Machines-mechanics-transports	-	-	-	0
Consumer goods-construction	1	0	0	0
Total	5	7	7	9

EPO and INPI data, OST computing *OST - 2007*

- *European patent applications are geographically attributed according to the inventor's address*
- *The European patent applications counted here are the published European patent applications and the PCT applications that designate at least one European country.*
- *These indicators, based on a integer count, cannot be summed over the different domains*

Table A.12: Argentina – number of American patents, by technological domain, in fractional counts (from 2001 to 2004)

	Argentina: Number of US patents (fractional counts)			
Domain	2001	2002	2003	2004
Electronics-electricity	4	4	3	2
Instrumentation	15	15	15	16
Materials-chemistry	3	4	4	4
Pharmacy-biotechnologies	5	6	8	8
Industrial procedures	7	6	7	6
Machines-mechanics-transports	12	12	12	10
Consumer goods-construction	5	6	6	6
Total	51	53	55	53

USPTO data, OST and ipIQ computing *OST - 2007*

- *American patents are geographically attributed according to the inventor's address*

Table A.13: Brazil – number of American patents, by technological domain, in fractional counts (from 2001 to 2004)

	Brazil: Number of of US patents (fractional counts)			
Domain	2001	2002	2003	2004
Electronics-electricity	9	10	13	13
Instrumentation	16	16	18	14
Materials-chemistry	13	14	15	15
Pharmacy-biotechnologies	7	8	9	10
Industrial procedures	16	14	13	15
Machines-mechanics-transports	26	25	29	33
Consumer goods-construction	17	18	17	12
Total	104	105	115	112

USPTO data, OST and ipIQ computing *OST - 2007*

- *American patents are geographically attributed according to the inventor's address*

Table A.14: Chile – number of American patents, by technological domain, in fractional counts (from 2001 to 2004)

	Chile: Number of US patents (fractional counts)			
Domain	2001	2002	2003	2004
Electronics-electricity	1	1	1	2
Instrumentation	1	1	1	1
Materials-chemistry	2	2	2	4
Pharmacy-biotechnologies	1	2	2	1
Industrial procedures	4	4	4	2
Machines-mechanics-transports	1	1	1	1
Consumer goods-construction	1	1	1	1
Total	12	12	12	13

USPTO data, OST and ipIQ computing *OST - 2007*

- *American patents are geographically attributed according to the inventor's address*

Table A.15: Mexico – number of American patents, by technological domain, in fractional counts (from 2001 to 2004)

Domain	Mexico: Number of US patents (fractional counts) 2001	2002	2003	2004
Electronics-electricity	10	12	14	16
Instrumentation	7	8	11	15
Materials-chemistry	17	15	13	13
Pharmacy-biotechnologies	6	6	6	6
Industrial procedures	13	16	17	17
Machines-mechanics-transports	16	17	17	15
Consumer goods-construction	14	18	17	15
Total	83	93	96	97

USPTO data, OST and ipIQ computing *OST - 2007*

- *American patents are geographically attributed according to the inventor's address*

Table A.16: Argentina, Brazil, Chile, Mexico et Uruguay – number of projects, participations and coordinations in the 5th and 6th FP

Country	5th FP			6th FP		
	Number of participations	Number of projects	Number of coordinations	Number of participations	Number of projects	Number of coordinations
Argentina	52	37	0	33	25	1
Brazil	83	51	0	51	32	1
Chile	23	18	1	29	23	0
Mexico	39	25	0	9	9	0
Uruguay	9	7	0	4	4	0

Cordis data, OST computing

- *The 6th FP indicators are based on data available in the database of the Cordis service of the European Commission in February 2006*
- *All projects of the FP are considered except "Marie Curie" specific actions.*

XIII. Annex 2. Definition of the eight scientific disciplines

The scientific disciplines taken into account for the calculation of indicators are the eight standard disciplines of the OST. They have been defined as an aggregation of the 180 odd subject categories implemented by Thomson Scientific for the natural sciences in the Web of Science®. The following table provides the correspondence between a discipline and the subject categories that it covers.

FUNDAMENTAL BIOLOGY
ANATOMIE, MORPHOLOGIE
BIOCHIMIE, BIOLOGIE MOLÉCULAIRE
BIOINGENIERIE
BIOLOGIE CELLULAIRE, HISTOLOGIE
BIOLOGIE MOLÉCULAIRE ET CELLULAIRE
BIOMATÉRIAUX
BIOMÉTHODES
BIOPHYSIQUE
BIOTECHNOLOGIE ET MICROBIOLOGIE APPLIQUÉE
EMBRYOLOGIE
GÉNÉTIQUE, HÉRÉDITÉ
GÉNIE BIOMÉDICAL
MICROBIOLOGIE
MICROSCOPIE
NEURO-IMAGERIE
NEUROSCIENCES
NUTRITION, DIÉTÉTIQUE
PARASITOLOGIE
PHYSIOLOGIE
PSYCHOLOGIE
SCIENCES COMPORTEMENTALES
SYSTEMES REPRODUCTEURS
TECHNIQUES DU LABORATOIRE
VIROLOGIE

APPILED BIOLOGY - ECOLOGY
AGRICULTURE
AGRICULTURE, MULTIDISCIPLINAIRE
AGRONOMIE GÉNÉRALE
BIODIVERSITÉ, CONSERVATION
BIOLOGIE GÉNÉRALE
BIOLOGIE, AUTRES
BOIS ET TEXTILES
BOTANIQUE, BIOLOGIE VÉGÉTALE
ÉCOLOGIE
ENTOMOLOGIE
HORTICULTURE
MYCOLOGIE
ORNITHOLOGIE
SCIENCES DES PRODUCTIONS ANIMALES
SCIENCES ET TECHNIQUES AGRO-ALIMENTAIRES
SCIENCES ET TECHNIQUES DES PECHES
STATIONS AGRICOLES EXPÉRIMENTALES
SYLVICULTURE
ZOOLOGIE GÉNÉRALE

MEDICAL RESEARCH
ALLERGOLOGIE
ANDROLOGIE
ANESTHÉSIOLOGIE
CANCÉROLOGIE
CHIMIE, CLINIQUE ET MÉDECINE
CHIRURGIE
SOINS INTENSIFS
DERMATOLOGIE, VÉNÉROLOGIE
ENDOCRINOLOGIE
GASTROENTÉROLOGIE
GÉRONTOLOGIE
GYNÉCOLOGIE, OBSTÉTRIQUE
HÉMATOLOGIE
IMMUNOLOGIE
MÉDECINE INTÉGRATIVE ET COMPLÉMENT
MALADIES INFECTIEUSES
MÉDECINE CARDIOVASCULAIRE
MÉDECINE CARDIOVASCULAIRE 2
MÉDECINE CLINIQUE, AUTRES
MÉDECINE D'URGENCE
MÉDECINE DE LA DÉPENDANCE
MÉDECINE DU SPORT
MÉDECINE EXPÉRIMENTALE
MÉDECINE INTERNE GÉNÉRALE
MÉDECINE LÉGALE
MÉDECINE TROPICALE
MÉDECINE VÉTÉRINAIRE
SANTÉ PUBLIQUE 2
ÉTHIQUE MÉDICALE
NEUROLOGIE CLINIQUE
ODONTOLOGIE
OPHTALMOLOGIE
ORTHOPÉDIE
OTORHINOLARYNGOLOGIE
PATHOLOGIE
PÉDIATRIE
PHARMACOLOGIE-PHARMACIE
PNEUMOLOGIE
PSYCHIATRIE
RADIOLOGIE, MÉDECINE NUCLÉAIRE
RÉHABILITATION
RHUMATOLOGIE
SANTÉ PUBLIQUE
TOXICOLOGIE
TRANSPLANTATIONS
UROLOGIE-NÉPHROLOGIE
SOINS INFIRMIERS

Annex 2 (continued): Definition of the eight scientific disciplines

CHEMISTRY
CHIMIE ANALYTIQUE
CHIMIE APPLIQUÉE
CHIMIE GÉNÉRALE
CHIMIE MINÉRALE ET NUCLÉAIRE
CHIMIE ORGANIQUE
CHIMIE PHYSIQUE
CRISTALLOGRAPHIE
ÉLECTROCHIMIE
MATÉRIAUX COMPOSITES
MATÉRIAUX/ANALYSE
SCIENCE DES MATÉRIAUX
SCIENCE DES MATÉRIAUX - BOIS, PAPIER
SCIENCE DES MATÉRIAUX - CÉRAMIQUES
SCIENCE DES POLYMÈRES
TRAITEMENTS DE SURFACE

PHYSICS
ACOUSTIQUE
INSTRUMENTATION
OPTIQUE
PHYSICO-CHIMIE
PHYSIQUE APPLIQUÉE
PHYSIQUE DES FLUIDES ET PLASMAS
PHYSIQUE DES PARTICULES
PHYSIQUE DU SOLIDE
PHYSIQUE GÉNÉRALE
PHYSIQUE MATHÉMATIQUE
PHYSIQUE NUCLÉAIRE
PHYSIQUE, AUTRES
SPECTROSCOPIE

ASTRO and GEO-SCIENCES
ASTRONOMIE ET ASTROPHYSIQUE
BIOLOGIE MARINE - HYDROBIOLOGIE
DIV. GÉOPHYSIQUE-GÉOCHIMIE
GÉOGRAPHIE
GÉOLOGIE
GÉOSCIENCES
GÉOTECHNIQUE
LIMNOLOGIE
MÉTÉOROLOGIE
MINÉRALOGIE
OCÉANOGRAPHIE
PALÉONTOLOGIE
RESSOURCES EN EAU
SCIENCES DE L'ENVIRONNEMENT
TECHNOLOGIES DE L'ENVIRONNEMENT

MULTIDISCIPLINAIRE

ENGINEERING
BIOCYBERNÉTIQUE
COMPOSANTS
REVUES DE SYNTÈSE EN INFORMATIQUE
CONTRÔLE
CONTRÔLE 2
ÉNERGIE ET CARBURANTS
GÉNIE MARITIME
GÉNIE AÉROSPATIAL
GÉNIE CHIMIQUE
GÉNIE CHIMIQUE ET THERMODYNAMIQUE
GÉNIE CIVIL
GÉNIE DE LA CONSTRUCTION
GÉNIE ÉLECTRIQUE ET ÉLECTRONIQUE
GÉNIE INDUSTRIEL
GÉNIE MÉCANIQUE
GÉNIE MÉTALLURGIQUE ET MINIER
GÉNIE MINIER
GÉNIE PÉTROLIER
INFORMATIQUE
INFORMATIQUE (DIVERS)
INFORMATIQUE ET CHIMIE
INFORMATIQUE ET ROBOTIQUE
INFORMATIQUE/APPLICATIONS
INFORMATIQUE/DIVERS 2
INFORMATIQUE/IMAGERIE
INFORMATIQUE/THÉORIE ET SYSTÈMES
INGÉNIERIE/SYSTÈMES
INTELLIGENCE ARTIFICIELLE
MÉCANIQUE
MÉTALLURGIE
PHOTOGRAPHIE, IMAGERIE
RECHERCHE OPÉRATIONNELLE
ROBOTIQUE
SCIENCE - TECHNOLOGIE NUCLÉAIRE
SCIENCES DE L'INFORMATION
SYSTÉMIQUE
TECHNOLOGIES MARINES
TÉLÉCOMMUNICATIONS
TÉLÉDECTION ET TÉLÉCONTROLE
SCIENCES ET TECHNIQUES DES TRANSPORTS

MATHEMATICS
MATHÉMATIQUES
MATHÉMATIQUES APPLIQUÉES
MATHÉMATIQUES GÉNÉRALES
MATHÉMATIQUES THÉORIQUES
MATHÉMATIQUES, AUTRES
MÉTHODES MATHÉMATIQUES (BIOLOGIE ET MÉDECINE)
MÉTHODES MATHÉMATIQUES (SCIENCES PHYSIQUES)
MÉTHODES MATHÉMATIQUES (SCIENCES SOCIALES)
STATISTIQUE ET PROBABILITÉS

N.B. The term “multidisciplinary” refers to the multidisciplinary journals of the Web of Science® for which Thomson Scientific has not affected a specific subject category.

XIV. Annex 3. Definition of the seven technological domains

Patents are very precisely classified according to a universally defined nomenclature, the Intellectual Patent Classification (IPC), used to describe the state of the art in technology. This classification has a hierarchical structure of several levels: 8 sections, 118 classes, 628 sub-classes and about 69 000 groups and sub-groups. The OST has, from this international classification, constructed a more appropriate, restrained, nomenclature in light of current technological strategies.

The table below provides the correspondence between the 7 defined technological domains and the IPC codes used at a sub-class level.

Technological domain	IPC Codes
1. Electronics - electricity	
	F21 ; G05F ; H01B,C,F,G,H,J,K,M,R,T ; H02 ; H05B,C,F,K
	G09F,G ; G11B ; H03F,G,J ; H04N,R,S
	G08C ; H01P,Q ; H03B,C,D,H,K,L,M ; H04B,H,J,K,L,M,Q
	G06 ; G11C ; G10L
	H01L ; B81
2. Instrumentation	
	G02 ; G03B,C,D,F,G,H ; H01S
	G01B,C,D,F,G,H,J,K,L,M,N,P,R,S,V,W ; G04 ; G05B,D ; G07; G08B,G ; G09B,C,D ; G12
	A61B,C,D,F,G,H,J,L,M,N
	G01T ; G21 ; H05G,H
3. Chemistry – materials	
	C07D,F,G,H,J
	C08B,F,G,H,,K,L ; C09D,J
	A01N ; C05 ; C07B ; C08C ; C09B,C,F,G,H,K ; C10B,C,F,G,H,J, K,L,M ; C11B,C,D
	B05C,D ; B32 ; C23 ; C25 ; C30
	C01 ; C03C ; C04 ; C21 ; C22 ; B22 ; B82
4. Pharmacy - biotechnologies	
	C07K ; C12M,N,P,Q,S
	A61K,P
	A01H ; A21D ; A23B,C,D,F,G,J,K,L C12C,F,G,H,J ;C13D,F,J,K
5. Industrial procedures	
	B01 ; B02C ; B03 ; B04 ; B05B ; B06 ; B07 ; B08 ; F25J ; F26
	B25J ; B41 ; B65B,C,D,F,G,H ; B66, B67
	A41H ; A43D ; A46D ; B28, B29 ; B31 ; C03B ; C08J ;C14; D01 ; D02 ; D03, D04B,C,G,H ; D06B,C,G,H,J,L,M,P,Q ; D21
	A62D ; B09 ; C02 ; F01N ; F23G,J
	A01B,C,D,F,G,J,K,L,M ; A21B,C ; A22 ; A23N,P ; B02B ; C12L ; C13C,G,H
6. Machines – mechanics - transports	
	B21 ; B23 ; B24 ; B26D,F ; B27 ; B30
	F01 (sauf F01N) ; F02 ; F03 ; F04 ; F23R
	F22 ; F23B,C,D,H,K,L,M,N,Q ; F24 ; F25B,C ; F27 ; F28
	F15 ; F16 ; F17 ; G05G
	B60 ; B61 ; B62 ; B63B,C,H,J ; B64B,C,D,F
	B63G ; B64G ; C06 ; F41 ; F42
7. –Consumer goods - Construction	
	A24 ; A41B,C,D,F,G ; A42 ; A43B,C ; A44 ; A45 ; A46B ; A47 ; A62B,C ; A63 ; B25B,C,D,F,G,H ; B26B ; B42 ; B43 ; B44 ; B68 ; D04D ; D06F,N ; D07 ; F25D ; G10B,C,D,F,G,H,K
	E01 ; E02 ; E03 ; E04 ; E05 ; E06 ; E21

XV. List of Tables