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ERAWATCH Country Report 2008
An assessment of research system and policies

France

Patrick Eparvier, Nicolas Turcat, Antoine Schoen, Gerard Carat and Jan Nill

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ERAWATCH
COUNTRY REPORT 2008
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ERAWATCH Network - Technopolis France

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Executive summary

Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU's economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development, with a particular focus on the private sector.

As part of ERAWATCH, the JRC-IPTS is producing analytical country reports to support the mutual learning process and the monitoring of Member States' efforts. The main objective of the reports is to characterise and assess the performance of national research systems and related policies in a structured way that is comparable across countries. In order to do so, the analysis focuses on key processes relevant to system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. This analytical approach was tested in 2007 by applying it to a number of countries, of which France is one. This report is based on a synthesis of information from the ERAWATCH Research Inventory and other important publicly available information sources.

Strong scientific traditions and a sustained public support for research have created favourable framework conditions for the French R&D system. The French system has been marked by some quite specific responses to generic challenges, as summarised in the table on its strengths and weaknesses below.

Domain	Challenge	Assessment of system strengths and weaknesses
Resource mobilisation	Securing long-term investment in research	Well established mechanisms and high volume of public long-term investment in R&D
	Dealing with barriers to private R&D investment	Private resource mobilisation for R&D is stagnating and still mainly dependent on a few large companies, a pattern reinforced by public funding Significant increase in the public R&D support to the private sector
	Providing qualified human resources	Unattractive career prospects for researchers may discourage good students from choosing a scientific career and thus weaken the human resource base
	Justifying resource provision for research activities	Strong public debate on, and support for, resource provision for R&D
Knowledge demand	Identifying the drivers of knowledge demand	Strong mechanisms to identify knowledge demand drivers Increase involvement of industry in the definition of the strategy of the research programmes and of the Universities (in the context of the Law for autonomy of Universities)
	Channelling knowledge demands	The main sectors' established knowledge demands are well covered by public support mechanisms, but limited capacity for strategic steering and co-ordination of knowledge demands is restricting adaptation to changing needs beyond established strategic areas
	Monitoring demand fulfilment	If fully implemented, the use of evaluation (of research programmes and research units as benchmarks in the contract process between the State and research organisations) could strengthen the research system

Domain	Challenge	Assessment of system strengths and weaknesses
Knowledge production	Ensuring quality and excellence of knowledge production	Low demand for research outcomes from potential new companies Domains of world level scientific and technological excellence exist, but are often specialised in stable/mature research fields
	Ensuring exploitability of knowledge	Sector-specific research institutions ensure that knowledge production links up with economic uses in those sectors, whereas mechanisms to ensure the exploitability of general scientific knowledge production are less well developed
Knowledge circulation	Facilitating circulation between universities, public research organisations and business	Poor knowledge circulation between academic research (universities/CNRS) and business
	Profiting from international knowledge	High degree of internationalisation of scientific research
	Enhancing the absorptive capacity of knowledge users	A highly qualified labour force is available; however, the entrepreneurial and innovation culture, as well as SMEs' participation in R&D, are limited

There are highly centralised mechanisms of resource mobilisation for R&D by central government and a few large firms. Knowledge demands and the production of excellent and economically useful knowledge have tended to focus on a relatively small number of strategic fields and sectors.

However, a changing environment and rigidities in the existing system mechanisms have also revealed some weaknesses, such as a recent stagnation of private resource mobilisation, a poor outlook for boosting human resource mobilisation for R&D, scientific and technological specialisation in somewhat mature fields, and weak knowledge circulation beyond strategic sectors. Several assessments have expressed a need for a reform for the French research system. A consensus on the need for reforms has emerged. This said, the agreement on the need for reforms does not mean that there is agreement on how the system should be reformed.

In the last few years, a range of governance changes and new policies have been implemented, which have created opportunities for new and better responses to the weaknesses and specific challenges described (see overview table below).

Domain	Main policy-related opportunities	Main policy-related risks
Resource mobilisation	• Research is higher in the policy agenda than it was in the past • Additional public funds, mainly through increased competitive project funding • New incentives to support young firms performing research	• Measures might not be sufficient to reach Barcelona/Lisbon objective for private R&D • Disagreement between the Government and researchers on the most desirable structuration of the public research system and on the governance mechanisms

Domain	Main policy-related opportunities	Main policy-related risks
Knowledge demand	• Enhancement of strategic steering, e.g. through the increased role for the Ministry in charge of research, could help channel and meet society's demands more effectively • Increase in the policy mix due to efficient inter-Ministerial relationships • Improvement of research programming e.g. through the new Agency for Research and an increase in project-based competitive funding so as to enhance openness to changing needs	• Effectiveness of new institutional arrangements (so far a limited role of the High Council for Science and Technology (HCST) remains to be proven • Criticisms on the Governmental willingness to increase the strategic role of the State on the definition of research priorities • Distribution of responsibilities between the State and the Regions not always clear
Knowledge production	• Combination of new network oriented instruments, competitive basic research funding and modernisation of university management to strengthen excellence and increase the effectiveness of public funding • Competitiveness clusters strengthen orientation of knowledge production towards economic uses beyond strategic sectors	• Complexity and strong thematic focus of policy measures might not be beneficial for excellence emerging from new cross-cutting scientific opportunities • Implementation may partly be blocked by the research community • Policy measures oriented towards existing regional strengths might not be sufficient to prevent a loss of leadership in the fast growing technological areas
Knowledge circulation	• Development of promising instruments to increase diffusion of knowledge: newly created Competitiveness Clusters and Carnot Institutes may bridge the persisting gap between academia and business	• Current measures might not be sufficient to overcome the low private R&D investments

The Innovation Plan presented by the Ministry in charge of research in 2003 initiated the reform of the research system. Since 2003, significant measures have been taken by the Government to overcome the weaknesses of the French research system:

- **Increase in the public R&D expenditures**. For the 2009 budget, the public resources for higher education and research, would reach €27.6b. This includes the MIRES (Inter-ministerial Mission for Research and Higher Education) budget, the funding agencies, and also the estimated volume of fiscal measures. The MIRES budget allocation is €24.6b (against €21.3b in 2007 and €23.4b in 2008).
- **Enhancement of competitive research funding mechanisms**. In 2007, the ANR budget reached €800m and was expected to reach €950m in 2008 which represented a total of €1.8b between 2005 and 2007 for 4500 projects funded (2008 NRP).
- **Change in the evaluation system** with the creation of the Agency for the Evaluation of Research and Higher Education (AERES) which, among other things, unites the missions that were formerly in the hands of other bodies.
- **Creation of an *ad hoc* structure for public-private partnerships (Competitiveness Clusters)** with an increased focus put on the participation of SMEs in the last years.

- **Reinforcement of contractual research between public and private actors (**creation of Carnot Institutes)

Since 2008, OSEO innovation is in charge of the measure initially managed by the Agency for Industrial Innovation. Originally, the measure was aimed at supporting and subsidising large pre-competitive programmes for industrial innovation. Networking between large firms and SMEs had a crucial role. However, in order to reinforce the participation of SMEs in these programmes, the management of the measure was given to OSEO innovation. The original objective to support structuring and large projects was then abandoned. Now, the goal is to support innovative projects of smaller size based on R&D. The maximum amount that can be granted is €10m. The budget for 2008 for these projects was earmarked at €300m.

From a rhetoric point of view, European issues have always received a strong emphasis. Until very recently, the ERA dimension as far as research is concerned was always mentioned as a crucial issue for the French policy. In practice however, the actual articulation between the national and the EU policies was questionable. To name but an example, the Pact for Research devoted a whole chapter to the ERA dimension, the last chapter. One might have expected a more transversal concern and a reference to the ERA dimension in each and every chapter.

The increasing importance of the ERA in the daily life of the researchers, the companies and the research institutions has changed the situation. Awareness of these actors of the role of the ERA has increased. Now, the ERA dimension is considered as the shaping element of every research activity and as a matter of fact has gained more attention from the State/research institutes than in the past.

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1 - Introduction and overview of analytical framework

1.1 Scope and methodology of the report in the context of the European Research Area and the Lisbon Strategy

As highlighted by the Lisbon Strategy, knowledge accumulated through investment in R&D, innovation and education is a key driver of long-term growth. Research-related policies aimed at increasing investment in knowledge and strengthening the innovation capacity of the EU economy are at the heart of the Lisbon Strategy. The strategy reflects this in guideline No. 7 of the Integrated Guidelines for Growth and Jobs. This aims to increase and improve investment in research and development (R&D), with a particular focus on the private sector. One task within ERAWATCH is to produce analytical country reports to support the mutual learning process and the monitoring of Member States' efforts.

The main objective is to analyse the performance of national research systems and related policies in a comparable manner. The desired result is an evidence-based and horizontally comparable assessment of strength and weaknesses and policy-related opportunities and risks. A particular consideration in the analysis is given to elements of Europeanisation in the governance of national research systems in the framework of the European Research Area, relaunched with the ERA Green Paper of the Commission in April 2007.

To ensure comparability across countries, a dual level analytical framework has been developed. On the *first level*, the analysis focuses on key processes relevant to system performance in four policy-relevant domains of the research system:

1. Resource mobilisation: the actors and institutions of the research system have to ensure and justify that adequate public and private financial and human resources are most appropriately mobilised for the operation of the system.
2. Knowledge demand: needs for knowledge have to be identified and governance mechanisms have to determine how these requirements can be met, setting priorities for the use of resources.
3. Knowledge production: the creation and development of scientific and technological knowledge is clearly the fundamental role of a research system.
4. Knowledge circulation: ensuring appropriate flows and distribution of knowledge between actors is vital for its further use in economy and society or as the basis for subsequent advances in knowledge production.

These four domains differ in terms of the scope they offer for governance and policy intervention. Governance issues are therefore treated not as a separate domain but as an integral part of each domain analysis.

On the *second* level, the analysis within each domain is guided by a set of generic "challenges" common to all research systems that reflect conceptions of possible bottlenecks, system failures and market failures (see figure 1). The way in which a specific research system responds to these generic challenges is an important guide

for government action. The analytical focus on processes instead of structures is conducive to a dynamic perspective, helps to deal with the considerable institutional diversity observed, and eases the transition from analysis to assessment. Actors, institutions and the interplay between them enter the analysis in terms of how they contribute to system performance in the four domains.

Figure 1: Domains and generic challenges of research systems

Resource mobilisation	Knowledge demand	Knowledge production	Knowledge circulation
• Justifying resource provision • Long term research investment • Barriers to private R&D funding • Qualified human resources	• Identification of knowledge demand drivers • Co-ordination of knowledge demands • Monitoring of demand fulfilment	• Quality and excellence of knowledge production • Exploitability of knowledge production	• Knowledge circulation between university, PRO and business sectors • International knowledge access • Absorptive capacity

Based on this framework, analysis in each domain proceeds in the following five steps. The first step is to analyse the current situation of the research system with regard to the challenges. The second step in the analysis aims at an evidence-based assessment of the strengths and weaknesses with regard to the challenges. The third step is to analyse recent changes in policy and governance in perspective of the results of the strengths and weaknesses part of the analysis. The fourth step focuses on an evidence-based assessment of policy-related risks and opportunities with respect to the analysis under 3) and in the light of Integrated Guideline 7; and finally the fifth step aims at a brief analysis of the role of the ERA dimension.

This report is based on a synthesis of information from the European Commission's ERAWATCH Research Inventory[1] and other important publicly available information sources. In order to enable a proper understanding of the research system, the approach taken is mainly qualitative. Quantitative information and indicators are used, where appropriate, to support the analysis.

After an introductory overview of the structure of the national research system and its governance, chapter 2 analyses resource mobilisation for R&D. Chapter 3 looks at knowledge demand. Chapter 4 focuses on knowledge production and chapter 5 deals with knowledge circulation. Each of these chapters contains five main subsections in correspondence with the five steps of the analysis. The report concludes in chapter 6 with an overall assessment of strengths and weaknesses of the research system and governance and policy dynamics, opportunities and risks across all four domains in the light of the Lisbon Strategy's goals and the ERA.

[1] ERAWATCH is a cooperative undertaking between DG Research and DG Joint Research Centre and is implemented by the IPTS. The ERAWATCH Research Inventory is accessible at http://cordis.europa.eu/erawatch/index.cfm?fuseaction=ri.home. Other sources are explicitly referenced.

1.2 Overview of the structure of the research system and its governance

At government level, the Ministry in charge of research coordinates research policy. Six other ministries have competences for certain areas of research. Inter-ministerial co-ordination takes place formally in the Inter-Ministerial Committee for Scientific and Technical Research (CIRST, *Comité interministériel de la recherche scientifique et technologique*), run by the Ministry in charge of research and chaired by the prime minister. There is also a range of consultative bodies (see figure 1 below). Besides the Ministry in charge of research, the Ministry of Economy, Finances and Employment, which is responsible for industrial research and energy research, has a specific role to play in relation to research through the agencies that are under its auspices. These are*:*

- The National Agency for Research, which was created in 2005[2] to fund basic research projects on a competitive basis. It is under the aegis of the Ministry in charge of research, but the Ministry of Education, the Ministry of Health, the Ministry of Budget and the Ministry of Economy, Finances and Employment are represented on the Executive Board too.
- OSEO innovation (called OSEO Anvar from 2005 to 2006 and ANVAR before 2005), which provides SMEs with support for R&D and innovation projects. The Agency for Industrial Innovation (AII), which was created in 2005 in order to strengthen cooperation between large firms and SMEs on pre-competitive research activities, has been dissolved in 2008. Its duties have been given to the OSEO innovation since. Whereas the projects funded by the Agency for Industrial Innovation were “large programmes”, OSEO innovation now has the responsibility for projects involving medium enterprises. The rationale for the inclusion of the AII objectives into OSEO innovation was precisely to increase the emphasis put on the medium enterprises and to increase the number of gazelles[3] in France.

The most important public research performers in terms of funds are higher education institutes, which comprise 82 universities (as counted by the Conference of Universities’ Chairmen) and the “grandes écoles” (See section 2.1.3).

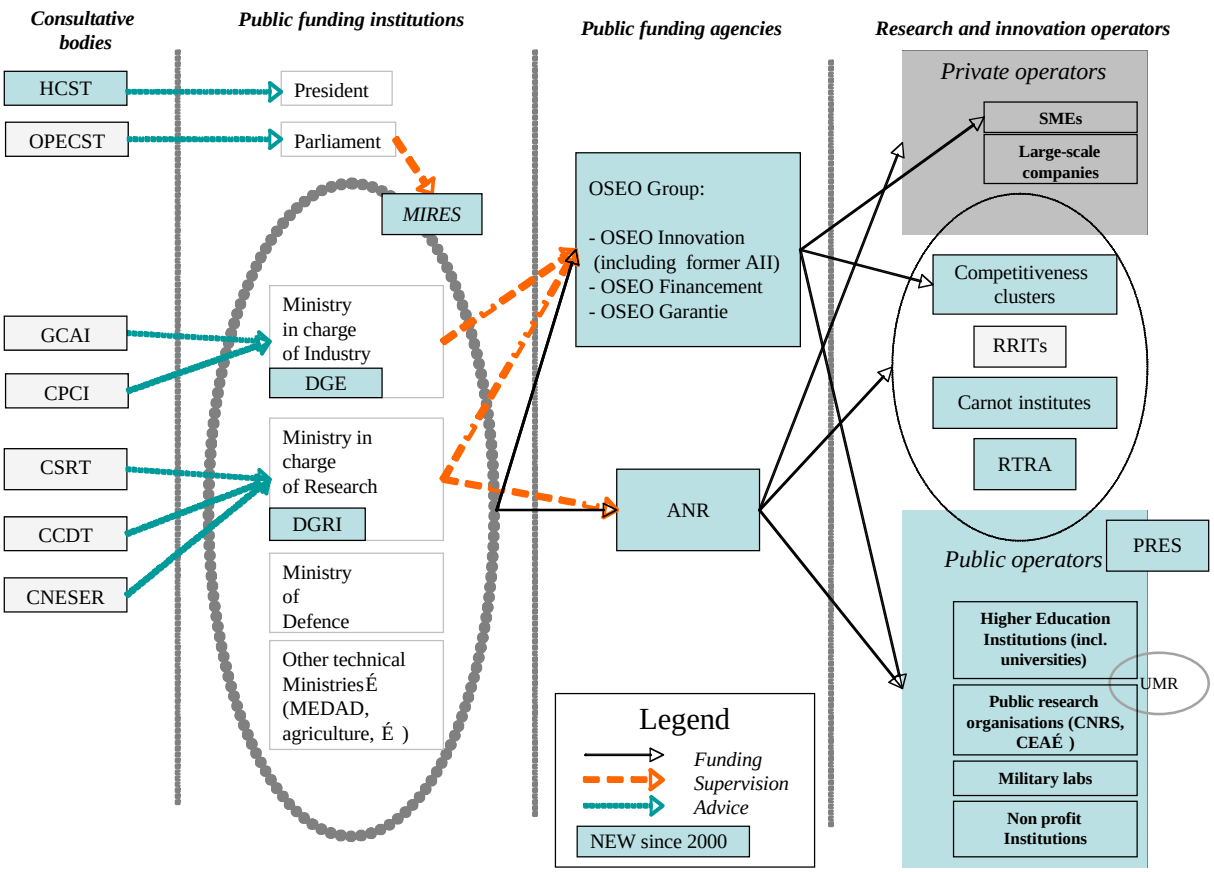
Alongside the higher education institutes, research is also carried out by public research organisations (PROs). PROs were given their specific status in 1982 by the Law of Orientation and Programming of Technological Research and Development (*Loi d’orientation et de programmation de la recherche et du developpement technologique*), which has subsequently been amended several times. PROs are divided into two categories, EPIC (*Etablissement public à caractère industriel et commercial* – Industrial and trade-related public institute) and EPST (*Etablissement public à caractère scientifique et technologique* – Scientific and technological public institute). The main principle is that the PROs are under the supervision of one Ministry, in accordance with the research area, that is in charge of orienting its strategy.

The main PRO is the National Centre for Scientific Research (*Centre National de la Recherche Scientifique* – CNRS). The CNRS is a publicly-funded research

[2] The decree of August 1, 2006 defines its organisation and functioning. On January 1, 2007, the ANR was made an administrative public institute (EPA - *Etablissement public administratif*).
[3] Cf. section 2.4

performing organisation that defines its mission as producing knowledge and making it available to society (See also section 2.1.1). Other large PROs include the National Institute for Agronomic Research (*Institut national de la recherche agronomique* - INRA), the National Institute for Computer Science and Automation (*Institut national de recherche en informatique et en automatique* - INRIA), the National Institute for Health and Medical Research (*Institut national de la santé et de la recherche médicale* - INSERM), and the Atomic Energy Commission (*Commissariat à l'énergie atomique* - CEA).

Figure 2: Main institutions of the French Research System



Source: ERAWATCH Research Inventory, Technopolis France
For acronyms used in the figure which are not explained in the text see the list of abbreviations

The relationships between the State and the regions are organised through the State Region Plan Contract (*Contrat de Plan Etat Région* – CPER) which covers a period of several years. During both the negotiation phase and the follow-up of the Contract, the State is represented by the Secretariat General for Regional Affairs (*Secrétariat Général pour les Affaires Régionales* - SGAR). The Plans Contracts define the financial aid provided by the State in accordance with its objectives. Research forms an explicit chapter in these contracts, which have been renewed for the period 2007-2013 under the name State-Regions Project Contracts. In 2003, the regional budgets for R&D accounted for 4.1% of total public R&D expenditures. In 2007, the Regions have spent €465m on research and technological transfers[4].

[4] For further information and metadata, see:
http://cisad.adc.education.fr/reperes/public/chiffres/france/reg.htm

2 - Resource mobilisation

The purpose of this chapter is to analyse and assess how challenges affecting the provision of inputs for research activities are addressed by the national research system: its actors have to ensure and justify that adequate financial and human resources are most appropriately mobilised for the operation of the system. A central issue in this domain is the long time horizon required until the effects of the mobilisation become visible. Increasing system performance in this domain is a focal point of the Lisbon Strategy, guided by the Barcelona objective of a R&D investment of 3% of GDP in the EU as a whole and an appropriate public/private split.

Four different challenges in the domain of resource mobilisation for research can be distinguished which need to be addressed appropriately by the research system and research policies:

- Securing long-term investment in research
- Dealing with uncertain returns and other barriers to private R&D investment
- Providing qualified human resources
- Justifying resource provision for research activities

2.1 Analysis of system characteristics

In terms of R&D expenditure, France has the second largest research system in the EU. France's GERD amounted to €37.8b in 2006, which accounted for 18.1% of EU-27 expenditure in this field. France belongs to a group of Member States which experienced declining average R&D intensities between 2000 and 2005 (European Commission, 2007a)[5]. However, with a ratio of GERD to GDP of 2.09% (2006), France is still above the European average (1.84%), although the R&D intensity is considerably lower than in the early 1990s (e.g. 2.38% 1992). The share of GERD financed from abroad culminated in 2004 (8.8% against 8.0% in 1993) but has decreased since: it represented 7.4% in 2005 and even 6.8% in 2006 (according to the non-definitive figures)[6].

2.1.1 Justifying resource provision for research activities

Like most developed countries, economic development is one the main stated goals of the French government to justify public support for R&D. And science is considered to be instrumental in achieving this goal. The central role played by science in France in military and nuclear matters should not be overlooked, however. This was recently illustrated by the strong effort made to ensure the ITER reactor would be developed in France[7].

In the past, successive conservative governments have increased the emphasis put on research policies, continuing the process begun by the Socialist Government in 1997. This testifies of the common importance put on research among governmental

[5] Other countries in this group are: the United Kingdom and the Benelux countries of Belgium, the Netherlands and Luxembourg.
[6] http://cisad.adc.education.fr/reperes/public/chiffres/france/gene.htm
[7] ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power (see http://www.iter.org).

parties. The reform of the research and innovation system is nowadays one element of the Government's overall reform strategy. It is worth noting that research policy matters have recently been put higher on the government agenda, especially with the 2006 Law for Research which provides measures to enforce strategic orientation capabilities by creating a High Council for Science and Technology and bolstering the powers of the existing National Agency for Research. The fact that the research portfolio has been promoted - after the 2007 presidential election - within the remit of a fully-fledged Ministry may be confirmation that R&D policy is now taking a central position within the French Government's priorities.

This political focus on R&D public support stems largely from a national movement, called 'Let's Save Research' ('*Sauvons la recherche'*), kicked off in 2003. Concerned by the perceived decline of the French research system, some researchers chose to voice their worries to the press and to put pressure on the Government regarding the design of the promised Law for Research. In 2004, PROs' directors launched national discussions in order to gather researchers' and ordinary citizens' concerns and suggestions. Discussions and meetings organised from March to October 2004 culminated in the publication of a report aimed at synthesising research community's point of view on research policies (Etats Généraux de la recherche, 2004). The movement is still active nowadays.

The importance accorded to research is also reflected in the share of GBAORD in the total government budget (1.91% 2006), which is higher than the EU-27 average of 1.62% (2006), although a small increase can be observed here (from 1,81 to 1,91% between 2005 to 2006).

2.1.2 Securing long-term investment in research

While financing 38.4% in 2006 of all R&D performed in France, the Government is still the main actor in mobilising resources for long-term investments in research and corresponding infrastructures. All public resources for higher education and research are secured in the form of yearly inter-ministerial budgets. In 2006, for the first time, the State Budget was defined according to the 2001 Constitutional bylaw on the Finance Acts (*Loi organique relative à la loi de finances* - LOLF), including the setting of objectives and corresponding missions and programmes. As far as research policies are concerned, the Constitutional bylaw on the Finance Acts identifies one inter-ministerial mission (MIRES: Inter-ministerial Mission for Research and Higher Education - *Mission interministérielle recherche et enseignement Supérieur*).

Contractual arrangements between the State and universities or public research organisations have traditionally been an important funding mechanism for securing long-term investment in research. These contracts guarantee resources for four years and a statute whereby most of the researchers at the PROs (whose mission is mainly scientific) and teacher-researchers have life-long contracts. An important share of publicly financed GERD[8] is performed by the government sector (37,4% in 2005), while that performed by higher education was 47% and the share performed by the business sector was 15%. Figure 2 below illustrates the important role of the government sector and its components on the basis of disaggregated national data on expenditures of the public sector in 2003[9]. CNRS is the largest of the EPSTs and

[8] i.e. funded by the government plus the higher education sector
[9] latest available figures on this level of disaggregation

also the largest PRO in Europe, with 32,000 employees of which 26,000 are CNRS tenured employees (11,600 researchers; 14,400 engineers and support staff), and an annual budget which represents a quarter of French public spending on civilian research. Another established mechanism for securing long term investments have been large research programmes (see also section 3.1.2).

Table 1: R&D expenditures of the Public sector in 2006 (million €)

Government expenditures (civil + defence)			**6,254**	**44%**
	S&T public institutes (EPST) excluding CNRS and Institutes	1,654		12%
	Industrial and Commercial public institutes (EPIC)	3,443		25%
	Administrative public institutes (EPA), excluding "*grandes écoles*" which are not under the aegis of the Ministry of Education and ministerial services	162		1%
Defence		885		6%
Higher education			**7,279**	**52%**
	CNRS	2,689		19%
	Universities and other higher education institutes	4,360		32%
Private non profit			**461**	**3%**
Total			**13,994**	

French recipients received about €1.7b for the European 6th Framework Programme (ANRT, 2007) as a whole[10]. According to MENESR-DEP data, European Union funding represented 14% of funding from abroad in 2003 (€406m) and hence only around 1% of total R&D funding. France is also a major stakeholder in shared research infrastructure facilities such as ESA, the European Space Agency (as one of its ten founding members), CERN, etc. This is reflected in the fact that funding from other international organisations exceeded the EU funds and represented 24% of funding from abroad in 2003 (€675m).

To sum up, basic mechanisms for securing long-term investment in research in France are well established and functioning effectively. This is also underpinned by the government appropriations for R&D. In 2006, in France, GBAORD, expressed as a percentage of GDP, amounted to 1.01%, well above the European (EU 25) average (0.75%). Also the moderate growth in the share of basic research over the period 1993-2003, reaching 24.1% of GERD in 2003, points in this direction (ERAWATCH Network, 2006).

However, total public funding of R&D has grown slower over the last 10 years as compared to the GDP (34% against 41%), with growth being restricted to research performed in the higher education sector. The recent reforms of the Research Tax Credit would normally decrease this share for the last couple of years and for the future. For 2008, the Government expects €3.9b (according to the fresh 2008 National Reform Program of France) of tax credit (in comparison with the €489m in 2002 and the €1.5b in 2005).

[10] For comparison, according to ANRT (2007) Germany, UK and Italy received respectively for the same period: €2.512b, €1.635b and €1.163b.

2.1.3 Dealing with uncertain returns and other barriers to business R&D investment

In 2006, the private sector financed 52.5% of GERD in France, a share which has declined since 2001. This share is lower than in countries such as Germany, the UK and the US. As large firms can cope better with the risk and long time horizon of R&D investments, it is not surprising that business R&D is concentrated among large companies, as shown in figure 3 below: more than 75% of R&D is performed in firms with more than 500 employees and more than half (56%) is conducted by companies with more than 2000 employees (which represent 3% of the workforce). According to the 2007 EU R&D Investment Scoreboard, the largest French R&D investor is Sanofi-Aventis, followed by Renault, Peugeot (PSA) and Alcatel-Lucent (European Commission, 2007).

In 2006, large firms concentrated more than one third (39%) of R&D expenditures. This share has remained constant over the past years (it already reached 38,2% in 2000). The smallest firms (less than 500 employees) spent one fourth (26%) of the total R&D expenditures of the private sector in 2006 (this share was 20,3% in 2000). This evolution shows indeed an increasing role played by the smallest firms, which is very positive. If the European definition of a SME is used, the share shrinks to 14.1% (2002) which is below EU25 average.

Table 2: BERD and size distribution of firms in 2006

Number of employees	% of total	R&D expenditures (in million €)	% of total R&D expenditures	Public funds (in million €)	% of total public funds
Less than 500	90%	6 196	26%	466	17%
500-999	5%	2 137	9%	189	7%
1000-1999	3%	2 814	12%	232	8%
2000-4999	1%	3 341	14%	1 175	43%
5000 or more	1%	9 426	39%	678	25%

Source: MENESR – DEPP

R&D investment by large multinational firms plays an important role in resource mobilisation. Despite a slight decrease in its share of the world's total (from 8.8% 1995 to 8.2% in 2001), France has remained an attractive location for investments in manufacturing R&D by firms under foreign control (OECD 2005). If more than 10% of business R&D was financed from abroad, it was only 8,8% in 2004.

In order to help businesses deal with the uncertain returns from R&D investment, government support for private R&D is well established, both in the form of public funds and tax incentives (see section 2.3). Public funding of R&D executed by business amounted to €2b in 2005, although it represented 10% of total BERD (ERAWATCH Research Inventory, 2007). Public funding of BERD in 2001 was predominant in three sectors: aerospace, machinery and instruments (ERAWATCH Network, 2006). This is partly related to defence. However, the share of defence related R&D has fallen considerably the last 20 years. Defence contracts used to represent 18.5 % of BERD in 1982, but this had dropped to 13.3% by 1992 and was only 7.4% in 2003. The distribution of public funds is clearly biased towards the largest companies, to the detriment of small businesses: SMEs received 17% of

public funds whereas they performed 24% of companies' R&D, while companies with more than 2000 employees captured two thirds (68%) of public funds (see figure 3).

Other non-State financing mechanisms, such as venture capital or foundations, have for a long time played a minor role, but are increasing in importance. In 2006, funds raised through venture capital-investment have reached a volume of €536m, steadily increasing since 2003 (SESSI, 2006). The European Innovation Scoreboard 2005 figures on early-stage venture capital put France 14% above the EU average. Nevertheless, the French figure (0.029% of GDP) is below that of Sweden, Finland or Denmark (0.081%, 0.065% and 0.063%, respectively, in 2003) (European Trend Chart on Innovation, 2006).

Remarkable measures have been taken in order to support SMEs. This started with the creation of the OSEO Group in 2005. In 2008, €5b were budgeted for the support of SMEs through guaranties and co-funding. Another noticeable initiative corresponds to the SME Pact that was launched in 2006. It can be seen as a first attempt to go against the SMEs' lack of recognition of their role in the innovation system and in the creation and diffusion of new technologies. The SME Pact is undeniably a reply to this but seems nevertheless not ambitious enough to overcome the insufficient role played by the SME in the innovation system.

In 2003, the legal framework governing Research Foundations was modified in order to strengthen the position of existing foundations and to support the creation of new foundations devoted to research. For instance, 60% of donations by individuals to Research Foundations may be deducted from income tax up to the limit of 20% of taxable income. As far as companies are concerned, 60% of donations are eligible up to the limit of 0.5% of their turnover. Furthermore, in order to simplify administrative procedures for the creation of a Research Foundation, status models were designed for the General Assembly and for the Monitoring Council. There is however no evidence that the measure enabled an increasing trend of creation of Foundations.

To sum up, private resource mobilisation for R&D relies to a significant extent on a few large, often partly state-owned, companies. Low private R&D investment – at least in comparison with other leading research systems - has been assessed as weakness of the French system for quite some time (e.g. Eparvier, 2007) and has subsequently been addressed by policies. The share of GERD financed by the business sector as a percentage of GDP amounts to 1.11% (2004), above the EU 27 average of 1.01% (2004) but has been declining recently, due to a near stagnation of private R&D funding between 2001 and 2004.

2.1.4 Providing qualified human resources

In 2006, the number of students enrolled in the higher education system reached about 2.2 million, a figure which has risen by about 6% since 1999. Within this overall rise, it is possible to distinguish between a growth of 18% for the engineering degrees, growth of just 1% in generalist university education and a decrease of 1% at some technical institutes (IUT: *Instituts universitaires de technologie*). Social and Human Sciences attract the bulk of this still growing population of students. They account for about 943,000 students, whereas 543,000 persons were studying natural sciences (including life sciences) (OST, 2006a).

Compared with the EU 25 average, France has a high proportion of S&T graduates, with more than 20 graduates per thousand population aged 20-29. However, for reasons discussed below this does not translate into a similarly high share of S&T related PhDs. In 2005, the French higher education system awarded about 9,600 PhD degrees, as compared with 23,000 in Germany and 15,000 in the UK and 91,000 in the EU 25 as a whole (OST, 2006a).

At the doctorate level, France appears to be relatively attractive for foreign researchers as 25% of PhD degrees are awarded to foreign students. PhD Degrees are more attractive to foreign students (12%) than French students (3.6%).

In 2005, the number of researchers in France (in full time equivalent terms) reached almost 357,000, which represents a rise of 35% in 5 years. Researchers working for the private sector represented 52.2% of this growing population of knowledge workers, compared with 46.5% ten years earlier (OST, 2006a).

Despite this expansion, French governments have regularly emphasised (for instance in the recent Pact for Research, which sets out the main challenges that the research system is assumed to be facing) the need to provide researchers (particularly young researchers) with good conditions in which to work in the public research system, as many people find research careers unattractive. According to a Ministry in charge of research ' statement about the implementation of the Pact for Research, PhD student's status would be improved through measures such as current PhD education reforms, increasing research assignment or enhancement of professional integration.

This lack of attractiveness is partly due to a characteristic specific to France, namely the dual tertiary education system – in science, engineering and management - with universities on the one hand and *grandes écoles* on the other. The "*Grandes écoles*" are uniquely French institutions that offer specialised education of a high standard. This high standard is reflected in the strict admission requirements. The *grandes écoles* generally offer high-quality educational programmes and excellent career prospects. Some of the *grandes écoles* are also planning to run doctorates. However, their role in research and innovation is limited compared to that of universities (Veltz, 2007).

The outlook for a young person with a university degree in science, engineering and management is on average much less favourable than that of someone leaving the education system with an engineering or business school qualification acquired in a *grande école*, especially one of the leading *grandes écoles*. One result of this is that French firms are not in the habit of employing PhDs, preferring instead to recruit graduates from the leading *grandes écoles*. The situation is quite different in the health sciences, in the humanities, in law or in the social sciences, however, where universities are the leading teaching institutions. The five larger institutions of higher education in engineering – INPG, INPL, INPT, Insa Lyon and UT Compiegne – operate as universities although they select their students in the same way as the *grandes écoles*.

There are also a range of measures in place to address the human resource mobilisation challenges, e.g. CNRS PhD grants for engineers or post PhD recruitment (*Recrutements de post-doctorants*) at the CNRS. In order to induce companies to support research by young researchers and technicians', specific instruments have been implemented, too, such as the support for the recruitment of PhD candidates on an applied research project within an enterprise - CIFRE

convention. According to an ANRT study about the CIFRE supported students' careers, 75% of the students find a steady work less than 3 months after the graduation (Technopolis France 2008). Initiatives in this area also include a post-PhD initiative programme (*Programme initiative post-doc*), which started in the wake of the innovation plan to support French PhDs obtaining a postdoctoral fellowship abroad to ease their return to France. Reflections about the attractiveness of careers have also been lead by Schwartz and Hoffmann Committees (Academy of Science). Hoffmann report released in July 2008 was followed up by the recent plan for improving attractiveness of careers in HE and research announced by government on 20 October 2008

Finally, the Law of autonomy for universities passed in Fall 2007 is aimed at strengthening the linkages between Universities training and industry needs. Industry participation in the governing board has been increased in order to better articulate training with the industrial needs. The possibility for the (local) industry to voice its needs in terms of competences to the supplier of S&T human resources is seen as a major progress towards stronger coherence between supply and demand of human resources. To be complete, one should emphasis that the influential role assigned to industry in the definition of the competences of the young trainees is not supported by everyone. Criticisms were raised in the name of the diplomas' equality throughout the French higher educations.

2.2 Assessment of strengths and weaknesses

The main strengths and weaknesses of the French research system in terms of resource mobilisation for R&D can be summarised as follows:

Strengths	Weaknesses
• Well established mechanisms and high volume of public long-term investment in R&D • Strong public debate on support for providing resources for R&D • Significant increase in the public R&D expenditures for the private sector	• Poor career prospects for researchers may discourage good students from choosing a scientific career and weaken the human resource base • Private resource mobilisation for R&D is stagnating and still mainly dependent on a few large companies, a pattern reinforced by public funding

France benefits from well-established mechanisms and high volume of public long-term investment in R&D. There is agreement on the needs to perpetuate the efforts in the future. For instance, public research expenditures are already close to the fatidic 1% of GDP.

There is also consensus on the necessity for the industry to enhance its R&D efforts. Public expenditures devoted to private R&D have significantly increased in the past (as a consequence of the reforms of the Research Tax Credit in particular). But the private sector is definitely the weakest link of the research and innovation system to that regard. French companies in general and small/medium companies in particular do not devote sufficient resources to R&D.

As a consequence, the demand for high level skills remains relatively low. Along the limited opportunities in the public sector, this negatively impacts on the choice for a scientific career by the young people. This might become a dramatic issue in the future when the baby-boomer researchers will all have retired.

To that regards, the willingness of the Government to increase the participation of the industry in the governing board of the Universities (in the context of the Law for Autonomy of Universities passed in Fall 2007) is a promising attempt to increase the linkages between science and industry. The actual impact cannot obviously be estimated at the time being. Furthermore, one cannot expect an effect in the short term.

2.3 Analysis of recent policy changes

The Innovation Plan presented by the Ministry in charge of research in 2003 initiated the reform of the research system. Expected to be launched in the second quarter of 2005, the bill was slightly delayed from the original schedule. Two of the six priorities of the Pact for Research relate to resource mobilisation challenges, aiming at supporting enterprises' research efforts and making scientific careers more attractive. One element of this reform, which culminated in the 2006 Law for Research, was a commitment to increase public R&D funding and to achieve the 3% goal by 2010 (Republique Francaise, 2006). The achievement date of this target was delayed two years to 2012 in the course of 2007.

For the 2009 budget, the public resources for higher education and research, would reach €27.6b. This includes the MIRES (Inter-ministerial Mission for Research and Higher Education) budget, the funding agencies, and also the estimated volume of fiscal measures. The MIRES budget allocation is €24.6b (against €21.3b in 2007 and €23.4b in 2008). In 2007, the MIRES' distribution of resources among the 13 programmes and 3 groups was as follows:

1. Programmes under the aegis of the Ministry in charge of research, mainly bringing together the PROs (EPST and EPIC) along with the Agency for Research, with a budget of €6.3b. The funding agencies' budget was increased by €280m: €235m for ANR (with a €825m budget), and €45m for OSEO innovation (which has a €160m budget).
2. Higher education, university research, and student life (€12.5b) with a budget increase of 5.71% compared with 2006. The part on higher education and university research (excluding student life) increased by 2.82%.
3. Programmes under the aegis of other ministries than the Ministry in charge of research (€2.5b).

The Research Tax Credit (*Crédit d'impôt Recherche* - CIR) is a key measure in supporting R&D investments within companies which have been radically transformed in 2008. The Research Tax Credit is a horizontal measure, non-discriminatory across sectors of activity, which is aimed at supporting corporate R&D investments through tax incentives. The Research Tax Credit underwent significant changes in the past years, in particular in 2008. The first main reform in 2004 was the introduction of a volume-based scheme (5% of all R&D expenditures, since 2006 10%) and the reduction in the scale of the incremental scheme for additional R&D expenditures (from 50% to 45% and later to 40%). From 2008 on, the incremental based-scheme has been suppressed. Instead, companies can benefit from tax credit corresponding to 30% of their R&D expenses up to expenses of €100m. Beyond this 100 million threshold, they can benefit from a 5% tax credit. The government expects research tax credit of €3b for 2008. An evaluation has found positive effects on firms

already doing R&D, but it was not found to act as an incentive for firms to start R&D activities (Larrue et al., 2006).

Further changes which abolish the incremental part of the incentive and substantially raise the absolute ceiling to the benefit of large R&D performers were passed in the autumn of 2007 and took effect in 2008. All these changes, which are expected to triple the amount of foregone tax revenue, are expected to increase its leverage on private R&D expenditures. In addition, a new 'Young Innovative Company' status was designed in 2004, which has since begun to be implemented. The idea is to exempt eligible companies from tax on profits during the first three financial years in which they make a profit and to reduce the tax by 50% for the following two financial years of profit. To be eligible, companies need to be less than eight years old and have a level of R&D expenditures equal to 15% of their turnover. The measure responds to one identified weakness of the French system and provides an opportunity to broaden the base of private R&D funders by fuelling the growth of small R&D intensive firms. With the focus on already commercially successful firms, however, the scheme provides fewer incentives for early R&D stages. The total value of tax incentives is expected to reach €3b per year. According to the Statistical services of the Ministry of Industry, the scheme has most likely enabled an increase in the recruitment of qualified persons characterised by high productivity level (SESSI 2008).

Another renewed mechanism aimed at increasing R&D activities and leveraging R&D funding of companies has been a series programmes for industrial innovation (*Programmes Mobilisateurs pour l´Innovation Industrielle* - PMII) which were initially supported by the Agency for Industrial Innovation and which are now supported by OSEO innovation. The main purpose had been to support large firms in launching major R&D programmes in areas that go beyond their core activities. With this focus, the measure strengthened a well functioning element of private resource mobilisation rather than addressing the size composition weakness (see also Eparvier, 2007). In 2007, duties of the Agency for Industrial Innovation (AII) were given to OSEO Innovation. The objective is to increase the participation of SMEs in such programmes.

However, all these measures seem to be insufficient to achieve the ambitious French objective, set in accordance with the Barcelona target and the Lisbon Strategy, of having two thirds of GERD financed by private enterprise by 2010 (Republique Française, 2006).

A number of policy measures are in the pipeline or have already been taken to address the human resource mobilisation challenge. For instance, the 2005 reform of the Research Tax Credit means companies may be eligible for a tax credit equal to twice the expenses involved in recruiting a PhD holder for the first year (providing that there has been no decrease in staff numbers and the PhD is not on a fixed-term contract). As a follow up to the Pact for Research, PhD fellowship remunerations have been increased. In the same vein, Higher Education Institutes' degrees are evaluated by the Agency for the Evaluation of Research and Higher Education since 2007.

Distribution of PhD fellowships between scientific disciplines will be adapted accordingly. Furthermore, the role of doctoral schools (*Ecoles Doctorales*) will be reinforced in order to improve doctorate training. These schools will be evaluated on the basis of several criteria, including scientific achievement, quality of mentoring and job-market access for PhD holders. Assessment outcomes will be taken into account in the contract process between the State and Higher Education Institutes. French Court of auditors in its 2008 annual report acknowledged the 2008 Research Tax Credit efforts within the simplification and improving legal and fiscal security.

Challenges	Main policy changes
Justifying resource provision for research activities	
Securing long term investment in research	• Increase in public R&D expenditures
Dealing with uncertain returns and other barriers to private R&D investment	• Reform of the Research Tax Credit • Transfer of duties of the Agency for Industrial Innovation towards OSEO innovation
Providing qualified human resources	• Increase in evaluation of Higher Education Institutes' degrees

2.4 Assessment of policy opportunities and risks

In the light of the Lisbon Strategy, the main opportunities and risks for resource mobilisation in France arising from recent policy responses can be summarised as follows:

Main policy opportunities	Main policy-related risks
• Research figures more prominently on the policy agenda than in the past • Additional public funds, mainly through increased project funding • New incentives to support young firms performing research	• Measures may not be sufficient to achieve the Barcelona/ Lisbon objective for private R&D • Disagreement between the Government and researchers on the most desirable structuration of the public research system and on the governance mechanisms

Since the last ten years, research and innovation has received a stronger focus from the successive Governments as compared with the previous period. Research, innovation and human capital are consensually perceived as a key driver for the competitiveness of the domestic companies.

Outstanding efforts have been made to deeply reshape the French research and innovation system:

- increase in public budget for public as well as for private R&D
- design of a long-term strategy for research and innovation policies
- increase in competitive funding in order to increase research excellence
- set up of instruments in order to reduce the fragmentation of the public research institutions.

However, in spite of substantive efforts, the French research and innovation system still suffers from the same pitfall: the worrying lack of medium companies and in particular of “gazelles” those technology-based companies with a potential high rate of growth.

The French research and innovation system has been based on large public-owned companies for decades (or even centuries) that were the main entry point of any research and innovation policy with the idea that spill-overs will benefit the medium and small companies afterwards.

Governmental authorities have changed their mind as far as rhetoric is concerned. Several instruments (see below) were recently set up in the benefice of the small and medium companies. However, large companies still benefit from the lion’s share of public support to private R&D (the reform of the research tax credit as well as the competitiveness clusters seem to mostly benefit large companies despite they were not only oriented towards large companies).

By all and large, Governmental efforts in favour of research are acknowledged by economic and research actors. For example, in October 2008, the Conference of the President of Universities voiced their satisfaction in the increase in the budget for Universities. However, the increase in the public budget for R&D raises many discussions, in particular as regards the increase in the Research Tax credit or the increasing importance given to the project-based research.

2.5 Summary of the role of the ERA dimension

France is a major stakeholder in shared European research infrastructure facilities such as the European Space Agency, CERN, etc. However, the importance of European funding from the FP in total French R&D funding is rather low. With regard to human resources, efforts have been made in the past couple of years in order to (temporarily) attract foreign researchers (from the EU Member States but not only).

3 - Knowledge demand

The purpose of this chapter is to analyse and assess how knowledge demand contributes to the national research system's performance. It is concerned with the mechanisms used to determine the most appropriate use of, and targets for, resource inputs. Main challenges in this domain relate to governance problems stemming from specific features of knowledge and the need for priority setting. These include:

- Identifying the drivers of knowledge demand
- Co-ordinating and channelling knowledge demands
- Monitoring and evaluating demand fulfilment

Responses to these challenges are of key importance for the more effective and efficient public expenditure on R&D aimed at in the Lisbon Strategy Integrated Guideline 7.

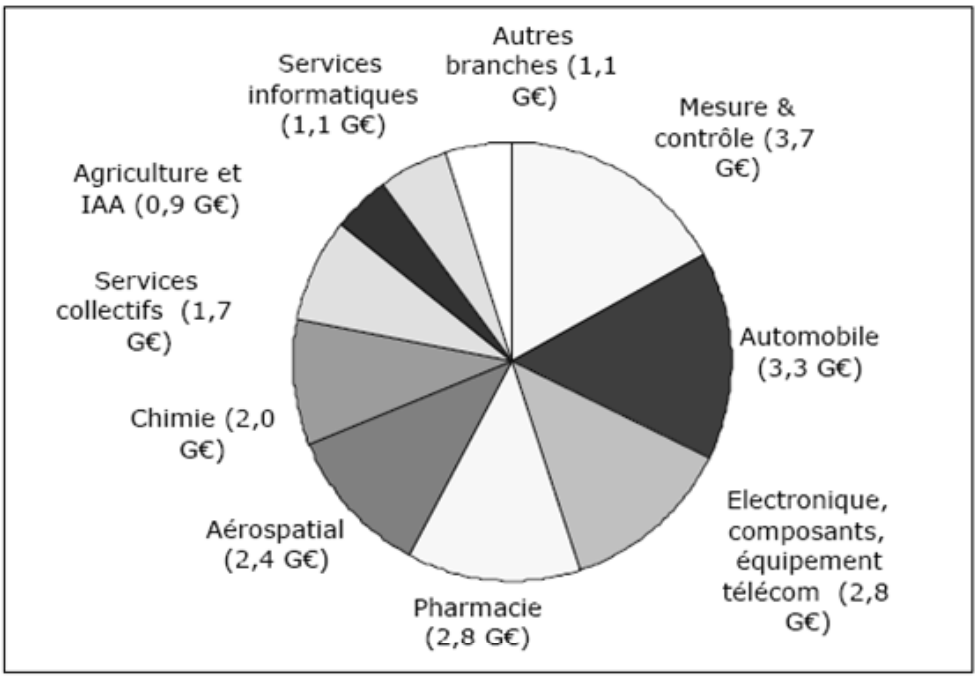
3.1 Analysis of system characteristics

The sectoral structure of the economy is an important determinant of knowledge demand. France is characterised by a relatively large share of high-tech in manufacturing BERD (44.6% in 2002, above the EU average of 41.4%). The most important R&D performing sectors are instruments, electronics, pharmaceuticals, ground transport, chemicals and aerospace (see figure 4 below). This share is supported by a sophisticated consumer demand: 59% of French consumers are favourable towards innovative products and services, a share which is among the highest in the EU and significantly above EU average (European Commission 2005).

While the share of medium-high tech in 2002 was comparatively low (42%, EU=47.7%), the share of medium-low tech was 13.4% (EU=10.9%). The share of BERD performed in services is somewhat low, at 11% in 2002, which is below the EU average of 15%.

As one indicator of the structure of public knowledge demand, the breakdown of GBAORD by socio-economic objectives shows that the majority (about two thirds) of the Government R&D budget can be attributed to specified socio-economic objectives while non-oriented objectives represent about one third of French GBAORD. Relative to the EU 15, between 1993 and 2003 France increased its GBAORD specialisation in the fields of Energy, Space and the Environment, while it decreased its specialisation in Defence and Human health. A sharper decline in specialisation can be observed in agriculture, where France became unspecialised over the course of a 10 year period (ERAWATCH Network, 2006).

Figure 3: Business sector knowledge demand according to sectors



Source: Operation FutuRIS (2005b)

3.1.1 Identifying the drivers of knowledge demand

Several actors and institutions contribute formally to the identification of drivers of knowledge demand. The High Council for Research and Technology (*Conseil superieur de la recherche et de la technologie*, CSRT) is a consultative body set up in 1982 under the aegis of the Ministry in charge of research, bringing together stakeholders of the scientific and technical communities and research partners. The Centre for Strategic Analysis under the prime minister, which replaced the *Commissariat General du Plan* in 2006, also contributes to the definition of long-term strategies relating to research and innovation (e.g. Lallement and Paillard, 2003). Reports are also produced by the Parliamentary Office for the Evaluation of Scientific and Technological Choices (OPECST). Although the afore-mentioned bodies have political visibility, the major actors in identifying knowledge demand drivers remain the Ministry in charge of research and its strategy department, and the ANR.

Business knowledge demands are articulated formally and informally. The formal consultation bodies are the Consultative Committee on Technological Development (CCDT) of the Ministry in charge of research, consisting of experts in the field of applied research, innovation and business creation, as well as the Permanent Commission for Consultation with Industry (CPCI) advising the Ministry of Economy, bringing together experts from this and other ministries, industry representatives from the enterprise association MEDEF and other stakeholders. Ad hoc consultative bodies producing reports on specific issues on behalf of the prime minister, and often chaired by industrialists, are another important mechanism. One example is the report by Christian Blanc (see 4.2) which initiated the creation of Competitiveness Clusters.

In recent years, the processes identifying and shaping knowledge demand have broadened. FutuRIS, the first systemic foresight exercise on research and innovation was launched at the end of 2001. It is co-financed by government and R&D performing enterprises. In 2005, it became the prospective strategic service of the National Association of Technological Research (ANRT). FutuRIS has elaborated a synthesis report whose conclusions contributed to the drafting of the 2006 Law for Research and therefore to the reorganisation of the system. A contribution to the debate was also made by the *'Etats Généraux de la recherche'*, following the movement to save research initiated by researchers.

3.1.2 Co-ordinating and channelling knowledge demands

French research policy was for a long time characterised by a tradition of large "top-down" sectoral public R&D programmes uniting large state PROs and state-owned firms in domains such as aerospace, nuclear energy or ICT. Since the 1990s, priority setting has become more bottom-up and some of the "large programmes" have disappeared, to be replaced by network-oriented funding (Mustar and Laredo, 2002). The Government has increased the number of research funding mechanisms based on competitive calls for proposals, although in 2004 the share of public funding that was project-based was still less than 10%. This opened up the mechanisms with which priorities could be changed. Recently, agencies were created for this purpose (see section 3.2). Although decreasing, the GBAORD share of defence related public R&D is still above 20%. In 2000, 38% of public funding was still spent in the form of military and large technological programmes (€5.30b of which €2.3b was on civil programmes, Operation FutuRIS, 2004a).

The political channelling of knowledge demand seems to respond well to knowledge demands from the dominant sectors. The bulk of public funding of business R&D is oriented toward the aerospace industry, which received 34.6% of public funds earmarked for research in enterprises in 1999. This fact resonates with the high specialisation of BERD in this sector compared with the EU 15 average (ERAWATCH Network, 2006). The same appears to hold for two other sectors that receive large shares of government funding, such as the instruments and electronic equipment. However, this relationship does not hold for the machinery sector.

France is a country which plays an active part in European co-ordination and priority setting mechanisms. According to the Pact for Research, the articulation of national research policy with European research policy is one of the main aspects of the reconfiguration of the French research and innovation system. The Government's point of view on the European Research Area (ERA) is that Europe can offer a comparative advantage in structuring research systems. One way in which it is envisaged that this might be achieved is by stepping up national participation in European Technology Platforms, and Joint Technology Initiatives. Also France's participation in ERA-NETs confirms this high degree of European involvement. With 9.8% of participations, it is only slightly behind Germany (10.6%) and ahead of the UK (6.7%) (Horvat, Guy et al., 2006).

Along with the Ministry in charge of research, six other ministries are involved in priority setting and channelling knowledge demands: the Ministry of Economy, Finance and Employment (energy research and industrial research), the Ministry of Ecology, Sustainable Development and Town and Country Planning, the Ministry of Agriculture and Fisheries, the Ministry of Defence and the Ministry of Culture and Communication. Inter-ministerial co-ordination and priority setting takes place formally through the Inter-Ministerial Committee for Scientific and Technical Research (CIRST, *Comite interministeriel de la recherche scientifique et technologique*), prepared by the Ministry in charge of research and chaired by the prime minister. In practice, this is only rarely used. The Court of Auditors even concluded that the Ministry in charge of research did not have any real power to steer government research policy (*Cour des Comptes*, 2004). In the same vein, the Futuris report stressed in 2006 the lack of a mechanism and/or an institution aimed at identifying priorities. This is a feature that FutuRIS has assessed to be a weakness of the strategic steering for the French research and innovation system (Lesourne and Randet, 2006).

With the implementation of the 2001 Constitutional bylaw on the Finance Acts (*Loi organique relative à la loi de finances* - LOLF), in 2006 the coordinating role of the Ministry in charge of research with regard to civil research budget priorities was formally strengthened. There is now one inter-ministerial mission (Mission of Research and Higher Education), which involves several Ministries through 13 programmes. This mission, which replaces the former Civil Budget for R&D, has been seen as a means to give the Ministry in charge of research the ability to truly orient research policy. MIRES also monitors the programmes performance in a yearly report ("*Projet annuel de performances*"), listing all the credits allocated to research programmes for all PROs and universities.

An assessment by the FutuRIS project highlighted that the functions and responsibilities relating to setting strategy, programming and performing research are not distributed and separated in a satisfactory way within the system (Lesourne and

Randet, 2006). Large institutions like CNRS usually combine responsibilities for strategic planning, programming with a role as research performers. And other large research performers like universities lack a level of strategic steering. This situation, which creates the need for ad hoc adjustments on a case by case basis for institutions eager to develop collaborations, is not considered to be sustainable. Indeed, it has been classed as a "systemic dead end". A reorganisation is therefore felt to be necessary to improve the channelling of knowledge demand.

Last but not least, the increasing role of the Regions in the field of research and innovation enhances the complexity of the whole national research and innovation systems. The Law of 13th August 2004 provided the regions with more competences, in particular in the fields of economic development, tourism, life-long learning and health. The increasing role given to the region regarding research issues goes hand in hand with an increase of the regional strategies of the national public actors. The General Code of the Territorial Authorities indicates that "*the Region is associated to the design and the application of the national research and technology policy*" (Article L4252-1). It also mentions that "*for the execution of multiannual programmes of regional interest (…), the Region can contract for a limited duration with the State, public or private research organisations, public establishments, technical centres or enterprises*" (Article L4252-2). On this basis, some regions have set up a regional Research and Higher Education Plan. This trend has been strongly accelerated in 2008 with the demand of the government to the Regions to make a diagnosis of their own regional innovation system (see below).

3.1.3 Monitoring demand fulfilment

With regard to evaluation of policies and programmes, the evaluation culture has changed significantly in France since the mid-1990s. As well as evaluations by the Court of Auditors, which mainly focus on financial flows, policy evaluations are now also conducted.

As part of the LOLF, performance of each programme is evaluated on the basis of three criteria: social and economic effectiveness, quality of service and efficiency. Practically, each programme lists several specific results to which the programme managers commit themselves. It reports appropriations, main goals, performance indicators, expected results and financial data. Public performance and efficiency will then be based on performance measurements.

The evaluation of researchers and research units has a longer tradition. Currently, evaluation of teachers-researchers and of research units are performed by the National Council of Universities (*Conseil national des universités* – CNU) and the Scientific, Technical and Pedagogical Mission (*Mission scientifique, technique et pédagogique* – MSTP), respectively, during the negotiation phase of the four-years contracts between the State and the Universities. Evaluations of Higher Establishments are performed by the CNE, the National Evaluation Committee (*Comité National d'Evaluation*)[11].

In the case of the CNRS, the National Committee of Scientific Research performs an evaluation of researchers and research units, including the Mixed Research Units (*Unités Mixtes de Recherche* – UMR) which bring together researchers from a University and from a Scientific and Technological Public Institute (EPST).

[11] In 2007, CNE was incorporated in AERES (cf. 3.2).

In a report published in 2005, the Court of Auditors advocated a unification of evaluation mechanisms and committees because of the excessive number of research evaluation procedures and research evaluation structures, and because of a lack of coordination between these structures (Cour des Comptes, 2005). Those recommendations were fully acknowledged by the governmental authorities and as a consequence the 2006 Law for Research endorsed the creation of the Agency for the Evaluation of Research and Higher Education (see also section 3.2).

The aim of updating the research evaluation system is to set up an evaluation system for every scientific activity. The Government stresses the need to assess research programmes, research units and researchers on a regular basis. Evaluation reports will be taken into account in the contract process between the State and research organisations. It should be noted that this element is the real novelty since evaluations have already been created in the past 15 years, but the Court of Auditors underlined in 2003 that, despite their high quality, the National Council for the Evaluation of Research (*Conseil national d'évaluation de la recherche* – CNER) evaluation reports were not really used by the Ministry in charge of research. It seems, however, that things are changing, as the 2005 annual report of the CNER (published in June 2006) emphasises that three evaluation studies that it has published from 2002 to 2004 were actually taken into account. Some of the report's recommendations were subsequently followed.

At institution level, evaluations are mostly carried out from now on by the Agency for the Evaluation of Research and Higher Education (AERES). The Agency is in charge of the evaluation of all the public research institutions (Universities and PROs).

Along internal evaluations of policy strategy and research institutions, programmes and schemes are increasingly evaluated too. As far as they are concerned, external evaluators most often perform them. Symptomatic examples are the recent evaluations of the research tax credit (Larrue et al., 2006), the competitiveness clusters' scheme (BCG & CM International, 2008), the incubator's scheme (Technopolis 2006) or the Young Innovative Company's scheme (in progress). However, contrary to what was said for the internal evaluations of the policy strategy, because evaluations of programmes and schemes are more frequent than they were in the past does not mean that their impact on the policy design has necessarily grown. Most often, outcomes are never consensually accepted. The impact of the evaluation reports on the actual schemes is highly questionable.

Furthermore, the systematisation of evaluation raises criticism within the scientific community. The principle of evaluation is not questioned, but the criteria of evaluation on the one hand and the use of the evaluation results on the other hand is highly criticised. Some researchers have voiced their concern about the emphasis put on short-term results during the evaluation and about the willingness of the Ministry to take the lead as regards the definition of research priorities. The disagreement between the Government and the scientific community to that regards is a crucial point since the willingness of the former to reshape the French public research landscape has to take researchers' position into account.

3.2 Assessment of strengths and weaknesses

The main strengths and weaknesses of the French research system in terms of knowledge demand can be summarised as follows:

Main strengths	Main weaknesses
• Strong mechanisms to identify knowledge demand drivers • Established knowledge demands by main sectors well covered by public support mechanisms • Increase involvement of industry in the definition of the strategy of the research programmes and of the Universities (in the context of the Law for autonomy of Universities)	• Limited capacity for strategic steering and co-ordination of knowledge demands limits adaptation to changing needs beyond established strategic areas

3.3 Analysis of recent policy changes

In September 2008, the Minister in charge of research announced the willingness of the Government to establish a strategy for research and innovation policy drawing up the overall challenges and priorities for research and innovation. The steering committee of the national research and innovation strategy was set up on October 2008. It is composed of representatives of public and private research. Its role will be to identify the principal socio-economic stakes to which French research will have to answer. The identified challenges will be analysed during workshops scheduled from November 2008 to March 2009. A large consultation gathering the scientific community and the business world will then be organised to work out the first strategic paper. This first strategic paper is scheduled for March 2009 and would cover the period 2009-2012. The High Council for Science and Technology (HCST) will be rehabilitated; its new mission will be to give advice and follow-up the national research and innovation strategy.

The growing importance of competitive research funding mechanisms was underlined by the creation of the National Agency for Research (ANR) in 2005. The Government's goal is to reach 20% project-based funding by 2010[12] (Republique Francaise, 2006). The mission of the ANR is to fund exploratory research projects open to all types of research performers according to the thematic priorities identified by the Government. The National Agency for Research's calls for projects are organised around seven themes. These themes are Biology and health; Ecosystems and sustainable development; Sustainable energy and the environment; Materials and information; Human and social sciences; Non-thematic or transversal programmes; and Partnerships and competitiveness. In 2007, the ANR budget reached €800m and was expected to reach €950m in 2008 which represented a total of €1.8b between 2005 and 2007 for 4500 projects funded (2008 NRP). The majority of funding (80% in 2005) was dispensed through calls for project proposals. The remaining 20% was distributed among the specific actions to which the State had committed itself. In 2005, the top beneficiary of the National Agency for Research funding was the CNRS (30%). Enterprises received 18%, the majority of which went to SMEs. As far as basic research is concerned, this implies that a funding system based on projects is coupled to the traditional funding system based on research institutions (such as the Universities and the scientific research umbrella organisations).

[12] In 2004, most of the public funding to businesses was project-based, but less than 3% of PROs funding was project-based (excluding international, European or industrial contracts). The objective to double project-based public funding would be linked to the increasing budgetary power of the ANR which would raise PROs' project-based funding to 10% of PROs' national resources.

The Law for Research passed in April 2006 enacted a change in the evaluation system with the creation of the Agency for the Evaluation of Research and Higher Education (AERES) which, among other things, unites the missions that were formerly in the hands of other bodies. In 2007 and 2008, a first batch of Universities were evaluated as well as several Public Research Institutes, of which the National Centre for Scientific Research (CNRS), the Health and Medical Research Institute (INSERM), Agronomic Research Institute (INRA) and the National Institute for Computer Science and Automation (INRIA).

Challenges	Main policy changes
Identification of knowledge demand drivers	• Establishment of a strategy for research and innovation policy
Co-ordination and channelling knowledge demands	•
Monitoring of demand fulfilment	• Trend towards systematisation of evaluation of research programmes/measures

3.4 Assessment of policy opportunities and risks

In the light of the Lisbon Strategy, the main opportunities and risks for knowledge demand in France that arise from recent policy responses can be summarised as follows:

Main policy opportunities	Main policy-related risks
• Enhancement of strategic steering, e.g. through the increased role for the Ministry in charge of research, could help channel and meet society's demands more effectively • Improvement of the policy mix due to efficient inter-Ministerial relationships • Improvement of research programming e.g. through the new Agency for Research and increase of project-based competitive funding enhances openness to changing needs	• Effectiveness of new institutional arrangements (so far a limited role of the HCST) remains to be proven • Criticisms on the Governmental willingness to increase the strategic role of the State on the definition of research priorities • Distribution of responsibilities between the State and the Regions not always clear

As compared with what was the tradition in France, the set-up of new instruments or the reforms of existing instruments show a strong coherence with the overall strategy. The period when new instruments were put in force whereas similar instruments were maintained seems to be over now. Each and every policy is now clearly defined in the context of the existing institutional set-up (this statement stands either for the objectives or for the implementation mechanisms).

This certainly results from the increase role given to strategy. For example, the Pact for Research in 2005 paved the way for the policies implemented since. The Ministry in charge of research was reorganised in 2007 and a dedicated Department in charge of strategic studies was created. Last but not least, in September 2008, the Minister announced the willingness of the Government to design a multiannual

research plan. The first plan is expected for March 2009 and will cover the period 2009 up to 2012.

The willingness of the Government to better shape research and innovation policies goes in hand with its willingness to increase its control on the funding flows. The National Agency for Research (ANR) is the main instrument in its hands to that regard as well as the Competitiveness Clusters' funding to a lesser extent (to a lesser extent since the identification of the projects follows a bottom-up approach even if it is up to the inter-Ministerial ad hoc committee to decide which projects will be funded and which will not).

As regards the increased control of the State on the design of research priorities, the least that can be said is that the scientific community does not unanimously accept it. Individual researchers as well as research directors within PROs consider that this activity should follow scientific needs and therefore cannot be the responsibility of the State.

To finish with the coherence of the policy mix, one should emphasize that the inter-Ministerial relationships (mostly between the Ministry in charge of research and the Ministry in charge of industry but not only) are very efficient and are definitely an asset for the future. The Governmental services share a view and share objectives and do act in the same direction regardless of their Ministerial belonging.

The distribution of roles is not as clear as far as the State and the Regions are concerned. Regions enjoy more responsibility in research and innovation issues than ever, but the articulation between the national instruments and their own is not always fully efficient. Some regions already have set-up innovative and coherent instruments. Rhône-Alpes is a good example (see Eparvier & Zaparucha 2008) but this region should certainly not be considered as representative of the French regions. French authorities have released a guide for regional strategies of innovation to assist regions in elaborating their own innovation strategies (Prager 2007). The aim is for each Region to make a diagnosis of the regional innovation system in order to better shape the regional innovation strategies afterwards. Regions have almost all started the exercise.

3.5 Summary of the role of the ERA dimension

The ERA dimension is unanimously considered as a crucial issue. However, in most cases, the way the ERA dimension and the "French research area" dimension should be coordinated with each other is loosely defined.

For example, the French research programme on transportation (PREDIT 3) that started in 2002 is still searching the best way to co-ordinate with the EC Framework programme. The secretariat of the programme theorised three different options for coordination[13]:

[13] The proposals were acknowledged by a dedicated working group that tried to figure out the relationships between the FP and the PREDIT.: Groupe technique national Transport (2007), « Articulation FP7/PREDIT ».

- The first option, called “springboard”, considers that the French programme should be aimed at strengthening the French research teams before they compete at the European level;
- The second option, dubbed “partnership”, means that the French and the European programmes cooperate to identify common thematic fields for research;
- The third option, labelled “complementarity”, relies on a repartition of priorities between the European and the French levels: the French programme funds what is not considered as a European priority by the European Commission but as a French priority.

Most often, at policy level, at programme level or at research institution level, the coordination is at best made according to the third option. Priorities are defined first in function of domestic challenges. . Once this done, cooperation with the EC Framework programme and/or with other Member States is considered but not beforehand.

4 - Knowledge production

The purpose of this chapter is to analyse and assess how the research system fulfils its fundamental role of creating and developing excellent and useful scientific and technological knowledge. Any response to knowledge demand has to balance two main challenges:

- On the one hand, ensuring knowledge quality and excellence is the basis of scientific and technological advances. It requires considerable prior knowledge accumulation and specialisation as well as openness to new scientific opportunities, which often emerge at the frontiers of scientific disciplines. Due to the expertise required, quality assurance processes are here mainly the responsibility of scientific actors, but may be subject to corresponding institutional rigidities.
- On the other hand, there is considerable interest in producing new knowledge which is useful for economic and other problem solving purposes. Spillovers which are non-appropriable by economic producers as well as the lack of possibilities and incentives for scientific actors to link to societal demands lead to an exploitability challenge.

Both challenges are addressed in the research-related Lisbon Strategy Integrated Guideline.

4.1 Analysis of system characteristics

4.1.1 Improving quality and excellence of knowledge production

France's academic knowledge production is characterised by a split between universities and large public research organisations such as the CNRS. However, most research at public research organisations is now performed in around 1500 jointly funded mixed research units. These are run jointly with universities and often

located in them (e.g. 80% of CNRS staff). This has increased the role of universities in research, although management is complicated.

Besides, this peculiar organisation of the research landscape in France is very often described by the French researchers as a factor explaining the bad results obtained by the French public research organisations in the Shanghai ranking of top 500 academic institutions.

Researchers at public research organisations enjoy life-long employment and a high degree of freedom in setting their research agenda. Excellence and quality assurance mechanisms are mainly left to knowledge producers' self-governance mechanisms. Strong efforts have recently been made in order to increase scientific excellence, such as the increase in the competitive funding distributed by the ANR, the larger autonomy given to the Universities in Fall 2007 and the systematisation of evaluation.

The national scientific profile is specialised in stable research areas. The most important scientific fields measured in terms of publication numbers are clinical medicine, physics and chemistry. The main areas of scientific specialisation, compared with the EU 15 average, are mathematics, physics and geosciences (ERAWATCH Network, 2006). France publishes 7.4% of the world's articles in mathematics, but it only contributes 3.7% of articles in applied biology and ecology, while accounting for 4.7% of the total number of world publications in 2004 (OST, 2006b).

The dominant block funding for academic research in France is to a certain extent linked to evaluation mechanisms related to knowledge production, as described in section 3.1.3. Universities conclude four-year performance contracts with the Ministry in charge of research, which include funding on the basis of ex-post evaluation. In practice, the Court of Auditors noted in a report on University research in 2005 that, in the context of the negotiation of the four-year contract with the State, although teachers-researchers have to write a note describing their past research activities, the impact is only for their research teams and not for themselves (Cour des Comptes, 2005).

A slight drop has been observed in the French contribution to the global creation of new scientific knowledge: in 1999, France accounted for 5.4% of world publications and for 4.9% of worldwide citations. In 2004, France accounted for 4.7% of the total number of world publications and 4.4% of citations (OST, 2006b)[14]. Other sources of information as CWTS , are a bit more favourable with share of France in total world publications by 6.3% in 2000 and 5.6% in 2006. This decline seems to be largely the effect of the emergence of new large scientific publishers (e.g. China and India) and should not be only interpreted as a decline of French scientific research: during the same period, the two year impact factor for national publication rose from 0.91 to 0.94. Publication output stands at 741 per million population, which is only slightly above the EU-25 average of 664 (ERAWATCH Research Inventory, 2007). Reasons cited include the large share of publicly funded non-academic technical research by EPICs, and features of the way research is organised, such as the opaque recruitment system of researchers by cooption by colleagues which, although in theory providing freedom to explore new pathways, in practice tends to favour

[14] The EU 25's corresponding contributions amounted to 34.2% and 33.8%.

proximity networks rather multidisciplinarity, scientific openness and originality (Lallement and Paillard, 2003).

4.1.2 Improving exploitability of knowledge production

Patent law and other intellectual property rights intended to enhance the creation of economically useful knowledge have a long tradition in France. Nevertheless, ensuring exploitability of knowledge for economic and other societal goals remains an important objective for the French research system.

With regard to linkages between the production of scientific and technical knowledge and possible economic uses, until the early 1990s the focus was on a few strategic sectors and mainly organised in form of large programmes (see section 3.1.2). An important role is played by specific sectoral public research institutions (EPIC). The main EPICs include the CEA, CNES (*centre national d'etudes spatiales* – space research centre), IFREMER (*Institut francais de la recherche pour l'exploitation de la mer* – sea exploitation research). And they also include the Agronomic Research Institute (INRA) and the Health and Medical Research Institute (INSERM), which are both fully publicly financed EPST. This is reflected in a good fit between BERD and value added specialisation in some sectors such as air transport, instruments, petroleum, pharmaceuticals and agriculture. In certain other sectors, however, the match is not as close (ERAWATCH Network, 2006).

The question of diffusion and commercialisation of scientific outcomes is unanimously considered as a critical issue for the French public research institutions. The newly created Agency for the Evaluation of Research and Higher Education (AERES) puts a strong emphasis on that activity along the research and training activities. In line with this issue, institutions have been making strong effort to strengthen this activity. As far as the INSERM is concerned, there is agreement on the fact that the level of professionalism of that activity has considerably improved in the past years.

Apart from the strategic sectors and institutions, in France, as in many EU countries linkages between academic and industrial knowledge production are somewhat weak. An initiative to strengthen these links was taken in 1999 by the Law for Innovation and Research in order to incite researchers to exploit ("valorise") the results of their own research within existing or new companies. The Innovation Plan has also tried to reinforce relations between public research organisations and companies in general.

In the past decade, several initiatives have been run with a view to strengthening links between public and private research activities in order to enhance the industrial use of scientific knowledge. In 1998, the Research and Technological Innovation Networks (*Réseaux de recherche et d'innovation technologiques* – RRIT) were designed to couple public research and enterprises on priority fields assessed by the State where the effort achieved by usual structures is deemed insufficient: information and communication technologies, health technologies and life sciences, environment technologies and other fields such as transport, materials, batteries, aeronautics. Projects in RRITs usually involve public research laboratories, SMEs or start-up companies and industrial groups. At the end of 2004, 15 networks were running. In total, from 1998 to 2004, 964 projects were funded, with a total budget of €398m. Since 2005, the RRITs are managed by the National Agency for Research.

The ANR distributed €267m and €279m respectively in 2005 and 2006 for these projects.

The National Centres of Technological Research (CNRT- *Centres nationaux de recherche technologique*) are another instrument being used to create stronger links between public and industrial research and as a vector for technology transfer. From July 2000 to December 2004, 20 CNRTs were created in the context of the State Region Plan Contracts which formalised the relations between the State and the Regions. While RRIT include SMEs as stakeholders, CNRTs mainly involve large companies. Each Centre is dedicated to a specific scientific thematic area, corresponding to those regional competences matching national research priorities. The partnerships have an ad-hoc legal structure, depending on the needs that exist.

With the creation of more recent instruments (see 4.2), especially Competitiveness Clusters with strong political backing, it is possible that the CNRT and RRIT subsist on a more pragmatic stance, i.e. successful networks or centres will either keep working or become integrated in new instruments.

An overall assessment of the French research system with regard to the exploitability of knowledge is therefore difficult. While there are historical strengths in some specific sectors, the overall picture is less positive. If patent data are used as indicator of the creation of economically useful knowledge, France scores only slightly above the EU average: In 2003, applications to the EPO were 149 per million inhabitants for France, and 128 for the EU-27. In the European patent system France displays a specialisation in the fields of machinery, mechanics and transportation (with a world share of 7.4% and a specialisation index of 1.31) and in the field of consumption and construction (with a world share of 7.1% and a specialisation index of 1.27, OST, 2006b). According to the ERAWATCH specialisation report on France, the country appears to have increased its specialisation over the period 1993-2003 in the case of almost all benchmarks in the medium–low growth sectors (ERAWATCH Network, 2006). In the fast growing sectors, the only notable exceptions are pharmaceuticals, which increased in specialisation in patents and value added, and transport services, which increased their specialisation in BERD and employment.

4.2 Assessment of strengths and weaknesses

The main strengths and weaknesses of the French research system in terms of knowledge production can be summarised as follows:

Main strengths	Main weaknesses
• Domains of world level scientific and technological excellence • Sector-specific research institutions ensure that knowledge production links up with economic uses in those sectors	• Lack of medium companies making R&D • Specialisation in stable/mature research fields

France is all in all good at research at international level. This said France is characterised by a specialisation in stable/mature research fields.

The unavoidable role of large companies makes it difficult to modify the industrial demand for research outcomes. As far as new technologies are concerned (energy and ICT to name but a few) France has strong assets because the state-owned or previously state-owned companies were able to adapt to the changing world and to compete at international level. In the same time, these giants companies receive

more attention from the public authorities because they were well-established and historical, than the small and medium companies.

France suffers from a lack of dynamic medium companies performing R&D (see Betbèze and St Etienne 2006).

4.3 Analysis of recent policy changes

Five main changes can be highlighted which may contribute to improving the quality and the exploitability of knowledge produced by the French system of research and innovation.

The first change is the **rationalisation of the evaluation of the research system**. The Pact for Research drafted in 2005 put a strong focus on the rationalisation and the diffusion of evaluation procedures. The aim was twofold: the enhancement of the use of evaluation on the one hand and the harmonisation of evaluation procedures on the other hand. As planned in the Pact, a new agency was created in 2007, the dubbed Agency for the Evaluation of Research and Higher Education which encompassed the different previous agencies in charge of evaluation of research. The duties of the AERES are smaller than those mentioned in the Pact for Research. After several researchers and researchers unions voiced their disagreement on the possibility to apply the same rules to different research activities, AERES' duties were limited to the evaluation of research teams, research institutions and education institutions. The participation in the design of evaluation rules for the individual researchers, which was mentioned in the Pact, was not put in force. This testifies of the fact that the willingness of the Government to strengthen the monitoring of the public research (related both to the strategy and to the implementation) by the State through an increased use of evaluation does not meet consensus. Every week, newspapers report arguments either for or against the reinforcement of the monitoring of research at State level. Some argue for such reinforcement while others claim that the strategy must be made at institution level. Of this debate are related all the questions regarding the reform of the Universities or the reinforcement of linkages between research institutions.

The second is the **launch of the National Agency for Research,** which is aimed at developing research quality through an increase in competitive funding (see section 3.2). However, some research actors have expressed their concern that the growing budgetary power of the ANR, which is under direct ministerial control, as well as other new instruments (see below) would eventually be detrimental to the multidisciplinary nature of EPSTs like the CNRS, and would allow the Government, rather than the research community, to pick and choose new areas of research (Sauvons la recherche, 2006). A further shift between block funding of research institutions and competitive project-based funding is expected to encounter some resistance from parts of the scientific community seeking to ensure that the shift does not lead to reductions in block grants. This issue is indeed crucial since there is a strong disagreement between the Governmental authorities and the scientific community on who should identify research priorities. The formers strongly believe that this activity is part of their duties while the latter considers that it is up to the researchers to decide upon their research agenda. The issue relates to the extent to which the research activities should be connected to the economic/industrial needs.

The third change is the **strengthening of research capabilities and excellence** by Research and Higher Education Clusters (*Pôles de recherche et d'enseignement supérieur* - PRES) and Thematic Advanced Research Networks (*Réseaux thématiques de recherche avancée* - RTRA). Both will foster public research actors on scientific projects. Participants of the Clusters or of the Networks will be given extra resources. The logic is to increase research excellence and reverse the fragmentation of research activities. The statutes of these two regional instruments, which were introduced by the Pact for Research, were published in May 2006:

- The PRES is an instrument pooling the resources of what are currently often small higher education or research organisations (public or private), in relatively close geographical proximity, in order to boost efficiency at the regional level, and raise the international profile and attractiveness of the French research and higher education system. Their legal form can be flexible and their status and activities are not limited in time. In December 2006, there were nine PRES and further five under preparation.
- RTRA also aims at federating resources but with a focus on scientific excellence with international recognition. Its thematic nucleus of research units must also be geographically close[15]. Selected projects will be given the status of Foundation for scientific cooperation (FCS – *Fondation de cooperation scientifique*). The criteria for the creation of a RTRAs are: (i) a critical mass of very high level researchers, superior or equal to the best world research centres in a given field; (ii) Plurality of specialisation within a given theme; (iii) a strong international dimension; (iv) openness to other disciplines and/or the socio-economic sectors; and, (v) definition of a common strategy. Thirteen RTRA were selected in October 2006, some of them having links to Competitiveness Clusters by working on a related theme).

The fourth change relates to the **deep reform of the public research system**. Concerning the reforms of the French university system, a Court of Auditors' report published in 2005[16] made five recommendations:

1. A central regulation organisation (as orientation councils) should monitor research relations between universities and PRO;
2. Incentive schemes should be implemented – as already done with the research and innovation agencies;
3. Autonomy of universities should be implemented;
4. Research and production units should get common management tools
5. Mobilisation of the R&D human resources should be improved through individual activity contracts and evaluation procedures.

In 2008, the President of the AERES claimed for improvement of the research system. He pleaded for 1) the improvement of training delivered by the Higher Education Institutes 2) the increase in attractiveness of the research careers 3) the reinforcement of the doctoral schools within Universities 4) the increase in

[15] In the Law for Research that was passed in April 2006, the Thematic Networks for Research were called Campuses of Research (*Campus de recherche*).
[16] Cour des Comptes (2005), see bibliography.

cooperation between public research institutions 5) a highest interest of the companies in the training delivered by the Higher Education Institutes[17].

In 2007, the law about the universities (labelled Law of autonomy for universities) has been published and mainly provided (within 5 years) that all French universities get the autonomy concerning budget matters and human resources issues. The law also changes universities' governance system (reducing of administration councils and increasing role of the University chairman). 20 first universities will access the autonomy in 2009. The reform, to be implemented over the next five years, aims to:

- Grant universities more autonomy to decide their budget and staff, allowing universities to create foundations, to collect money and put in place their own recruitment processes; in particular, it includes the possibility of proposing short-term contracts to researchers;
- Give universities more competence in opening their administration to external staff, allowing, for example, representatives of the business world to take part in university governance;
- Strengthen the state's legal control.

In general, the law brings the status of France's universities closer to that of those in other European countries, but is opposed by researchers' organisations. Increased autonomy is a necessary condition for the effectiveness of a range of the competitive new instruments. However, the French Science Trade Union (SNCS) argues that the text does not consider the needs of universities in the research area. In particular, the possibility of offering short-term contracts to researchers would be contrary to the nature of research activity (Inter syndicale Enseignement Supérieur-Recherche, 2007).

As a follow-up of the law on university reform, next year, in 2009, 20 Universities will start benefiting from a larger autonomy as compared to their counterparts.

Still regarding the reform of the research system, the Government is pushing for a reform of the role and the place of the PROs within the research system.

The fifth change is the **creation of an *ad hoc* structure for public-private partnerships**, the Competitiveness Clusters (*pôles de compétitivité*) that pool public and private resources on specific research areas, jointly addressing excellence and exploitability in specific regional clusters. The logic of Competitiveness Clusters is to create regional poles of excellence in accordance with regional strengths. Industry and public research institutions identify collective innovating projects with an international dimension and are supported by public funds. In the European cooperation context and in the context of international competition, Competitiveness Clusters should reinforce the attractiveness of the areas concerned by bringing together their public research units, training centres and enterprises on projects, whether focusing on emerging or more mature themes. This project was born in September 2004, following a report from Christian Blanc, a former Air France CEO. The French Prime Minister launched a call for proposals entitled "growth ecosystems". In this context it was decided to implement structures to reinforce

[17] http://www.aeres-evaluation.fr/Edito

innovation and particularly in relation to research units. The overall objective is to improve French competitiveness and therefore to improve the quality of employment. In July 2005, the Government identified 67 Competitiveness Clusters from among 105 proposals submitted in response to a call for projects. The list of the 67 selected poles covers a large range of disciplines, including nanotechnologies, microelectronics, aeronautics, telecommunications, health, agriculture, oceanography, chemistry, risk management, and cosmetics. Out of the 67 clusters, 16 have or will have a worldwide dimension. The Government encourages Competitiveness Clusters to be actively involved in European research programmes. Since July 2007, there are 71 clusters. Together these clusters are due to receive funding of €1.5b between 2006 and 2008.

In 2006, ANR was among the main funders of Competitiveness Clusters with a contribution of €176m, broken down as follows: 242 research projects were submitted by 51 clusters for total funding of €169.2m, which represented 15% of the 1622 projects financed by ANR in 2006; the partners involved in the clusters were public laboratories (57%), businesses (35%[18]), other organisations such as associations and technical centres (8%); complementary funding of €5.7m euros for new cluster projects; a €1m support to global clusters. In July 2007, 5 new clusters were announced, along with added flexibility regarding geographical coverage[19].

An evaluation was carried out in 2008 (BCG & CM International, 2008). The objectives were twofold: to make an individual assessment of each cluster on the one hand and to make an evaluation of the whole support scheme on the other hand. The results show that the scheme is promising and that it should be extended and even perpetuated. At cluster level, the evaluators concluded that 39 clusters have reached their objectives while 19 have partially reached them. According to them, 13 clusters would better be reshaped. In terms of recommendations, the report underlines that a better embedding of the competitive clusters' scheme in the national RDI policies would strongly reinforce the whole coherence of the scheme.

Challenges	Main policy changes
Ensuring quality and excellence of knowledge production	• Rationalisation of evaluation procedures of the Higher Education Institutes and of the Public Research Organisations • Reform of the research system • Increase in budget of the National Agency for Research
Ensuring exploitability of knowledge production	• Implementation of the Competitiveness Clusters

4.4 Assessment of policy opportunities and risks

In the light of the Lisbon Strategy, the main opportunities and risks for knowledge production in France arising from recent policy responses can be summarised as follows:

[18] Out of which 14% for SMEs and 21% for other businesses

[19] A new system of "twinning" (*endossement*) allows geographically remote research centres to join existing clusters

Main policy opportunities	Main policy-related risks
• Combination of new network oriented instruments, competitive basic research funding and modernisation of university management is bolstering excellence and increases effectiveness of public funding • Competitiveness clusters strengthen orientation of knowledge production towards economic uses beyond strategic sectors	• Complexity and strong focus of policy measures on priority areas may constrain excellence emerging from new cross-cutting scientific opportunities • Implementation may partly be blocked by the research community • Policy measures oriented towards existing regional strengths might not be sufficient to prevent a loss of leadership in fast growing technological areas

Policies are clearly in line with the Lisbon strategy in the sense that the State considers the modernisation of the management of the research institutions and universities, more effective and more efficient public expenditures, an attractive and improved framework for companies, the reinforcement of PP/P and the creation and the development of regional as major issues.

However, what is desirable is not always feasible. First, the willingness to increase competitive and targeted funding is not unanimously accepted by the scientific community that still considers to some extent that block funding should be the rule and the competitive funding the exception. Secondly, the set-up of regional competitiveness clusters can push some regions to make efforts to build their regional research and innovation system on their strengths, even if these strengths relate to traditional sectors. The risk is that this development is made at the detriment of fast growing technological areas.

4.5 Summary of the role of the ERA dimension

As mentioned already in Section 3.5, French authorities do consider the ERA dimension as a crucial issue. However, most often, they consider that the articulation should rather be tackled at institution or even research level. It most cases, the Governmental authorities insist on the needs for the institutions or the actors to integrate the ERA dimension in their daily activities but do not necessarily give directions/instructions to do so.

The general strategy of the French authorities as regards the ERA dimension (and most generally as regards international R&D collaboration policies) relies upon the notion of excellence. The Ministry in charge of research has set explicit objectives for its international R&D activities[20]:

- Strengthen scientific excellence through various alliances;
- Strengthen technological excellence and the innovation potential of France;
- Ensure the French position as scientific and technological power;
- Attract the best competences to strengthen the excellence of the French research and education system;
- Contribute to the international efforts in R&D to cope with global challenges;

[20] From official website of the Ministry.

- Contribute to the French commitments in terms of support to development to southern countries.

The action of the Ministry in charge of research is based upon the idea that research is operated in an international and competitive context. International collaboration is a bottom up phenomenon that ministries would not precisely plan. Given the international competition, researchers have to engage with the best partners wherever they are located.

However, in November 2008, the French Government, represented by the State Secretary of trade and SMEs, proposed to increase sectoral and technological partnerships in order to fight against the lack of European world-class clusters.

5 - Knowledge circulation

The purpose of this chapter is to analyse and assess how the research system ensures appropriate knowledge flows and sharing between actors. This is vital for its further use in the economy and society or as the basis for subsequent advances in knowledge production. Knowledge circulation is expected to happen naturally to some extent, due to the mobility of knowledge holders, e.g. university graduates who go on to work in industry, and the comparatively low cost of reproducing knowledge once it is codified. However, there remain three challenges related to specific barriers to knowledge circulation which need to be addressed by the research system in this domain:

- Facilitating knowledge circulation between university, PRO and business sectors
- Profiting from access to international knowledge
- Enhancing the absorptive capacity of knowledge users

Significant elements of Integrated Guideline 7 relate to knowledge circulation. To address them effectively requires a good knowledge of the system's responses to these challenges.

5.1 Analysis of system characteristics

5.1.1 Facilitating knowledge circulation between university, PRO and business sectors

In line with the sector specific patterns of knowledge production (see section 4.1.2), the links between (some) public research organisations and industry are stronger than those between universities and industry. Correspondingly, in 2003, the business sector funded 5.7% of Government research, a figure close to the EU 27 average of 6.1% for 2004, but only 2.7% of Higher education sector research (6.7% for EU 27 in 2004). In interpreting the comparison with the EU average, the comparatively generous public funding of research has to be taken into account, as it reduces public research institutions' need for private funding.

Nevertheless, inter-sectoral knowledge circulation and R&D collaboration have been considered sub-optimal in the French research system since at least the 1999 Law for Innovation and Research. Among other things, it has provided measures

pertaining to the mobility of human resources from the research world to business and cooperation between public research and enterprises.

Each year, the Ministry in charge of research publishes figures to that regard. From 2000 to 2006, the commission in charge of giving an authorisation to a researcher to participate in a company has received 684 applications.

For a long time, for instance, French universities used to have to resort to associations to develop their research results. These associations were in charge of managing laboratories' agreements with enterprises. It was therefore important to put in place a legal instrument allowing universities to have their own internal services, with adapted rules and the ability to lead the policy of development of universities' research results. Specifically to strengthen university and PRO-industry links, the 1999 Act created the SAIC, Industrial and Commercial Activities Services (*Services d'activités industrielles et commerciales*) within Universities. Launched in 1999, the Industrial and Commercial Activities Services take charge of all industrial and commercial activities that are not performed by a company or a group of companies. This includes research convention management with enterprises, development and exploitation of patents, licenses, intellectual property rights, room rental or services delivery, excluding on-going training. These services also propose a development policy and therefore the drafting of price scales for industrial and commercial services. In addition to tax breaks worth €23m, funding of €150,000 has been earmarked for each SAIC.

In 2002, three years after their creation, there were only a dozen SAICs in place. There was a need to further clarify the re-allocation of patent royalties; to unequivocally designate project leaders in research partnerships; to implement best practices during contract negotiations between research units; and to redefine their fiscal and legal framework (Ministry in charge of research, 2002).

The objective of strengthening links between universities, PROs and industry was underlined again in the 2003 Innovation plan. The plan intended to encourage the better use of research results by means of public/private partnerships, by the application and exploitation of a portfolio of patents and by the creation of young innovating enterprises.

The Technological Platforms (*Plates-formes technologiques* – PFT) have the purpose of facilitating transfers of technology from public Higher Education Institutes to firms. Again, the management of the Platforms is embedded in the State Regions Plan Contracts. There were 77 Platforms in December 2004.

A recent assessment has confirmed the weakness of knowledge circulation from universities and the CNRS to the business sector and is sceptical about the effectiveness of the existing measures to strengthen science-industry links (IGF, IGAENR, 2007). However, the study has received some criticism in the academic debate (Eparvier, 2007). In 2007 already, the Court of Auditors had the same diagnosis as regards the diffusion and the transfer activities of public research institutions. The report reminded the fact that until recently, these activities were not given sufficient resources to obtain any valuable results. It emphasised that outstanding efforts have been made in the past decade, but there is no evidence so far that they have been efficient.

5.1.2 Profiting from access to international knowledge

International cooperation has been a part of science since its beginnings. Co-authored articles (co-publications) can serve as an indicator of features of this cooperation in the production of scientific knowledge as it takes place among researchers from various countries. Within the European Union the share of a nation's publication output that can be attributed to international collaboration varies widely from Member State to Member State. In 2003, France' share (23.2%) was slightly above the EU-15 average of 22.9%, and above the share of the other largest publishing countries in Europe (OST, 2006b)[21]. Beyond institutional support, access to international knowledge is also supported by the Cultural areas (*Aires culturelles*) programme which hands out fellowships to PhD students for a scientific visit in any country lasting from three to 12 weeks. Regions also distribute post-doctorate grants to facilitate international mobility of PhD holders. It is difficult to know the exact number of such grants, but most likely it should be around 100 per year.

The openness of the French research system to the inflow of European and international knowledge has been bolstered by the increased role of project funding. For instance, for all the 2005 ANR projects, the proportion of non-nationals was 18% for experts and 10% for members of evaluation committees.

In order to counterbalance the effects of the brain drain (outflows) and of an ageing population, the Government has put the emphasis on the need to attract foreign researchers from outside. A particular emphasis is precisely put on young researchers. In 2003, the Prime Minister announced several actions that may be investigated to do so, such as the possibility given to the research labs to pay foreign researchers on the basis of international wage scale. However, this was never put into action. In 2005, the National Agency for Research has launched a Call for Proposals for inviting foreign researchers and teachers for a scientific visit in a French PRO or HEI. The Programme was called "Chairs of Excellence". 15 projects were selected[22]. In order to incite young foreign students to learn in France, the Association Egide makes a non-exhaustive census of grants distributed to foreign people whatever the funder (http://www.egide.asso.fr/).

5.1.3 Absorptive capacity of knowledge users

With regard to knowledge users' absorptive capacity, the picture is mixed. On the one hand, entrepreneurial and innovation culture, as well as SME participation in R&D (see section 2.1.2), are limited (Eparvier, 2007). This is reflected in CIS4 data which show that only one third of enterprises can be characterised as innovative, while the EU27 average stands at almost 40%. On the other hand, there is a highly qualified labour force available. The number of higher education students and S&T graduates is high and rising (see section 2.1.3). Correspondingly, France ranks 5th in Europe in terms of the number of scientists and engineers in the labour force, with a figure of 6.9 per thousand (2006), compared with a EU 27 average of 5.4 ‰ people in the labour force.[23]

[21] The respective shares are: Germany 21.0%, Italy 22.7%, Spain 21.8% and United Kingdom 18.9%.
[22] http://www.agence-nationalerecherche. fr:80/documents/aap/2005/finances/financeEXC2005.pdf
[23] Finland, Sweden, Denmark and Belgium are the countries showing the greatest density of researchers in the workforce, with 14.7, 10.3, 9.1 and 7.4 per thousand workers respectively.

Financial and other support for SME R&D and innovation projects is provided by OSEO Innovation. OSEO covers three areas of activity through its three branches (OSEO Innovation, OSEO financing and OSEO guarantee): First, innovation support and funding for technology transfer and innovative technology-based projects with real marketing prospects; secondly funding investments and operating cycle alongside the banks; thirdly guaranteeing funding granted by banks and equity capital investors. Its main instruments for intervention are loans, but also include subsidies and expertise. It has become a cornerstone of public support to R&D and innovation in SMEs, including in medium firms which were largely forgotten until now.

5.2 Assessment of strengths and weaknesses

Main strengths	Main weaknesses
• High degree of internationalisation of scientific research	• Weak knowledge circulation between universities/CNRS and business • Mechanisms to ensure exploitability dimension of general scientific knowledge production less developed

The main strengths and weaknesses of the French research system in terms of knowledge circulation can be summarised as follows:

- French research is well embedded within the world research.
- French public research institutions are traditionally weak at transferring knowledge into the economic sector. The linear model, which shaped the reorganisation of the French research system after WWII, continues to be considered sometimes as the model for research. It is occasionally argue that the researchers do not have to bother about the use or the usefulness of their research activities and that their only concern should be to produce research outcomes. As a matter of fact, diffusion of knowledge is still often overlooked and its importance underestimated.

5.3 Analysis of recent policy changes

Since 2008, OSEO innovation is in charge of the measure initially managed by the Agency for Industrial Innovation. Originally, the measure was aimed at supporting and subsidising large pre-competitive programmes for industrial innovation. Networking between large firms and SMEs had a crucial role. However, in order to reinforce the participation of SMEs in these programmes, the management of the measure was given to OSEO innovation. The original objective to support structuring and large projects was then abandoned. Now, the goal is to support innovative projects of smaller size based on R&D. The maximum amount that can be granted is €10m. The budget for 2008 for these projects was earmarked at €300m.

An important new measure to improve inter-sectoral knowledge circulation, building upon the model of the German Fraunhofer Institutes, was the creation of Carnot Institutes in 2006[24]. These have the following characteristics:

- A clearly defined research structure (partners, activity, critical mass)

[24] The first call for applications was launched in October 2005

- A clear research strategy (technological challenges, competitive positioning, partnership strategy)
- Clearly defined governance and organisation (budget allocation, strategic orientations, human resources)
- Demanding quality criteria
- A strong partnership spirit with the private sector, with at least 10% private funding
- Management of IPR on behalf of partners.

There are currently 33 Carnot Institutes disseminated within the country. According to the website dedicated to the Carnot Institutes[25], they involve 12% of the researchers of the public research.

Challenges	Main policy changes
Facilitating circulation between university, PRO and business sectors	• Implementation of Carnot Institutes
Profiting from international knowledge	• Implementation of Carnot Institutes
Enhancing absorptive capacity of knowledge users	• Absorption of the Agency for Industrial Innovation within OSEO innovation

A federal structure makes collective actions on behalf of the Carnot institutes on IPR advice, marketing and prospective actions, technology watch, support to project management, best practices, information for partners and clients, internal and external communication on both national and international bases. The Carnot quality stamp (Label Carnot), granted for a 4-year period, was granted to 20 research structures in 2006, rising to 33 in 2007. The budget available from the State in 2007 was €62m (2008 NRP). Research structures that are labelled "Carnot" receive additional public funding (from the ANR) in proportion to the level of their resources gained from contracts with enterprises.

While the SAIC (see 5.1.1) is a legal structure helping out with logistical and administrative matters to foster *any* university/PRO - industry links, the Carnot quality stamp rather aims at research excellence and visibility. This suggests that the focus is now on the new Carnot instrument, which benefits from stronger financial and political backing.

5.4 Assessment of policy opportunities and risks

Main policy opportunities	Main policy-related risks
• Development of promising instruments to increase diffusion of knowledge: newly created Competitiveness Clusters and Carnot Institutes may bridge the persisting gap between academia and business	• Current measures might not be sufficient to overcome the low private R&D investments

[25] http://www.instituts-carnot.eu/

The recent set up of new instruments aimed at increasing the level of research oriented towards scientific needs on the one hand and at increasing the diffusion of knowledge into the industry is a noteworthy effort to reduce the main weakness of the French research system.

This is strongly coherent with the Lisbon strategy. The impacts of the measures cannot be estimated at the time being. Furthermore, they cannot be expected overnight.

5.5 Summary of the role of the ERA dimension

The CNRS developed the European Associate Laboratory (LEA) composed of 2 or 3 CNRS labs and 1 or 2 institutes of a European country. Laboratories put resources in common for four years duration. 27 LEA are operational. This tool is also declined at the international level with International Associate Laboratory (LIA)[26].

Apart from scientific cooperation in the frame of European Programmes, France has developed several scientific cooperative projects with Germany. There are currently nine of such cooperative projects with regard to the following thematic fields: materials, aeronautics, space, oceanography, medical research, transportation, vegetal genomics, microelectronics and laser techniques. All these cooperative projects but one consist of supporting common research projects, or exchange of researchers between research labs. There is only one cooperative project that is closed to a common research centre. It is related to medical research. A research unit of the National Institute for Health Medical Research (INRA) has been created within the German Cancer Research Centre in Heidelberg.

Participation in EU Framework Programmes is another indication of France's strong presence in international networks and the country has emphasised the importance of European collaboration. Since 2006, France has had a global share of 10.8% of participation in the FP 6 and a particularly strong presence in aeronautics and space (20.5%)[27]. Additionally, there are a large number of international S&T agreements in force.

6 - Overall assessment and conclusion

6.1 Strengths and weaknesses of research system and governance

Strong scientific traditions and sustained public support for research have created favourable framework conditions for the French R&D system. The French system is characterised by highly centralised mechanisms of resource mobilisation for R&D by central government. Knowledge demands, together with the production of excellent and economically useful knowledge, have tended to focus on a small number of strategic fields and sectors and on a small number of large firms. Corresponding governance structures and institutions often combined steering, policy

[26] www.drei.cnrs.fr/rub4/CNRS/p2_copy_1/;view

[27] Since 2006, Germany accounts globally for 14.8% of participations in the 6th FP and the UK accounts for 11.2% of participations.

implementation and performance of research. This is complemented by a strong role for the CNRS, which is a relatively autonomous actor, in general scientific knowledge production and also, to some extent, in channelling knowledge demands.

However, a changing environment (e.g. new knowledge demands, global competition) and rigidities in the existing system's mechanisms have also revealed some weaknesses, such as the recent stagnation of private resource mobilisation, a poor outlook for enhanced human resource mobilisation for R&D, a scientific and technological specialisation in somewhat mature fields and weak knowledge circulation beyond strategic sectors. Several assessments have expressed a need for a reform of the French research system.

The table below summarises the system's main strengths and weaknesses. According to FutuRis, French research may be even trapped in a systemic dead end if no major reorganisation across system domains is carried out, with the change of governance and co-ordination of knowledge demands as main point of departure. And indeed a consensus on the need for reforms has developed and considerable transformation of the French research governance structure is on the way.

Domain	Challenge	Assessment of system strengths and weaknesses
Resource mobilisation	Securing long-term investment in research	Well established mechanisms and high volume of public long-term investment in R&D
	Dealing with barriers to private R&D investment	Significant increase in the public R&D expenditures for the private sector Private resource mobilisation for R&D is stagnating and still mainly dependent on a few large companies, a pattern reinforced by public funding
	Providing qualified human resources	Unattractive career prospects for researchers may discourage good students from choosing a scientific career and thus weaken the human resource base
	Justifying resource provision for research activities	Strong public debate on, and support for, resource provision for R&D
Knowledge demand	Identifying the drivers of knowledge demand	Strong mechanisms to identify knowledge demand drivers Increase involvement of industry in the definition of the strategy of the research programmes and of the Universities (in the context of the Law for autonomy of Universities)
	Channelling knowledge demands	The main sectors' established knowledge demands are well covered by public support mechanisms, but limited capacity for strategic steering and co-ordination of knowledge demands is restricting adaptation to changing needs beyond established strategic areas
	Monitoring demand fulfilment	If fully implemented, the use of evaluation (of research programmes and research units as benchmarks in the contract process between the State and research organisations) could strengthen the research system
Knowledge production	Ensuring quality and excellence of knowledge production	Domains of world level scientific and technological excellence exist, but are often specialised in stable/mature research fields Low demand from potential new companies of research outcomes
	Ensuring exploitability of knowledge	Sector-specific research institutions ensure that knowledge production links up with economic uses in those sectors, whereas mechanisms to ensure the exploitability of general scientific knowledge production are less well developed

Domain	Challenge	Assessment of system strengths and weaknesses
Knowledge circulation	Facilitating circulation between universities, public research organisations and business	Poor knowledge circulation between academic research (universities/CNRS) and business
	Profiting from international knowledge	High degree of internationalisation of scientific research
	Enhancing the absorptive capacity of knowledge users	A highly qualified labour force is available; however, the entrepreneurial and innovation culture, as well as SMEs' participation in R&D, are limited

6.2 Policy dynamics, opportunities and risks from the perspective of the Lisbon agenda

In the last few years, a range of new policies and changes in governance have been implemented which have created opportunities for new and better responses to the weaknesses and specific challenges discussed here. The policy priorities set out in the Pact for Research are consistent with the analysed strengths and weaknesses and also with the research-related objectives of the Lisbon Strategy. The transformation of the governance structure is being spearheaded by a strengthened role of the Ministry in charge of research and a new high level council advising the president. The mode of channelling knowledge demands is increasingly based on competitive project funding by new intermediary agencies. This has very recently been complemented by an increase in the autonomy of Universities, which should allow them to better adapt to these changes. The increasing funds programmed by the Agency for Research and the new unified Agency for Research Evaluation also introduce new or improved quality assurance mechanisms for scientific knowledge production. This is accompanied by an extensive and also somewhat controversial public debate.

The changes are being boosted by additional public funds. In parallel, a range of new instruments have been introduced which try to ensure knowledge excellence, exploitation and circulation beyond the traditionally focused sectors, such as the thematically advanced research networks, which may provide interesting tools for overcoming fragmentation, the competitiveness clusters and the Carnot institutes. Competitiveness clusters and strengthened tax incentives may leverage private resource mobilisation for R&D.

However, a policy-related risk in the domain of resource mobilisation is that the very ambitious policy goal of a privately funded R&D intensity of 2% of GDP, which implies a break with recent trends, does not seem feasible with current measures. Other policy-related risks relate to the knowledge production domain. The set of new measures is complex and adds to existing mechanisms. Effective implementation of some of the "top down" changes might be blocked by the research community. Moreover, the strong focus on existing regional strengths might not be sufficient to prevent a loss of leadership in the fast growing technological areas. The following table summarises the main policy-related opportunities and risks.

Domain	Main policy-related opportunities	Main policy-related risks
Resource mobilisation	• Research is higher in the policy agenda than it was in the past • Additional public funds, mainly through increased competitive project funding • New incentives to support young firms performing research	• Measures might not be sufficient to reach Barcelona/Lisbon objective for private R&D • Disagreement between the Government and researchers on the most desirable structuration of the public research system and on the governance mechanisms
Knowledge demand	• Enhancement of strategic steering, e.g. through the increased role for the Ministry in charge of research, could help channel and meet society's demands more effectively • Increase in the policy mix due to efficient inter-Ministerial relationships • Improvement of research programming e.g. through the new Agency for Research and an increase in project-based competitive funding so as to enhance openness to changing needs	• Effectiveness of new institutional arrangements (so far a limited role of the HCST) remains to be proven • Criticisms on the Governmental willingness to increase the strategic role of the State on the definition of research priorities • Distribution of responsibilities between the State and the Regions not always clear
Knowledge production	• Combination of new network oriented instruments, competitive basic research funding and modernisation of university management to strengthen excellence and increase the effectiveness of public funding • Competitiveness clusters strengthen orientation of knowledge production towards economic uses beyond strategic sectors	• Complexity and strong thematic focus of policy measures might not be beneficial for excellence emerging from new cross-cutting scientific opportunities and the research community may not cooperate wholeheartedly in implementation • Policy measures oriented towards existing regional strengths might not be sufficient to prevent a loss of leadership in the fast growing technological areas
Knowledge circulation	• Development of promising instruments to increase diffusion of knowledge: newly created Competitiveness Clusters and Carnot Institutes may bridge the persisting gap between academia and business	• Current measures might not be sufficient to overcome the low private R&D investments

6.3 System and policy dynamics from the perspective of the ERA

The articulation of French research policy with European research policy has always been strong and is seen as one of the main aspects of the ongoing reconfiguration of the French research and innovation system. The French government has embraced the ERA concept and has recently also made a commitment to the research-related Lisbon Strategy goals. Efforts are being made to increase French participation not only in traditional instruments but also in new European initiatives such as ERA-NETS and Joint Technology Initiatives.

From a rhetoric point of view, European issues have always received a strong emphasis. Until very recently, the ERA dimension as far as research is concerned was always mentioned as a crucial issue for the French policy. In practice however,

the actual articulation between the national and the EU policies was questionable. To name but an example, the Pact for Research devoted a whole chapter to the ERA dimension, the last chapter. One might have expected a more transversal concern and a reference to the ERA dimension in each and every chapter.

The increasing importance of the ERA in the daily life of the researchers, the companies and the research institutions has changed the situation. Awareness of these actors of the role of the ERA has increased. Now, the ERA dimension is considered as the shaping element of every research activity and as a matter of fact has gained more attention from the State/research institutes than in the past.

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List of Abbreviations

AERES	Agence d'évaluation de la recherche et de l'enseignement supérieur (Agency for the Evaluation of Research and Higher Education)
AII	Agence de l'innovation industrielle (Industrial Innovation Agency)
ANR	Agence nationale de la recherche (National Agency for Research)
ANRT	Association nationale de la recherche technique (National Association of Technological Research)
CCDT	Comité consultatif pour le développement technologique (Consultative Committee for Technological Development)
CGAI	Comité de gestion des aides à l'industrie (Managing Committee for aid to industry)
CIR	Crédit d'impôt recherche (Research Tax Credit)
CIRST	Comite interministériel de la recherche scientifique et technologique (Inter-ministerial Committee for technical and scientific research)
CNE	Comité national d'évaluation (National evaluation committee)
CNER	Conseil national d'évaluation de la recherche (National Council for the Evaluation of Research)
CNESER	Conseil national pour l'éducation supérieure et la recherche (National Council for Higher Education and Research)
CNU	Conseil national des universités (National council of universities)
CPCI	Commission permanente de concertation avec l'industrie (Permanent Commission of Consultation with Industry)

CSRT	Conseil supérieur de la recherche et de la technologie (High Council for Research and Technology)
DGE	Directorate General for Enterprises
DGRI	Directorate General for Research and Innovation
EPIC	Etablissement public à caractère industriel et commercial (Public institute with a industrial and trade focus)
EPST	Etablissement public scientifique et technologique (Scientific and technological public institute)
ERA	European Research Area
HCST	Haut conseil de la science et de la technologie (High Council for Science and Technology)
LOLF	Loi organique relative à la loi de finances (Constitutional bylaw on the Finance Acts)
MEDEF	Mouvement des entreprises de France (Enterprise association of France)
MIRES	Mission interministérielle sur la recherche et l'enseignement supérieur (Inter-ministerial Mission for Research and Higher Education)
OPECST	Office parlementaire pour l'évaluation des choix scientifiques et technologiques (Parliamentary Office for Evaluation of Scientific and Technical Choices)
PRES	Pôles de recherche et d enseignement supérieur (Research and higher education centres)
RRIT	Réseaux de recherche et d'innovation technologiques (Research and Technological Innovation Networks)
RTRA	Réseaux thématiques de recherche avancée (Thematic Networks for Advanced Research)
SAIC	Services d'activités industrielles et commerciales (Industrial and Commercial Activities Services)
SNCS	Syndicat national des chercheurs scientifiques (national researchers union)
UMR	Unités Mixtes de Recherche (Joint Research Units)

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Abstract

The main objective of ERAWATCH country reports 2008 is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. The reports are produced for each EU Member State to support the mutual learning process and the monitoring of Member States' efforts by DG Research in the context of the Lisbon Strategy and the European Research Area. In order to do so, the system analysis focuses on key processes relevant for system performance. Four policy-relevant domains of the research system are distinguished, namely resource mobilisation, knowledge demand, knowledge production and knowledge circulation. The reports are based on a synthesis of information from the ERAWATCH Research Inventory and other important available information sources.
This report encompasses an analysis of the research system and policies in France.

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