

Fraunhofer ISI Discussion Papers *Innovation Systems and Policy Analysis*, No. 18

ISSN 1612-1430

Karlsruhe, April 2009

France: Innovation System and Innovation Policy

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1 Introduction

During the 1980s and 1990s, the French innovation system was still clearly marked by strong state involvement, corresponding to what could be described as an interventionist philosophy ("technological Colbertism", cf. Larédo/Mustar 2001). In an attempt to broadly characterize innovation in France today, it can be stated that the French innovation system is undergoing profound transformations, coupled with new actors, regulations and frameworks, as well as new ways of implementing priorities. In the past decades, great emphasis was given to "*grands programmes*" encompassing civil and defence activities and aiming at technological developments and national independence in specific fields (such as the nuclear, space, aeronautics, telecommunications or defence sectors). Public support strongly focused on large companies active in high-technology fields, and aimed to achieve a leading position for France in research and innovation. Small and medium-sized enterprises (SMEs), on the other hand, were only modestly involved in research activities. In the meantime, the French "R&D landscape" has evolved and the next sections attempt to depict the current situation and the ongoing changes taking place within the French institutional framework.

Since France is at the crossroads between centralization and decentralization, its governance system is now very complicated and variable, involving several levels of regional/local actors and national/European institutions and policy frameworks. Unlike federal states, no clear legal distribution of roles is fixed and as a result, complex multi-level/multi-actor processes in the design and implementation of policies can be observed.

This contribution provides an overview of the innovation system and focuses on current innovation policies in France. Following a presentation of the French innovation system, major recent developments are explored (section 2) and innovation policy instruments are reviewed (section 3). The specific issue of multi-level and multi-actor governance is addressed in section 4. The last section draws a general conclusion.

2 Overview of the French Innovation System

In 2005, France spent about € 36.5 billion on research and development activities, which corresponds to 2.12% of the gross domestic product (GDP). The French R&D intensity in 2005 is lower than that in 1995 (2.29%) and fluctuated between these two shares during the ten-year period between 1995 and 2005. The highest share of research and development expenditures in France is realized by business firms (1.32% of GDP), followed by the higher education sector (0.40%), the government (0.37%) and private non-profit organizations (0.03%). Thus, in order to achieve the Lisbon goal by 2010 of spending about 3% of the GDP on research and development activities, of which about two-thirds should originate from the private sector, France has to increase its efforts in R&D.

In order to give a rough idea of the institutional weight of research and technology issues in France (from the viewpoint of the state), some budgetary indications can be examined. The 2008 planned state budget for higher education and research foresees an increase of € 1.8 billion compared to 2007 (which means an increase of about 7.8%).¹ Taking the figures for 2007,² higher education and research spending – from which the research budget takes a certain share – ranks in fourth position after primary and secondary education, public debt and reimbursement and expenditures in the defence sector (cf. table 1).

Table 1: The most important French budget lines in 2007

Education (primary and secondary)	€ 58.982 billion
Public debt and reimbursement	€ 40.863 billion
Defence	€ 36.251 billion
Higher education and research	€ 21.284 billion
Public security	€ 15.703 billion

Since the end of the 1990s, important initiatives in the field of innovation policy have been undertaken in France. The 1999 Innovation and Research Act ("Loi Allègre") aimed at modernizing and reorganizing the French innovation system. The general aim of this *Loi sur l'Innovation et la Recherche*,³ was directed towards efficient technology

1 Cf. Ministère de l'Enseignement Supérieur et de la Recherche (2007c).

2 Cf. <http://www.budget.gouv.fr> (10/10/2007).

3 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/loi/inovloi.htm> (23/10/2007).

transfer from public research to private firms, and the creation of innovating firms. The main objectives were the encouragement of technology diffusion and the exploitation of research results and innovation. The Innovation Act had four main areas: (i) the mobility of (public) researchers towards private enterprises, for instance through the authorization for public researchers to participate in an innovative firm start-up without losing their civil service status for 6 years, or the possibility for public researchers to engage in consulting activities or in private firms' boards of directors; (ii) public-private research collaboration, for instance via incubators in universities and public research organizations, the introduction of industrial and commercial service activities in public research organizations, and simplified administrative procedures; (iii) fiscal measures for innovating firms, directed towards the *Crédit d'Impôt Recherche* as well as the *Fonds Communs de Placement dans l'Innovation*; and (iv) a legal framework for innovating firms: the extension of the simplified status of the joint stock company (*Société par Actions Simplifiée*) to all innovative firms (see also section 4).⁴

Resulting from discussions of underused potentials in research and innovation leading to obstacles for national competitiveness, the French Innovation Plan of 2003 was produced jointly by the Ministry of Research and the former Ministry of Industry. The main lines of this document concern the diffusion of research results and the facilitation of innovation. Its focus is on publicly funded research and its exploitation for innovation, including support for young innovating companies, research funding, industrial strategic research, etc. Research is not only attributed an important role at the national, but also at the international level. Precise measures elaborated in this plan after national consultations, are (i) the status of business angels; (ii) support for projects of *Jeunes Entreprises Innovantes*; (iii) further new instruments to foster innovation, including tax reductions; (iv) simplified access to public funding through attributing a central role to ANVAR (now OSEO Anvar) (v) better exploitation of research results for enterprises; (vi) the attribution of a central role to innovation in a national and European perspective; and (vii) the support of industrial strategic research.⁵

In October 2005, the French government passed the *Pacte pour la Recherche*, which has been legally implemented in the *Loi de programme pour la Recherche* of 18 April 2006. The Research Pact project pursued the aim of modifying the existing national research and innovation system that had evolved comparatively little in the preceding period. This pact is based on three axes: (i) the balanced development of the three

⁴ Cf. also http://trendchart.cordis.lu/tc_policy_information_fiche.cfm?id=875 (23/10/2007).

⁵ Cf. <http://www.enseignementsup-recherche.gouv.fr/plan-innovation/planinnov9avril.pdf> (23/08/2007).

basic components of the research system (basic research, research with societal and economic implications); (ii) the development of interfaces and cooperation between actors of the research landscape; and (iii) the introduction of a global and long-term strategy that aims to increase confidence between research and society. The Research Pact foresees the support of government strategy building and decisions by the new High Council for Science and Technology, the introduction of a rationale of financing specific research projects instead of regular support for institutions by the *Agence Nationale de la Recherche* (ANR), and systematic evaluation through the *Agence d'Evaluation de la Recherche et de l'Enseignement Supérieur* AERES (cf. also below). In its general logic, the Pact further focuses on cooperation between public research actors (in *Pôles de Recherche et d'Enseignement Supérieur* and *Réseaux Thématiques de Recherche Avancée*), between public and private actors (*Pôles de Compétitivité*, Carnot Label), on better links between science and society, on young researchers and their career opportunities and on new professional perspectives of researchers (cf. Ministère délégué à l'Enseignement supérieur et à la Recherche 2007b: 8ff).⁶ Besides the National Agency for Research, another funding agency was created which disappeared nevertheless quite quickly: the *Agence de l'Innovation Industrielle* (All, see page 10). The All was officially dedicated to support high-technology industrial developments, but its existence was controversial. Both agencies (ANR and All) were supposed to distribute research funds on a competitive base; the ANR on the basis of calls for projects in specific themes, the All for large programs under the lead of large firms, joined by SMEs and public research bodies.

2.1 Research administration and research support institutions

Figure 1 gives an overview of the institutional structure in the French innovation system. At government level, the Ministry of Higher Education and Research (*Ministère de l'Enseignement supérieur et de la Recherche*)⁷ is responsible for coordinating research policy.⁸ The *Conseil Supérieur de la Recherche et de la Technologie* (Higher Council

⁶ Cf. also <http://www.enseignementsup-recherche.gouv.fr/pacte/index.htm> (19/07/2007), <http://www.france-science.org/home/page.asp?target=news&ID=565> and <http://www.recherche.gouv.fr/discours/2006/loiprogrecherche.htm>(20/07/2007). The *Loi de programme pour la recherche* can be found at <http://www.legifrance.gouv.fr/WAspad/UnTexteDeJorf?numjo=MENX0500251L> (14/09/2007).

⁷ Website: <http://www.enseignementsup-recherche.gouv.fr/>.

⁸ Research is however also conducted under the aegis of other ministries, such as the Ministries of Ecology, Sustainable Development and Regional Planning, of Economy, Finance and Employment, of Defence, etc. Cf. also European Commission 2006b: 15.

for Research and Technology, CSRT), which was created in 1982, is a consultative body for research issues. Consultancy encompasses the budget for research and higher education, the preparation of an annual report on research and technological development, foresight exercises and analyses of science and technology, the creation of scientific and technological public institutes (*Etablissements Public à caractère Scientifique et Technologique*, EPST) and mobilization programs. Following the 2006 Law on Research, the Higher Council for Research and Technology and the new High Council for Science and Technology (*Haut Conseil de la Science et la Technologie*, HCST) are responsible for scientific advice, with the CSRT working on research questions, and the HCST on national research and innovation strategies. The mission of the High Council for Science and Technology is to advise the President of the Republic and the government concerning science and technology matters, more precisely national policy orientations with respect to scientific research, technology transfer and innovation. The two main goals of the HCST are to increase coherence in French public research policy and to contribute to the reform of the French research system. The Council meets on the initiative of the President of the French Republic, of the Prime Minister or of the Council's President.⁹

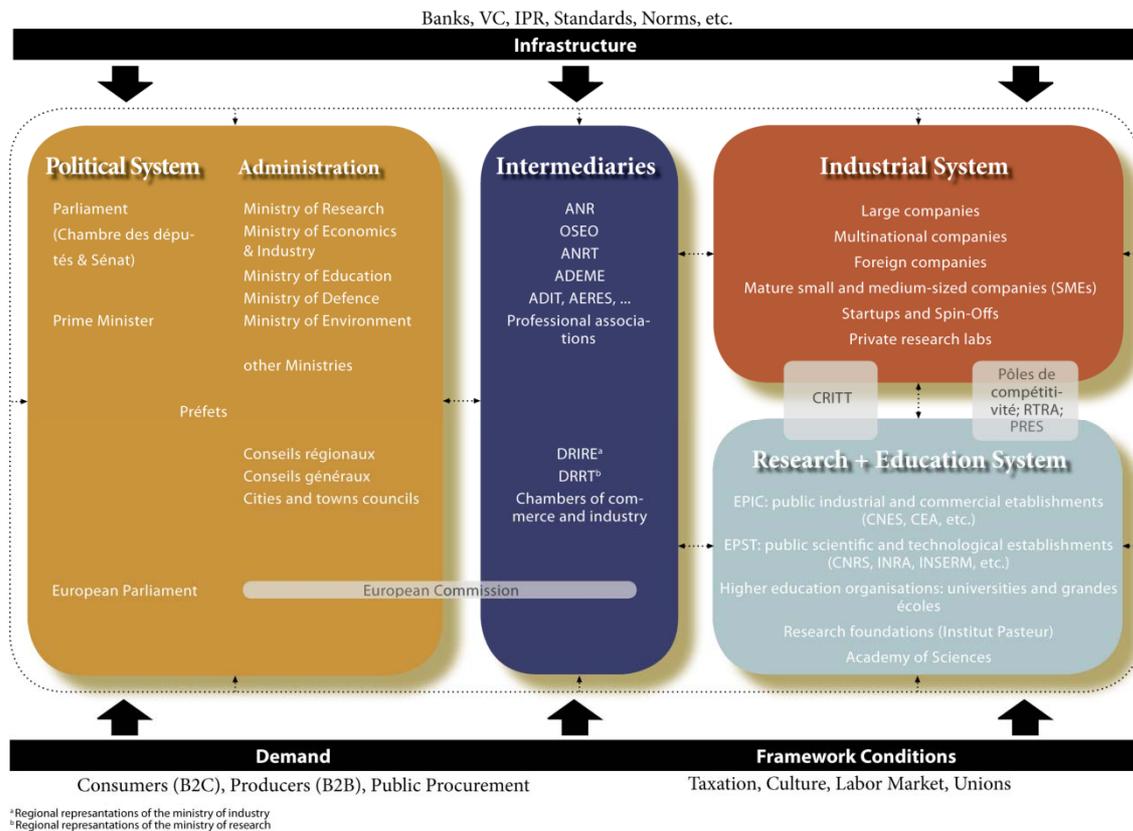
Following a decree of May 2007, the missions and the composition of the CSRT were modified and extended, the Council now being responsible for the coordination between research actors and society. It contributes to dialog processes and to the diffusion of scientific and technical information to the national community. This interface function is strongly supported by *rencontres nationales sur les politiques de recherche, d'innovation et de développement technologique* (national meetings concerning research, innovation and technological development policies).¹⁰ Economic development, firms, SMEs, and information technology are, among others, the responsibility of the Ministry of Economics, Finance and Employment (*Ministère de l'Economie, des Finances et de l'Emploi*).¹¹

⁹ In 2007, the Council prepared the first two statements concerning the scientific and technological efforts in energy issues and concerning questions of the attractiveness of scientific careers. These reports are downloadable at <http://www.enseignementsup-recherche.gouv.fr/conseil/hcst/avis.htm> (19/07/2007). Cf. also <http://www.hcst.fr/articles.php?lng=fr&pg=90> (09/11/2007).

¹⁰ Cf. <http://www.enseignementsup-recherche.gouv.fr/conseil/csrt/> (24/08/2007), European Commission 2006b: 19.

¹¹ Website: <http://www.minefe.gouv.fr/>.

Figure 1: Overview of the French Innovation System



Traditionally, French technology and innovation relied on the targets of the central state, performed and implemented in the framework of *Grands Programmes*. Main industrial actors have been large companies (*Champions Nationaux*). However, this general pattern is changing, and during the last years, innovation efforts increasingly included small and medium-sized enterprises (SMEs). Technology transfer nowadays focuses on the validation and transfer of research results generated in universities, public scientific and technological research organizations (*établissements publics à caractère scientifique et technologique*, EPST), and public industrial and commercial research organizations (*établissements publics à caractère industriel et commercial* EPIC).¹² Interlinkages and technology transfer between research and the industrial system are supported by networking measures such as the competitiveness clusters, thematic advanced research networks or research and higher education clusters (cf. section 3). The regional technology transfer centers CRITT (*Centres Régionaux d'Inno-*

¹² Examples for EPST are the *Centre National de la Recherche Scientifique* CNRS, the *Institut National de la Recherche Agronomique* INRA, the *Institut National de la Santé et de la Recherche Médicale* INSERM, whereas the *Centre National des Études Spatiales* CNES or the *Commissariat à l'Énergie Atomique* belong to EPIC.

vation et de Transfert de Technologie, Regional Innovation and Technology Transfer Centers) belong to the interface structure between public research and regional firms. *CRITT prestataire* focus on the technological needs of SMEs, whereas *CRITT interface*'s mission is to raise firms' awareness through specific advice by *Conseillers en développement technologique*. Both types of CRITT aim to support innovation and technological development in SMEs at the regional level. *Centres nationaux de recherche technologique* (CNRT, National Centers for Technological Research) favor collaborations between public research laboratories and research centers of large industrial groups, whereas *Equipes de recherche technologique* are medium-term research teams established for specific technological questions.¹³

Besides the region-specific organizations such as CRITT that interlink research and industry, knowledge transfer in France is organized through national institutions and/or – in some cases – their regional offices. Organizations of this intermediary structure are, for instance, the *Agence Nationale de la Recherche* (National Agency for Research, ANR), the *Association Nationale de la Recherche Technique* (ANRT),¹⁴ the *Agence de l'Environnement et de la Maîtrise de l'Energie* ADEME, or the *Agence pour la Diffusion de l'Information Technologique* ADIT.¹⁵ The creation of the *Agence Nationale de la Recherche* (ANR)¹⁶ at the beginning of 2005 was the first major change that affected the French institutional innovation system. Founded with the mission to allocate financial support for research projects, the ANR is in charge of supporting basic and applied research efforts. Financial support is allocated after a competition procedure and evaluation; support can be granted to research institutes and to firms, but aims at projects managed by specific groups within the organization. The goal of the ANR is to stimulate the emergence and performance of research projects by participation in competition projects for funding. As such, its philosophy is close to the National Science Foundation (NSF) practice in the US which reveals a shift

13 Cf. <http://www.recherche.gouv.fr/technologie/cnrt/default.htm>,
<http://www.recherche.gouv.fr/technologie/critt/index.index.htm>,
<http://www.recherche.gouv.fr/technologie/reched/index.htm> (20/07/2007).

14 The National Agency for Technical Research's objective is to improve the efficiency of the French research and innovation system, and to support cooperation on the national and the European levels. Cf. <http://www.anrt.asso.fr/index.jsp> (21/08/2007).

15 The French Environment and Energy Management Agency ADEME, an EPIC, is supervised by the Ministries for Ecology, Sustainable Development and Spatial Planning, and for Higher Education and Research. Its missions are in the field of environmental protection and energy management. Cf. <http://www2.ademe.fr/>. ADIT'S missions are in business, economic and territorial intelligence as well as prospecting and technology watch. Cf. <http://www.adit.fr> (21/08/2007).

16 Cf. <http://www.agence-nationale-recherche.fr> (19/07/2007).

in the way research will be funded in the future in France. Since both public and private laboratories can apply for funding, the actions of the ANR are expected to strengthen public-private partnerships in the French research landscape. In 2006 the budget was € 800 million for research projects over 4 years, divided among response mode projects across all disciplines, specific programs, industry-academic collaboration and non-project funding. Together with the Ministry in charge of research and OSEO, ANR organizes a national competition for the creation of technology-based companies. In this context, technological projects of public research organizations or of the private business sector eligible for funding are identified in France.¹⁷

The *Agence d'évaluation de la recherche et de l'enseignement supérieur* (AERES) has the objective to ensure the systematic and objective evaluation of research institutes, programs, groups and scientists.¹⁸ It assumes in part the role of the *Comité National de la Recherche Scientifique* (working alongside the CNRS),¹⁹ thus diminishing the institutional power of CNRS, since the *Comité* used to evaluate the best university laboratories and joint CNRS/university laboratories (*unités mixtes*, see below). The Agency is an *autorité administrative indépendante* (AAI), i.e. independent administrative body. The agency evaluates scientific, cultural and professional public establishments, organizations for scientific cooperation as well as the National Research Agency, furthermore certificates and degrees of higher education. AERES issues an annual report concerning the situation of research in France.²⁰

A further institutional modification of the past years regarding evaluation is the *Loi organique relative à la loi des finances* (LOLF; Institutional Act of the Finance Law), which was applied for the first time to the 2006 public budget. This Act results from a parliamentary initiative in 2000 concerning the management of public funds (based on recommendations by the OECD and the Court of Auditors), and aims at improving the transparency of public sector accounts. This budgetary evaluation instrument for public programs is thus complemented by research program evaluations of AERES. Additionally, the Court of Auditors (*Cour des Comptes*) audits public accounts (cf. European Commission 2006b: 20).

17 Cf. <http://www.agence-nationale-recherche.fr/Concours> (24/08/2007).

18 Cf. for instance <http://media.education.gouv.fr/file/87/4/2874.pdf>, <http://www.enseignementsup-recherche.gouv.fr/discours/2007/daeres.htm> (21/08/2007).

19 Cf. <http://www.cnrs.fr/comitenational/accueil.htm> (09/11/2007).

20 Cf. <http://www.enseignementsup-recherche.gouv.fr/discours/2007/cpaeres.htm>, http://www.sncs.fr/IMG/doc/AERES-rapport_PR-V5.doc (19/07/2007).

In addition, the merger of the innovation agency ANVAR²¹ with the SME development bank *Banque du développement des petites et moyennes entreprises* (BDPME) to form the OSEO group was decided in 2005. OSEO, a holding with public status referring to the Ministry for Economy, Finance and Employment, and the Ministry for Higher Education and Research, has the mission to provide assistance and financial support to SMEs in crucial stages of their development, i.e. in the start-up, innovation, development and buy-out phases. Within the OSEO group, *OSEO innovation* (former ANVAR) is in charge of innovation support and funding in the fields of technology transfer and innovative technology-based projects, thus at the same time improving public support for SMEs and supporting the development of innovative firms.²² The OSEO regional network is present in all French regions and its objective is to support entrepreneurs, to network SMEs and to foster their activities, especially in risky phases of development (cf. European Commission 2005: 5, 29).²³

Technological platforms (*Plate-formes technologiques*) relate education organizations and their competencies to SME and small and medium-sized industries. *Réseaux de développement technologique* coordinate the different actors in innovation at the regional level.²⁴ The regional delegations for research and technology (DRRT, *Délégations Régionales à la Recherche et à la Technologie*) under the supervision of the French Ministry for Research coordinate and stimulate activities in the fields of research, technology, innovation, knowledge diffusion and interaction with the public. They focus on public research in the regions, support for technological development in

21 The *Agence Nationale de Valorisation de la Recherche* ANVAR (or *Agence Française de l'Innovation*) has been a central institution for innovation support with regional delegations (since 1996). The Agency was created in 1974 to promote the exploitation of public research results, and later on increasingly focused on support for SMEs. ANVAR's missions enlarged during time, including loans for innovation projects, SME contracts with research societies, as well as the recruitment of PhD students and researchers by SMEs (cf. Mustar/Larédo 2002: 65, European Commission 2005: 41/42).

22 OSEO Financement & Garantie (the former *Banque de Développement des Petites et Moyennes Entreprises* BDPME and Sofaris, *Société de Garantie du financement*) is responsible for funding investments with banks and for guaranteeing funding of banks and equity capital investors. Finally, *OSEO services* perform studies and provide on-line services to SME (cf. http://www.oseo.fr/notre_mission/qui_sommes_nous/nos_metiers/innovation, http://www.oseo.fr/notre_mission/qui_sommes_nous/nos_metiers/financement_garantie, as well as OSEO (no year): 5; 17/08/2007).

23 See also http://www.oseo.fr/notre_mission/notre_offre, http://www.oseo.fr/notre_mission/qui_sommes_nous/organisation, http://www.oseo.fr/notre_mission/nos_equipes_en_region; 17/08/2007).

24 Cf. <http://www.recherche.gouv.fr/technologie/pft/index.htm>, <http://www.rdt-france.org/> (20/07/2007).

firms, and promotion of a scientific and technical culture. DRRT are also a platform for granting support to regional firms, or managing the CIFRE measure (see below). DRRT also manages the European Structural Funds in the region.²⁵ DRRT work closely with the *Délégations Régionales de l'Industrie, de la Recherche et de l'Environnement* (DRIRE), regional divisions for industry, research and the environment that are in charge of several state services for technical and regulatory control of industrial activities.²⁶ DRIRE activities in the French regions are harmonized with governmental industrial policy by the *Direction générale des entreprises* (DGE), the Enterprise Directorate within the Ministry for Economic Affairs, Finance and Employment.²⁷ They contribute to innovation policy in the regions, but their mission is more general (industrial safety and standards, environmental regulation, etc.). Further actors of the intermediary structure are professional and branch associations as well as chambers of commerce and industry.

The 2005 Research Bill announced € 40 million for centers of excellence in collaboration between public labs in partnership with industry. 'Institut Carnot' is a quality mark and institutes will receive supplementary funding.²⁸ Currently, 33 *Instituts Carnot* receive support from the ANR (for a renewable time period of four years). The philosophy is inspired by the German model of the Fraunhofer Institutes and the institutes concerned are expected to play a major role in the future in applied research, taking the form of private-public partnerships.

The *Agence de l'innovation industrielle*²⁹ (AII or Industrial Innovation Agency) was established in 2005 with a € 1.7 billion budget over the first two years to give grants and loans to around 10 industry-led R&D programs, including biomass exploitation, energy efficiency, a new light rail system, the Franco-German search engine Quaero

²⁵ Cf. <http://www.recherche.gouv.fr/drrt/drrt.htm> (21/08/2007).

²⁶ DRIRE activities fall under the field of environmental protection, automobiles, metrology, pressure instruments, nuclear safety, energy, mines, and since 1975, the development of SMEs. DRIRE are responsible for the implementation of the policies of the Ministry for Ecology, Sustainable Development and Spatial Planning. Cf. <http://www.drire.gouv.fr>. (21/08/2007).

²⁷ DGE is a merger of the former *Direction Générale de l'industrie, des technologies de l'information et des postes* (Directorate for Industry, Information Technology and Post) and the *Direction de l'action régionale et de la Petite et Moyenne Industrie* (Directorate for Regional Action and Small and Medium-sized Manufacturing Firms) in January 2005. DGE'S activities are oriented towards companies and their competitiveness, local policies, and coordination of local and national policies. Cf. http://www.industrie.gouv.fr/portail/une/index_esse.html (23/08/2007).

²⁸ Cf. <http://www.agence-nationale-recherche.fr/carnot>, <http://instituts-carnot.eu> (17/08/2007).

²⁹ Cf. <http://www.aii.fr> (19/07/2007).

and a mobile TV project. It was specifically oriented towards large French companies to support exceptional R&D efforts, as well as towards French medium-sized high-tech firms planning activities on a global scale.

Following the logic of the former *grands programmes*, All was conceived as the instrument of an active industrial policy expected to concentrate excellence in high-tech sectors and to promote the development of highly qualified jobs and high-tech exports.³⁰ With this aim, the Agency was expected to contribute to the funding of programs fostering innovation.³¹

Created at the time of Jacques Chirac's presidency, All was viewed as a continuation of the classical French philosophy of helping national champions. Nevertheless, this strategic orientation was the object of strong controversies: the most recent political developments – following the election of Nicolas Sarkozy in 2007 – focus on the necessity to boost the national SMEs (with the German *Mittelstand* as a targeted model). As a consequence (and a drastic illustration) of this policy shift, the All was officially abolished at the beginning of 2008.

Since the beginning of the 1980s, the regional level has gained importance in the French political system, including innovation-related issues. The 26 French regions (22 of which are in metropolitan France) do not have legislative power, but they receive part of the national tax income and have a significant budget to spend in their priority areas. They negotiate their priority fields with representatives of the state in the frame of specific contracts (*Contrats de Projet Etat-Région*, CPER).³² Since 1986 and following the 1982 decentralization law, French regions are regional authorities with an elected Council (*Conseil régional*) that is responsible for the regional administration. The *préfet*, on the other hand, represents the French state in the regions. Mainly social questions and transport, but also partly education, culture and local development are the responsibility of the 96 *départements*, which are administered by the General Councils (*Conseils généraux*).

³⁰ The establishment of this institution was one recommendation of the 'Beffa report' on new orientations of French industrial policy (cf. Beffa, 2005: 17-31, 47-60, see also European Commission 2005: 27/28).

³¹ Cf. for instance <http://www.enseignementsup-recherche.gouv.fr/pacte/lexique.htm> (12/07/2007).

³² Former *Contrats de Plan Etat-Région*. Cf. also page 188.

2.2 The Big Players (CNRS, CEA, INSERM, INRA, INRIA)

A variety of research organizations belong to the French (publicly funded) research landscape, they can be seen as the “big players”.³³ They have their missions in different technologies and diverse fields of activity. The most important French actor in basic research is the *Centre National de la Recherche Scientifique* (CNRS, the National Center for Scientific Research). Founded in 1939 by a governmental decree, the CNRS emerged from the *Caisse Nationale des Sciences* (National Office of Science), but its strong development started after WW2. CNRS is funded by the French government and is currently the largest public research institute in France and Europe. It has a budget of € 3.08 billion (including € 513 million income generated by the organization itself)³⁴ and currently employs 30,000 persons, of whom 11,700 are CNRS tenured researchers. CNRS has the general mission to engage in knowledge creation and knowledge transfer for the economic benefit of society, in the application and promotion of research results, in the development of scientific information, of research training, and in the analysis of the scientific climate on a national and international scale, in order to develop a national research policy. The different CNRS laboratories have their locations all over France. They work on contracts on a four-year basis and are continually evaluated. In 2005 a reorganization process was started in CNRS, giving the institutes' research activities a stronger regional focus. CNRS hires about 400 researchers every year who participate in a centrally organized national examination competition (*concours*), which consists of an application procedure and audit. CNRS researchers are civil servants.³⁵

Specific research demand of government departments and public authorities is met by mission-oriented public research institutes (government laboratories). Research centers of the *Institut National de la Recherche Agronomique* (INRA, French National Institute for Agricultural Research)³⁶ perform applied research in the fields of agriculture,

³³ A list of the main public research and higher education institutes can be found at <http://www.enseignementsup-recherche.gouv.fr/lien.htm> (29/05/2007).

³⁴ The sources of funding of the annual CNRS budget are the government and public funding, as well as CNRS funds which originate from industrial and EU research contracts, royalties on patents, as well as licenses and services (cf. <http://www2.cnrs.fr/en/8.htm>; 13/07/2007).

³⁵ Cf. <http://www.sg.cnrs.fr/drhchercheurs/concoursch/default-fr.htm>, <http://www2.cnrs.fr/en/352.htm> (28.08.2007). CNRS offers diverse further programs for their staff, such as post-doc recruitment, internal and external mobility programs, secondments, etc. Cf. for instance <https://www2.cnrs.fr/DRH/post-docs07/>, <http://www.sg.cnrs.fr/drh/mobilite/mob-cnrs.htm>, <http://www.sg.cnrs.fr/drh/mobilite/mob-hors-cnrs.htm>, <http://www.cnrs.fr/liensutiles/bourses.htm> (28/08/2007).

³⁶ Cf. <http://www.inra.fr> (19/07/2007).

food, nutrition and food safety, environment and land management. This mission-oriented public research institution was founded in 1946, and is under the authority of the Ministry of Higher Education and Research and the Ministry of Agriculture and Fisheries. With about 1,900 researchers, about 2,430 engineers, 4,600 technicians and administrative staff, and 1,600 doctoral students, INRA is the second largest public research institute in the French research landscape. It has 21 regional centers with specific orientations. The budget for 2005 was € 606 million. The *Commissariat à l'Énergie Atomique* (CEA, the French Atomic Energy Commission) is active in energy, information and health technologies, as well as defence and national security. Its main goals, to become the leading technological research organization in Europe and to ensure the future effectiveness of the nuclear deterrent, are pursued through links between basic and technological research. The public body of CEA was established in 1945 by General de Gaulle. In 2006, the nine CEA research centers employed 14,910 persons. CEA institutes maintain contact with other research centers, local authorities and universities in the respective region. In 2006, the CEA's budget amounted to € 3,210 million.³⁷

INRIA (*Institut National de Recherche en Informatique et en Automatique*),³⁸ the National Institute for Research in Computer Science and Control, operating under the dual authority of the Ministry of Research and the Ministry of Industry, is dedicated to basic and applied research in information and communication science and technology. The Institute also plays a major role in technology transfer by fostering training through research, diffusion of scientific and technical information, development, as well as providing expert advice and participating in international programs. By playing a leading role in the scientific community in the field, and maintaining close contacts with industry, INRIA is a major participant in the development of information and communication technologies (ICT) in France. With its six research units, INRIA has a total workforce of 3,600 (2,800 of whom are scientists from INRIA's partner organizations such as CNRS, universities and engineering schools). Start-ups are financed in particular by *INRIA-Transfert*, a subsidiary of INRIA that supports four start-up funds. INRIA has an annual budget of € 160 million, 20% of which originates from its own research contracts and development products.

The National Institute for Health and Medical Research (*Institut National de la Santé et de la Recherche Médicale*, INSERM) is under the dual auspices of the Ministry of Health and the Ministry of Research. It has a scientific and technical mission, and

³⁷ Cf. <http://www.cea.fr> (19/07/2007).

³⁸ Cf. <http://www.inria.fr/inria/enbref.en.html> (20/07/2007).

works on issues related to human health, through research in biology, medicine and public health. INSERM sees itself as an exchange generator between basic research, clinical research, therapeutic or diagnostic research, and public health research, and collaborates with other research institutes and care centers. INSERM was founded in 1964, and has 335 research units in France. 13,000 persons, of whom 6,000 are researchers, work in INSERM centers.³⁹

2.3 Higher Education

Higher education in France is organized along two main lines: (i) universities and (ii) specialized schools.⁴⁰ University education offers three national diplomas: the *licence* after three years' study, the *master* after a further two years and the *doctorat* which should be performed in three years after the master's degree. Specialized schools can be public or private and offer specialized professional training. Among them are the *grandes écoles*, a specifically French feature of the higher education system. They educate a limited number of students and prepare them for future tasks in engineering, administration and management, but also in arts and human sciences.

The new law concerning the autonomy of French universities (LRU: *Loi relative aux libertés et responsabilités des universités*) came into force in September 2007.⁴¹ This law has the general aim to align the French university system more closely with international norms. Universities with this increased autonomy will then be more than "regional branches" of the national university system, and can define their own programs for education and research. However, the general adaptation to the international standards of master studies affects a higher congruence with foreign higher education principles and norms. A decisive issue is also linked to the property and management of real estate assets (buildings, laboratories, etc.) by French universities as a consequence of a higher degree of autonomy. This issue, which at first glance seems not to directly affect the capacity of universities to contribute to the national innovation system, may have radical consequences on the financial situation of the universities concerned.

In the past, cooperations between industry and (public) researchers were rather rare, leading to a gap between French universities and industry/the production system (cf.

³⁹ Cf. <http://www.inserm.fr> (19/07/2007).

⁴⁰ For an overview of the French higher education system cf. for instance <http://www.education.gouv.fr/cid26/l-enseignement-superieur.html> (10/07/2007).

⁴¹ Cf. <http://www.nouvelleuniversite.gouv.fr/-le-projet-de-loi-relatif-aux-libertes-des-universites-.html> (22/10/2007).

Chesnais 1993; Mustar/Larédo 2002; Quéré 1999). In the meantime, the differentiation between universities and the CNRS has been replaced by a stronger interrelation between both institutional forms; consequently, the majority of CNRS units are currently *unités mixtes* (mixed research units) between CNRS and universities (cf. European Commission 2005: 3). In addition, the *Grandes Écoles* which formerly concentrated on education and qualification of future managers are to an increasing extent involved in research activities. Furthermore, validation of research results and their application gained importance (cf. Larédo/Mustar 2001; Mustar/Larédo 2002, Vavakova 2006). The mission-oriented research institutes have also undergone changes. These include for instance the increased involvement in contract research projects, growing importance of technology transfer and valorisation of research, and enhanced relationships between research institutes and with industry.

3 Research and Innovation Policy Instruments

3.1 Financial Measures

Among the financial measures to support innovation, the French *Crédit d'Impôt Recherche* (CIR) is a central tax incentive to enhance firms' competitiveness through research and development activities. It is not restricted to specific sectors of activity or firm sizes. Introduced in 1983, the CIR was modified in 2004 and in 2005 in order to better adapt to the needs of SMEs and to constitute a reliable element of the financing plan of innovating firms. This instrument was strengthened in the past years and recently transformed (1 January 2008). The general principle consists in reducing firms' taxes in proportion to their R&D efforts. Before the very last amendment, CIR was based on two components: (i) 10% of the annual R&D volume, and (ii) 40% of the increase in firms' R&D expenditures (adjusted by the average of the R&D expenditures of the two preceding years).⁴² The taxation scheme involved also a ceiling in the eligible expenses: € 10 million in 2006 and € 16 million in 2007. From the year 2008 onwards, the system will be simplified, considering 30% on the R&D volume up to a level of € 100,000 and 5% of the costs beyond this level. This development introduced therefore at the same time a principle of simple proportionality in the tax reduction up to a certain threshold, and a principle of lesser proportionality after the threshold, but with no limitation. In terms of international comparison, France has now clearly adopted the "volume" norm (historical models being Canada or Norway), instead of the "incremental norm" used in the US and in Japan. Additionally, since 2007, the CIR also includes expenses for technology survey, human and material resources for research, subcontracting in research and costs of the patent application procedure. In addition, the aspect of human resources was also introduced in recent years: the employment of highly qualified personnel (young PhD graduates) and partnerships between public and private research are specifically considered.⁴³

Generally, CIR is offset on the tax to be paid, or it is directly refunded to newly created firms, to young innovating firms and to growing SMEs. In 2005, 7,400 firms applied for a tax credit (5,428 of whom were successful) with a volume of € 981 million, referring to research expenditures of € 13.5 billion. 64% of the applicants, particularly very small firms with less than 50 employees profit from this instrument. It is generally considered

⁴² Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/cir/2007/brochurecir07.pdf> (25/10/2007).

⁴³ Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/cir/bilancir2005.pdf> (28/08/2007).

an efficient policy instrument for fostering research activities in all types of firms, and furthermore it has the advantage of being inexpensive to run. In sectoral terms, firms in the electrical and electronics industries as well as vehicle construction account for about 35% of the applicants; in terms of territorial distribution, the Paris region of Île-de-France clearly hosts the highest share of applicants (32.18%), followed by Rhône-Alpes (13.93%).⁴⁴ It is not a regionally oriented policy, as it is centrally monitored by the Ministry of Finance. Summarizing, the CIR system since its introduction increased in (financial) importance, placing France in the mainstream, if not above, OECD countries for the relative importance of this particular innovation policy instrument, and – in the new configuration – particularly favors medium-sized enterprises, which is also a priority for the new philosophy of public policy.

In order to grant financial support for the creation of research-intensive companies, and considering the relatively weak presence of business angels in the French funding landscape, the government launched various measures to provide financial support for firms at the different stages of development. In their start-up phase, innovating firms can be supported by private funds called *fonds de capital-amorçage* in order to finalize the development of their technology. Since new technologies generally originate from research and/or higher education facilities, these latter act as partners of *fonds de capital-amorçage*. The later stages of firm development are financially covered by risk and development capital. The government funding is reimbursable within 12 years (maximum). There are *fonds de capital-amorçage* on the national, as well as on the regional level, the latter generally with a thematic focus. In 2005, the eleven *fonds d'amorçage* (five thematic ones on the national level and six general regional funds) received a government budget of € 22.87 million. On average, the investment of a national fund is € 1 million, and the regional fund investment can reach € 0.3 million (cf. Ministère de l'Enseignement supérieur et de la Recherche 2007b: 64).⁴⁵

Aiming to increase the supply of risk capital for innovative companies, in 1998 the French state established a public fund for risk capital (FONDS: *Fonds public pour le capital-risque*) amounting to € 137 million, divided between the state, the *Caisse des*

⁴⁴ Cf. Ministère délégué à l'Enseignement supérieur et à la Recherche 2007a, Ministère délégué à l'Enseignement supérieur et à la Recherche 2006: 3, Technopolis France 2006, <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/cir/index.htm> (17.08.2007). See also the national balance of the tax credit for 2005 at <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/cir/bilancir2005.pdf> (28/08/2007).

⁴⁵ Cf. also <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/incub/incub3b.htm>, <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/incub/fonds.htm> (14/09/2007).

depôts et de consignations (CDC) – that is in charge of the management of the fund, via the intermediary *Commission des opérations de bourses* – and the European Investment Bank. In 2000, the French government decided to establish another fund to supply risk capital, the *Fonds de promotion pour le capital-risque*, with similar objectives, constituted as *Fonds commun de placement à risque* (FCPR), with a capital of € 150 million. At the end of 2004, nine FCPR – which are financed by the common funds for risk capital – invested € 84 million in 83 enterprises, and at the end of 2005, the 55 *fonds de placement pour le capital-risque* have altogether invested € 980 million in more than 700 enterprises, according to the Ministry for Higher Education and Research. Further funds for young and technology-oriented firms are the *fonds de co-investissement pour les jeunes entreprises* (FCJE) – aiming at refinancing young innovative firms – and the *Fonds de fonds technologiques* (FFT) that accompanies technology-oriented firms with high growth potentials in a longer-term perspective (cf. Ministère de l'Enseignement Supérieur et de la Recherche 2007b: 64).

A *Fonds Communs de Placement dans l'Innovation* (FCPI) can be considered as a savings plan with fiscal advantages, which is attractive for private individuals. 60% of these funds are invested in innovating companies with their location in the European Union with less than 2,000 employees. Besides some further legal criteria, these firms are required to have considerable research expenses and to create innovating products, procedures or technologies. Innovating firms are selected and accompanied by OSEO Innovation. Individual persons who invest in these companies benefit from a 25% tax reduction related to their annual investments (to a maximum of € 6,000 per annum). Additionally, these advantages can be combined with tax benefits from the *Fonds Communs de Placement à Risques* (FCPR) that are invested with a minimum of 50% in non-listed societies.

Considering measures in favor of young firms and start-ups more specifically, the '*Jeune Entreprise Innovante*' status was created in the framework of the Finance Law in 2004. This status makes young firms eligible for tax credits to compensate for their R&D investments. It refers to independent small and medium-sized enterprises with less than 250 employees and a turnover of less than € 40 million (or a balance sheet of less than € 27 million) that have existed for less than eight years and spend at least 15% of their total expenses on research and development activities. Firms with the JEI status benefit from diverse tax reductions, as well as being exempted from social secu-

rity contributions. It is possible to combine the young innovating firm status with the *credit d'impôt recherche*.⁴⁶

In order to stimulate and facilitate the creation of innovating firms originating from public research, incubators offer firm founders favorable conditions to start their business and to interact with other young firms. Incubators that are promoted by the Ministry for Higher Education and Research deal with innovating projects that have their roots in public research, and are located in close proximity to a scientific institute in order to facilitate cooperation with the respective laboratory. Between 2000 and 2003, 31 incubators were put in place, with a total budget from the Ministry of € 25.54 million (of which about € 8 million come from the European Social Funds). Within this period, 964 projects were promoted in incubators. Between 2000 and the end of 2005, 1,415 projects of innovating companies were hosted in the incubators, nearly 50% of which are based on public research results, mostly in life sciences/biotechnology (34%), information and communication technologies (33%) and engineering sciences (29%). These projects led to the creation of 850 companies and about 3,600 jobs, according to the Ministry in charge of Research (cf. Ministère délégué à l'Enseignement supérieur et à la Recherche 2007b: 63).⁴⁷

The *Loi de finances* dated 2006 introduced two regulations or modifications to benefit innovation: (i) the *Société unipersonnelle d'investissement à risque* (SUIR), and (ii) the *Impôt de solidarité sur la fortune*. The SUIR – a fiscal status existing since 2004 – is an instrument to encourage financial and personal involvement of business angels in start-up firms through tax exemption. The 2006 Financial Law adapts the instrument further to the specific situation of business angels. It aims to give incentives for potential business angels to invest in young and innovating firms and thus to enhance business angel activities in France. Securities, stocks and bonds held in companies are partly freed from the *Impôt de Solidarité sur la Fortune* (ISF), a tax that is paid by persons with a fortune of more than € 760,000, if the owner of these stocks has his/her principal (active or passive) activity in the company concerned.⁴⁸

46 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/jei.htm>, <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/guidejei0604.pdf> (19/07/2007).

47 Cf. also <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/incub/index.htm>, <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/incub/definition05.pdf> (19/07/2007).

48 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/suir.pdf>, <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/isf.pdf> (28/08/2007).

3.2 Public Procurement Policy

"Demand is a major potential source of innovation, yet the critical role of demand as a key driver of innovation has still to be recognized in government policy. Public demand, when oriented towards innovative solutions and products, has the potential to improve delivery of public policy and services, often generating improved innovation dynamics and benefits from the associated spill-overs. Nonetheless, public procurement as an innovation policy has been neglected or downplayed for many years" (Edler/Georghiou 2007: 949). This assertion to be found in a very recent paper considering different European countries perfectly reflects the current situation in France.

In order to give an indication of the economic weight of public procurement in France, it must be kept in mind that its volume amounted to approximately € 15 billion for 2005. The two biggest "buyers" in volume were together responsible for more than half of this total: the Ministry of Defence (35%) and the Ministry of Economic Affairs (22%).⁴⁹ Several developments in public procurement in France can be identified. There is a clear willingness to simplify procedures by merging the rules applicable to the (central) state with those applicable to the local and regional authorities. In this respect, the creation in 2004 of an inter-ministerial public procurement agency (*Agence centrale des achats* or ACA) led to savings corresponding to approximately € 50, 100 and 150 million respectively for 2006, 2007 and 2008 (expected).⁵⁰ The development of e-procurement in France provides a further example of development. Since January 2005, French public administrations cannot refuse tenders that are submitted electronically. In doing so, France has made a significant step towards the electronic processing of its public procurement procedure. Such action goes further than the recommendations of the European Directives regarding procurement procedures.⁵¹

The issue of sustainable public procurement (*achat public durable*) is progressively emerging in France,⁵² but so far, and according to a study performed on behalf of the European Commission,⁵³ only the Ministry of Defence has explicitly incorporated innovation-promoting criteria in its procurement system, promoting notably the participation

49 Cf. Direction Générale de la Modernisation de l'Etat (2006): La modernisation de l'Etat en pratique – Les achats de l'Etat. Paris.

50 Cf. <http://alize.finances.gouv.fr/modernisation/feuilleteroute/chantier8.htm> (25/10/2007).

51 Cf. <http://www.egovbarriers.org/?view=maillist&NewsletterID=3> (05/10/2007).

52 Cf. http://www.ecologie.gouv.fr/IMG/pdf/061025_Dossier_Final_FEDD_26-10-06.pdf (25/10/2007).

53 Cf. ftp://ftp.cordis.europa.lu/pub/innovation-policy/studies/6_france.pdf (18/09/2007).

of innovative SMEs, provided they can prove they are on the brink of an innovative technology. More generally, it can be stated that the discussion currently taking place in France about public procurement is influenced by the example of the US Small Business Act. But, as far as military programs are concerned, French policy will compare with the US in terms of economic impact. The French army currently buys "on the shelf" specialized goods and no longer maintains "dual technology" projects, for instance. The defence sector is still important in the French innovation system, but the good times of the "spin-off model" are over.

3.3 Network-related Measures

For a long time, the French system of research and innovation was described as "Colbertist" (Chesnais 1993), based on state involvement in science and technology, within a triangle of state, academic research, and industry. Although this model is no longer relevant (Mustar and Laredo 2002), the end of 'Colbertism' is however not the end of state intervention (cf. Lanciano-Morandat and Verdier 2004). New forms of state intervention have emerged in the context of the drive for excellence, competitiveness and cohesion in the European Research Area (ERA), which has highlighted the structural gap between science, technology and innovation in France.

The policy initiative which is most likely to exert a long-lasting influence on the R&D landscape is probably the competitiveness clusters (*pôles de compétitivité*) program. Presented commonly as the most important recent innovation policy development in France, the *pôles de compétitivité* concept was launched in September 2004⁵⁴ and announced in July 2005. The initiative aims to strengthen the competitiveness of the French economy by developing synergies between research institutes, firms and education organizations in a given geographical space. Active partnerships between the cluster members are supposed to contribute to fostering synergies of the sector or technology underlying the cluster. Cluster members are eligible for direct aid, tax incentives and privileges for accessing funding sources. From more than 100 proposals, 66 competitiveness clusters were selected in 2005, of which six are high-level ones labelled *pôles de compétitivité mondiaux* and ten *pôles de compétitivité à vocation mondiale*. A budget of € 1,500 million over 3 years has been dedicated, with ministries encouraged to allocate around 25% of their funds to collaborative projects. A cluster has, in a given area, three ingredients (business, higher education and research units) and three key factors (partnerships, R&D projects and international visibility). The current innovation policy initiative of *pôles de compétitivité* constitutes a shift from a rather

⁵⁴ Cf. <http://www.competitivite.gouv.fr/> (20/07/2007).

top-down to a bottom-up philosophy with competition orientation between initiatives on the regional level.

The *Réseaux Thématiques de Recherche Avancée* (RTRA) measure was launched by the Prime Minister as an initiative to foster competitiveness through cooperation. RTRAs are networks of the scientific community that receive financial aid from the state. They are selected in the framework of a national competition on the basis of scientific quality, added value and originality. The RTRA measure was announced in the 2005 Research Act; networks are designed to carry out research projects in order to create clusters of internationally excellent science. The general objective of the French government is to promote high-level scientific networks with an international reputation. At the core of a network are research institutes in close geographical proximity. Priority goes to proposals that are cooperative and multidisciplinary, with quality links to economic sectors. The networks will receive substantial funding for new infrastructures and to attract top scientists. A list of 12 regional RTRA (plus one inter-regional one in social sciences) were announced in October 2006, located in first place in Île-de-France, further in Rhône-Alpes, in the south of France (Midi-Pyrénées and Languedoc-Roussillon) and one *réseau* in Strasbourg. A further network in social and human sciences associates institutes in Lyon, Aix-Marseille, Nantes and Paris.⁵⁵

Research and higher education clusters (*Pôles de Recherche et d'Enseignement Supérieur*, PRES) are a mechanism to coordinate research and higher education activities within a particular geographic area, to increase efficiency, visibility and the attractiveness of French higher education. There is no national competition or limit to numbers of PRES and no initial finance attached.⁵⁶ PRES is a way to achieve more concentration in higher education, but such a goal can of course be met by purely merging universities, which is also a tendency now in general university towns. PRES can be used as a sort of intermediary policy, for instance, between two towns.

Since 1991, the CIFRE convention (*Les conventions industrielles de formation par la recherche*) enables young PhD students to realize their doctoral thesis in a company. They are accompanied and supported by an external research unit (the laboratory of the PhD supervisor) during a three-year period. Besides the PhD thesis, the program aims to strengthen technological research of the participating firm and further to provide incentives for collaboration between the firm and the research institute in charge of the scientific PhD supervision. The laboratory can be a higher education institute, a

⁵⁵ Cf. <http://www.recherche.gouv.fr/discours/2006/rtra.htm>,
<http://www.recherche.gouv.fr/lopr/rtra/index.htm> (19/07/2007).

⁵⁶ Cf. for instance <http://www.enseignementsup-recherche.gouv.fr/discours/2006/presrtra.htm>
(23/10/2007).

public research institute, a technical center, or an industrial laboratory in France or abroad. A CIFRE project receives financial support from the Ministry in charge of research (through ANRT) or European structural funds.⁵⁷ The number of PhD students benefiting from CIFRE contracts has constantly increased. The budget has been extended recently and, in the next years, the number of 1,000 new CIFRE contracts per year could be realized.

The CORTECHS (*Les conventions de recherche pour les techniciens supérieurs*) agreement is directed towards the recruitment of a technician through a SME for one year (minimum). During this time, the technician develops an innovation project. As in the case of CIFRE, the measure furthermore aims to provide incentives for the company to collaborate with a research institute that monitors the innovation project. Thus, CORTECHS also bring together three actors: the young technician, the SME and a competence center (research institute, engineering school, technical or professional college (*lycée*), technology transfer center, etc.) that is preferably located close to the participating company. In the course of the project, the technician receives an additional qualification in innovation management. A CORTECHS contract is signed between OSEO Anvar and the company, and receives co-financing from the Ministry in charge of research, municipalities or the European Structural Funds.⁵⁸ In the past, regions were often associated with the development of this policy, as this instrument is well adapted to territory-oriented policy. On the same level, the Alsace region has introduced further innovations: in the PRISME arrangement, the "young technician" is replaced by university graduates (master level).⁵⁹

Further measures to support innovation activities and the qualification of young researchers are, for instance, post-doc programs of the Ministry of Higher Education and Research and the "Recruitment support for innovation in SMEs" program. The "*Aide au recrutement*" program subsidizes the hiring of R&D personnel in order to create a research and development measure or to strengthen a research team in the framework of an innovation project. The "Initiative Post-doc" is directed towards French post-docs who perform their research activities abroad. It aims at providing them with incentives to return to France and to integrate them into the French research system.⁶⁰

57 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/aides/cifre.htm>, <http://www.anrt.asso.fr/index.jsp> (28/08/2007). Cf. also Héraud/Lévy 2005.

58 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/aides/cortec.htm> (28/08/2007).

59 Cf. http://www.alsace-technologie.org/downloads/Fiche_PRISME.pdf (12/11/2007).

60 Cf. <http://www.enseignementsup-recherche.gouv.fr/technologie/mesur/aides/innovpme.htm> (28/08/2007).

4 Multi-level and Multi-actor Governance

New forms of public intervention, budgetary constraints, particularly in relation to university infrastructure, and the importance of the European project have coincided to strengthen the regional dimension of science and research.⁶¹ The reinforced importance given to the regional level is also driven by the need to increase the efficiency of the research system and to maximize economic returns from investments in R&D through spatial clustering and geographic proximity.

New forms of public intervention have become dominant, with policy looking less substantial and more procedural. While the state still defines the rules of the game, it does not specify implementation mechanisms, leaving a vacuum between strategic direction and necessary and available policy instruments. Increasingly, science policy is formulated between top-down and bottom-up procedures. Decentralized actors, in particular regional authorities, must respond to proposals and initiatives within a centrally designed framework, corresponding to the type of public action that Lanciano-Morandat and Verdier (2004) described as the model of "*Etat facilitateur*". This is a trend that can also be seen in other European countries, such as Germany. In the French context, key examples include the *pôles de compétitivité* and the *réseaux thématiques de recherche avancée* (RTRA). The *pôles de recherche et d'enseignement supérieur* (PRES) represent a slightly different initiative, insofar as these are bottom-up developments, not subject to national competition and with no initial dedicated funding attached. The PRES are largely academic collaborations and poorly connected to local actors, although regional/local authorities express their interest in the design of such initiatives and are ready to support them by their own means and policies. Despite significant differences in the scale, scope, funding and governance of these initiatives, they all represent varying attempts to bring combinations of academic, industry and local economic actors together within geographical proximity. The emphasis on clusters and networks as tools for economic and scientific development builds on existing regional scientific competencies and innovation infrastructures. However, contrary to the British case, it is important to note that the role of regional authorities has not been restricted to innovation activities; regions are also now welcomed, should they so desire it, as partners in basic science and research as well as exploitation.

Financing higher education has been a key area in which regional authorities have developed substantial roles, despite having no official competence in this area. Through the program called *Université 2000* (U2000), the state put in place a negotiation proce-

⁶¹ Cf. Crespy/Héraud/Perry 2007.

ture in order to involve regions in addressing the huge and rapid investment necessary in university infrastructures (cf. Pouyet 1998). In exchange for regional money, the state was forced to concede a role to sub-national authorities as partners in the policy-making process. Cities and other sub-national authorities, as well as regional councils, have taken a lead in science and technology policy, driven by the desire to host or develop university or higher education training on their territory. *Université du Troisième Millénaire* (U3M) was the second large planning operation involving national and sub-national authorities in higher education. The novelty here was the embedding of plans for medium-term academic infrastructures, through the *Contrats de Projet Etat-Region* (CPER),⁶² within a longer-term foresight exercise with various regional actors. University infrastructures have been a large part of the CPER, accounting for 11.5% of the total allocations in the 2000-2006 planning phase (cf. CIIACT 2006). U2000 and U3M were mainly top-down procedures and can be viewed as opportunistic instruments for financing national policy in higher education. But, out of economic necessity, a small revolution emerged leading to the lasting involvement of sub-national authorities in education and science policy.

A third driver of an increasingly regional dimension to higher education, science and research is the development of the European Research Area (ERA). In official documentation, France's active support for the Lisbon challenge of raising R&D expenditure to 3% of GDP by 2010 is evident and the Consultation on Research (2003) highlighted widespread support for *inter alia*: integrating national research policy into a European perspective; bringing French influence to bear on the ERA project; the creation of a European Research Council and a better articulation between European research and university policy. In reality, while an emphasis on centers of excellence can be seen, efforts to increase public and private R&D to meet the 3% target have not taken center stage in the general context of public budget restrictions.

The ERA project has specifically driven increased concern with efficiency, competitiveness and international excellence in science. Yet regionalization has also been an important corollary to European developments and even a stepping stone to international visibility and world-class excellence. For instance, the RTRA program aims to encour-

⁶² CPER (former Contrats de Plan Etat-Région) are arrangements between the government and the regions which determine financial transfers of the state to the regions and fix joint projects to be realized at the regional level. The elaboration of CPER is the responsibility of the regional representative of the state, the préfet, and the elected regional administration, the conseil régional. In the frame of these contracts, regions are - along with other regional/local authorities - involved in science and technology policies and can negotiate their policy for research and development and innovation issues. An important part of the negotiation is about priority ranking for state/region joint investments.

age the emergence of internationally excellent clusters of research, on the basis of the best French research units, but sees geographical proximity as the key to this aim. Similarly, the PRES aim for international visibility of higher education through creating critical mass at the sub-national level. The resources of regions to participate actively in these initiatives were enhanced through the recent decentralization of European regional funds, as part of the reform of the CPER. The timing of the CPER agenda has been adapted to fit in with EU program timing. French reforms are thus marked by a dualism between regional action and international profile.

For their part, national research institutes, such as the *Centre National de la Recherche Scientifique* (CNRS), have also started to reform their missions and organization with the aim of linking education, research and innovation and to improve the relationship with universities in the context of increasing 'hybridization' (cf. Mustar and Laredo 2002). Debates have recently developed regarding a potential territorial dimension to this reform and the possible reshaping of CNRS on an inter-regional level. Nevertheless, the decentralization of CNRS has had greater administrative than scientific significance. On the whole, the orientation of research institutes has remained resolutely international and national. It remains to be seen what the implications of new cluster and pole initiatives may be in altering the geographical orientation of research actors.

The principle of regional equity, if not equality, has also shaped a distinctive French response to the needs of a competitive, international knowledge-based economy. Networks and clusters of scientific excellence, rather than the concentration of resources per se, have become preferred policy tools, demonstrating equality of opportunity to compete for science resources, if not equality of outcome. This reflects a more gradual evolution in French policy towards equity rather than equality as a precondition for competitiveness: 'equity represents a means of striving for equality within the reasonable limits of efficiency' (Baudelles and Peyrony 2005: 109). Baudelles and Peyrony note a changing regional development paradigm in which competition between territories is no longer seen as a zero-sum game, a position supported by the rejection of the notion of 'compensatory solidarity' by the most modern and progressive localities (ibid 109).

A good example of the distinctive French response to equality and competition – or equity – is in the *pôles de compétitivité*. It was originally intended that there would be only 15 clusters selected, chosen on the basis of international excellence and visibility, partnership and the capacity for innovation. This form of operation was clearly seen as a way to apply the European approach of networking centers of excellence and is considered as a pathway towards the implementation of the Lisbon strategy. In the planning documents, the initiative was conceived of as an important tool of industrial policy,

driven by a philosophy of 'variable geometry' (cf. CIADT 2004). However, a three-tier system of clusters has subsequently emerged, representing an attempted balance between competition and balanced growth. Of 105 applications, demonstrating the high degree of local interest in the concept, 67 clusters were eventually funded (now 66 after some regrouping), with priority and preferential conditions given to 6 world-class clusters and 9 second-tier clusters that might join the priority group subject to reaching critical mass. The remaining successful clusters have been designated as being of 'national status' and even those clusters that did not make it into the 'top 67' have € 12 million earmarked for their development. The geographical distribution of the clusters across France is balanced, with each region participating in at least one cluster, thus highlighting the real limits to French concentration (cf. DATAR 2005). Compared with the UK context, for instance, the location of national research institutes is also deemed a legitimate tool for regional policy, such as in the recent move of the *Institut national de recherche sur les transports et leur sécurité (INRETS)* to Lyon-Bron (cf. CIACT 2005) or the successful application to host the International Thermonuclear Experimental Reactor (ITER) in Caderache in Provence-Alpes-Côtes-d'Azur (PACA).

As with other European countries, the last two decades have witnessed an evolution of the French administrative system towards greater devolution. What distinguishes the French experience is the way in which *devolution* to sub-national public authorities – in terms of the transfer of specific competencies – has been accompanied by the *decentralization* of the agencies of the central state.

Since the initial decentralization laws of 1982, the various sub-national levels – *régions*, *départements* and *communes* – have emerged as increasingly significant intermediaries in the relationship between the state and its citizens. In 2003, legal changes strengthened processes of devolution and enshrined the concept of a 'decentralized organization for the French Republic' within the constitution. Importantly, regions were made constitutionally equal with other territorial authorities and given financial autonomy. In 2005, a second law further defined the transfer of competences from the state to the territorial authorities, clarified responsibilities between tiers and rationalized local and regional administration. Nevertheless, functional overlap remains. Regional councils have been given explicit responsibility for economic development, yet other local authorities also have the right to intervene. Departments and local authorities, and more recently *intercommunalités* (sets of communes regrouped for the sake of specific projects) are now almost as active as regions in the economic field. This is an important point to note, as it is via these economic development functions that sub-national actors have increasingly encroached, from the bottom up, on the traditionally centralized policy domain of science, research and higher education.

Indeed, sub-national authorities have no constitutional rights to intervene in research and higher education. Science policy is decentralized, through the functions of the Regional Delegation for Research and Technology (DRRT), but not devolved. The DRRT is the representative of national government in the regions, akin to the English Government Offices for the Regions, taking orders from the Ministry for Research. Yet it is generally considered that the relative autonomy of the regional offices of national ministries and agencies (*services déconcentrés de l'Etat*) is as important as the existence of devolved authorities for achieving efficient regional governance. The expertise of such "decentralized" teams from the central administration, as well as the room for manoeuvre vis-à-vis the Paris administration, are judged important success factors in the design of relevant regional policy. The decentralized administrations of the state are now in a position to cooperate with regional authorities for the sake of institutions localized within the territory of the region. In the case of the science of innovation, regional authorities have in principle no specific competence, but since they are in charge of the economic development of the territory following the Decentralization Law, by extension they can intervene in the science and technology scene if they want. The main constraint here is the extent to which a specific region wants to intervene.

The republic is decentralized, but not federal. Regional autonomy is limited, with variations between some 'historical' regions such as Brittany (cf. Pasquier 2003) and Alsace, and those regions without a strong cultural identity. Yet recently, limited flexibility has been introduced through the notion of *le droit à l'expérimentation*. This established the legality of implementing a devolved function in one (or more) region(s), as a means to 'test' an idea. It is consistent with Cole's (2006: 32) interpretation of decentralization as a mechanism to 'liberate the entrepreneurial energies and political capacity of local and regional players'. However, the success of any experimental devolution is supposed to lead to the general implementation of the initiative, regardless of the wishes of other regional authorities. This acts as a strong constraint on devolution, since the unanimous willingness of the French regions for greater autonomy cannot be assumed. In this respect, the 'right to experimentation' is a good example of the balance between diversity and equality that characterizes the new French political philosophy. Nevertheless, it is an important innovation in French policy. Firstly, national administration will be 'locked in' to changes through the political difficulties of withdrawing any function from a region once it was officially granted and successfully trialled. Secondly, local decisions are increasingly being taken in the absence of specific legal competence, science policy being a case in point, and such spontaneous experiments may well be legalized after the fact. The experimentation right is therefore important in creating potential gaps in central state control that can be exploited by sub-national authorities to bring about multi-level governance, from the bottom up.

The primary arena for negotiation of national and regional interests in priority-setting and policy formulation in all areas of policy is the *Contrat de Projet Etat-Régions* (CPER, formerly *Contrat de Plan Etat-Régions*). The procedure was introduced in 1982 as a tool to integrate national and regional plans. It is now the single multi-level negotiation platform between central and regional authorities, dealing with public objectives, co-funding infrastructures and joint policies. There have been four generations of CPER, the last between 2000 and 2006. Over this period, the amounts allocated by the state and regional authorities have tripled (cf. Institut Supérieur des Métiers 2006). In theory the contributions of the central state and regional authorities are equal: in 2000-2006 the € 38 billion total allocations were made up of € 19.5 billion from the state compared with € 18.5 billion by regional authorities, in addition to the mobilization of resources by other territorial authorities (cf. CIIACT 2006). Yet, as we discuss below, in practice the balance is less clear, given that the state does not always deliver on its commitments, leaving a deficit to be met by the regions.

The CPER cover all areas of public investments, including science and higher education - to the extent that central and regional authorities have deemed this a priority in different territories. As the regional role in science, research and higher education has expanded, as detailed above, so the importance of the CPER as an arena for negotiation in this domain has also increased. Regional authorities, as well as departments and cities in certain cases, have become real partners for science, innovation and higher education policy, negotiating their own priority-ranking against the central administration's policy for the territory (cf. Baraize 1996). In the negotiation procedure, regional and national interests are compared, leading to various tradeoffs under the general idea of global co-funding. Generally speaking, there are few problems in reaching agreement for investments in areas where the region is obviously leading. However, the increasing competition between regions in strategic areas such as S&T policy means that the state may be reluctant to co-finance technological or training infrastructures in one region in domains where another region is more advanced. Where disagreements occur, certain projects are 100% financed either by the state or by the region. Île-de-France failed to find an agreement with the state on the 'research' part of the CPER and decided to fund a series of projects on its own. Many regions prefer to fund education, training and technology transfer rather than pure research, and are ready to finance a large part of specific projects in those fields. For the current CPER, 83% of scientific investments (excluding facilities) were realized at the end of 2005. This is due to the high priority attached to higher education and research by the state, contrary to other fields like health and social action, for instance, where only 64.75% of investments were realized (cf. CIIACT 2006).

5 Conclusion: A System in Evolution?

To what extent can multi-level governance be said to characterize science policy in France? The evidence is partial, indicating that the potential for multi-level governance has not been realized in practice. Shifts in science policy governance reflect processes which are ongoing rather than fixed in time.

During the last decade, the traditional philosophy of centralized policy design and implementation has changed more in reality than officially advertised. The financial context has encouraged the French state to share certain functions relating to science, research and higher education with local and regional authorities, leading to a more complex governance organization. More recently, another shift in policy can be observed, with (at least partial) bottom-up and competitive procedures being encouraged at the national level. New instruments like "competitiveness clusters" or PRES are designed on the initiative of decentralized actors (universities, territorial communities, and firms) and only subsequently 'labelled' by the central administration. The example of science policy thus also offers insights into the restructuring of the French administration, in terms of forms of public interventionism, new modes of steering and management and the involvement of the regions in the necessary reconstruction of a globally competitive state. Government is creating frameworks that have to be shaped by territorial configurations, leading to more selective action and resource concentration.

Within new national frameworks, regions are emerging as intermediate actors within complex governance structures. It is not likely that regional councils can be "the dominant player", but they can mobilize both sub-regional and supra-regional levels to implement their own strategies. Spaces for the negotiation of science policy between national and regional actors have been created and regional science policies are beginning to emerge in certain regions. Some of these spaces are institutionalized, like the CPER negotiations; others are created ad hoc in relation to particular initiatives. However, the French system is less characterized by uniformity of regional organizations than it might seem at first. Only two strong (Île-de-France and Rhône-Alpes) and two emerging contenders (PACA and Midi-Pyrénées) emerge in terms of participation within a multi-level science polity. As the case of Strasbourg illustrates, it might even be that alternative scales emerge as more relevant for the construction of local science priorities, such as cities, city-regions or departments. Despite identical institutional structures, patterns of implementation diverge.

The emerging dynamics of a multi-level science system therefore pose challenges to a traditionally centralized French state, with its commitment to balanced growth and regional symmetry. New compromises between concentration and balanced growth have

been struck through networking inter-regional groupings and offering equality of opportunity through national competitions. Yet the principle of territorial equality can no longer be seen as a strict rule in national policy: the success of top-down initiatives (and the corresponding distribution of resources) depends inherently on the willingness and the capacities of the territories. Within an increasingly regionally-sensitive national framework, it is the capability of actors at the regional level that determines the extent of multi-level governance in different arenas.

It is expected that the recent French national elections in May and June 2007 and the resulting policy changes will deeply affect the French S&T institutional landscape. The most notable aspects could be an evolution of the place of the French university in society and the economy, as well as structural changes involving the largest research organizations, such as CNRS. More generally, the analysis of the French innovation system reveals an apparent contradiction when comparing the relatively high propensity to invest in scientific activities and relatively low propensity to produce patents. So far, no definitive or mono-causal reasons able to explain this paradox seems to be the object of a consensus among the scholars engaged in the analysis of the French innovation system. Nevertheless, an alternative explanation may be suggested by the recent works of Jensen et al. (2007) on forms of knowledge and modes of innovation. These authors contrast two main modes, i.e. the STI mode and DUI mode. The STI mode (Science, Technology and Innovation) has its roots in scientific knowledge and its primary aim is to produce explicit and codified knowledge, while the DUI mode (learning by Doing, Using and Interacting) refers to learning resulting in competence building, often with tacit elements. In this respect, one hypothesis would be to consider France as rather DUI-oriented.

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