

# FORESIGHT TO REDUCE ASYMMETRY OF INFORMATION: THE EXPERIENCE OF THE FRENCH NATIONAL RESEARCH AGENCY

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## Summary

ANR is a public organization devoted to competitive project funding in both fundamental and applied research. ANR was created in 2005 after the vote of a law whose objective was to improve the French Research and Innovation system. ANR is both a result of the evolution of the French research and innovation system and a tool to confirm and stabilize this evolution. The objective of ANR is to promote creativity, to bring more flexibility and, subsequently, reactivity, and to increase competitiveness while keeping a good balance between fundamental research and applied research. ANR addresses both public research institutions and industries with a double mission of producing new knowledge and promoting interaction between public laboratories and industrial laboratories through the development of partnerships.

ANR disposes of programs and calls for proposals, but it cannot define on its own the content of these programs. It needs knowledge about the evolution of science at national and international levels, about the evolution of society at national and international levels, about national priorities as well as European ones, about the strategy of research institutions, universities and industries, about competencies, markets' and needs' analysis. Each year, at the beginning of the programming step, there is asymmetry of information between ANR and scientists from French and European research organisations and universities, scientists from industries and policy-makers in different ministries.

The agency currently has three broad approaches to define its programs and reduce asymmetry of information: (a) monitoring and Intelligence; (b) expert opinion, i.e. consultations of individuals or panels in the form of an annual epistolary consultation, international consultations and foresight workshops, a Foresight Council as well as sectoral and steering committees; and (c) analysis, i.e. extrapolation of perceived trends through the analyses of proposals and end of programs workshops.

The approaches adopted by ANR leave important challenges for the future: ANR must express its underlying paradigms as it has entered the political and the economic arenas; it must stay close to frontier research and reduce the time span between anticipation and action; last but not least, it must drastically increase the number of foreign scientists in its committees.

**Keywords:** Funding agencies; foresight; programming; principal-agent theory

THEME: FTA IN RESEARCH AND INNOVATION

## **Introduction**

The European countries have made the choice to be knowledge-based economies. This implies shifting from manufacture-based structures to intangible, knowledge-and-service based business models. The shift from a resource-based to a knowledge-based paradigm occurs to different degrees and at various speeds in both developed and developing countries. It is contributing to modifying the distribution of both wealth and income and, sometimes, also to widening gaps and deepening existing unbalances. Multinational enterprises play a major role in shaping worldwide industrial and R&D activities, as they account for a major share of global business R&D. Although global R&D is still geographically concentrated in the developed countries, the role of the big Asian developing economies is increasing. Moreover, the enterprises of these developing economies are gradually becoming stronger contenders for global markets and R&D activities. One of the biggest challenges lying ahead is ensuring a global socio-economic and ecologically sustainable development. The need arises to find the most effective ways to solve acute problems like poverty, hunger, health, and the protection of the environment. These can be pursued also and especially through global collaborations in education, science and technology, thus making of globalization a welfare-enhancing opportunity rather than a zero-sum game (Squicciarini and Loikkanen, 2008). This implies new S&T and innovation policies.

Next to that movement, a growing number of economists and philosophers claim that there is a “choc of civilisation” (Huntington, 1993), that “modernity is in crisis” (Morin, 2007) and that “the growth cycle is coming to an end. ... Beyond the inevitable cyclical reversal, it is becoming more and more clear that we have now reached the limits of our development model. (Cercle économistes, 2008).

It is in this political, social and economic context that, in 2005, the *Agence Nationale de la Recherche* (ANR) a funding agency for R&D; was created. ANR is both a result of the evolution of the French research and innovation system and a tool to confirm and stabilize this evolution. One of the challenges of ANR is to define its programs and calls for proposals. This is a difficult exercise and best practice does not occur in vacuum. In general, effects are determined by the combination of policy instrument, processes and context. ANR must therefore set up processes and find the information which will allow her to define programs that will “strengthen development of knowledge” and “encourage technology transfer and foster public-private partnerships”. The objective of this paper is to show how ANR links up with the scientific community but also the political and the economic communities to carry out its mission.

We will first present the context in Europe and in France, as well as ANR. The second section will be devoted to the analytical model used, i.e. the principal – agent theory. Then we will see how foresight and future-oriented technology analysis processes helps in the exchanges of resources between ANR (the principal) and the agents. Policy implications will be analysed at last.

## **ANR, a French research council for R&D**

### ***The evolving scientific context***

From a historical perspective, most studies on the development of science policy in Western countries converge on a similar picture (Lengwiller and Simon, 2005). Authors usually

distinguish between two periods since the Second World War. The first period is usually set between 1945 and the early 1970s. In this era, science policy was based upon a “social contract for science”, under which the relations between science and politics were guided by the principle of “blind delegation” granting science wide autonomies of self-regulation (Guston 2000). Research activities were boosted by military demand, which still represents in the United States approximately half of the national expenses devoted to science. Since the 1970s or 1980s, as most scholars argue, this social contract has been replaced by new forms of governance in science policy. The first energy crisis (1973) was probably a trigger for this movement; research budgets started to diversify. The research lobby grew in influence and was strong enough to obtain credits from governments and firms, arguing the needs for competitiveness and innovation. As part of this process, the seemingly clear-cut boundary between science and politics was redefined and science in particular was held more accountable to political authorities and to the public. The current literature offers different interpretations for this process: some understand it as the contemporary answer to the “delegation problem of principal-agent-relations” (Braun and Guston 2003); others see the process as the emergence of complex, heterogeneous “government arrangements” (Rip 2002) or as a new regime of “collaborative assurance” in science aiming at increasing the integrity and productivity of research (Guston 2000); again others highlight the changing models of innovation, distinguishing the traditional linear from a new co-evolutionary model of innovation as illustrated, for example, in the “triple-helix” model (Etzkowitz and Leydesdorff 1997). Finally, there is a wide literature on the changing research practices, stressing the rising significance of interdisciplinary or transdisciplinary approaches when research is increasingly done in applied contexts with close interactions between theoretical and practical work (Rammert, 2003; Nowotny et al. 2003). All studies agree that the social sub-systems of science, industry and the state are increasingly interacting – often indeed with differing intentions and expectations – and that this process has led to new approaches in science policy.

### ***The European Research Area***

In 2000, the European Union decided to create the European Research Area (ERA). This means creating a unified area all across Europe, to enable researchers to move and interact seamlessly, benefit from world-class infrastructures and work with excellent networks of research institutions; to share, teach, value and use knowledge effectively for social, business and policy purposes; to optimise and open European, national and regional research programs in order to support the best research throughout Europe and coordinate these programs to address major challenges together; to develop strong links with partners around the world so that Europe benefits from the worldwide progress of knowledge, contributes to global development and takes a leading role in international initiatives to solve global issues.

Over the last few years, important decisions and initiatives have been taken:

- The Lisbon strategy (2000) aimed at making the European Union the most competitive economy in the world and achieving full employment by 2010, which was revised in 2005. More recently, in 2008, the "Ljubljana Process" was launched which implies a vision for the future of the ERA, targets, indicators, monitoring and evaluation criteria.
- The Framework Programs for Research and Technological Development have developed a project funding approach of research. Beyond the framework programs, a number of tools exist to encourage collaboration, partnerships and harmonization. There are, for

example, the ERA NET scheme which aims at developing and strengthening the coordination of national and regional research programs, Collaborative projects, Networks of Excellence, Co-ordination/support actions, Technology Platforms which bring together stakeholders under industrial leadership to define and implement a Strategic Research Agenda, Joint Technology Initiatives (JTI) which facilitate pan-European public-private partnerships, etc.

- The European Research Council (ERC) created in 2006 funds frontier research in all fields of knowledge.
- The European Partnership for Researchers encourages mobility and career development. The "fifth freedom" aims at removing barriers to the cross-border mobility of researchers, students, scientists and academic staff.
- A legal framework assists Member States to develop and fund pan-European research infrastructures to create a favourable environment for research.
- Recommendations and strategies on the management of Intellectual Property Rights aim at facilitating cooperation.

Research policies and activities in France take into account what is done at European level. ANR takes especially into account the FP7 and has strong relationships with the ERC.

### ***The evolving French Research and Innovation System***

After the Second World War, France research was geared towards recovery. Objectives were well known and well accepted: nuclear energy, airplane production, high productivity in agriculture, etc. Research organisations for applied research were created for that purpose: the CNET (*Centre national d'études en télécommunications*), the CEA (*Commissariat à l'énergie atomique*), the INRA (*Institut National de la Recherche Agronomique*), etc. CNRS (*Centre national de la recherche scientifique*) concentrated on basic research. Universities and schools for higher education were created all over the country; their mission was training.

In the last fifteen years, it appeared that this model was no more adequate. Globalization, competition, emergence of new sectors, changing paradigm for innovation, have led to the necessity to change the research and innovation system. The objectives of the reforms are to reduce complexity, to increase efficiency and to have most industrialised countries standards (Futuris, 2007; Theves et al., 2007; Futuris, 2008).

The first step was the introduction of mixed research units (*Unités mixtes de recherche*) which are joint laboratories involving more than one institution, typically a university and CNRS. This organisation model was introduced in the 1960s to support university research and promote partnerships in the research system (Theves et al., 2007). At the end of the 1990s, the hybridising between universities and research organisations has succeeded. It has led to the establishment of clusters for research and higher education (*pôles de recherche et d'enseignement supérieur- PRES*) in 2006, to pool activities and means of universities and schools and coordinate and give them more dynamism and visibility. However, as institutions were just pooled and not dissolved, they have a tendency to defend their identity. The reform has not yet completely succeeded.

The second step has been the law on innovation and research to promote the transfer of public sector funded research to industry and the creation of innovative technology companies (1999).

This is particularly important in France where the share of national R&D expenditures funded by enterprises was 53.5% in 2005. The intensity of R&D effort by private enterprises is stagnating: 1,34 % of GDP in 2004 and 2005, and 1.41% in 2002. This ratio is above the European Union one (1.18% of GDP for EU-25) but far below the USA (1.82% of GDP) and Germany (1.71% of GDP) (CPCI, 2007).

It was followed by a “new industrial policy” (2004) which has led to the establishment of competitive clusters (*pôles de compétitivité*). For a given local area, a competitiveness cluster is defined as an association of companies, research centres and educational institutions, working in partnership to generate synergies in the execution of innovative projects in the interest of one or more given markets. The label “competitiveness cluster” was attributed to local areas on a competitive basis. Today, there are 71 competitive clusters.

In 2006 when a law<sup>1</sup> to improve the French Research and Innovation system was voted which reinforces the first and second step. It aims at increasing efficiency in the process of strategic priorities definition, intensifying cooperation between public research and private research and stimulating innovation, offering stimulating careers to young scientists, setting up an efficient system for research evaluation, and increasing international partnerships.

It led to the creation of several institutions, including the National Research Agency (ANR). The other institutions are the Agency for Industrial Innovation (AII), the Carnot Institutes which are dedicated to applied research, the Higher Council for Science and Technology, and the Research and Higher Education Evaluation Agency (AERES). In 2007, the Agency for Industrial Innovation (AII) and an other agency specialised in the support of SME (OSEO) were merged.

The third step is the reform of the governance of universities which goes in the direction encouraged by the European Union. A law<sup>2</sup>, set to be implemented over the next five years, gives universities more autonomy to decide upon their budget and staff (by creating foundations to collect money and devise their own recruitment processes), and enables universities to open their administration to external staff, allowing representatives of the business world to take part in university governance. In 2008, ten universities with a pluri-disciplinary approach were chosen to be renovated and become leading scientific universities and attractive campuses (*Opération CAMPUS*). The building up of the campuses leads to tensions, but the impulsion has been given.

During the same period, the French regions' influence increased through funding by Regional Assemblies and local organisations which devote about 2.6% of their budget to R&D (PLF, 2008). The State signs with each region a contract (*Contrat de Projets Etat Région*) to help research and innovation in the different regions. The competitive clusters and the regional poles for research and education (PRES) reinforce the territorial approach. Project funding via the European Union increased also drastically. The consequences of this strong movement of decentralization which has been encouraged by the State is not always well accepted by government officials.

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<sup>1</sup> Loi de programme pour la recherche n° 2006-450 du 18 avril 2006

<sup>2</sup> Loi n° 2007-1199 du 10 août 2007 relative aux libertés et responsabilités des universités (LRU)

Over the last few years, many reports have criticized the fact that, at national level, there was no definition of a real strategy for research and innovation (Sénat, 2008; Futuris, 2008). Each research organisation has its own foresight and priorities setting activities. Each university signs a four-year strategic plan with the Ministry of Higher Education and Research (*contrats quadriennaux*) but there is no synthesis of all plans and hardly any coordination among them. In June 2008, the committee for the modernization of public policies decided that every four year, under the aegis of the Ministry of Research, a priority setting exercise for research and innovation would take place. All stakeholders would take part (members of the scientific community, the economic community, representatives of associations) and the strategy would be approved by the Council of ministers. This exercise will start in October 2008.

### ***The Agence Nationale de la Recherche – ANR***

ANR (*Agence Nationale de la Recherche*), which was created in 2005 is a public organisation devoted to competitive project funding in both fundamental and applied research. Structurally, ANR has been the combining of the former *Fonds National de la Science* (FNS) and *Fonds pour la Recherche Technologique* (FRT) which were managed by the Ministry of Higher Education and Research, and part of the *Fonds de Compétitivité des Entreprises* (FCE) which was managed by the Ministry of Finance. Supplementary funds were added, and ANR's budget has grown substantially over the years: 590m€ in 2005, 825M€ in 2007, 955M€ in 2008, representing now about 2.3% of the French National R&D expenditures (public and private), and 4.8% of the R&D expenditures of public administrations. In the French Financial Law (*Projet de Loi de Finances*), the budget of ANR is included in the "Program 172" managed by the Ministry of Research. Therefore ANR receives all of funds from this Ministry and this creates a dependency relation (Scott, 1992; Slipersaeter et al., 2007).

ANR reaches out to both public and private research bodies within the framework of a mission that has two primary objectives:

- to strengthen development of knowledge through high-level projects in all areas of research;
- to encourage transfer of knowledge and foster interaction between public and private laboratories through the development of public-private partnerships.

ANR seeks to promote creativity, to bring more flexibility and, subsequently, reactivity, and to increase competitiveness while keeping a good balance between fundamental research and applied research. ANR addresses both public research institutions and industries with a double mission of producing new knowledge and promoting interaction between public laboratories and industrial laboratories through the development of partnerships. Like most funding agencies, with the exception of the UK, ANR's mission is purely related to funding; it does not carry out research itself.

ANR invites proposals in six thematic areas, but there calls ask for interdisciplinary work. These are Biology and Health, Engineering, Processes and Security, Ecosystems and Sustainable Development, Human and Social Sciences, Sciences and Technology for Information and Communication, and Sustainable Energy and Environment.

Submissions are also invited for Non-thematic actions under four calls for proposals: *Blanc* (blue-sky) Research, Young Researchers, and Excellence Chairs. The blue-sky program encourages anticonformism and boldness in research. ANR is therefore a mix of a science-based funding agency and a strategic funding agency (Braun, 1998).

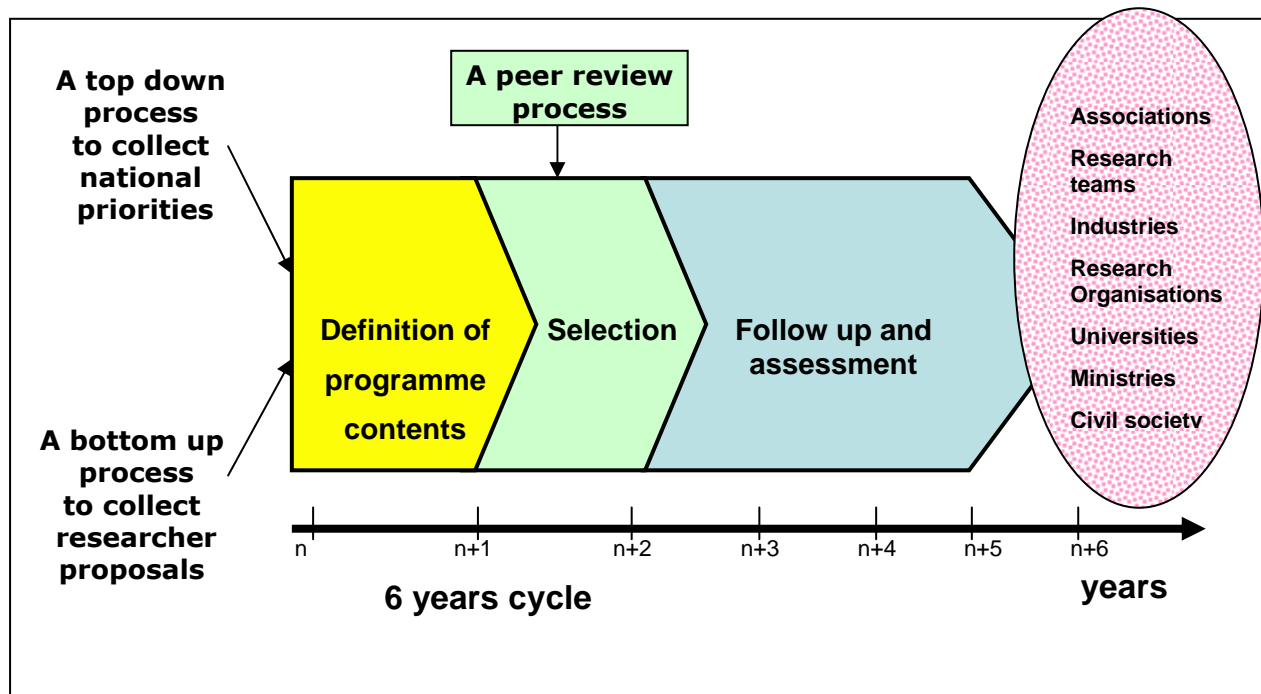
The structure of ANR's programs is underpinned by two categories of calls for proposals:

- 'open' calls: intentionally non-specific with regard to goals to be achieved; these calls apply to proposals aimed at the production of knowledge;
- 'partnership' calls: aimed at more targeted topics from all or part of a thematic area; partnership calls are open only to consortia of research organisations and companies.

In 2007, ANR issued 50 calls for proposals, of which four were ERA-NETs, i.e. trans-national European calls. 607,4M€ were devoted to the funding of these programs, and about 1500 projects are funded each year (success rate of about 25%).

ANR's cycle has three steps: programming, selection, monitoring and ex post evaluation (figure 3).

Figure 3: The three steps of the ANR cycle



The objective of the programming process is to decide every year on a list of programs. This list is the result of three decisions:

- The end of certain programs (their maximum duration must be set when launched).
- The opening of new programs (their maximum duration must be set when launched).

- The evolution of the content of certain programs.

The selection process is under the responsibility of Evaluation Committees, with support from Steering Committees (*comités de pilotage*) if necessary. After the closure of the calls for proposals, they identify referees within the committee and external referees who carry out peer review. Projects are chosen under a selection process made possible thanks to the commitment of more than 10 000 French and international experts. At the end of the individual peer review process, the Evaluation Committee meets again and classifies the projects according to grades and comments. The final choices (projects to be funded) are made by the Director General of ANR. This process is certified ISO 9001 (quality label) by AFNOR, the French standards association.

The monitoring and ex post evaluation process is currently defined. It comprises reports of ongoing projects as well as end-of-projects reports, visits of laboratories, mid-process and end-projects conferences, etc.

### **The principal – agent theory**

The principal-agent theory is used to provide insights on efficient incentive contracting within an organisation and across organisations in an environment where contracts cannot be enforced by the law (Huffman and Just, 2000). Literature deals with delegation, in which two actors are involved in an exchange of resources. The principal is the actor who disposes of a number of resources but not those of the appropriate kind to realize the interests. The principal then needs the agent, who accepts resources and is willing to further the interests of the principal (Braun and Guston, 2003). Various aspects of science policy and the relationships between institutions of science have often been analysed over the last ten years by use of principal–agent theories. Research councils<sup>3</sup> have been viewed as principals and the research community as the agents (Braun, 1993; Rip, 1994; Rip and van der Meulen, 1996; Guston, 1996; van der Meulen, 1998; Caswill, 1998; Braun, 2003; Morris, 2003; Guston, 2003) although the limits of the concept have been analysed (Shove, 2003). Due to changed ideas about the role of science in our society, research councils can be seen in a tripartite configuration: the research council differs from the government as a principal and the research performing sector as agent, because its interest is

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<sup>3</sup> “Research council” is a generic term denoting a body or set of bodies which mediate between state patronage of fundamental and strategic research and the research world itself” (Rip, 1994). It thus includes what can be called research councils, funding agencies, services or committees inside a ministry, technological agencies, academies, international organisations, charities. In most countries, research councils’ main task is to organise part of the funding relationship between government and universities as a peer-review based competition for project funding (van der Meulen, 2003). They are also “the preferred way of institutionalising the second stream of research funding in most industrialised countries” (Slipersaeter et al., 2007). Research councils play a crucial role in scientific development and in science policy in most industrial countries and are often assigned the task of allocating large parts of public budgets for science and for implementing science policy. Modern research councils are surrounded by tensions: ideological and organisational dilemmas and paradoxes that no solution or mechanism can remove (Gulbrandsen, 2005). Councils are between policy and science (Slipersaeter et al., 2007); they need to have some collaboration with scientists to fulfil their mission of implementing government policies and priorities. “Funding agencies are most of the time quasi-public organisations financed by the state in order to define and execute a large part of the science policy” (Braun, 1998). CNRS, in France, has been considered a funding agency by certain authors (Braun, 1998; Braun et al., 2003; Lepori et al., 2007; Theves, 2007).

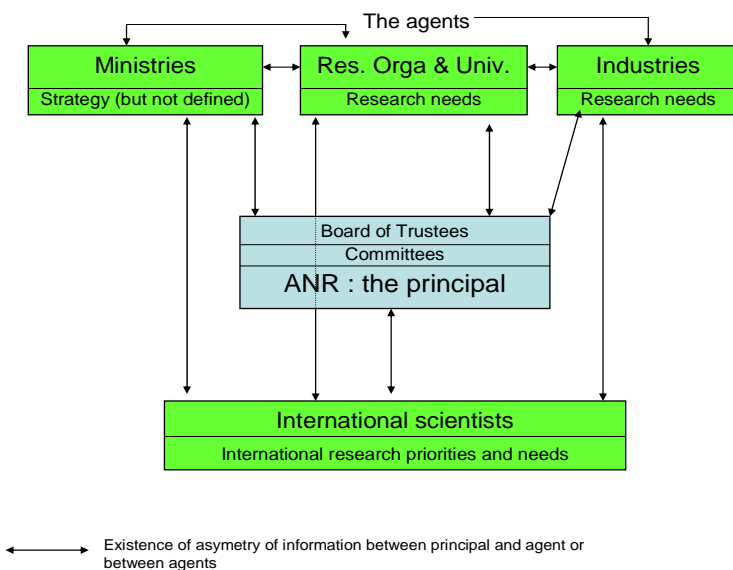


defined in terms of the interest of the other two actors (van der Meulen, 2003). The forms of delegation between the policy makers and the scientist have developed over time (Braun, 2003). From 'blind delegation' being the typical form from the early days of science up to the 1960s, delegation developed through a transition period when curbed public spending resulted in 'incentive' and 'steady state' modes by the end of the 1970s, before the more formal 'contract' mode and the 'network' mode emerged during the 1990s.

Basing our analysis on the principal-agent perspective, our hypothesis is that in the particular case of the *Agence Nationale de la Recherche* (ANR) foresight and future-oriented technology analysis can help reducing some of the tensions that exist in the institution.

ANR is the principal and disposes of programs and calls for proposals, but it cannot define on its own the content of these programs. It needs knowledge about the evolution of science at national and international levels, about the evolution of society at national and international levels, about national priorities as well as European ones, about the strategy of research institutions, universities and industries, about competencies, markets' and needs' analysis. It therefore relies on agents who are scientists from French and European research organisations and universities, scientists from industries and policy-makers in different ministries. At the start of each programming process, there is therefore asymmetry of information between ANR and the actors of the French and the European research and innovation systems (the agents), but also between each kind of agent (figure 4). In economics and contract theory, information asymmetry deals with the study of decisions in transactions where one party has more or better information than the other. This creates an imbalance of power in transactions which can sometimes cause the transactions to go awry. Examples of this problem are adverse and moral hazard.

Figure 4: Analytical model



## **The foresight and future-oriented technology analysis processes**

A major challenge for ANR is to launch thematic programs that answer, from the point of view of society, major social, economic and environmental challenges as well as scientific and technological challenges. The programs must not duplicate what is currently done in research organisations and universities, but they must aim at new focuses in research as well as at fields where cooperation between the public sector and industry or between different disciplines will be particularly beneficial. ANR has made the choice not to launch or finance foresight exercises in the broad sense of the term, but to use foresight and forward-thinking information produced by research organisations, international organisations, and groups of industries. Over 50 methods arranged in nine “families” have been identified (Rader and Porter, 2008), but to look also at social and economic evolutions and

The agency currently has three broad approaches to define its programs and reduce asymmetry of information:

- Monitoring and Intelligence;
- Expert opinion, i.e. consultations of individuals or panels in the form of an annual epistolary consultation, international consultations and foresight workshops (*Ateliers de Réflexion Prospective*), a Foresight Council as well as sectoral and steering committees;
- Analysis: extrapolation of perceived trends through the analyses of proposals and end of programs workshops.

Other methods such as roadmapping or bibliometrics are used to facilitate debates during expert consultations, especially committees.

### ***Monitoring and Intelligence***

In order to define its priorities, ANR must take into account the evolution of science, the evolution of a wide range of societal, economic and environmental concerns, and the evolution of the organisation of R&D at national, European and even global levels. Some of information needs are similar for all six departments of ANR and others are specific to each department. A major challenge is to encourage programs launched by at least two departments to facilitate interdisciplinarity and convergence of technologies and usages. Sources of information are both national and international.

ANR has organised strategic intelligence so as to provide:

- All heads of programs with general forward-thinking information related to French society, economics, environment, public perceptions and acceptance of S&T, etc.
- All heads of programs with general forward-thinking information on important trends and studies in the world.
- Each head of program with forward-thinking information related to his(her) field of activity.

### ***Expert opinion***

Every year, ANR consults by mail ministries, universities, research institutions, competitive clusters and independent companies. About 600 letters are sent to Presidents of Universities, heads of research institutions, enterprises, heads of laboratories, etc. to know what their researchers consider to be challenges for the future as well as topics of major importance. Over the last two years, the response rate has been about 17%. In the epistolary consultation, one observes that in certain cases proposals come from the scientists themselves, but that in most cases proposals come from scientific directions and that researchers at laboratory levels are not consulted. Ideas proposed tend to stick to the current strategy of the organisation consulted instead of proposing new themes that seem important but are not yet in the strategy. A second problem in the epistolary consultation is that the same idea must be proposed by several actors at the same time in order to capture attention of ANR (need for a critical mass). The epistolary consultation has a bottom-up approach, but it is not yet very efficient in reducing asymmetry of information. A current challenge for ANR is to consult researchers, especially the younger ones, without by-passing their hierarchy. ANR is considering opening an e-mail address where contributions could be sent.

In 2008, ANR organized international consultations for each of its six thematic departments in order to have an evaluation of its programming process, the pertinence of its current programming choices, and proposals for future research programs. Six teams of four to six international experts came for one to two days at ANR to look at each thematic department. The results were quite concurrent. The programming process was considered mature for a three years old institution, the themes of programs were considered adequate although often not sufficiently focused, and the duration between the idea of a program and the launching of a project was considered too long. International consultations helped to reduce asymmetry of information because they helped introducing more international scientists in the programming process.

Also, when an idea for a new program has been identified but it appears that the idea is not quite mature and that the research community is not sufficiently aware of this research question, ANR launches a foresight workshop. Its objectives are twofold: deepening the research question and creation new linkages between researchers that do not necessarily yet work together.

For forward-thinking, ANR has set up three types of committees which each have a role in forward-thinking analysis (table 1):

- a Foresight Council which has a long-term horizon and makes recommendations to the Board and the general direction,
- Sector Committees which have a medium-term horizon and lead to the evolution of the content of programs and the creation of new programs,
- Steering Committees which have a one-year time horizon and produce calls for proposals.

Each of these committees has a specific mission. ANR is aware that the linkages between these committees must be improved and that the composition of the committees must be far more international than it currently is.

Table 1: The three types of committees involved in forward-thinking analysis

|                      | <b>Foresight Council<br/>(conseil de prospective)</b>                                     | <b>Sector committees<br/>(comités sectoriels)</b>  | <b>Steering committees<br/>(comités de pilotage)</b>   |
|----------------------|---|--|--|
| Mission              | To contribute to ANR's strategic choices, to orient programs, to legitimate ANR's choices | 1. To contribute to ANR sectoral strategic choices and ANR programs proposals.<br>2. To facilitate the evolution of themes and programs' perimeter.                        | 1. To participate to the writing of the calls for proposals and to propose evolutions of programs.<br>2. To propose to ANR a list of projects to finance, and to make proposals on funding |
| Time horizon         | Long-term (15 – 20 years)   | Medium term (10 ys)  | Short term (1 year)  |
| Members              | Personalities chosen <i>intuitu personae</i> by the DG                                    | Scientists chosen <i>intuitu personae</i> and coming from the academic and the business worlds and nominated by DG. Mandate no longer than one year and renewable 3 times. | Two types of members:<br>- Qualified persons nominated by DG for one year.<br>- Representatives of institutions. Mandate of one year renewable 3 times.                                    |
| Number of committees | One committee   | 8 Sector Committees  | 34 committees  |
| Foresight domain     | Society's needs<br>S&T<br>Institutional framework   | Society's needs<br>S&T   | S&T  |
| Output               | → Recommendations to DG   | → Program sheets   | → Text of calls for proposals  |

The members of the Foresight Council, the Sector Committees and the Steering Committees are scientists from French and European research organisations and universities, scientists from industries and policy-makers in different ministries (Table 2). In its first year of existence, the Foresight Council has seven members coming from the academic world, one from industry and one foreigner. The composition of Sector Committees varies from one committee to the other. However, the high proportion of scientists should be noted. In the Steering Committees, an effort to include foreign scientists started this year; the proportion of representatives of ministries and industries is about the same.

Table 2: Composition of ANR's committees

|                        | Personalities from the academic world | Personalities from ministries | Personalities from industries | Foreign personalities | Total |
|------------------------|---------------------------------------|-------------------------------|-------------------------------|-----------------------|-------|
| Foresight Council      | 7                                     | 0                             | 1                             | 1                     | 9     |
| 8 Sector Committees    | 140<br>61%                            | 29<br>13%                     | 56<br>25%                     | 1                     | 226   |
| 34 Steering Committees | 218<br>46%                            | 131<br>28%                    | 111<br>24%                    | 7<br>1 %              | 467   |

The committees form a useful process to limit asymmetry of information. In the sector committees, the presence of researchers representing the main research organisations, universities and industries allows ANR to get information on foresight work and strategy done by the main French institutions; there is also useful exchange of information. The presence of foreign scientists, allows information transfer to ANR but also to all the French scientists present in the committees. At the beginning of the programming period, there was asymmetry of information between ANR and the individuals as well as asymmetry of information between them. During the course of discussion, the asymmetry of information between ANR and the members of the committees, and among committee' members has been reduced.

In the ANR committees, one also observes that the voice of scientists from the public sector comes often from institutional representatives; they tend to defend institutional positions, whereas private sector scientists tend to present S&T and markets needs.

***Extrapolation of perceived trends through the analysis of proposals and end of programs conferences***

Two other means to reduce asymmetry of information are:

- Analysis of thematic and non thematic research proposals to identify new topics of research.
- Conferences which have about 50 to 200 researchers active in the ANR funded projects, members of committees, young researchers, researchers from public and private laboratories and which take place at the end of programs. Scientists present their results. It is not only a way to communicate results. It is also a mean to think about future subjects.

**Results and perspectives**

The approaches adopted by ANR leave three important challenges for the future.

***Entering the political and the economic arenas implies expressing the underlying paradigms***

Foresight pushes institutions to go into the political arena (de Lattre-Gasquet et al., 2003). By having personalities from the academic world, ministries and industries, as well as foreigners, ANR has entered the political and economic arenas. As these actors can have competing agendas, ANR needs to express its underlying paradigms in order to be able to defend its position.

Setting priorities is often seen as important because of competing demands on budgets (Weinberg, 1963; Ziman, 1987). But beyond general resource constraints are the constraints on the capacity of government and institutions and the limitations on the number of issues which can be pursued. While there are many pressing needs, it is imperative to set priorities. A key aspect of prioritization is an awareness of sequencing (Stiglitz, 1998). Paul Joyce (Joyce, 2001) explores priority setting in the British National Health Service (NHS) and shows that the perceived shift in the formula of governance results in a different conceptualisation of the subject of health governance based on the management of individual risk.

Choices about science and technology relate to paradigms, investment, governance, policy and other ways to influence the behavior of producers, consumers and food chain actors. They have powerful impacts on goals. There are many uncertainties of the future, and therefore a number of alternative futures can be identified. It is unlikely that all goals can be achieved in any of these futures. In choosing among alternative options, decision makers need to recognize tradeoffs and realize that solutions appropriate at one scale may have undesirable effects when scaled up or down.

As Seneca wrote: “There is no favorable wind for the person who does not know where he wants to go”. Depending on which development direction society chooses and how funds are allocated, different drivers will be emphasized. When making decisions, policy makers will need to consider the opinions of the local population and organisations, and the increasing number of NGOs involved. Interventions on some trends or in response to some uncertainties can be more quickly implemented and be more effective than on others.

The scientific-political alliance that prevailed after the Second World War, when research was geared towards major socio-economic objectives is no more valid. The concept of innovation has changed. For example, research is not anymore seen as the only factor leading to innovation; the concepts of open innovation and global innovation are widely recognized. Research is not considered as leading automatically to improved well-being. In this context, ANR is currently working on the criteria it could use to identify its priorities.

***Staying close to frontier research and reducing time span between anticipation and action***

Foresight should help to stay close to frontier research. In a number of funding agencies, non thematic calls for proposals exist to encourage frontier research. The High Level Expert Group convened by the European Commission (EC, 2005) has noted that classical distinctions between basic and applied research have lost much of their relevance at a time when many emerging areas of science and technology (e.g. biotechnology, ICT, materials and nanotechnology, and cognitive sciences) often embrace substantial elements of both. They used

the term *frontier research* to reflect this new reality. Frontier research, because it is at the forefront of creating new knowledge, is an intrinsically risky endeavour that involves the pursuit of questions without regard for established disciplinary boundaries or national borders.

For funding agencies, like ANR, the balance between non thematic and thematic programs is an important question. In non-thematic programs the identification of topics of importance is made by the researchers themselves and confirmed or infirmed by a panel of international experts. For thematic programs, the agency – with the support of experts – has to identify topics of future importance.

Frontier research implies strategic intelligence to know what is done in the world, flexibility in the programming process, convergence of technologies and combination of research on technologies and their usages (“market push”), rapidity in decision making to launch new programs and stop others, capital venture and capacity to create innovative firms, as well as adaptability.

Science is evolving so quickly that a major challenge for a funding agency like ANR is to reduce the time span between anticipation (identification through forward-thinking analysis of a important research questions and thematic priorities) and action (launching a call for proposals and even more funding research projects that will lead to answers to the identified research questions). ANR is making efforts to reduce this time span. For example, in its first year of existence, ANR launched foresight workshops that lasted two years. It took therefore three years to get to action (a new program). The Foresight Council, established in 2008, helped reducing the time span. In June 2008, an idea for a new program was presented to the Council and it will be launched early 2009.

### ***Increasing the number of foreign scientists in committees***

A comparative advantage of ANR is that the members of the Foresight Council and Committees can be nominated *intuitu personae* by the Director General. ANR is starting to increase the number of foreign scientists in committees. This trend is important as research priorities cannot be set only in a national context. Taking into account international competencies, especially European ones, is extremely important. As has been shown by the international reviews, the presence of foreign scientists renews perspectives and allows benchmarking.

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