Chapter 6

Innovating Technological Innovation

To accelerate innovation, the parallel existence of the two distinct worlds (public and private research) has to end… numerous obstacles are still slowing down the cooperation… Academic laboratories will have the opportunity to collaborate with large companies, as well as with small businesses, with which they almost never work.

Valérie Pécresse, French Minister of Research

6.1. Researchers, R&D and innovation

Innovation has always been considered to be a full-time activity of public research laboratories and of R&D departments of companies. The two populations do not have the same objectives and do not work at the same speed. CNRS[1] (French national center for scientific research) has 1,100 research units (95% are joint university and industry research laboratories). Some laboratories seem outdated while those essential for the future are lacking and are not included in eco-bio-tech and info-nano-bio fields or in the recently created sections [CNR 08].

Research has always been considered costly, for both the State and businesses. Therefore, researchers working in public labs are poorly paid and require other motivations. The beginning of the 1990s saw the acceleration of the reduction or even the suppression of R&D in large companies. As for small businesses, they can be distinguished based on technological transfer, those whose activity is based on technological innovation (some industries, sport equipment, building,

1. http://www.cnrs.fr/en.

entertainment), SMEs in services related to technology or not and others. The first cannot exist without R&D. We sometimes find them in ANR[2] and European projects. The percentage of French small businesses in the latter is rather low. In the others, innovation depends on the owners' motivations, many of which focus on short-term incomes, saying they do not to have the time or means to innovate.

Since its beginnings, the European Union, probably inspired by MITI, has invested a lot in technological innovation by setting successive framework programs, such as Esprit 1 and 2 followed by 6 and 7 FP[3] and others. The strategy guiding these programs was first the strengthening of Europe's position by collaborative research. Nevertheless, an estimate of the return on investment is still not required from the participants of the financed projects. The Commission is not *a priori* interested in what these projects and their partners have become. It just requires the dissemination and presentation of results in conferences, books, workshops or at events, such as ICT[4].

The Lisbon strategy[5] developed in March 2000 was considered insufficient [BER 07, KOK 04]. In November 2009, the European Commission launched a public consultation, in order to develop a new strategy by 2020.

Like the Silicon Valley, technology parks and competitiveness clusters have emerged, as well as other groups such as the Latin, Transalpine or Mediterranean Arcs and recently Euromed.

Launched in 2004, the policy of competitiveness clusters aims to bring together into the same territory, companies, training centers and research units of the same sector of activity, in order to generate synergies and lead to innovative projects. Its objective is to facilitate "public-private" partnerships (PPP) and to open access to research for small businesses via collaborative projects. Its instigators had the ambition to create a technology transfer flow from laboratories towards companies and to create new companies and therefore new jobs.

The objective announced in 2004 remains topical: "strengthening the specialization of French industry, creating favorable conditions for the emergence of new activities with a high international visibility and therefore improving the attractiveness of territories and fighting against relocations"[6]. Initially focused on the public-private partnership and on the creation of synergies between populations

2. French National Agency for Research http://www.agence-nationale-recherche.fr/en/project-based-funding-to-advance-french-research/.

3. Framework Program http://cordis.europa.eu/fp7.

4. http://ec.europa.eu/information_society/events/ict/2008.

5. http://europa.eu/scadplus/glossary/lisbon_strategy_fr.htm et http://europa.eu/lisbon_treaty.

6. www.industrie.gouv.fr/poles-competitivite/brochure.pdf.

working together sporadically, the authorities have not defined the right indicators to measure the impact of this initiative. The authors of the recent French Senate report[7] are very optimistic about the five year assessment. However, they consider success according to the mobilized budget, the number of submitted projects and the involvement of the actors, including small businesses and territorial collectivities. To our knowledge, only ANR is checking during the project reviews, if the partners are really doing collaborative work.

According to the authors of the above report, more effort has to be put into *training*, integration of *environmental* aspects, and participation in the clusters of private actors of innovation *financing*. The authors noted that measuring the impact on job creation is difficult to achieve with statistical methods. However, they do not ask questions about the existence of alternative methods, adapted to the knowledge economy, such as those coming from artificial intelligence (knowledge discovery in databases and texts) or practiced by specialists in the measurements of intangible values [EDV 02, MER 00, SKY 98]. Although some words specific to the industrial vocabulary, such as "roadmap", were introduced to the CNRS vocabulary, it still lacks the expression "return on investment".

Most institutional researchers only consider companies to be useful for funding work on the topics of their choice. Organizations, founders of innovative projects, are putting emphasis on the impact of research on economic development, job creation and on the prevention of relocation, but do not propose appropriate indicators to measure this impact. We can observe a scattering of the means, which complicates the process of applying for funds and a proliferation of institutional actors, whose role is not always justified.

The 3,851 funding possibilities are listed by the "Institut pour le financement de la recherche"[8] and are giving France the status of a financing paradise. Closely monitored, the access to these subsidies remains difficult, even impossible to obtain for small businesses, who become lost while facing a variety of possibilities, the cumbersome procedures and the low probability of being elected. The small size and fragility of these organizations greatly reduces the chance of access to these funds, even those that are networked; all for the simple reason that such a structure is not recognized from the administrative point of view. All project evaluations only take into account the financial situation of the company and not its talents, its ability to succeed and its connections.

Applied and even fundamental research has the potential to create economic values but it is poorly governed and underexploited. A periodic or permanent

7. www.senat.fr/rap/r09-040/r09-0401.html.
8. www.ifr-finance.com. French Institute for research financing.

evaluation of the regional and national level would detect and put in motion this value-, activity- and job-creating potential[9]. The creation of AERES[10] is a step closer to an evaluation that is more focused on capacities. However, it remains to be innovative in the choice of evaluators, in the implementation approaches and the criteria.

Technological innovation is an indisputable capital and remains full of hope. Governmental reforms have established a national strategy aiming to create a dynamic between innovation and economic development. However, the efforts are carried out on all levels and by various actors, without checking the understanding of this strategy, without a global, visible and governed synchronization, without progress measurements adapted to knowledge economy and without a continuous feedback from the field; these efforts thus remain scattered and their impact seems insufficient compared to the stated ambitions.

The previously described productivity paradox persists. Its consequences are well-known: a lack of connection with the market, lack of long-term vision and an associated strategy, lack of market visibility, marketing weaknesses, little innovation in business models and lack of marketing and commercial talents, particularly in the high-tech areas. There is also a lack of connections between researchers and "customers", resulting, amongst other things, from evaluation criteria of the French (and not only French) researchers, whose only result obligation is publications on scientific projects. Few researchers take an interest in the available industrial solutions. Their technological watch is limited to scientific conferences in their respective fields.

The above situation is a consequence of the education system, which is still unsuitable for the knowledge economy, and of a depreciation of "mar-com" professions in comparison to the "noble" professions of scientific researchers. The Juppé-Rocard report [JUP 09] recommends a significant investment in higher education – an associated strategy could correct this phenomenon.

For more than ten years, the French government has experimented with several ways to motivate researchers for the creation of businesses, but the results of these actions are far from spectacular. Creating a company when we have a guaranteed salary for life is a risk that few tenured researchers are willing to take. In 1999, the "Ministère de l'Enseignement Supérieur et de la Recherche – MESR (French Ministry of Higher Education and Research) launched the first call for creating innovative companies. More than 14,000 projects were submitted in 10 years. There

9. Estimating the capacity to innovate, Chapter 5.

10. "Agence d'évaluation de la recherche et de l'enseignement supérieur", French agency for the evaluation of research and higher education.

have been 2,049 winners and 1,031 businesses have been created. Winners are invited to join incubators (29 public) and they are offered entrepreneurship training at the EM[11] Lyon (2 weeks) and HEC[12] (26 days). These training courses are limited to industrial era management. According to the document by the DGRI, *Research and Development, Innovation and Partnership* of September 2009 [DGR 09], assessing the actions carried out by MESR in 2007, 16% of the companies hosted in incubators have stopped their activities. The mentioned causes are only of a financial nature.

The measurements of the effects of these expensive actions on the national and European economy are difficult to find.

Most governmental and European actors consider technological innovation as a key drive for regional, national and sectorial development. Nevertheless, other types of innovation are necessary for balanced development. Amongst them, we need to mention innovation in the approach and governance, in the system of values, in education, in social success models, in the ways of managing intangible capital, which are too often ignored by rankings, cognitive innovation, mentality innovation, those in the management of the capacity to innovate, in the estimate of the return on investment or innovation guided by the citizen's needs, and finally innovation of creative industries, which is essential to increase the attractiveness of technological objects.

Education and training play a predominant role in the preparation and motivation of young people, as well as older people, for creativity, innovation and entrepreneurship. They could influence the change of paradigm, to the condition of anticipating future needs, in synergy with a national and European strategy. Although engineering schools are opening MBA training courses, in most cases they teach the traditional management methods of industrial companies. There are still not enough entrepreneurship schools teaching how to be visionaries, to manage and succeed in the dynamics of the knowledge economy [FOR 09, TAT 09]. Medias have a tremendous potential, but this potential is not used to influence change.

The Observatory of Educational Practices in Entrepreneurship was created in 2001 by public authorities and by APCE[13]. Its mission is to identify, share and promote initiatives favoring the development of entrepreneurship. Is this sufficient to succeed in the knowledge economy?

11. Ecole de Management (Management School).
12. Famous French "Grande école", http://www.hec.edu/.
13. Agence pour la création d'entreprises (Agency for business creation), www.apce.com/.

This chapter provides an overview of the current initiatives, as well as the available elements of the assessment. It suggests a few ideas which could favor technological innovation at the service of tangible and intangible prosperity.

6.2. Technological innovation actors

According to the brochure by the Ministry of Higher Education and Research [MES 10], "public research is mainly conducted within 83 universities, hundreds of 'Grandes écoles' and higher education institutions, about 30 research organizations with an interdisciplinary (CNRS) or finalized (INSERM[14], INRA[15], INRIA[16], CEA[17], CNES[18], IFREMER[19], etc.) purpose, and two foundations (Pasteur and Curie Institutes)". The public research sector employs full-time 160,000 people, including 96,000 researchers, who are considered to be the key players of technological innovation in France.

Private research employs 200,000 people. It is focused on four industrial branches: electronic, automotive, computer services and pharmaceuticals: all of which are part of private actor departments R&D of public services, large groups, and technological SMEs, as well as research centers of major international companies established in Ile-de-France (Paris suburbs), Sophia Antipolis (near Nice, French Riviera) and then in other places, following opportunities offered by regions wishing to develop. Some of these actors were gathered at the end of the 1990s in seven research and technological innovation networks, which were created in order to intensify, diversify and increase the flexibility of the relationship between science and industry, to promote the participation of small or young innovative technological companies and increase the efficiency of existing public incentives for private R&D [OCD 04].

In these considerations, there are some forgotten actors such as those innovating in services in relation to the use of technologies, or individual inventors, who often struggle to sell their inventions transformed into products, because of their isolation, the ignorance of the 3,851 financing arrangements, cumbersome procedures and

14. Institut National de la Santé et de la Recherche Médicale (health sciences), http://english.inserm.fr/.

15. Institut National de la Recherche Agricole (agriculture), http://www.international.inra.fr/.

16. Institut National de Recherche en Informatique et Automatique, http://www.inria.fr/en.

17. Centre d'Etudes Atomiques, http://www.cea.fr/english_portal.

18. Centre National d'Etudes Spatiales, http://www.cnes.fr/web/CNES-en/3773-about-cnes.php.

19. Institut Français de Recherche pour l'exploitation de la mer (sea), http://wwz.ifremer.fr/institut_eng.

skepticism concerning the eligibility. There are also employees in contact with customers and partners, who do not know to whom they should present their ideas and all those, whose ideas are not exploited, because of a lack of organization of the innovation process as a whole. The new generation is intensely consuming of technologies and could bring many ideas, but it is not integrated in the mentioned initiatives. Let us also note that Bill Gates and Paul Allen created Traf-O-Data, to sell computers dedicated to traffic control in Seattle, when they were teenagers and Microsoft at the age of 20.

So many institutional individuals have the word innovation on their business cards that we can wonder what the ratio of innovators is. Some of them even kill the creativity and entrepreneurship with the complexity of the procedures.

6.3. Contexts and ambitions

The current economic context – globalization and the resulting mix of cultures and talents, hyper-competition, relocation in order to have cheaper workforce and resources, the crisis, the decline of some industries caused by a lack of innovation and the resulting lay-offs – have produced an environment imposing a radical change of strategy, method and behaviors, to survive and succeed. This environment is also favorable to innovation.

The Juppé-Rocard[20] report [JUP 09] describes a worrying context, which is imposing the transition towards another model: "The crisis has impoverished us. The ageing will reduce the active population and the growth. International competition is extending to new fields, such as higher education and research. In industry, new actors are appearing, including in the sectors where Europe has positions of excellence, such as aerospace. Our development model will come up against the supply problems in fossil resources and is threatened by the consequences of climate change. Nowadays, we need to start the transition towards a new model, less dependent on fossil energies and more focused on knowledge".

The innovation combining research and industry, has lost its usual reference points. The tendency to protect environment and to reduce the impact of human activities is leading to other paths and activities, but they are not the only opportunities.

The power of computers, the evolution of smart phones and the impact of the Internet, of networks and of ubiquitous waves are imposing other ways of thinking and working. At the same time, the knowledge of technological possibilities and

20. Co-chairs of the commission to propose priorities for future national debt.

imagination can expand our capabilities and help us to better capture and exploit opportunities.

Trend and tendencies produce "waves", which, when they are uncontrolled or poorly exploited, due to misunderstanding all the phenomena including the impact, can sometimes become devastating economically, socially and environmentally.

In this context, there is no choice other than to innovate with the knowledge of these ecosystems and their cross-influences. European authorities wish to have an innovative, strong and prosperous Europe. The same ambitions can be seen on the national level.

6.3.1. *European policies*

After the failure of the Lisbon strategy, the "EU now needs to make a stronger effort to work together to make a successful exit from the crisis and to shape the next generation of public policies in a very different set of circumstances" [EC 09]. The European Commission has launched a public consultation, in order to collect the opinions of companies and citizens. The new strategy was published in March 2010 [EC 10a]. It relies on three mutually reinforcing priorities:

– *Smart growth*: developing an economy based on knowledge and innovation.

– *Sustainable growth*: promoting a more efficient and greener resource, and more competitive economy.

– *Inclusive growth*: fostering a high-employment economy delivering social and territorial cohesion.

Progress will be measured by aiming at following objectives:

– 75% of the population aged 20-64 should be employed.

– 3% of the EU's GDP should be invested in R&D.

– The "20/20/20" climate/energy targets should be met (including an increase to 30% of the emissions reduction if the conditions are right).

– The ratio of dropping-out students should be under 10%, and at least 40% of the younger generation should have a tertiary degree.

– 20 million less people should be at risk of poverty.

To ensure that each Member State tailors the Europe 2020 strategy to its particular situation, the Commission proposes that EU goals should be translated into national targets and trajectories.

To achieve these objectives, the Commission is putting forward seven flagship initiatives:

– *Innovation Union* in order to improve the framework conditions and access funding for research and innovation, so as to ensure that innovative ideas can be turned into products and services that would create growth and jobs;

– *youth on the move* to enhance the performance of education systems and to facilitate the entry of young people into the labor market;

– *a digital agenda for Europe* to speed up the roll-out of high-speed internet and reap the benefits of a digital single market for households and firms;

– *resource efficient Europe* to help decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernize the transport sector and promote energy efficiency;

– *an industrial policy for the globalization era* to improve the business environment, notably for SMEs, and to support the development of a strong and sustainable industrial base able to compete globally;

– *an agenda for new skills and jobs* to modernize labor markets and empower people by developing their skills throughout the lifecycle, with a view to increase labor participation and better match labor supply and demand, including through labor mobility;

– *European platform against poverty* to ensure social and territorial cohesion so that the benefits of growth and jobs are widely shared and so that people experiencing poverty and social exclusion are able to live in dignity and take an active part in society.

Concerning the Innovation Union, the EU will develop a strategic research agenda. The aim is to re-focus R&D and innovation policy on the challenges that our society faces, such as climate change, energy and resource efficiency, health and demographic change. They also plan to improve and modernize the intellectual property protection system. Community patents could thus save French companies €289 million each year.

A European Innovation Partnership between the EU and national levels (each of the E25) will be launched to speed up the development and deployment of the technologies required to meet the challenges identified. The first will include: building the bio-economy by 2020, the key enabling technologies to shape Europe's industrial future and technologies to allow older people to live independently and be active in society. The procedures will be simplified to facilitate access to funding, particularly for SMEs. The EU will also work on promoting knowledge partnerships

and strengthen links between education, business, research and innovation and on promoting entrepreneurship by supporting Young Innovative Companies.

These guidelines are made to help Europe rise out of the crisis. The flagship initiatives are all the subjects of innovation. Some elements are emerging, such as the systemic aspect of innovation, the necessity to organize the relative knowledge and to innovate in measurements of the efficiency and the impact of innovation on economy and the European leadership.

As an example, our joint contribution with Charles Savage (*Knowledge Era Enterprizing*) to this consultation was as follows:

> Energizing the Knowledge Economy
>
> Our vision: A strong and prosperous Europe – building upon individual competencies at all levels, instead of social position.
>
> Suggested strategy: Develop and master the New Rules for **Energizing the Knowledge Economy**, including education, research and synergy with companies and territories. As a starter, the reader can refer to the *Three Laws of Knowledge Economics* [AFM 05].
>
> This helps us move in a systemic, holistic and global direction and certainly supports the impulses towards a "Green" economy.
>
> Set the **Energizing** program (not programs) with these principles (not words) embedded.
>
> Some points:
>
> – to be inventive, we do not need necessarily a lot of money, but different thinking;
>
> – with the right measures of innovation capacity based on knowledge economy principles (collective results, capacity of addressing and discovering the needs and the capability of generating value through dynamics linkages), we can build momentum;
>
> – by involving "forward thinkers" instead of the traditional reputable institutions, we can harvest new innovations;
>
> – our research system must be need-based, with ROI measures, so that we can more efficiently transform ideas and research projects into

value generating activities. In other words, we need more business thinking in our research centers;

– a stronger collaboration between companies, including SMEs and research, will bring multiple benefits;

– by awakening the entrepreneurial spirit within younger students, we will be able to move people from "button-pushers" to economic "idea-generators" who are whole-brain in their thinking;

– by learning to mimic nature, we will likely find cheaper and more endurable long- term solutions;

– we are not starting anew, but building upon amazing ideas and exciting concepts, already worked out in Europe. By creating a common virtual space of knowledge (not data), we will be able to share experiences and results and to find the right partners;

– more ICT (intelligent and creative technology instead of information and communication technology).

Some elements of this proposal are visible in the new 2020 strategy.

6.3.2. *Policies in France*

The reforms undertaken by the government since 2005 aim to associate innovation, research and economic development [RGP 08]. Their objective is to make French research "more effective and more visible"[21]. This consists of "improving the global efficiency of the system and its interaction with society, in terms of the economic and social dimensions, while clarifying the function of each institution". In the text of these reforms, we can find a vocabulary close to that of businesses, which is a step towards a common language to practice in the knowledge society.

The new organization seems complex: "the mission of monitoring and strategic direction of the research system is conducted by the Ministry of Higher Education and Research, which through its General Directorate for Research and Innovation (DGRI), endowed with a Directorate of Strategy which has a central role alongside other ministries in the development of national research policy.

Moreover, the French High Council for Science and Technology, established in September 2006 and attached to the President of the Republic, reinforces the

21. www.enseignementsup-recherche.gouv.fr/pid20003/politique-et-administration-de-la-recherche.html.

legitimacy of government policy choices. In terms of research, DGRI gives the role assigned to the Ministry of Coordination of the Inter-ministerial Mission of Research and Higher Education (MIRES); the general director of research and innovation being the program director for three programs: multidisciplinary scientific and technological research, research on resource and natural environment management and space research".

The external actors have no opportunity to provide the authors with feedback on the field implementation of the above reforms.

The National Agency for Research[22] (ANR) was established by the French government in 2005 to fund research projects, in addition to the means provided by the European Commission through the 7th Framework Program. ANRs thematic calls for projects are directing research teams towards governmental priorities – biomedical, sustainable development and sciences of information and communication technologies. Despite efforts towards multi-disciplinarity, the partitioning is only now beginning to crumble. Nevertheless, the evaluation of multidisciplinary projects is raising some problems, because there are very few experts able to properly evaluate such projects.

Experts, highly specialized in a specific area have the tendency to seek excellence in each field separately, which is not in accordance with the Bellman theorem of optimal control. Experts are not paid and some may not take enough time to conduct meticulous work. Funds are very limited and it thus remains difficult to obtain them, even for very promising projects.

Major groups which are part of competitiveness clusters are all displaying innovation as a strategic priority. They are considered by authorities to be an innovation drive, able to involve small businesses, which is not always the case.

6.4. Motivations, evaluations and promotion

Motivations to innovate can be personal (inventor), triggered by a fad, by the want for recognition of a sector considered as not serious from a scientific point of view (as were electronic games for a long time), by needs (care services for the elderly) or by a financing opportunity. The motivations of the researchers are directly related to the evaluation criteria.

22. http://www.agence-nationale-recherche.fr/en/project-based-funding-to-advance-french-research/.

6.4.1. *Evaluation criteria of the researchers*

CNRS is 5th and INRIA is 12th in the world ranking of CINDOC's Top 2000[23]. Its objective is to provide extra motivation for researchers worldwide for publishing more and improved scientific content on the Web, making it available to colleagues and people wherever they are located. The "Ranking Web of World Research Centers" was officially launched in 2008, and it is updated every 6 months. The Web indicators used are based on and correlated with traditional scientometric and bibliometric indicators. Research Center activity is multi-dimensional and this is reflected in its web presence. Therefore, the best way to build the ranking is to combine a group of indicators that measures these different aspects. The four indicators were obtained from the quantitative results provided by the main search engines as follows:

Size (S) – Number of pages recovered from four engines: Google, Yahoo, Live Search and Exalead.

Visibility (V) – The total number of unique external links received (inlinks) by a site.

Rich Files (R) – Selected formats: Adobe Acrobat (.pdf), Adobe PostScript (.ps), Microsoft Word (.doc) and Microsoft Powerpoint (.ppt).

Scholar (Sc). Google Scholar provides the number of papers and citations for each academic domain.

Table 6.1 shows the significance of each indicator.

WEBOMETRICS RANK	
VISIBILITY (external links) **50%**	SIZE (web pages) **20%** RICH FILES **15%** SCHOLAR **15%**

Table 6.1. *Criteria of the CINDOC ranking*

Putting the salary aside, the researchers' motivations are directly related to evaluation and promotion criteria. Despite the AERES creation, the CNRS criteria[24] have not evolved much – they are not taking into account the influence on economic

23. http://research.webometrics.info.
24. Section 7 groups Information Science and Technology, http://www.cnrs.fr/comitenational/english.

development, nor efficiency measurements, nor the real collaboration (applied research) with the business world, which are mentioned in the reforms.

A researchers' activity is evaluated every two years. They have to write an activity report including a list of publications. A large number of aspects of the researcher's professional activities are taken into account and includes scientific references, mobility, opening up to industry, teaching activity and dissemination of the scientific culture. The sections establish the evaluation report from these elements. They also provide an opinion throughout the career of researchers, on requests for promotion and reallocation.

As an example, the criteria for section 7[25] are given.

Common criteria for all researchers are as follows:

– Scientific contribution: publications, prototypes, software, originality of work, risk taking, national or international collaborative projects, national or international recognitions (awards, honors, etc.).

– Valuation: technological and/or economic impact of activities relative to a research or consultancy contract, patenting, participation in start-ups.

– PhD supervision and teaching: coaching and follow up of PhD students, diffusion of scientific culture, participation in teaching.

– Mobility and international relations: geographic mobility, international collaboration, area or functional mobility.

There are four ranks from the lowest to the highest: CR2, CR1, DR2, DR1. The CR1 (researcher rank 1) is evaluated on the capacity to set a personal research project. The CR2 has to take responsibility in the national or international scientific community (scientific committees, advisory bodies, congresses, etc.). They must demonstrate dynamism and leadership.

The DR2 (Director of Research) has to be a team leader, able to manage research projects and scientific reputation, as well as take responsibility in the national and international scientific community (scientific committees, advisory bodies, congresses, etc.).

The DR1 has to perform even better than the previous rank.

The aforementioned criteria are also specific criteria for getting ranked or being promoted.

25. www.cnrs.fr/comitenational/sections/critere/section27.htm.

Promotion to CR1:

– dynamics of the publication activity;

– progress of the works since recruitment;

– insertion into a research team and/or program;

– national and international audience;

– involvement in teaching, training and supervision of students;

– research promotion (contracts, patents, licenses) and knowledge dissemination.

Promotion to DR1:

– excellence of the publications;

– international diffusion of the work (expertise, editorial activity, invitations to conferences, organization of conferences, awards, honors);

– capacities to manage a team and/or research;

– local, national or international collective responsibilities;

– administration and contract management;

– supervision of young researchers;

– participation in teaching (higher education);

– geographical mobility;

– thematic evolution;

– knowledge dissemination;

– research promotion (patents, licenses, transfers).

Promotion to exceptional class DRCE (in addition to the qualities required for the DR1):

– founding and structuring action for a given discipline;

– outstanding scientific qualities and exceptional national and international scientific influence.

Generally, the review of the researcher activities will not be limited to the accounting of publications, but will also include all the activities inherent in the practice of research (promotion, teaching, scientific culture diffusion, administrative responsibilities). The quality of publications and productions will considered to the

same extent as their assumed impact. Moreover, (reasonable) risk-taking will be encouraged, with its implications of success or difficulties (or even failures).

Let us note that these criteria are not making a distinction between fundamental and applied research. Research valorization is the last item on the list and is very succinct. Next to "patents, licenses and transfers", we do not find the word "entrepreneurship", instead we just find "participating in business creation". Filing a patent in universities is not so simple, because it requires a specific approach and is quite costly. Some universities and public research centers have a valorization unit, which is, in principle, in charge of this task. For example, Aquitaine Valo's[26] objective is to promote Bordeaux research, patents drafting is a part of their concerns. The Bordeaux laboratory of research in computer science[27] has its own transfer unit. Moreover, few transfer specialists are able to formulate a patent document [BRE] for intellectual inventions and it is always difficult to patent a software and impossible to patent an idea.

Software can only be protected by copyright, which requires legal skills and the ability to sell licenses. Concerning selling licenses, to our knowledge, it remains marginal, because this point is also marginal in the evaluation process. The license sales process remains complex and it can be only initiated by a person in charge of industrial relations in the research center [LOR 09]. "A company wishing to exploit the patent of an academic researcher should get in touch with the organization that filed the patent and for which the researcher works. Concerning services, a company can directly contact a laboratory, but for contract management, it will often have to go through the valorization service of the organization hosting the laboratory. Depending on the offered service, the contract negotiations can be complex. This situation is slowly evolving through the competitiveness clusters and academic valorization services", Marc Chevalier, http://blog.innovageek.com.

The above mentioned evaluation criteria include "reasonable" risk taking; we do not have any specifics in the available documents on the nature of the risks to take nor on the degree of "reasonable" risks. Nothing in this list encourages collaborative and multidisciplinary projects and we also cannot find any criteria related to the consideration of environmental impact. Amongst Lisbon criteria, only mobility is mentioned several times, without however giving the objectives or conditions to this mobility. Generally, this is the "visiting professor" status. Let us note that frequent mobility is contrary to the principles of sustainable development. On this level, these criteria are not encouraging the use of ICT for distance work.

26. www.aquitaine-valo.fr/.

27. www.labri.fr/.

No criterion verifies updating the researchers knowledge, notably the knowledge of industrial solutions (business intelligence) or of similar works carried out in other fields. Consequently, most conferences and publications remain limited to the "community".

In accordance with ministerial directives, the Agency for evaluation of research and higher education[28] (AERES) was established in March 2007, "in order to provide research stakeholders, ministries and funding agencies with evaluation data, to enable them to improve the global performance of the system and to decide organizational reconfigurations and allocations of more relevant means." AERES simultaneously evaluates the units of the same site, whether they depend on universities, research organizations or whether they are mixed. Four evaluation criteria help to assess the current state of the unit, its strategy and projects:

– *Scientific quality and production*: this consists of estimating the relevance and value of research, the quality of the results and their originality, scientific advances, their impact on international level and risk taking. The quality and quantity of publications in international journals, of communications in conferences, of books, the number and quality of supervised and obtained PhD and habilitations[29] and, when it is relevant, the quality and quantity of developed software, of maintained collections, observations, patents, knowledge dissemination documents and scientific and technological culture documents, as well as the societal benefits and impact and those in the field of clinical research (translational research, implementation of procedures, clinical protocol, etc.). In the domain of applied research, obtaining contracts, especially with businesses and in relation to ongoing scientific programs rather than simple services, is also a significant aspect of evaluation.

– *Influence and attractiveness, integration into the environment*: this rating system takes into account the reputation, visibility and attractiveness of the laboratory or of the team and its members. We are taking into account the international relations, guest talks in conferences or abroad, received awards or honors, participation in national and European projects, successful transfer and valorization actions, relations with the socio-economic, industrial or cultural world, organization of conferences, participation of laboratory members in editorial boards and international and national evaluation of teaching or research, hosting of foreign researchers and post-doctorals and capacity of the laboratory to attract good researchers and leading lecturers-researchers.

28. www.aeres-evaluation.fr.

29. HDR – habilitation to supervise research can be obtained after several years of research. The applicant has to provide a report on his/her work to the jury, who decides whether to accord the HDR title. It is the step before applying for the title of Professor.

– *Strategy, governance and life of the laboratory*: this consists of assessing the organization, coherence, vitality of the unit, the existence and effects of a policy of scientific activities, of emergence of transversal structures or young teams, of incentive of exchanges within the laboratory, the existence and effects of a recruitment policy open to the outside, the involvement in ambient higher education and in doctoral training, insertion into the regional environment, internal and external communication capacities.

– *Evaluation of the project*: the assessment committee actually observes a four-year project quality, relevance and consistency, in relation to the means and feasibility: defining lines, strength of the human potential, renewing and incentive to the emergence of innovative subjects, evolution of the organization, allocation of means, projected recruitment policy and positioning in appropriate networks.

Out of the four notation criteria, the first two examine the current state of the unit and the other two are interested in its management and strategy, as well as in the quality of the project, the opportunity to develop research in the field concerned and the ability of the unit to achieve its ambitions. The results of this evaluation will provide advice for the unit actors and will inform funders, financing agencies, supervisors and other stakeholders in the field about the development potential of the evaluated unit [AER 08].

It is important to note that AERES expert teams, which are made up of prominent personalities, do not include any marketing, commercial or SME actors able to evaluate the market relevance and the capacity to generate market values from research results. This is the same for strategists and knowledge economy management specialists, which would help in planning the training of the skills that the economy needs to thrive. The logic of technological transfer is not from needs, but is in push mode – researchers are deciding the research topics. The aspect 1 also mentions risk taking, but it is unclear how we are to know to what this risk is related.

The creation of AERES represents progress in the evaluation of research. The business vocabulary, with words such as strategy, management, project, resource allocation, road map begins to merge with the research vocabulary. This will certainly facilitate closer relations between the two populations. The choice of the evaluators and the real opening to the outside for recruitment remains to be innovated – no outside applicants was accepted during the competition exam CNRS 2010. Some of the mentioned criteria are just desired now, but changing mentalities takes time and it is not always possible to leap frog, in particular in an environment with a long research tradition.

6.4.2. *Other motivations*

Since 1954, CNRS has been awarding with the gold medal, the work of a scientific personality, who has made an outstanding contribution to the dynamism and influence of French research. The silver medal distinguishes researchers for originality, quality and importance of their work, recognized on the national and international level; the bronze medal awards the first work of a researcher, which makes them a talented specialist in their field. This award is an encouragement from the CNRS to continue this well-underway and already fruitful research.

Another award, the CNRS Crystal, which was created in 1992, each year values engineers, technicians and officials, who with their creativity, technical mastery and their sense of innovation, are contributing alongside researchers to the advancement of knowledge and to the excellence of French research.

There is no award for applied research or for the most successful technology transfer.

6.4.3. *Ambitions of the CNRS*

Following the engaged governmental reforms, the CNRS is expressing the ambition to be a driving force behind the adaptation of national research and innovation system to global competition [CNR 08]. According to the authors of the 2020 strategic plan[30], "this global competition of intelligence requires consequent financial resources and an optimized organization". They are not specifying how to find these resources and how to use them to compete.

The strategic plan "CNRS Horizon 2020", published in July 2008 [CNR 08] is at the origin of a series of actions; the first was the change of logo! The target contract with the State [CNR 09] shows the ambition to "overcome knowledge boundaries and technological obstacles, but also to go beyond the geographical and disciplinary borders, whether they are within the European research space or between continents". The CNRS must rely on "the values that have shaped its competences, credibility and international reputation: the elitism of recruitment, freedom and autonomy at the service of the researcher creativity, risk taking in terms of research, combination between competition and collaboration to carry out a scientific project, opening to new disciplines and the implementation of multidisciplinarity on the field."

30. www.cnrs.fr/fr/organisme/docs/Plan_Strategique_CNRS_CA_080701.pdf.

The mentioned recruitment elitism is leaving no room to a brilliant mind coming from outside. The notion of scientific excellence deserves to be more precisely defined.

The contract with the State is supposed to be in a model that is common to all the major industrialized countries:

– "The State is setting the major priorities of Research, but research organizations are involved in the definition of the national research strategy. They are structuring the research policy on the national level and ensuring a balance between collaboration and competition; they are preferably structured into networks and can form an alliance; they are strengthening their role of means agency and are preserving their research operator function, especially for long-term research;

– research is carried out in laboratories, which are mainly located on the sites of universities on their way to become autonomous. These sites are research and higher education clusters (known in France as PRES) in a triangle structure 'teaching-research-innovation';

– funding agencies, such as the ANR, are encouraging research on middle-short term projects, which are selected by peers;

– the evaluation of research organizations and activities of the units is performed by an independent agency, the AERES".

Three scientific challenges are presented in Table 6.2.

Advancing on the knowledge front	Mathematics and digital sciences From the infinitely large to the infinitely small Matter and waves Development and complexity of the living beings Knowledge of mankind and societies	Pooling of s research instruments
Taking up major global challenges	Environment and climate Sustainable development, resources, biodiversity Energy Medicine, treatments, handicap Significant social change, new vulnerabilities, safety	Methods and tools
Making new advanced technologies emerge	Nano-science and nanotechnologies Information, communication Molecules, materials, procedures and structures Developing advanced instrumentation	Technological platforms and large instruments

Table 6.2. *Scientific overview of the 2009-2013 CNRS contract with the State*

Multidisciplinarity trends are: sustainable development at the service of mankind, origin and control of matter, nano-sciences, nano-technologies and networked society. We can notice that artificial intelligence which has invented methods of knowledge processing is not very present and is enclosed within other digital sciences, whereas it is multidisciplinary. The word *company* is mentioned several times in this 143 page document, but as a research receiver and not as an initiator or stakeholder. This document, however, reveals a deficiency in the consideration of the knowledge economy principles.

Amongst European countries, Great Britain is reviewing its research promotion system. The department of education and skills has announced the replacement of the RAE[31] by the *Research Excellence Framework* (REF), in which evaluation should essentially be carried out on bibliometric indicators and contract resources indicators (volume of public and private contracts obtained by a department).

In the new formula, they propose to measure not only the quantity of research, but also its economic and social impact, as well as the participation of stakeholders in development, research project management and in the deployment of the results. The research environment will also be assessed to take into account the facilities, resources, organization, strategy and human resources management. They wish to add to this, measurements of the progress of diversity.

In Baltic countries, the creation of businesses at the end of training, or even during studies, is encouraged. This trend was known in France for 40 years under the name of "Junior Enterprise". Nowadays, the French national confederation of junior enterprises[32] gathers 140 together.

But when students have completed their studies, it is difficult to know if they kept the entrepreneurship spirit or what they have become, because this association does not practice the knowledge management principles. Associations of graduates of "Grandes écoles" make an effort to keep connections. Social networks are completing these connections, but the objectives of each initiative are different.

6.5. What is the role of education?

"Out of the €32 billion State investment in the future, half of it will support higher education, research and innovation" [JUP 09]. John Kao, in his book *Innovation Nation* [KAO 09], emphasizes the importance of higher education for value generative innovation. Why only higher education, whereas in the United

31. Research Assessment Exercise.

32. www.junior-entreprises.com/.

States, being an entrepreneur is almost genetic? How should we conduct reforms in France and Europe, to move from research to economic success?

According to Sheridan Tatsuno [TAT 09], "most universities teach old knowledge with courses that are more economic and technology history than state-of-the-art thinking. So students turn off from this stale knowledge. And governments focus mostly on proven knowledge, much less on imagination, daring and breakthroughs. That is why they prefer PhDs to college dropouts like Steve Jobs, Bill Gates, Larry Ellison or Jim Clark. They focus on proven, conservative people and technologies, not wild cards which often create totally new industries. In Silicon Valley, Google, Yahoo!, Apple, Netscape etc. were created by young people who were not and would never have been subsidized by the government or VCs in their early years."

The capacity to innovate is a skill that must be taught and practiced at the youngest age by games and individual and collective projects of students, who succeed from their idea. Medias could also play a significant role in this education process. In the movie by Blair Treu, *The Brainiacs.com*[33], the main characters are 10 years old. They have to find a business idea to present at school. One of them has decided to buy the toys company off his father, a workaholic, to spend more time with him. His "associate" uses Internet subscription to raise money. They buy shares in the company and become a majority. During the first staff videoconference meeting, the new CEO is represented by his avatar. He radically modifies work habits – the employees must play with the toys they manufacture and they must modify their schedules, to spend more time with their children. New leaders are innovating toys from the opportunities arising, including the introduction of a neural "chip". The latter has been developed by the sister of the new CEO – a teenager passionate about artificial intelligence. French (and other) schools and medias could draw inspiration from this example.

6.5.1. *University ranking*

The ranking criteria of Shanghai Jiao Tong University is the most well-known and is quite conventional[34]: quality of teaching, quality of the staff (Nobel prize and citations), research results in number of publications and greatness of institutions in number of students.

The European U-Multirank classification[35] "under development" is more sophisticated. The objective of this project, funded by the European Commission, is

33. http://www.youtube.com/watch?v=-_vS06Va9iw.

34. http://www.universityrankings.ch/en/methodology/shanghai_jiao_tong.

35. www.u-multirank.eu.

to develop an instrument that can contribute to enhance the transparency of institutional and programmatic diversity of European higher education in a global context and can test its feasibility. The general intention is to create a transparency instrument that will have a global outreach, potentially covering higher education institutions of all continents.

It covers five dimensions: research, education, professional inclusion, innovation, internationalization and regional engagement. It also includes the performances of universities by discipline. Indicators have been set and the *consortium* has carried out a pre-test to ten establishments. On this basis, a larger test has been carried out for 150 institutions inside and outside Europe in the second phase of the project. Results of the first phase are published in two reports and can be found on the project website. A decision about whether U-Multirank will enter a second phase and who will carry out this phase is expected in early 2012. We have to hope that this classification will take into account the key-indicators of the knowledge economy, such as the capacity to innovate, to create connections, to seek for opportunities and so on.

6.6. Some initiatives to transform technological innovation in economic values

Many initiatives have been and still are experimented, such as "incubators", various contests to encourage public and private research actors, as well as any project holder to create their own businesses. Many reports have been written. Amongst them, we can find that of SETTAR [DGR 09], which is a good summary of the actions carried out. It draws a report of these actions at the end of 2009.

6.6.1. *Creation of companies by researchers*

The national contest for the creation of innovative technology companies has been held every year in February since 1999, by the Ministry of Research[36]. The candidates can apply to one of two categories:

– "emerging" projects, still requiring a phase of maturation and technical, economic and legal validation may receive a grant of up to about €45,000 in order to finance the services necessary for the projects maturation;

– "creation-development" projects, whose concept proof is already established and which led or will lead shortly to a business creation. They can benefit from a

36. www.enseignementsup-recherche.gouv.fr/cid22991/concours-national-aide-creation-entrepriseentreprises-technologies-innovantes-2009.html.

subsidy of up to about €450,000, intended to help them finance their innovation agenda.

The "Tremplin d'entreprise" ("springboard of enterprise") [37] is organized by the Senate in favor of innovative projects that can compete in four categories: services, software, life sciences, material-components. The prize is €15,000 by category. Winners are offered the opportunity to meet investors. Almost 150 contests are held each year in France by public and private actors aimed at entrepreneurs. Some details can be found in the next chapter, because most of these competitions have regional development as the main objective.

6.6.2. *Business breeding-grounds and incubators*

In France, two business incubation structures exist: one is known as an "incubator", aiming to identify and assist innovative business start-up projects and the other is known as "pépinière d'entreprises" (business breeding-grounds), which offers shared premises and services for young businesses or companies in the process of being created. Finally, high-tech regional hubs, known as "technopôles" in French, group together companies, research centers, prestigious French universities and professional organizations and aim for the economic development of a territory via innovation[38].

Business breeding-grounds have been proposed by the Ministry of Research and have been progressively implemented since the beginning of the 1980s, first within the structures of research valorization. They then spread via local collectives, in order to favor creation of activities and jobs. They offer temporary accommodation and common resources to newly created businesses, as well as methodological support and coaching to enhance the chances of successful business. An incubator helps to break with the usual isolation of business creators and can facilitate information sharing via conferences or other events and exchanges with other creators. Legal, accounting, tax, commercial or technological development and management advice can be suggested in partnership with outside organizations.

As an example, Cap Alpha, close to Montpellier, hosts about 20 innovative companies, specialized in fields such as agricultural decision-making support systems, embedded mobile solutions, hearing aids or polyphenols, amongst other things. Other business breeding-grounds, Cap Omega, hotels and business houses

37. www.tremplinentreprises.com.

38. http://www.france.fr/en/knowing/research-and-innovation/competitiveness-clusters/article/business-incubation-and-high-tech-regional-hubs.

are also established there[39]. The return on investment and the impact of these initiatives are difficult to estimate – statistics published in regional communication media are always optimistic.

Incubators are the support structures for business creation projects. In 1999, ministries in charge of Research, Economy and Industry launched a call for project incubation and seed capital for technological companies, in order to encourage the creation of innovative companies from the results of public research. Following this action, 31 incubator projects were selected and became operational between 2000 and 2002: there are currently 29 of them. Other incubators such as those of schools, economic development agencies, competitiveness clusters, public or private companies, are now a part of the landscape.

6.6.3. *Technology parks and competitiveness clusters*

Technology parks appeared in France in the 1950s, either to promote a place by attracting companies with a significant job creation capacity or to involve an existing university and research potential in an economic development perspective. The technology parks of Vélizy (near Paris), Sophia Antipolis (Nice), Meylan (Grenoble), Futuroscope (Poitiers) and Compiègne were amongst the first to be created. About 20 technology parks are listed on www.zones-activites.net /technopole-technoparc-a-20.html.

Since their inception in 2002, the objective of the 71 competitiveness clusters is to connect researchers and companies located on a geographical area through collaborative projects, thus influencing the development of the territories by creating jobs. In other words, they must "strengthen the specializations of French industry, creating favorable conditions for the emergence of new activities with high international visibility and thus improving the attractiveness of the territories and fight against relocations" [BLA 04].

In most cases, they are using an association or an economic interest group. CESE[40] consider them both as essential tools for competitiveness, as well as levers for territorial development. The Council is placing emphasis on the necessity to carry on with the initiated policy and is suggesting ideas to improve efficiency. The DATAR[41] report [DAT 08] is proposing a set of fact sheets relating to: the involvement of major groups and small businesses and inter-enterprises synergies; connection between research and companies; governance assessment; project

39. www.montpellier.cci.fr.

40. Economic, Social and Environmental Council http://www.lecese.fr/.

41. Town and country planning http://territoires.gouv.fr/la-datar.

financing; the issue of training; business internationalization; the impact of the clusters on the dynamics of the settlement territory and capacity to create added-value. In reality, connecting research actors and companies is an arduous task, given the objectives, concerns and motivations differ for each population. Joint projects can create synergies if we take into account the specificities of each of them. From 2008, the policy of clusters was renewed over three years and endowed with an envelope of €1.5 billion.

6.6.4. *Grouping of technology parks – Archs and Euromed*

Clusters are beginning to spread across the borders. Lyon, Grenoble, Geneva, Lausanne, Turin are part of the transalpine arch. This initiative is a partnership policy launched by the Rhône-Alpes region in collaboration with the "Suisse Romande" (French-speaking part of Switzerland) and Piedmont. It involves training and research in health sciences, sport and ecology areas [SIB 09, KOH 09]. "Arco Latino[42] is a cooperation space between territorial collectivities within which integrated actions are implemented in several strategic fields for the social and economic cohesion of the territory comprised in it. The objective of this is to strengthen competitiveness and social integration, to improve the respect of the natural and cultural environment and to take into account the realities and traditions of the member regions. The Arco Latino observatory is equipped with an interactive platform for exchanges of skills, practices and information between its participants. The synergy with the researchers of the involved territories is scarcely visible on their website".

6.6.4.1. *Euromed*

In February 2009, President Nicolas Sarkozy put the senator Pierre Laffite in charge of a mission to create an innovation development network in Euroméditerranée with members of the Union for the Mediterranean[43]. Its objectives are defining and implementing an extended innovation strategy, federating the existing strategies, developing interaction between excellence zones and clusters around the Mediterranean and developing new partnerships and the exchanges of best practices between clusters and small businesses, in order to reinforce economic and social development. Priorities are motorways of the sea, detoxification of the Mediterranean and the Mediterranean solar plan. This will consist of helping to create new clusters around the priority axes of the Mediterranean, by favoring for example training for careers in cluster management. In order to succeed in such a venture, a Knowledge Management approach is vital. Our suggestion of creating a

42. www.arcolatino.org/.

43. http://ec.europa.eu/external_relations/euromed/index_fr.htm.

virtual knowledge space for Euromed was presented during the Global Forum 2009[44].

6.6.5. *European Research Area*

As specified in Chapter 1, the objective of the European Research Area is to provide European research with new perspectives – in order to allow the mobility of researchers; sharing, teaching, promoting and efficiently using knowledge for social, commercial and political purposes, optimizing and opening European, national and regional research programs, in order to support the best research through Europe and coordinating these programs to meet all key challenges; developing connections with partners all over the world, so that Europe profits from the global progresses of knowledge, contributes to global development and takes a leading role in international initiatives aiming to solve issues of global importance [EC 07]. The ERA-Net program[45] finances networking actions, its objective is to develop and strengthen the coordination of national and regional research programs within the European research area. Two types of actions are supported: the preparation and implementation of joint activities (ERA-Net) and the organization of joint national and regional calls, with resource pooling (ERA-Net plus). Some examples of financed actions can be found on the Cordis website, http://cordis.europa.eu /coordination/projects.htm.

The 2020 vision[46] wishes to promote the mobility of researchers, knowledge and technologies through public and private funding. Except for European programs, and country reports, there are no specific initiatives helping to create a common knowledge space, using innovative technologies, invented in the framework of collaborative projects, nor to transform these researches into values.

According to the long-term vision, "the scientific community, business and citizens need should have the following features:

– an adequate flow of competent researchers with high levels of mobility between institutions, disciplines, sectors and countries;

– world-class research infrastructures, integrated, networked and accessible to research teams from across Europe and the world, notably thanks to new generations of electronic communication infrastructures;

– excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters' including

44. www.items.fr/spip.php?rubrique102, session 10.

45. NETworking the European Research Area.

46. http://ec.europa.eu/research/era/pdf/era_vision_2020_fr.pdf.

'virtual research communities', mostly specialized in interdisciplinary areas and attracting a critical mass of human and financial resources;

– effective knowledge-sharing notably between public research and industry, as well as with the public at large;

– well-coordinated research programs and priorities, including a significant volume of jointly-programmed public research investment at the European level involving common priorities, coordinated implementation and joint evaluation; and

– a wide opening of the European Research Area to the world with special emphasis on neighboring countries and a strong commitment to address global challenges with Europe's partners" (*Green Paper The European Research Area: New Perspectives* [EC 07]).

All the initiatives mentioned are starting from the aforementioned vision, which is not yet that of the involved actors. For instance, it is rarely collective and shared. It is sometimes associated with a national strategy, such as governmental reforms. The positioning is clearly that of the knowledge economy, the transition from the industrial era is expected to be done by actions. Some objectives mentioned are mobility, collaboration, the knowledge space, experience sharing, unifying projects, public-private partnership and small businesses. Whatever the approach, the key issues are the economic development, territory revitalization and the regaining of the leadership position.

As in a strategic knowledge management approach, the conditions for the success of such initiatives are not gears, but appropriate management, the involvement of the stakeholders in the ongoing innovation process, the creation of a common knowledge, skill and experience space using the techniques equipped with intelligence, many of them are the results of various projects financed by national and European funds, but not well-known and not sufficiently exploited.

6.6.6. *Education: training of future entrepreneurs*

The observatory of educational practices in entrepreneurship (OPPE) was born in 2001. Created by ministries respectively in charge of research, education and industry, by the French agency for business creation (APCE) and by the Entrepreneurship Academy, it aims to identify the "best practices" and the educational initiatives and to disseminate them to students, lecturers and collectivities. It should also evaluate the impact of the initiatives, in terms of educational methods, in order to help lecturers and collectivities in their choice. A database available on www.entrepreneuriat.net provides Internet users with action sheets, bibliographical references, Internet links, testimonies on an action, case studies and the list of all the competitions for students and pupils. The OPPE

website[47] also offers to register teachers for more than 30 educational tools, most of which are for higher education. If you try to make a request for "entrepreneurship courses" on the search engine of this website, the answer is not really satisfactory. This website would certainly be more valuable, if it was using modern computer tools, at least those of Web 2.0.

Every year, OPPE organizes a seminar bringing together those involved in entrepreneurship, students, lecturers and those who wish to start a business. The seminar of 2008 gathered 170 participants. The impact of this initiative, which is however mobilizing lots of actors, seems negligible in relation to what it could be if the technological possibilities were fully used.

Entrepreneurship houses in universities were launched in 2004. Their objective is to develop inter-institutional projects and to promote the entrepreneurship spirit, to help students who wish to create an activity during their studies, to be accompanied by an advisor and make contact with support structures adapted to their project and to conceive projects between institutions. "This awareness entrepreneurship campaign can also be a reorientation of students in early courses and also for PhD students who do not want to or cannot become researchers"[48]. A bad corporate manager instead of a bad PhD student? Counseling advice could certainly offer more than this binary choice as a function of the students capacities, skills and wishes. There is, however, no link with junior enterprises, which has 40 years of experience to share.

6.6.7. *KIZ*

Knowledge Innovation Zone[49] is a new concept, adapted to the knowledge economy and introduced by Entovation Intl. – the international network of experts in Knowledge Innovation®. It has been implemented on a global scale since 2003. "KIZ are enabling new forms of enterprise, collaboration, cooperation, research and development, knowledge sharing and commercialization of ideas between the private sector, government, and academia. As with any new endeavor, there are successes, failures and lots in between. Our studies have distilled the key elements of KIZ and linked them to outcomes. Understanding and applying the dynamics for success will separate the investment successes from the failures."

47. http://www.apce.com/pid11493/qu-est-que-oppe.html.

48. http://entrepreneuriat.grenoble-univ.fr.

49. www.inthekzone.com/KIZ_Introduction.htm.

Focusing on sustainable knowledge creation and application, and directed towards economic and social development, they are rapidly expanding worldwide. As with all new investments, risks are high, rewards great.

A KIZ approach must be properly planned, supported and implemented. This involves new performance indicators, which take into account knowledge and skills, networking organizations, community of practices, innovation processes and the use of collaborative and intelligent technologies" [AMI 06].

Other initiatives are successfully carried out by members of the Entovation Intl network, such as the entrepreneurship schools of Piero Formica in Bologna (Italy), Tartu (Estonia), Abu Dhabi and Jönköping (Sweden). The New Club of Paris[50], founded in 2006, aims to share its experience in developing intellectual capital and setting up projects at a global level. Management classes in knowledge economy are given by Charles Savage (Knowledge Era Enterprizing) in several developing countries. The concept of the Future Center has been tested in the framework of a European project and is being transformed into the Virtual Future Center[51]. The certified training, "Innovation Leaders", have been co-developed by Innovation3D, Innovatika[52] and Knowledge Era Enterprizing (KEE) in order to educate the innovation culture by action.

6.7. Financing and return on investment

The DGRI document [DGR 09] lists financing systems and assesses the initiatives aiming to develop innovation and business creation activities. It exposes the measures implemented by the Higher Education and Research Ministry and by other public actors, in order to develop research and innovation activities in companies, to support innovative business creators and to favor knowledge exchange between companies, organizations and research centers.

Amongst these systems, we can find "credit impôt recherche" – the French R&D tax credit (CIR). Between 1994 and 2003, the average annual amount of business debt was €465 million. In 2007, it reached €1.7 billion and the reform in 2008 made this tax expenditure double to about €4 billion in 2008 and 2009. The R&D tax credit has thus become another crucial measure of the R&D promotion policy in France. The evaluation process established in 2005 is only interested in the impact of the R&D tax credit on R&D expenditures and employment of researchers by companies. The document mentioned above presents the various analyses of

50. www.new-club-of-paris.org/.

51. www.educore.nl/2009/01/future-center-alliance/.

52. http://innovatika.com/.

accumulation of aids by companies and the balance of expenses relative to the R&D tax credit.

Thus, companies are still spending more for R&D, are doing more long-term projects, but they are not taking many risks, are only relatively working with the actors of university research and are scarcely hiring PhD graduates. This impact analysis on economic development is quite limited.

Other support measures for the creation and development of innovative businesses include systems such as Eureka, Oseo, awareness campaign of students to entrepreneurship, incentive for researchers to create companies, incubators, contests, financing in capital of the innovative companies and aids for young innovative and university enterprises.

Concerning incubators, Table 6.3 is presents the 2000-2008 assessment.

Total Companies (2000-2007) (number given)	1,204	100%
Companies in activity at the end of 2008	1,010	83.9
Terminated companies at the end of 2008	194	16.1
Terminations because:		
Deregistration	105	54.1
Closing for insufficient assets	12	6.2
Dissolution	8	4.1
Legally active company but no noticeable economic activity	5	2.6
Compulsory liquidation	63	32.5
Disposal plan	1	0.5

Table 6.3. *Incubators: situation at the end of 2007 for companies created between 2000 and 2008 (source: [DGR 09])*

EUREKA[53] aims to strengthen the European competitiveness by supporting international innovative projects coming from technological companies. France finances two types of projects: collaborative projects led by companies which have primarily been funded by Oseo since 2008 and strategic initiatives, called clusters, which are major programs piloted and financed by the French general directorate for

53. www.eurekanetwork.org/.

competitiveness; industry and services (DGCIS) of the Ministry of Economy, Industry and Employment, through the competitiveness fund of the companies; SMEs, particularly high technology ones, represent an average of 40% in number and about 15% in amount of companies assisted through projects clusters together with major European groups. The amount of funding allocated to French partners in 2008 has risen to €8 million for 21 projects.

EUROSTARS[54] is a cooperative program involving EUREKA and the EU, in the program "Capacities" of the seventh FP. Jointly funded by the State members (€300 million) and the European Commission (€100 million), it is intended to support high-tech SMEs (at least 10% of the revenue spent on R&D). After the first two calls for EUROSTARS projects, more than 50 French small businesses benefited from funding.

In 2008, Oseo accompanied more than 5,000 innovative companies with €459 million of aid, €120 million of loans and €700 million of guaranteed bank financing.

Amongst the support measures for technological transfer mentioned by the DGRI document [DGR 09], we can also find competitiveness clusters, Carnot institutes[55], ANR and the CIFRE grant.

Concerning competitiveness clusters, territorial collectivities have co-financed the projects selected in the framework of the "Fonds unique interministériel" (FUI, French inter-ministerial single fund) up to €125 million against €239 million for the FUI[56].

From 2005 to 2008, clusters represented financing from the State of more than €1.5 billion for 1,400 projects of collaborative R&D. The renewal of the competitivity clusters which was announced in June 2008, was accompanied by a new financing of €1.5 billion up to 2010. 17 clusters are already asking for an additional budget of more than €900 million. In comparison, during the same period, Oseo invested a State budget of more than €500 million for 8,000 R&D projects (partly collaborative and mainly non-collaborative), in all regions, with the support of regional councils for more than €80 million (source: Oseo).

According to the Senate report of April 2009[57], "all the representatives of the work group have highlighted that it was nowadays impossible to evaluate the impact

54. www.eurekanetwork.org/activities/eurostars.

55. http://www.instituts-carnot.eu/en.

56. http://www.oseo.fr/a_la_une/actualites/resultats_du_10e_appel_a_projets_du_fui.

57. www.senat.fr/rap/r09-040/r09-0401.html.

of competitiveness clusters in terms of job creation. It is still too early to evaluate the impact of the system on innovation and employment. According to APEC[58], the impact on employment of any R&D action is premature. It is always difficult to measure and it requires several years of statistical collections".

The Carnot brand was created in 2006 to promote the conduct of public research in partnership with socio-economic actors, notably with companies. Research organizations branded as Carnot institutes receive funding from the State, which is managed by ANR and is calculated on the basis of the volume of contracts concluded with the socio-economic partners and the licensing revenues. The Carnot brand is awarded by the Ministry of Research, on a proposal of ANR, for a renewable period of four years. The financial envelope devoted by ANR to the Carnot system was €35.3 million in 2006 and €62.1 million in 2007.

It amounted to €60 million in 2008. The 33 Carnot institutes (2008) are organized into four thematic networks: electronics, micro and nanotechnologies, optics; the living and ecosystems; mechanics, materials, chemistry, energy; transport, aeronautics and space.

In 2008, allocations given by ANR to businesses in partnership projects (i.e. with at least one company partner and one research laboratory) were €127,511,094.

Figure 6.1 shows the financing system of the technological transfer in 2008 and Figure 6.2 shows the possible allocations for starts-up.

The CIFRE (Convention industrielle de formation par la recherche en entreprise – Industrial agreement of training by research in companies) system was created in 1981[59] in order to favor exchanges between public research laboratories and socio-economic environments, but also to favor the employment of PhDs in companies. It associates a company entrusting a PhD student with research work, a laboratory outside the company which is ensuring the scientific supervision of the student, and a PhD student, receiving financing during their thesis.

In reality, the approach is rather reversed – a PhD student looking for financing is contacting companies likely to be interested in their thesis subject. The company offering a CIFRE grant takes the commitment to hire students at the end of their thesis. This condition has not evolved since the creation of this grant and is certainly a constraint for businesses and sometimes for students wishing to have a scientific career.

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58. Agence pour Emploi des Cadres – Agency for Employement of Executives http://www.apec.fr.

59. www.anrt.asso.fr/fr/espace_cifre.

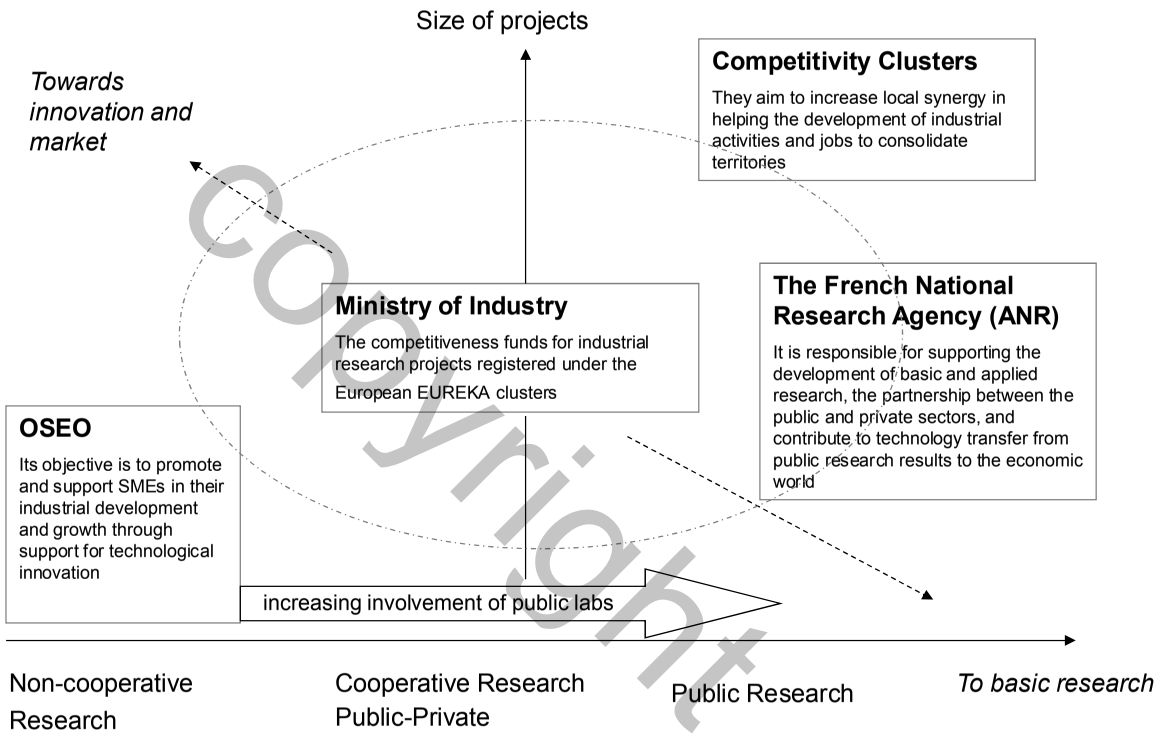

Figure 6.1. *Positioning of the actors of public funding . For updates visit http://www.industrie.gouv.fr/*

Since 1981, 12,000 PhD students have benefited from this system. For CIFRE grants finished in 2008, 14% of the companies declared that they received no fallout from the thesis. The rate of occupational integration of CIFRE doctors in the private sector is 72%. Half the CIFRE doctors are employed by a company other than the one which hired them during their thesis.

In 2008, the Ministry of Higher Education and Research subsidized six chosen *entrepreneurship houses* with up to €101,000 euros. Benefits announced for students included training in the form of conferences, seminars and optional modules in entrepreneurship. Benefits for lecturers included establishment of a network of interested lecturers via meetings. A project to develop an educational kit is being planned in order to gather their experiences, but we do not as yet know the form it is going to take.

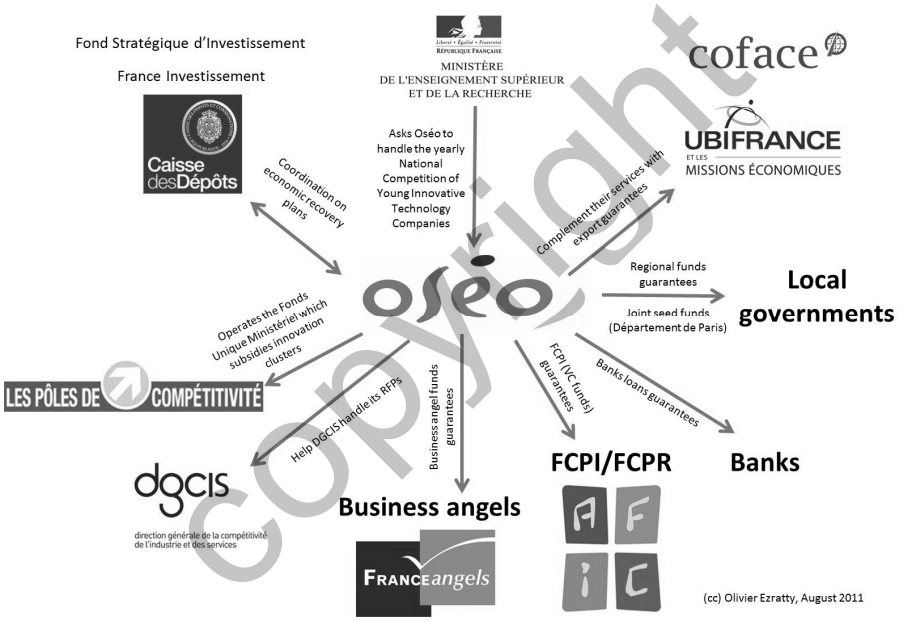

Figure 6.2. *Possible financing of starts-up (source: Olivier Ezratty, 2009)*

Given the scattering of the means and a diversity of views and objectives of the various available reports, it is difficult to estimate the return on investment of these actions. According to Jean-Michel Drevet, the Chief of Staff of the Minister of Industry, 7 innovative companies out of 10 are encountering failures. Possible causes could be: inadequate for the market (50%), cash flow problems (25%), management (25%) and financing (25%). According to the Billon report [BIL 05], one third of the winning companies of the national competition are not making any

turnover and half of them have a turnover of less than €500,000. The survival rate of these companies is 66% after four years, but they are in difficult financial conditions since 37% of them only have outside financing. Most of them have small seed funding and are only surviving thanks to the national competition subsidy. Frequently, they are encountering three major difficulties: insufficient human resources and an often inadequate profile of the entrepreneur for the management functions, a frequent immaturity of the projects when launching the company, insufficient seed funding and late occurrence in the creative process.

The vast majority of owners of SMEs, created after a technological transfer, have no preparation for managing a company. In 76% of the cases, the scientist behind the project is the CEO, manager or president of the created company, whereas in only 17.5% of the cases, scientists are associates and in 3.4% of the cases, they are technical or scientific advisers.

Following the analysis of the French situation by 200 experts and from 300 written contributions, the large loan ("Grand Emprunt") [JUP 09] will finance innovation according to 7 axes:

– supporting higher education, research and innovation – €16 billion;

– favoring the development of innovative small businesses – €2 billion;

– accelerating the development of life sciences – €2 billion;

– developing carbon-free energies and efficiency in resource management – €3.5 billion;

– making the city of tomorrow emerge – €4.5 billion;

– inventing the mobility of the future – €3 billion;

– investing in the digital society – €4 billion.

The authors of the report specify: "France is a large country of industry and knowledge. To take up the challenges of the future, it must (financially) invest". However, they also point out that it is necessary to find new drives and sources of development, such as knowledge economy and green economy.

To conclude, this report proposes allocating half of the amount to higher education, research and innovation, including €10 billion to favor the emergence of the campuses. It does not however give any suggestion of the professions needed in the future. This amount seems disproportionate in comparison to the other axes, such as for example encouraging the creation of innovative companies and social innovation (€0.5 billion) or facilitating the access to financing for innovative small businesses (€1.5 billion). We already have a lot of campuses. What is cruelly lacking is the means to reflect on skills and professions, enabling people to individually and

collectively succeed in the future, on how to produce quality rather than quantity and to reform universities functions and areas according to these aspects. Authors are not proposing any return on investment measure for an efficient campus. They are also not specifying the desired impact in exchange of this investment.

6.8. Proposal: technological innovation in the knowledge economy

The knowledge economy imposes a new perspective. It cannot rely only on the sectors and technologies, where France and other countries have (for now) strong positions. New sectors and technologies should be invented from a vision, the existing capacities and from those able to produce and put the imagination to work. Multiple and interconnected crises are creating an environment propitious to experiments.

Success is conditioned by the rapidity of evolution of the reference marks from the industrial era, in order to meet new stakes. Changing perspective in a country where for centuries we "were dividing to conquer" – the number of clusters and campuses proves this fact – requires a suitable strategy, perseverance, permanent feedback from the field and appropriate progress measurements. Humans with their habits, individual ambitions and weaknesses are influencing the final result. This evolution of attitudes can be generated by actions, such as joint projects, which are carried out with a holistic approach to knowledge management.

The triptych education-research-business appears in many mentioned texts, as a *sine qua non* condition to boost the economic development. Knowledge is playing the leading role, but only innovation dynamics can facilitate their transformation into economic values [AMI 05, MER 07b, UTT 96]. The know-how to detect and generate opportunities is part of it.

Obtaining meaningful results from the support of technological innovation for purposes of growth and competitiveness of the national economy requires new rules. They impose a change of the current logic – a logic where researchers are innovating, valorization units are filing patents and selling licenses to businesses and where an entrepreneur is first seeking the financing – to the logic where researchers are also working on solving company problems and where they are recognized for it.

One of the objectives of the reforms is to make research evolve towards being human-oriented, dealing with the problems to solve and address the needs of today and tomorrow. This type of research will know how to combine the natural and the artificial, as well as ancient knowledge in the production of new ones, while preserving the balance of ecosystems. Key subjects such as environment, transport and energy could be viewed with new logic: transportation and energy production

exert a strong impact on our environment and health. Current research is seeking new possibilities to fuel the same means of transportation – cars and trucks – but they are not focusing on the research of other transportation. What if we reduce the unnecessary transportation or if we moved differently? Do we need to produce that much energy or should we change our habits?

The problems of the 21st Century are complex and difficult enough to provide exciting challenges for both – applied and fundamental research. They need an organization other than organization by areas, or even grouped by concepts (e.g. cognitive sciences). New organization could combine the areas and issues addressed. Organizations in ecosystems are better suited to the challenges, because they take into consideration the multiple effects of actions and mutual impact. Figure 6.3 presents an example of such an organization of the stakeholders working in a collaborative logic, where everyone needs each other to succeed together.

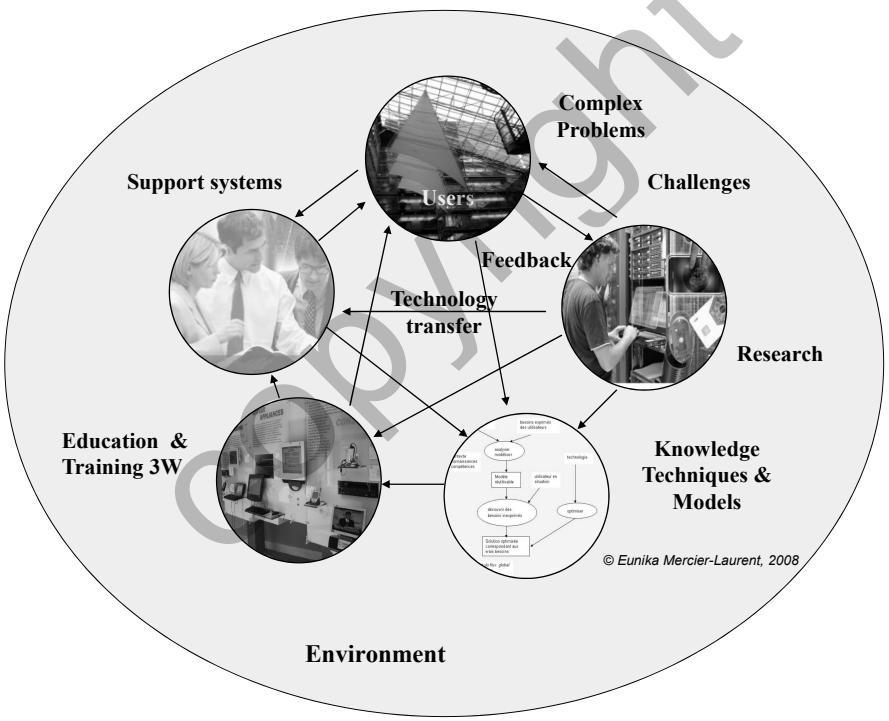

Figure 6.3. *Example of a technological innovation ecosystem*

The challenges and problems of businesses are feeding research programs. The latter make more use of knowledge technologies. Skills and knowledge are made

available to all stakeholders via a system facilitating continuous learning. The various decision-making support systems amplify the efficiency of participants. Users are involved in the innovation process and can be beneficiaries or initiators of a research program. The continuous feedback is organized and managed with the aim to improve solutions or to refocus research programs if necessary.

The required mobility is not geographical, but intellectual: the in-between domain thinking. The context is imposing abstract, conceptual and generic thinking, as well as collaboration and synergy onto the actions, instead of the current competition. This new research has the duty to contribute to the creation of intangible and tangible values for all stakeholders. It is unrealistic to carry on thinking that innovation is an elite matter and that research alone can save the world, that innovation cannot be done outside clusters or that the future lies in salaried jobs. The challenge of new education is the recognition of all these aspects, on all levels and not only by higher education.

6.8.1. *Which approach?*

Although CNRS claims a global and multidisciplinary vision of research [CNR 08], its interpretation and implementation on the field do not escape old habits. It is the same on the governmental level. A multitude of actors, levels and hierarchical layers prevent visibility of the results and generate the wasting of means.

A holistic, systemic and global approach to innovation based on strategic knowledge management [MER 07b] is certainly better adapted to the current context. Stakeholders are acting in a "win-win" logic and the triptych "vision-organization-action" is supervised by feedback from the field. An ongoing synergy "education-research-innovation-businesses" has a place here and could be improved by the participation of citizens 3G[60], connecting imagination, perseverance and experience. It is operating a change of values and an evolution of culture towards those of knowledge cultivators.

This process relies on a virtual knowledge space, which is designed using intelligent approaches and technologies. We can efficiently find there implementations, projects and ongoing initiatives, space to exchange ideas, a challenge box, a bank of partners, experts, skills and experiences, classes and online, educational playground, 3G collaborative innovation school, observatories of

60. Three generations: youth for imagination, middle for perseverance and "silver" for experience.

opportunities, entrepreneur bistros[61], investors in the future, etc. This space is not organized in arborescence, or territories or areas, but ecosystems, avoiding the dispersion of energies and funding of projects for which solutions already exist. It would facilitate the rapprochement of inventors, researchers and customers, as well as specialists of various fields in a spirit of multidisciplinary research and continuous learning.

Just as a company is about to succeed, public research would have more impact on the economy if it could be empowered by a facilitator of global innovation and managed by a scientific and commercial binomial. It is not about having a valorization unit at each university, a relic of the 20th Century, but about a cross-valuation: an idea or a technology can be developed not only in one field where it is born, but in all the fields where it can create value (for example the laser).

6.8.2. *What funding?*

It is sufficient to inject money into the current system, which is inadequate for the economic reality, but it would be better to rethink it, so that it can foster innovation generating values, establish measurements to monitor the progress and require a tangible and intangible return on investment. Based on skills and requirements, in line with future needs, it will have every opportunity to succeed.

Some funds are necessary and impossible in the current system. An innovative inter-disciplinary project on a key issue for the new economy, and of excellent quality, sometimes has difficulty obtaining financing, due to a lack of an evaluation system, whose experts are mostly single domain; such an evaluation may lead to disappointing results, because each expert will seek excellence in their field. Experts are not all visionaries and therefore a breakthrough innovation can be misunderstood and rejected. Some of them, which are too solicited, may not take enough time to read a proposal carefully. Although selection criteria are generally quite clear, this transparency is not the same concerning the return to the team, which submitted a project and has not obtained financing. Preparing a proposal of the quality level required by the institutions takes one full-time month. Due to the dispersion of resources, many very good projects do not get any financing. Such projects would deserve a second chance – the opinion of a visionary on the importance of proposed works for the knowledge economy, European leadership and radical innovation.

Current selection criteria, notably those of the clusters, favors major groups with teams specialized in consortium building and proposal writing, leaving no chance

61. *Bistro* means “quick” in Russian. In this context, this is about the quick and collaborative transformation of ideas into values.

for SMEs, for which one month of preparation is a huge sacrifice. This is the same for small research teams, which are not part of the CNRS because of their size. Moreover, some calls for proposals are announced late compared to the deadline and the application documents are quite complex. There are excellent ideas outside clusters, but the current system does not give any chance for small businesses to succeed. This is the same for specialists.

An innovative small business, in order to grow, does not necessarily need funding, but rather it must be taken seriously in terms of confidence and its capabilities. Small businesses are rarely chosen as providers by institutions and major groups.

SMEs need financing for intelligent promotion and business intelligence actions, such as participation in a study mission, a speaker at an event that could lead to a leadership (trip, accommodation, registration fee), participation in strategic fairs (such as, for example, those organized by HKTC[62]), professional clubs or professional networks meetings abroad. This kind of financing is impossible in the current system, where most decision makers do not know how to estimate or measure the intangible.

The financing system under the form of a "one-stop service" with simplified tools and clear rules would be more efficient for applicants; an online expert system could guide them in the process. Pooling resources and reducing the number of actors and their selection as a function of their capacity to innovate in the knowledge economy would reduce the decision time for the allocation of funding, generate more budget for deserving projects and give a chance to disruptive innovation.

Evaluation at two levels: a brief presentation of the project followed by an interview for the chosen applicants would certainly be more attractive for small businesses. Selection criteria should favor innovation "from a problem" (Figure 6.4) or projects of applied research on key-themes of the new economy, including those presented by small businesses that are able to influence fundamental research.

Regarding the financing of education and particularly in the context of the university autonomy, it should be allocated to those who know how to innovate in the choice of the taught topics, in educational methods, in the ways of introducing entrepreneurship for the knowledge economy and in the way of managing leadership. Appropriate performances measurements and the recognition of feedback would ensure the proper use of these funds.

62. Hong Kong Trade Center.

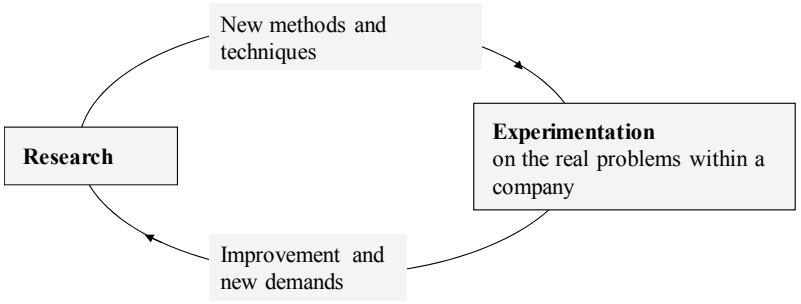

Figure 6.4. *Innovation from a problem*

Modern management training for university leaders would facilitate the transition from the "saving" logic to the logic of research of opportunities and contracts promoting the know-how of researchers.

6.8.3. *Innovating in evaluations and in measures of progress and impact*

The evaluation criteria of researchers has generated a multitude of scientific conferences, many of which are on the same or similar topics. To be well rated, everyone wants their own conference. Consequently, their quality and the number of participants are not always present. Moreover, the conference concept has not evolved for two centuries and, despite technological possibilities, is generating travel costs and results in an impact on the environment. Focusing on individual presentations, it does not facilitate the emergence of collective intelligence. Evaluation criteria could include these innovation aspects in conferences, such as their gathering around applicative subjects, new forms of lectures leaving more room for constructive discussion and creating a collective intelligence, as in innovation cafés or in the use of ICT (videoconference), in order to limit trips. However, a videoconference is more efficient if the participants already know each other (principle of trust).

Some assessors are not valuating invitations in prestigious conferences they do not know. Current evaluation criteria do not take into account the proposals of networking sessions for the European ICT event or the creation of synergies.

Other criteria could measure the imagination quotient (another IQ), creativity, adequacy of proposed projects to a strategy, relevance or articles written on strategic issues and prevail in the introduction of a disruptive innovation. To follow the logic of introduction of the corporate vocabulary, it would be interesting to initiate the teaching/research staff to individual and collective objective/performance

interviews, to the estimation of tangible and intangible ROI, to the business intelligence and to considering the feedback. The creation of a company by a researcher and its success should be part of the criteria.

Intellectual property protection (IPP) by filing a patent and the sale of licenses is changing. More and more patents are becoming collaborative – filing a patent just to have one point more in the evaluation does not contribute to the value-added if the patent is not immediately exploited. On the contrary, it leads to additional costs. The authors of the report [GOD 10] are recommending that "in some cases, to protect from copy, it is better not to file patents and to keep the secret of the procedure, as has been done by Coca-Cola".

Despite the efforts of valorization units, the sale of licenses remains marginal. Software is increasingly available in open sources[63] and valued by services, involving knowledge and skills. In this context, it would be more relevant to evaluate the number, the quality and the impact of the contracts obtained by researchers and linked to the use (or industrialization) of their software and their know-how.

6.8.4. *Using methods and techniques of knowledge processing*

In most cases, the capacities of computers are under-exploited. Professors, students and researchers should be aware of the existence of approaches and technologies for knowledge processing by computers, notably those of artificial intelligence and should learn to use them in their respective activities. In return, these techniques would evolve by adapting to requirements; new approaches may emerge. ICTs, amplified by the techniques of AI and embedded in an "intelligent assistant" would help researchers to be more inventive individually and collectively. The creation of a virtual knowledge space on the national, European and world level would facilitate creativity and connectivity, avoid wasting time reinventing that which already exists, would give an impetus to multi-disciplinary synergies and maximize the return on investment.

6.8.5. *Education and training*

In France, universities are preparing students to be researchers and not entrepreneurs. Given the fact that there are many universities in France, selective admission is minimal and the level of students is continuously decreasing. Moreover, some professors have not updated their lectures for a very long time.

63. http://sourceforge.net/.

Innovation in the system is imperative. The engaged reforms for the autonomy of universities comes under the autonomous business unit method of Alfred Sloan (1957); the staff is not prepared for this change. We are still far from the principles of the 5th generation, those of the knowledge society. More than ever, universities must learn to innovate and to teach this approach. One challenging option would be to make a leap frog and go directly towards the 5th generation, where exchanges between professors, students, researchers and companies and the intense use of ICT would replace the current functioning.

It would be wise to innovate, not only in universities but in the entire cycle of education – in the early detection of talents, replacing research for children with high potential[64] with research of children with high-potential, in the advice given to the youth for their future careers, in their education and in the training and recruitment of lecturers. There are some pioneers and exemplary efforts going on in the direction of a transformation of education, such as in the Baltic countries [DEC 05] and many others [FOR 09, INR 10, TAT 09]; these approaches could inspire others. Learning to think at the conceptual level, to work together rather than compete, in a win-win logic providing all participants with benefits and to complete push by pull [SEE 10], are only some aspects of a new education.

"Lifelong training" does not mean that teachers should constantly be in training. In the knowledge society, learning is a reflex – it has to be done in all circumstances, this consists of exchanges with their peers in other countries, with students, their parents, on the web, etc.

ICTs were introduced in e-learning in France in 2003 (University of Limoges, and then University of Paris 5) and plays a significant role in education and training. At the same time, they are the subject of research and innovation. Experiments carried out in artificial intelligence for computer supported education systems, on intelligent tutors and the introduction of immersion and serious games have increased the attractiveness of education [INR 10]. M-learning mixes various technologies and is from now on possible via smartphones. We still have to define the issues to be addressed by these tools in adequacy with the vision of the future society.

"Management knowledge economy" training for start-ups could be mandatory for the company creators following the technological transfer, in order to make them realize what are the skills needed to succeed and how to put them at the service of success, but it would be useful for all.

64. www.echa2010.eu/.

6.9. The future of research

In June 2008, the RETIS[65] network – federating all the technology parks, incubators and European centers of French innovative companies – published 10 proposals for the future of innovation:

– better detection of projects in laboratories;

– creating standard training "entrepreneur-studies" for students with the capacity to create new activities;

– creating a unique network with multiple-stop services, in order to favor the emergence of regional innovation networks, by federating on the territories all innovation actors and by encouraging them to enroll in a partnership approach;

– creating a brand enabling the recognition of the structures supporting innovative projects. Establishing a program of performance evaluation for the aforementioned structures;

– reinforcing the flexibility of accompanying structures;

– making private investment possible;

– opening up the worlds of research and business via a time-share contract;

– providing facilities for Business Angels;

– involving listed companies;

– developing the notion of corporate social responsibility of major accounts in relation to innovative small businesses.

This White Paper notes and suggests the improvement of the current organization. In order to better meet the challenges, pooling resources and simplifying current processes and organizations seem to be necessary stages. However, these are not the only conditions.

According to André Montaud, the director of CEEI[66], Thésame delegate for external relations [RET 08], "small businesses and laboratories are working differently. These two populations are not talking the same language and do not have the same notion of time. Indeed, a three to six months deadline for a company is equivalent to a three-year deadline for a laboratory." Many people are noticing a cultural gap and researchers do not have any results' obligations.

65. www.retis-innovation.fr/.
66. European Center of Entreprises and Innovation (Centres Européens d'Entreprise et d'Innovation).

The Senate's report[67] from October 2009 [HOU 09] made an assessment of competitiveness clusters, suggesting improvements and long-term prospects. It recommended the creation of indicators of the impact on employment and the territorial attractiveness and a study on the motivation of members. "In the long-term, competitiveness clusters must be put at the service of a real industrial policy, defining strategic sectors for France. The integration of the clusters into the European or even the Euro-Mediterranean network is also a priority".

Competitiveness clusters need to be managed according to the rules of the knowledge economy, combining a long-term vision, translated into strategy, preferably dynamic and tactics. Currently, the vision is not exceeding the project duration. A common language built on the fly via collaborative projects, would facilitate the rapprochement of researchers and companies. Listening and looking for synergies in "innovation cafés" brainstorming, learning to estimate tangible and intangible benefits and calculating the impact on ecosystems are just a few points to be added to the RETIS list. The creation of the brand is strengthening competition and should be avoided. The relevance of organizations supporting innovation still remains to be detailed. Concerning the social corporate responsibility of major groups with respect to small businesses, it simply consists of trusting them as suppliers of solutions and ideas.

Performance measurements (and not observatories) using indicators for knowledge economy and feedback integration are essential to progress. Sharing benefits (and not state financings) is a condition for the sustainability of the system.

We are proposing to transform regional clusters into virtual clusters in the image of the KIZ.

Research has an ambitious task, namely meeting the challenges of the 21st Century. Authorities agree on five priorities: transportation, energy, Green IT, environment and health. Another inferred challenge is to put research at the service of job creation and territorial development from innovation. The mentioned fields influence each other and fields not mentioned, such as the food industry, well-being and economy: currently feeding almost 7 billion[68] people, preferably on a local scale, this industry deserves research other than on artificial manufacturing of food. Chinese researchers are working on the convergence and synergies between natural and artificial intelligences (plants, insects). A better understanding of nature would facilitate an intelligent and balanced development, in harmony with ecosystems, as has already been recommended by Seneca: "True wisdom consists of not departing from nature but in molding our conduct according to her laws and model."

67. www.senat.fr/rap/r09-040/r09-0401.pdf.
68. www.populationmondiale.com/.