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**ROBERT CHABBAL**
FORMER DIRECTOR OF CNRS

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## Evolution and Recent Aspects of French and European Policies for Technology and Innovation

**Robert Chabbal**

I am delighted to have this opportunity to describe the evolution and the present situation of innovation and science policy in Europe and more particularly in France, to be compared later to the American case. This sort of international comparison is popular in Europe under the terms of “diffusion of best practice” or “benchmarking”. It permits one to introduce some clarity within a complex system whose numerous initiatives reflect European cultural diversity.

For a better understanding of these policies, it is useful to know where they come from; so let me describe the transformation of the science, technology, and innovation program, since the war. Indeed, due to my age, I have had the privilege of being a spectator and even, sometimes, an actor in this transformation. It is convenient to describe this evolution as the successive emergence of six layers of policies, each one completing the preceding one. It does not mean that Innovation policy, for example, took the place of Basic Research policy, but that now six policies have to be led simultaneously.

A few words about this term of policy. Usually the terms “plan of action” or “program” would be more precise. It becomes a policy when these actions are based on a set of principles, or on advisability. In Europe we tend to believe in principles, perhaps too much. Of course the nature of these actions is very different for Public Research policy or for Innovation policy: in the first case, NSF, for example, leads direct actions, the policy consisting in choosing priorities. In the latter case, local authorities try to create a conducive environment (institutional, fiscal, regulatory) and sometimes to correct the so called “imperfections of the market”.

Have in mind, throughout this paper, that Europe (at least the Continental one) believes in policies.

1) The first policy to emerge concerned fundamental Research in Science. In a country like France this brutal emergence of science and manufacturing was a real cultural break. I remember vividly a meeting at the end of the fifties, organized by an influential journalist who invited me as part of a group of scientists. He started by stating: "Our French culture is based on farming and liberal arts. What is this new fashion for developing science and manufacturing?" Such debate on the competition between the so-called "two cultures" is not that far removed: as a matter of fact it comes back regularly in other forms.

However, this rapid development of scientific research was made easier by the political determination of the European leaders, anxious to preserve the independence of their countries and to catch up with a leading America. Indeed, most of the European scientists turned towards American science, and neglected contacts with their European colleagues. Hence a lack of European cohesion in science. Only a small minority of European scientists was involved in the strong cooperation around European large instruments like CERN. The situation didn't improve until the mid-eighties, when the European Union developed a strong program for exchanging researchers among European countries

That Research policy is still very important, of course, but more difficult because we live now in a period of "zero growth" policy in Europe.

2) During the fifties, a **second policy** was developed, for the construction of "**Technology based big systems"**: nuclear energy, weapons, space, and aeronautics (what journalists called "Science"!). As a matter of fact, this second

policy was the real favorite of the European leaders, beginning with General De Gaulle.

Let us note that these big programs provided a strong base for European cooperation. Thus was created in 1960 the “Joint Research Center”, in Ispra, Italy, for building nuclear reactors. Later in 1964 the first form of the present “European Space Agency” was created. Nevertheless most countries, France, Germany, and the U.K. particularly kept their national agencies (CNES and CEA in France).

I believe that a happy spin-off of this policy was the construction of big scientific instruments: most of them were European, beginning with CERN in 1955, followed by ILL for neutron Physics in 1972, by ESRF, the cyclotron radiation facility, in 1985, and the JET (Joint European Torus) in 1982, part of the EURATOM program. The connection with the “Technology based big systems” has been the development of strong teams of specialized engineers, devoted to the building of challenging instruments and keen on using their talents. The joint lobbying of these engineers, of physicists, and of European believers helped to overcome the reluctance of budget managers and … of the scientists not involved in this so called “big science”.

The same thing happened with Space. As the chairman of the scientific committee of CNES, the French Space Agency, I could see the fascination of astronomers for the fantastic new possibilities of observation. Yet, in the eighties, other fields of science entered the competition for satellites use, with very interesting propositions from geophysicists for observing ocean and earth surfaces. Unfortunately for the astronomers, they unfairly resisted this competition: years later, the present minister of research, Claude Allègre, himself a geophysicist,

remembered their attitude and it is an understatement to say that he does not favor their present projects.

3) Many years later, a **third branch** of research and technology emerged, focussing on **industrial research**. In the second half of the sixties, I was a member of a high-level committee, created by General de Gaulle, the so called “Comité des douze sages”; this committee was in charge of preparing a bi-annual ministers’ council, chaired by the prime minister and concerned with the organization and the budget of science programs. While a large part of the debate was still about basic research and big science, the central preoccupation was becoming the role of R&D for the competitiveness of French firms and the best measures for inciting firms to increase their efforts. Indeed that was the time when European governments became more or less aware of the **globalization of the Economy**, and also of the great competitive advantage for those companies that would be able to develop their own Research and Development. It was the era of the “national champions” policy when governments believed that the future of their countries was linked to the success of a few large companies, like Thomson, Bull, Aerospatiale, Rhône-Poulenc or Renault.

However most companies, at least in France, were not culturally prepared to spend a significant part of their resources into R&D. Why? One of the reasons was the 200 year separation between universities and “Grandes Ecoles”. The leaders of industry were all “Grandes Ecoles” graduates, at a time when research in these schools was neglected or even despised, considered as a toy for university professors. Managers were more than happy to listen to the economists, who explained that the knowledge developed in their laboratories leaked rapidly toward their competitors, and that their individual efforts were essentially to the benefit of the

collectivity. From that they drew two consequences: a minimum of effort and a maximum of subsidies. As a result the part of the French Gross National Product (GNP) spent for R&D by firms stayed at less than 1% for a long time. Even now, it stagnates at 1.4%. Note also that this attitude is even stronger in Italy, where industrial research represents less than 0.7% of the GNP compared with 2% in the United States and 2.3% in Japan.

Even worse, research departments played a minor role within industrial companies. In 1980 the Saint-Gobain company asked me to evaluate its R&D activity. The main problem rapidly appeared to be knowledge transfer, within the company, from the research departments to production and marketing departments, as well as the interaction between these functions of the company. This happened just a few years before 1986, when Kline and Rosenberg introduced their interaction model, the successor of the now abandoned “linear model”.

This attitude had two consequences in terms of policy: on one hand, the launch at the beginning of the eighties of European “Technology Oriented Programs” that will be described later; on the other hand **a strong pressure on university research to increase its cooperation with industry**. In France, that was the object of a long battle: as a matter of fact university research circles were ideologically hostile to any cooperation with the private sector (“le grand capital”!). For example, I remember an agreement that CNRS (the French equivalent to NSF) concluded in 1975 with the chemical firm, Rhone-Poulenc. Week after week, the left-wing media attacked this agreement. So this opening of public research to industry had to be led cautiously, step by step. For instance, I launched a program on renewable energies, a subject that our researchers enjoyed participating in, even in partnership with industry. In this context, my major success, I think, was the

introduction into CNRS of a department of engineering and computer science, finally created in 1975, thus breaking a French tradition where these two fields were just considered as applied branches of Physics and Mathematics. In 1997, 60% of contracts with industry came from this department.

Finally it was a socialist minister, Jean Pierre Chevénement, who broke this cultural barrier between Industry and University Research. In 1981 he organized the so called “Assises nationales de la Recherche”. Laboratory by laboratory, region by region, debates were organized and converged towards a 3000 strong meeting (“une grand-messe”), where President Mitterrand himself came and expressed his will to see French public research contribute to the success of businesses.

**4) The major “Technology Oriented Programs”**:

That’s when the fourth branch of science and technology policy appeared, the “**Technology Oriented Programs**”. For the first time it was clearly at the European level that efforts were most visible and most structured.

In fact, governments sought a new framework for the aid that they wanted to give to industrial research: the policy of the “national champions” that were given large “carte blanche” subsidies, without any condition of interaction, had been an obvious failure and Europe was lagging behind in technology competition. An eminent European commissioner, Vicomte Etienne Davignon, who was closely connected to industrial leaders, understood that a technological program managed at the European level could solve both problems at the same time. That’s how the **“European Framework Program”** was built, composed of a few big technology programs. The first of these programs was named “Esprit” and was concerned with the totality of information technology: a by-product was “RACE” that especially targeted the telecommunication networks. Two other major programs were “BRITE”

and “EURAM” that supported technological development in processes and materials. Two other programs, of less importance, targeted biotechnology and environmental technologies.

You know how these technological programs work and help to develop “strategic” or “critical” technologies. As a matter of fact the long term objective of such programs consists in training, within the environment of the firm, men and women able to conceive and achieve the new products for the near future. The challenge lies in correctly foreseeing the technological competencies and skills that will be necessary. Hence the definition given by Mustar and Callon, from the research center on Innovation in Paris: “Technology programs encourage non-homogeneous, often competing, actors (scientific and/or technical research labs, large and/or small companies) to work together to identify the strategic skills of the future, and to promote initiatives which will enable the acquisition and development of those skills”

“The interest of this approach is to determine, in the same move, the nature of the future products, services or processes and the knowledge that will be necessary for producing them”.

We will see later that it is only recently that the Framework program fully fitted this definition.

We have already said that technological development was not the sole oblective of the “European Framework program”. Another was to contribute strongly to the construction of a **European industry** and of a **European science**, concepts that hardly existed in the early eighties. The challenge was to provoke the maximum of alliances between European firms as well as between laboratories and companies

of the various European countries. To achieve this objective, only projects presented by firms or laboratories from 3 or 4 different countries would be eligible.

Indeed the pro-European nature of the “Framework program” was the very reason for its launching and of its persistent success over the last 15 years.

At the industrial level the first initiative came from a group of big industrialists, “The European Round Table”, who were in the best position to foresee the nature and the amplitude of the globalization of the economy. They preached alliances between firms, as well as using the enormous potential of the whole European University research, clearly a wider reservoir than the one they were using at the national level. Of course, their arguments sounded like music to the ears of Etienne Davignon.

At the political level a favorable circumstance was the very positive attitude of the three ministers of research in France, the UK and Germany, each of them a convinced European closely linked to Davignon. Under the Minister Fabius and later under Minister Curien, I participated directly in these negotiations with my British and German colleagues. It was long and difficult, but fascinating. I remember meeting them regularly in airports in London, Paris or Bonn. Finally we agreed (in close cooperation with our seven other colleagues) on a strong and coherent program that became the core of the first Framework program. Unfortunately for the British minister, Mrs. Thatcher found him too enthusiastic, and dismissed him.

As a spin-off of this effort to build up the European Framework program, another big program, EUREKA, was launched. In 1985, in reaction to “star wars”, the big American military program, Mitterrand convinced his European colleagues to develop a European initiative. Fortunately, Hubert Curien and his collaborators, in particular myself, were prepared to propose a project that we considered as the

necessary complement to the Framework program: while the latter was top-down, managed from Brussels and “upstream”, that is far from the market, EUREKA would be bottom-up, decentralized and downstream. Typically a consortium of large firms agree to develop a platform of common knowledge towards the production of a system of products. Or several SME’s join to prepare a radical innovation. In the spring of 1985 we visited the main European capitals: the project rapidly took shape and in the middle of July, scarcely three months after its conception, ministers of research and/or industry from 18 countries met and decided to launch the EUREKA program. It was a very exciting time.

National and even local programs have been developed. Let us cite in France the “Filière Electronique“ and the program PREDIT for ground transportation. There, we had to fight the permanent opposition of the Ministry of Budget, which always found it easier to cancel such programs than to close laboratories. As a result, industrial and public labs now receive fewer program-contracts from Paris than from Brussels, where technology strategy is finally decided. Table 1 recapitulates some of these national programs in Europe.

What has been the impact of these programs? At the European scale the Commission has systematically led evaluations of each specific program. I would even say that there, a good methodology was developed. But because these evaluations were conducted immediately at the end of each program, it was always far too early to measure its direct economic impact. On the other hand these evaluations emphasized consequences in terms of development of economic networks, this means sustainable alliances among the participants in these programs, among university laboratories and companies, among large companies, between small businesses, etc. These evaluations have been most generally

positive. For example, the work of the laboratory Merit actually shows a very rapid increase in the number of alliances formed among large companies during the eighties; but they observe about the same sort of increase among American firms (it could be the result of similar programs) and also between Japanese and American firms, which is more surprising. This evaluation also notices a clear re-enforcement of the engineering and computer laboratories.

Nevertheless, after twelve years, political and industrial leaders expressed doubts about the efficiency of this program and wondered if it was worth going on. A high-level panel chaired by Davignon (now a business leader) conducted a global evaluation and finally concluded that they would continue but after a complete reconstruction of the program. What I would call “the Brussels Community”, that is the people in charge of the program plus the private and public national partners took the matter very seriously and produced a “beautiful” program, very much in line with the Mustar-Callon definition. With a major contribution from the British, inspired by their “Foresight Project”, it really is “Consumer demand driven”, and based on sixteen “key-actions”, each of them targeting a social, environmental, or economical objective. These are summarized in Table 2. The future will show whether it was a cosmetic change or a real in depth change.

These efforts were much appreciated by the European Council, the fifth Framework program is going to be launched, at a very good funding level of fifteen billions Euros to be spent over four years. As a matter of fact no one believed that the program would be abandoned. Indeed it has symbolic value, as a cornerstone of

the European construction, but also as a powerful motor for more inter-European cooperation between firms and laboratories.[1]

Another branch of technology policy concerns the **diffusion of technology.** Since small businesses are the main target of such a policy, it can be considered as a branch of Innovation policy.

5**) Innovation Policy favoring Small Business** :

Finally during the last few years was added a fifth and last stratum, the **policy for innovation**. This time the triggering political factor was the dramatic problem of unemployment in Europe, about 12% in France. Americans have not known this very serious social disease for over 60 years; it generates anguish, distrust and poverty. Defeating unemployment constitutes an absolute priority for European governments. In order to facilitate the creation of jobs a conventional approach consists in modifying the rules of the work-market; but it was observed, more than 10 years ago in the United States, and more recently in Europe, that the quasi-totality of jobs were created in small businesses and more precisely in innovating small businesses (cf. the work of Birch). This observation has triggered an immense political interest in innovation by small business.

Again, what does it mean to lead a policy in an activity which is entirely driven by private initiative? Later we will see a table established by the European Union that gives the content of this policy. To remove regulatory barriers, to adapt institutions, to compensate for market imperfections through a few subsidies, all

[1] Let us add a last remark relative to the European phenomenon. It has been the subject of thousands of comments and publications. Yet I think they underestimate, at least for the matters of research and innovation, the impact of European governance on the industrial and public actors. Action by action, meeting after meeting, we Europeans have to confront our ideas and culture with the ones of the other European countries. This sort of shock has an enormous effect for the destruction of prejudices and helps, even more than you could think, to communicate with other foreign people. This diversity of cultures and the permanent necessity to accept, to enjoy and to take profit from them is perhaps our greatest advantage.

these actions have to be implemented coherently with a clear and well-accepted political goal. I will try to show that in European countries efforts to innovate in SME's, to create start-ups are hampered by many non-market difficulties. To identify these problems, to find remedies, to create a conducive environment, and finally to increase the number and to foster the growth of these innovations, these are the objectives of the innovation policy.

We will examine later in more detail the tools of this innovation policy. As you know this type of policy has to address a variety of problems that extend far beyond technology and research, but that nevertheless include these two subjects; all the more so since interest in Europe as well as in the United States is more and more focused on the creation of new technology-based firms (NTBF), and quite particularly on the enterprises that are created and developed at the contact of research (spin-off's). In brief, Innovation policy is linked to Research policy but is quite wider and always fails as long as it is led as a simple subset of the Research policy.

For now, we will focus on the obstacles to development of such a policy in France and in Brussels. The interest in Innovation and SMEs is quite recent and comes entirely from the absolute priority for the creation of jobs. As a matter of fact, this new orientation is a cultural break. Up to now French leaders as well as Brussels leaders were only interested in large companies. Why?

First, these large companies represent a small, well-identified group of interlocutors, equipped to negotiate with ministerial departments. Thus was created, at the French level, but also at the Brussels level, a very interactive club bringing together industrialists specialized in contract research and, on the other hand civil servants in charge of managing the Technology Oriented Programs. It was

particularly true for the Framework Program. I have already said that it was conceived and organized to answer the needs of large companies and the problems of their cooperation with universities. Entirely managed from Brussels, with very complex and heavy procedures, it was practically inaccessible to small business.

On the other hand, most of the French executives, private or public, come from the “Grandes Ecoles”, that until now, have pushed their students to work life-long in large companies and in top public administrations. They knew very little about small businesses. They had a tendency to despise them and to see them as being nothing more than sub-contractors for large companies. Actually, for a long time, only a minority of French small business produced their own products. And even fewer were able to export them. Fortunately this situation has changed; indeed it has always been very different in Germany and Italy, known for their excellent small and medium enterprises.

Finally the research and technology policies were based on “the linear model” that assumed a one-way path from basic research to applied research, development and finally innovation. How to believe that innovation for products, services or processes, could emerge in quantity from small companies that did very little research or none at all.

All these reasons help explain why technocrats and politicians were so puzzled by this new challenge and slow to react to the new realities. They knew very little about the actors, and even less about the problems to be solved or the tools of action

Beyond that, a fourth reason might explain why, years later, the policy of innovation for SME’s still receives very little money. My interpretation is the

following. First, innovation policy is 90% a local (regional) policy. Second, Brussels and Paris technocrats are unable or unwilling to recognize the necessity of a decentralized policy, led at the regional level. Let us go into more details on the two sides of the problem.

A) You, in this room, are certainly convinced that a plan of action to facilitate innovation in SME's and in creation of firms is more a Wisconsin policy than a Washington policy (as a matter of fact many think it is not a matter of policy at all! but we are going to prove how strong and coherent actions can help). Actually, everything that can be done to help a SME happens in its close environment, where the interaction with its partners becomes easy and efficient. Let us check it by reviewing these partners (listed in Table 3 around the so-called "pentagon scheme"):

- Concerning the services to innovation (the generalists that the Italians call "real services", the technology providers and the other experts), SMEs prefer to consult them only if they are in their neighborhood. Of course, it is not forbidden to consult anybody anywhere, but practically it is difficult and time consuming to find and to interact with people who live far away.
- Proximity also favors networking with other firms, as can be observed everywhere, especially in the famous Italian, Danish or Silicon Valley clusters.
- Private financing is very much a question of trust and frequent interaction, conditions that you normally find in a local environment. It is clear for business angels, for seed-funds, but also for normal venture capitalists. When I asked Silicon Valley venture-capitalists last year if they would be interested in investing in French start-ups, they said that Middle-West start-ups were already too far away.

Let us summarize by saying that **proximity** is the key word for any aspect of SME innovation and especially for start-up creation. As a consequence, any public or private policy for increasing the number, quality and interaction of these different actors has to be led at the local level.

B) Let us go to the second side of the problem. What are the consequences relative to the public funding of innovation policy? Let me again refer to my personal experience.

When I left OECD in 1992, it was becoming very clear that innovation through SME's, especially start-ups, would be the challenge of the nineties. I tried to form a group of public executives, who could understand, define, and implement the corresponding policies. I found nothing but polite indifference at the Ministry of Research, and even some hostility in its counterpart at the Ministry of Industry, where the Directorate in charge of technology policy was strongly linked to large companies. Both were completely skeptical about regional initiatives favoring innovation, a field that they considered as just a subsidiary of Technology and Research policy.

Fortunately, I discovered efficient allies in the second directorate of the Ministry of Industry, traditionally in competition with the first one, and devoted to SMEs' and regional affairs. What made them different and successful was their decentralized organization with its twenty delegates in the twenty French regions. Through them I discovered a new phenomenon, triggered in 1982 by the minister Gaston Deferre, which is the building up of a sort of regional government, composed, on one hand, of the administration of an elected regional parliament and, on the other hand, of delegates of central administrations. What amazed me was the coherence of this group and their willingness to implement efficient policy. That was

the good news, but the bad news was that they had very little money, and, in spite of their enthusiasm for innovation, no significant budget was reserved for this newcomer.

In such a case, people turn to Brussels because more flexible money is in principle available there. During the spring of 1997 I was an advisor for the French ministry of research, the French member of the European Union research council. That was the time when the 5th Framework program was being prepared. We proposed that 20% of the program be devoted to innovation policy and managed in quite a different way: Distribution of funds would be delegated to regional authorities, to be spent on a few lines of action collectively defined at the Brussels level. This general policy, inspired by Europeans' best practices, would be adapted to the particularities of each region. The idea was easy to apply and was supported by most of the countries, particularly by those already used to decentralized governments, like Germany and the Netherlands. But the "Brussels system" strongly opposed this idea and used any excuse to kill the project. Culturally the Brussels civil servants (with the exception of DG16) appeared to be unable to break the rules of centralized management. Question of power or question of ignorance? I don't know. They talk and talk about priorities for SME's and innovation but they refuse to admit the regional nature of the latter.

As a matter of fact, this problem still poses a real dilemma for the leaders of DGXII, as intelligent and devoted people. Moreover they are under the authority of Edith Cresson, one of the Commissioners of the Commission, who always was personally interested in innovating SME's and knows quite well their specificity.

- Immediately upon her arrival, Madame Cresson launched a vast effort of reflection within the framework of "**the Green Book of innovation**". Working

groups internal to DGXIII, but helped by experts from the fifteen countries, built up this document that was discussed successively in fifteen workshops, one per capital. One can say that more than five thousand people participated in the green book venture. Recommendations from the final version of this green book have been widely diffused in the countries, mainly at the regional level.

- A first implementation of these recommendations can be observed in the regional contracts established by DG16. This general directorate is in charge of managing an enormous program of support for regions with economical difficulties. With the distributed subsidies, the concerned regions can choose the actions they want to lead. The point is that regional governments are building up more regional innovation programs, while previously, they had been satisfied with constructing more roads or airports. They are encouraged to do so by the DGXVI which, in close cooperation with the SPRINT program, is running an excellent program to evaluate these regional innovation programs, (RITS). The directorate pays half of the expenses, provided that the evaluation follows a general scheme established after wide consultation by the Commission. At the same time the exercise is suppose to bring together all the regional actors to reach a consensus for their next actions.
- But the contribution of DGXVI is not sufficient. By definition only special regions can be helped and yet rich areas, like Ile de France and Wurttemberg, for example, have an equal need of an efficient innovation policy. We can still hope that good use will be made of the resources of this axis of the Framework program which is named “innovation and SME’s”. It is provided with relatively modest resources (300 million Euros), but it coordinates “innovation cells” placed

in every specific technology program and is in charge of favoring innovating SME's with respect to large companies or university laboratories.

**VI) Last but not the least, the policy favoring the creation of start-ups related to Research, perhaps the sixth layer!**

Let us describe this effort at the Commission level. In December 1997, Madame Cresson, with the support of DGXIII, organized in Paris a large workshop, where more than 200 investors, creators of start-ups and policy executives, exchanged their experiences and established the basis for a new program. From this date until November 1998 working groups focused on four subjects: access to competencies, access to financing, access to markets, and environments conducive to innovation and creation of new businesses.

On the 12th and 13th of November 1998, 300 participants came to Vienna for a final forum. A consensus emerged on actions to be undertaken, with the explicit agreement of about 100 creators of new businesses coming from the fifteen EU countries and from every sector.

Table 4 summarizes the main recommendations of the Commission as a result of this consensus. Some are financial, some are institutional, others tend to change regulation, for instance as regards patenting measures. They do correspond correctly to the analysis that we have just made using the 'Pentagon' scheme. However, there are quite a few new approaches where innovation is developed through the creation of an enterprise: for example stock options, "mentoring" by heads of businesses, direct participation of the researchers in the project, policy patents (the tendency is to apply the rules of the Bayh-Dole act in Europe), the role of incubators, private seed-money completing public financing, an effort to change culture namely through entrepreneurial education.

Actually this sixth policy now receives better support from Paris than from Brussels. The French government recently organized the “Assises nationales de l’Innovation”, chaired by the Prime minister. A coherent set of measures facilitating the creation of Research related start-ups is now being launched.

To finish, let us examine three subjects that we have overlooked, although they are of first importance.

**First problem: seed-money and the financing of the first phases of development**: The debate in Europe tends to oppose two approaches that are in practice complementary: The liberals consider that only private money is good and sound for financing start-ups. Even so, there are still two solutions:

- **Business angels**: where you can find a climate of mutual trust between personal investors and creators of businesses, the business angels represent the best solution. They contribute to the success of the start-up by the capital they bring but also by their mentoring. In fact it is quite an art to be a good business angel, present but neither cumbersome nor smothering. Quite rare are the countries where you can find such a climate, such a balance. In Europe, up to now, it is principally in Great Britain that you can find them. Happily the situation is changing rapidly and in the right direction.
- Other possible solutions: **seed-funds** (fonds d’amorçage). As you know there are few of them in the United States because it is extremely difficult to make them profitable. Yet the French minister of economy, Mr. Strauss-Kahn, likes them. He launched a call for tender to support a few of these funds. Practically, the trend is to establish hybrid funds with the public part coming from local authorities.

The other party believes that public financing support is necessary for the phases of gestation. That includes the free admission into some incubators; the free

access to some research equipment; the possibility of continuing research in the university laboratories where the idea of the product was born; ANVAR-type subsidies; and even fellowships that give a salary to the creators for one or two years. This last solution is more and more practiced (Israel); the fellowships generally being conditional loans to be returned in case of success.

**The second problem, the incubators**: You Americans have developed incubators for quite a long time, whether in a Research Park or outside. But it has been rather rare in Europe; though of course we had pioneers: at Oxford, Warwick, and also at Helsinki, in Finland, Limerick in Ireland or Twente in the Netherlands. The results are quite impressive: in the region of Helsinki (1,000,000 inhabitants) more than 50 start-ups are created per year with help of the SPINNO Program. All based on ideas or technologies coming from the local universities' their failure rate is inferior to 5%.

During the last two years incubators have been mushrooming in Europe. Every university wants its incubator. However many people think, and so do I, that only incubation structures with a critical mass can create the conditions for a sustainable highly creative system, like the famous Silicon Valley, the ultimate objective. It is most important to place the new start-up in the middle of a dense and diversified network composed of business mentors, business angels or seed-funds, specialized experts and, last but not least, laboratories keen on transforming their ideas into start-ups. Only a few places offer such possibilities. Where and when it is possible, one should try to start a "Silicon Valley"; but it is not enough merely to want to succeed.

**Finally the third point, the education of entrepreneurship:** The main handicap in Europe and especially in France with respect to innovation is cultural. Professor Birch in his presentation to a large Forum in Luxembourg stated that when American parents want to impress their neighbors they claim that their son or daughter created a business. In Europe, he said, the parents announce proudly that he or she got a medical doctor diploma, became a professor at the university or, greater triumph, has a position as a civil servant! Anyway, we suffer from a scarcity of entrepreneurs who take the risk of creating a business. And, the farther Europeans go in their studies, the less likely it is that they will abandon their position in a large company, research or administration to create a company. Twenty years ago, there were no serious consequences of this. Nowadays economic growth and full employment depend essentially on the SME system and more particularly on young businesses. The lack of entrepreneurs is therefore a fatal danger. As a matter of fact, more and more political leaders, directors of engineering schools and business schools; presidents of universities have become aware of the necessity to develop education in entrepreneurship. Different types of training are now organized for future engineers, managers, and Ph.D. students. Americans were the pioneers for developing this type of education.

**Conclusion:** To summarize, European governments have always tried to intervene in the processes of research, but their action has become much more complex, inasmuch as its objectives have been multiplied, by successive layers. One must simultaneously sustain and manage basic research, achieve the realization of technology based on big systems (weapons, space, …), aid industrial research, develop basic technologies, and favor innovation. In France and in the majority of European countries the three political turning points that provoked this

evolution were successively: one, the concern of preserving national sovereignty; two, the globalization of the economy, and three, most recently, the dramatic crisis of unemployment. The European dynamic has been crucial in all these policies, with the exception of the innovation policy where the real approach has not yet been found (see Table 5).