Science and technology policy in France—from planning to strategy

Rémi Barré

A crucial factor in the competitiveness of businesses is their technological capability. This is the basis of product and process innovations,[1] which can be considered the source of a new industrial revolution. A mastery of technology and of innovation thus seems to be one of the determinants of the redistribution of economic power at the global level.

In addition, the military strength and degree of political independence of states is measured today—more so than ever—in terms of the relative level of countries' technological and industrial capabilities.[2] The US Strategic Defense Initiative (SDI), dubbed 'Star Wars', can be viewed as a result of fierce technological and industrial competition between major political blocs or, perhaps even more, between the major global economic powers. In sum, 'technological capability' is one of the major forces which will shape the geopolitical map of the 21st century.

Further, we can also consider how technology will contribute to solving the major social and environmental problems of our age, such as health, education and nutrition.[3]

Such a view of technology as a major strategic factor is evidently not a new one—and we do not intend to discuss further here either this view or its components. What is new, however, and what is of concern here, is that this analysis has been taken up increasingly by the governments of a number of countries. We find evidence of this in the declaration of heads of government at the 1981 Versailles summit,[4] in various official reports, government white papers and actual legislation produced over recent years in a number of countries as well as in the increase of the proportion of states' budgets devoted to science and technology (S&T).

States already have, and are increasingly going to have—whether they like it or not—a determinant role in the field of S&T. There are a number of structural reasons which explain this development and which make it independent of governmental policy options:

- The growing interdependence between science (including basic research), and technology,[5] and the importance of training industrial research staff, give a central role to universities and public research establishments.
- Public sector orders for military, aerospace and telecommunications equipment, play a major role in industrial research, and hence in the technological capability of companies. For the major OECD countries (with the exception of Japan) 20%–30% of industrial R&D expenditure is financed directly by public sector orders.
- From scientific research to industrial competitiveness, a number of factors lead states to intervene[6] in the process of technological development—eg in modifying elements of the regulatory, fiscal or institutional contexts, or in setting technical norms and standards.

Thus, even though the development of new technologies and of innovations are evidently the specific responsibility of industry, it is clear that public policies on S&T have a major and growing role. To competition between companies is added

Rémi Barré is at the Conservatoire National des Arts et Métiers, 2 rue Conté, 75003 Paris, France.

competition between states, notably in relation to S&T policies.[7]

Indeed, the ratio of national R&D expenditure in relation to GNP of all major OECD countries has increased since 1980, as well as the proportion of R&D expenditure in state budgets.[8]

Changing context of S&T policies

The current situation is also characterized by a rapid increase in the amount and variety of scientific research and technological applications. Every year whole new fields of research emerge which are promising areas for the future; some 'ageing' technologies become rejuvenated, while others considered to be on the point of becoming industrially important, do not deliver. Further, those actors concerned with research, form complex and changing systems of competition and cooperation at the global level—and it is not easy to identify the major dynamics of these systems. Hence the context to which government S&T policies are directed is in constant and rapid flux.

The rapidity of these changes and the level of competition involved require that there should be no delay in decision making concerning strategic issues and major programmes. Decisions must be taken in good time, and investment in manpower and resources must not be delayed. A delayed response or an insufficient allocation of resources—which lead to a programme failing to reach 'critical mass'—equal serious setbacks from which it would be difficult to recover. All this presupposes a good capability for anticipation, for decision, and for releasing the appropriate resources—even though the environment may be becoming more uncertain and the resources required for particular programmes may be burdensome, necessitating commitment over a number of years (this has to be so because some years are required to train research specialists in the areas one wishes to develop). This holds true for companies as well as for states. Last but not least, times of ever-increasing public spending are gone, and the S&T system has to be managed within ever stronger financial, institutional and political constraints.

The actual challenge: defining methods for the changing S&T policies

Having said that S&T is considered a strategic factor, that states recognize their central role and that the very context of the S&T policies has changed, it is not surprising, therefore, that since the late 1970s most countries have sharply reoriented their S&T policies; it has to be noted that they have done so along lines and objectives which are quite similar from one country to the other (including France):

- greater priority given to the use of S&T to achieve economic objectives and industrial competitiveness;
- promotion of greater academic–industry–government S&T co-operation and joint services;
- increase of the economic and social objectives of academic and government research;
- efforts to increase R&D expenditures in both academia and industry;
- attention given to the quality, effectiveness and relevance of S&T.

This leads us to the two following basic remarks: (a) if the nature and context of S&T policies in the most developed countries have changed, then the methods, instruments, procedures and institutions by which those policies are elaborated and carried out will necessarily be re-examined and eventually changed also (in what follows, we will simply use the word 'methods', to be understood, therefore in a broad sense); (b) even though the objectives of the new S&T policies are quite similar, the methods used to elaborate and carry them out can nevertheless be fairly different among countries; this is simply due to the difference in size, in the

institutional organization of S&T and, more generally to the specific socio-cultural and political context of each country.

Therefore, it appears that beyond the discussion about S&T policy objectives —which we will not address here—there is room for debate and exchange regarding the *methods* of the S&T policy: what are the methods used to perform the set of functions involved in the 'new' S&T policies? What assessment can be made today? What can be learnt from the experience of other countries?

It seems to be a proper time to do this since in many countries there is now an experience of five years or a little more since the re-orientation of S&T policy. Such was the idea of Irvine and Martin, showing how several countries had set up mechanisms for S&T forecasting.[9]

In this article, our purpose is, in the same spirit, to describe and assess the methods used in France regarding the overall policy orientation and decision-making function (which we will simply call the 'Strategic function') of the S&T policy. Such a function has obviously become critically important and is directly or indirectly addressed in the many aspects of the S&T policy reforms of the past five years in France.

This article is organized in three sections:

- the conceptual origins of the methods used in the strategic function of the S&T policy;
- the progressive appearance of the strategic function in the S&T policy;
- 1985 onwards: setting up an overall framework for the strategic function.

Conceptual origins of the strategic function in French S&T policy

The emergence of a strategic function within the French S&T policy as a response to the new context can be analysed as the combined operationalization of already existing methods, in an original way. Far from being an abstract or artificial construction, the strategic function is founded in already-existing methods. Yet the particular way in which these methods have come together in the face of a new situation, is itself an original one. It is thus possible to refer to methodological innovation and experimentation in regard to government S&T policy.

This is why it is necessary to examine those methods, which are the conceptual origins of the strategic function of the S&T policy; each of those is of a specific nature, and will be briefly described:

- a process: French planning;
- a procedure: the public policy evaluation;
- a methodology: *la prospective*;
- a set of techniques: the S&T indicators.

French planning process

Since 1946 the process of French planning has been conducted by the Commissariat Général du Plan. This becomes a formal 5-year plan by Parliamentary vote. This distinctive French planning system has been characterized as the expression of a 'third path' which reconciles the defined purpose of a plan with the flexibility of the market.

This process has existed for 40 years and "aims at reintroducing into the political sphere economic and social macro-decisions which were increasingly becoming removed from it".[10] The Plan can be viewed as generating social dialogue and coherence.

As well as being a document, the Plan is a learning process, a process of interaction between social actors. Indeed, a continuing feature of the Plan is that its formulation becomes an occasion for dialogue and confrontation between representatives of the state, of industry and of unions, on the subject of medium- and long-term development objectives. The preparation of the Plan—which usually takes two years—consists of various commissions and working groups examining specially prepared

studies, notably forward-looking *prospective* work. The Plan thus generates social dialogue and 'concertation'—ie information about and reciprocal sensitization to differing views.

The Plan also generates coherence, continuity and a rationale for state decisions by situating them within an overall framework and a long-term perspective by subjecting them to a set of common criteria. The Plan is thus valuable in providing indicators for the private sector and objectives for the government. In the IXth Plan (1985–89) specific 'priority programmes' have been identified and published: these programmes will be carried out over the five years, guaranteed with budgetary resources pledged by the Ministers concerned. These priority programmes are subject to annual reviews in relation to a range of quantitative indicators. The IXth Plan defines 12 such priority programmes.[11]

Finally, French planning is a method which articulates the studies of experts, the discussions of social actors, the directions of Parliament and the objectives of governments in relation to major long-term directions. This enables the intervention of public authorities in economic and social life, firstly through influencing change in the behaviour of economic and social and economic actors, and secondly through deriving better mutual information and through obtaining an awareness of one's own and others' new problems.

It is this kind of non-constraining intervention that the Plan allows as opposed to regulatory action. In this way is resolved—at least partially—the apparent contradiction between (a) the need for a directed and normative attitude in the face of long-term strategic challenges and (b) respect for the legitimacy of social and economic actors, as well as for the market, to guarantee both effectiveness and flexibility. In sum, the Plan is a process for the 'concertation' and stimulation of social actors regarding the strategic challenges of the long term.

Evaluation of public policies

As opposed to the French planning process, which is deeply rooted in habits and institutions, the evaluation of public policies is a procedure which is in its development stage.

Indeed, neither the objectives being pursued, the techniques employed, nor the way in which results are used, have been codified. The *'Rationalisation des Choix Budgétaires'* (RCB)—*'Rationalization of Budgetary Options'*[12]—at the end of the 1960s, engendered a great deal of disillusionment about the limitations of economic calculations applied to fields where external effects, the long-term and collective action are of primary importance. Disillusionment also derived from the lack of a clear relationship between these studies and administrative practice. Also, the control functions carried out by institutions such as the *Inspections Générales Ministérielles* or the *Cour des Comptes* are limited to verifying judicial regularity and accountability of actions.

From these inadequacies the theory and practice of public policy evaluation were born and have been developed. This was to respond to the growing need for knowledge of the mechanisms for governmental action, and of adaptation and transparency in governmental policies. Despite the heterogenous character of the activity of evaluation—which explains why no codified method has been established—it is none the less possible to identify the main characteristics which distinguish public policy evaluation from the RCB, from audits or classical government control mechanisms:[13]

(1) Evaluation is intended not only to provide a preliminary rationalization for decisions, but also to comprehend the genesis, development and actual observed impact of policies. The objective is to end up with an explanatory analysis of problems and to define the methods to be employed to improve the policy process.

(2) Both to observe the action and deployment of resources by the administration, and to track the impact of governmental action on private behaviour. In short, the final impact on society—the ultimate goal of governmental action—is what is explicitly taken into account: governmental action thus moves from being an obligation to provide resources to an obligation to achieve results (eg by defining objectives in terms other than those relating to resources).

(3) Not only to observe the effect of an isolated action on just one parameter, but to consider a whole system of interactions. The interdependencies existing between many governmental actions do not allow a simple causal link to be drawn between action and parameter; interdependencies between governmental actions in relation to the defined parameters must be taken into account in analysis (eg, do not overlook military expenditure when analysing public S&T policy).

(4) Finally, to integrate into the analysis the 'summit' of the decision-making system, ie the processes whereby the ends or grand objectives of policy are defined in order to relate them to operational processes through taking into account the links which exist between them. The interface between the administrative system and the political system must form a part of the analysis. This enables both an examination of the relevance of means for achieving objectives, and also, less conventionally, the relevance of objectives to political ends or major challenges.

The idea of evaluation of public policies has gained currency in political and administrative circles, eg the setting up of the 'Commission du Bilan'[14] after the change of government in 1981, the creation of the Parliamentary Office for Evaluation of Scientific and Technical Options, the affirmation of the principle of public policy evaluation in the report on planning reform,[15] and the proceedings of the colloquy on public policy evaluation in 1983, held at the initiative of the Economics, Finance and Budget Ministry.[16]

Such a shift in attitudes has been accompanied by the growing number of evaluations which have been carried out[17]—although their methods are still not particularly rigorous and the criteria described above often remain far from being met.

However, the ball has been set rolling, experience is being obtained and various methods are being set up. The problem of the management of and follow-up to state actions is being examined publicly using an analytical method which is becoming rigorous.

La prospective as a methodology

The experience of corporate planning evolving into strategic management in the 1970s is now enriched by the methodologies of *la prospective*,[18] in industry as well as in the administration; the evolution of the ideas, techniques and methods about planning and forecasting has led to a few key methodological concepts defining strategy and *prospective* which can be expressed in the following way:

(1) *To define a strategy*, is to choose a behavioural path that is both global and long-term in relation to the environment. This also necessarily entails the definition of an organizational logic which will guide, over time, the coherence of multiple decisions and current actions. Strategy thus concerns the relationship of the institution with its environment which will guarantee internal–external coherence.

(2) *Prospective analysis* consists of taking the occurrence of possible ruptures as the time horizon, of placing the strategies of actors who are in conflict and who are unequal at the heart of the socio-economic dynamic, and of identifying coherent and probable scenarios and hypothetical strategies (eventually quali-

tative ones) which signal possible futures. At root, we are essentially talking about an attitude in the face of the future and of uncertainties, which leads to a creative and permanent monitoring of the environment.

(3) *An affirmation of the distinctiveness of the strategic*, by reference to the operational or the budgetary. The confrontation between strategic objectives, internal capabilities, and threats—environmental opportunities—enables a global diagnosis or evaluation. From this one can identify what can only be achieved by a strategic action (choice of strategic options), ie by changes in structures, in procedures or in allocations of resources.

(4) The consideration that techniques (of forecasting, strategic planning, internal–external diagnosis) only have utility if they are actually incorporated into the decision process. Above all, they serve to bring about a new kind of interaction between managers themselves, and between them and the outside world.

S&T indicators as a monitoring technique

Since 1972, the US National Science Board has published the *Science Indicators*, at two-yearly intervals; it is a comprehensive quantitative description of scientific activities in the USA and the rest of the world; other countries, including the UK, and also the OECD publish such indicators.

Those indicators can be designed for measuring S&T activities at macro (national) level as well as at the micro (University or firm) level; they can refer to the inputs of the S&T activities (expenses, personnel . . .), to the outputs or results of those activities (S&T production measured in terms of S&T articles, patents . . .) and to the organization and dynamics of the S&T activities.

In the recent years, the betterment of the statistical databases about S&T activities as well as the progress in bibliometric techniques have given to S&T indicators the status of operationally relevant tools for S&T policies.

Progressive appearance of a strategic function in S&T policy

For the past five years a process has been occurring whereby the methods, structures and procedures[19] have been progressively established which together could constitute the strategic function for S&T policy in France.

This process stems not so much from a pre-determined overall project which is being set up according to a strict timescale; rather, it is a pragmatic development whereby the problems and needs experienced in the definition of governmental S&T policy have been superseded by specific solutions, in terms of methods developed along the lines of the four currents described above. This process has not unfolded in linear fashion, but has been stimulated importantly by two events—the passing of the 'Loi d'Orientation et de Programmation de la Recherche' (LOP)[20] in 1982, and of the Law on the Triennial Plan for S&T in 1985—intersected by a period of enactment and maturation (1982–1985). One can thus speak of three successive phases:

- The preparation and passing of LOP which did launch the process which will lead to the strategic function. This stage had been preceded, at the beginning of 1982, by a National Colloquy on Research and Technology,[21] which witnessed the whole research community examining its own place in the life of the nation, its future, and the role of research.
- From 1981 to 1985, the setting up and testing of the methods spelt out in the legislation.
- In 1985, at the time of the preparation and debate on the Triennial S&T Plan to replace the LOP at the beginning of 1986, an assessment was made of these methods,

which led to the definition of a general framework for a strategic function. From 1986 onwards this strategic function will become operational.

In other words, between 1981 and 1985, the mechanisms (methods) relating to a classical planning function are being substituted by others, relating to a strategic function; this has been done in a pragmatic way; from 1985, in a second step, those new mechanisms are being positioned in a more comprehensive framework. We will examine successively those two steps:

1981–1985: setting up the mechanisms for the strategic function

We examine first the main thrusts of the LOP and how they relate to the strategic function in the form of three principles. A first principle was that of the setting of objectives and the commitment of financial resources over a number of years. This was achieved by the fact that S&T legislation is 'programming law' similar to legislation for military programmes which commits resources on a pluri-annual basis. This legislation was integrated into the IXth Plan, in which S&T is the Number 3 priority programme. The annual review of this part of the Plan for the 1984–1988 period will include a range of quantitative indicators ("the National Plan will embrace into its objectives and strategies the orientations defined by the present law", LOP, article 2). This commitment over a number of years is essential because it is this characteristic which enables one to speak of a policy for long-term scientific staffing, and of a Scheme for Scientific and Technical Orientation (SOST). There would be no strategic function without commitment of resources over a number of years.

The second principle is that S&T policy is not only a matter for the scientific community, but that the nation as a whole should be involved in defining the major options which concern its future.[22] This has led to the aim of "bringing together as many as possible of all the partners involved to elaborate options", to developing the "transparency of decisions" which "by advancing democracy will guarantee the effectiveness of S&T policy".'[23]

This second principle has led to the creation of the institutions and procedures needed to carry out such an elaboration of the options with the 'social partners'; the most significant are the following:

- The setting up of the *Conseil Supérieur de la Recherche et de la Technologie* (CRST). This is an example of concertation and of dialogue with actors and partners involved in S&T. It is consulted on all the major options for governmental S&T policy, as well as on *prospective* and analytical reports relating to science and technology.
- The setting up of Regional Consultative Councils for S&T in the Regional Councils to enable them to play their role in the elaboration of S&T policy.
- The reform of the statute of public research bodies,[24] which resulted, among other things, in including elected staff representatives and persons representing the 'social partners' in their board and councils.
- The supervision of 'national programmes' by an Orientation and *Prospective* group which includes representatives of the actors of S&T (see below).
- The creation of 'national committees' or of 'groups for evaluation and *prospective*' on the various programmes, which include representatives of social groups.
- The Centre for Prospective and Evaluation (CPE), under the Minister of Research and Technology, plays a technical and methodological support role in evaluation and *prospective*. It plays the role of technological monitor,

intellectual animator (colloquies, seminars etc). It also conducts audits of research bodies, programme evaluations and comparative international assessments.

The third principle is that of concentration of efforts on priority objectives which would 'mobilize' the S&T community; this has directly led to the creation of the 'National Programmes', which have now become a central instrument in the S&T policy.

In fact, it is through the Programme's methodology that a strategic function has been able to develop: the above-mentioned aspects of pluri-annuality of resources and of effective participation of the social partners, have certainly been helpful and necessary conditions, but certainly not sufficient to bring a strategic function into existence.

Let us see now what those National Programmes consist in, in terms of method, and how they relate to the strategic function.

The strategic function in the technological diffusion programmes

It is a distinctive feature of the French S&T policy to operate through 'national programmes'; the so-called 'Programmes de Développement Technologiques' (PDT) (aeronautics, space and electronuclear) have been in existence for decades and have achieved important successes; their characteristic is to be focused on a 'technological object' to be bought essentially by the state and to correspond to military and geopolitical objectives of the nation. These programmes, of course, go on. But it has fully been recognized that the S&T battle for high-technology industries develops now in terms of competitive markets at world-scale, and that besides producing those technologies, a crucial issue is that the other sectors of the economy use them to improve their competitivity. Hence the idea of expanding the notion of the national programme to that of a 'technological diffusion programme'; This new kind of programme can be set up on a key technology (or diffusion technology) such as microelectronics, biotechnologies, new materials . . . , or on a major social or economic objective such as the relationships between technology, work and employment, the development of S&T culture or S&T cooperation with developing countries; such programmes are called 'programmes mobilisateurs'. Other programmes are defined in terms of an economic or industrial sector (transportation, food . . .); these are usually called 'programmes prioritaires'; let us use simply the generic term 'programme'. There exist now a dozen of such programmes which, in practice, consist of:

- a set of S&T research activities carried out by scientists from the public and industrial sectors, in order to reach a set of precisely defined objectives in a given period of time;
- a set of institutional, organizational and educational measures to be taken by the public S&T system;
- the creation of public–industry, interdisciplinary and interinstitutional networks of scientists and laboratories;
- a set of actions aimed at the diffusion and use of the results of the S&T activities.

An important aspect of the programmes method is that each one goes through well defined successive stages, the passing from one stage to the next requiring a decision of a strategic nature by the Minister for S&T:

- the first step consists in determining an area where a programme might be needed; this requires an assessment in terms of S&T, but also in terms of industrial development and sociopolitical objectives;
- the second step is to define the objectives of the programme, as well as the indicators needed to monitor and evaluate it; this step consists in a strategic analysis;

- the third step consists in the execution of the actions leading to the objectives; since this step lasts for three to five years, one of the roles of the Evaluation and Prospective Group of each programme is to keep the strategic analysis up to date and to adapt the objectives to the changing realities of S&T, industrial or sociopolitical order; this step is also concerned with scientific and operational evaluation. Most programmes are in that stage.
- the fourth and final step deals with results diffusion and use, which implies mechanisms going far beyond the scope of the programme itself.

On the basis of experience, the programmes require an instrument which enables circulation of information and dialogue between the partners involved. This is the aim of the Scientific and Technical Orientation Scheme (SOST),[25] which is a reference document. For each research field, and particularly for those which have a developed programme, the following are set up for each theme: (i) quantitative inventory of resources; (ii) qualitative evaluation of the situation; (iii) proposals on the priority actions. This document has already been published for each field.

But the SOST remains a procedure also. Its preparation consists of a whole range of working meetings with research bodies (to articulate programmes in coordination with their own research plans), with the ministries concerned, industrialists and economic and technological forecasting teams. The Evaluation and Prospective Group of the programme undertakes the synthesis—an annual exercise—and in principle provides an overview of the whole field. Because this synthesis is a public one and discussed with the CSRT, the Evaluation and Prospective Group must be able to argue its options and preferences at the scientific, economic *and* political levels.

Thus, after the initial impulse provided by the LOP, a whole range of methods, institutions and procedures have been established and tried out.

However, it appears that at this stage there is not a true general view of how all this fits together as a unified whole—there is not yet a thorough-going system of design, steering and follow-up for S&T policy.

This could lead to difficulties of internal adjustment (eg, the problem of the relationship between budget and programmes). Also, there is sometimes a lack of precision in the definition of certain responsibilities or in the laying down of procedures. The functioning of the system is thus marked by a fairly wide desgree of heterogeneity—which is valuable from the point of view of experimenting with methods but dangerous in the longer run. In short, even though the majority of the elements are in place, we cannot at this stage yet refer to a strategic function in S&T policy.

1985 onwards: setting up an overall framework for the strategic function

In 1985, the process of preparing the law to succeed and replace the LOP took place; this led to an assessment of the objectives, methods and mechanisms of the LOP, made jointly by the Ministry of Research and Technology and Commissariat Générale du Plan; it led to the Triennial Plan of S&T, which had been voted after extensive discussion by the CSRT and the Parliament.

The new S&T legislation—the Triennial Plan—contains one part (Title 5) entitled, "Evaluation of S&T policy". Article 12 sets out the principle of the evaluation of programmes, "at the latest two years after their execution", as well as that of public research bodies. Article 13 indicates that "the S&T minister will present every year on behalf of the government a report on S&T activities, which will recall the *strategic options for national policy* and the state of realization

of the objectives set out in the legislation, by presenting evidence by comparison with the results achieved in major foreign countries of *the position of France in international competition*" (our emphasis).

Further, the annex report to the legislation on this project[26] specifies that during the period of the Triennial Plan a coherent system of evaluation in the S&T sphere is to be established. It also specifies that the evaluation of programmes "should not be limited to the scientific aspects, *but should extend to the strategic*, operational and economic aspects". Clearly, from the text of the legislation and from its annex report a step forward has been made. The concept of strategy has been placed at the heart of the elaboration and evaluation of public policy on S&T.

Those political orientations as well as the dynamic process of testing and improvement of methods which took place within the Ministry of Research and Technology, resulted in four areas of progress in the making of the strategic function; progress here means better interaction between the instrument 'programme', which is the vector of the strategic function, and the other S&T policy instruments:

- interaction between the programmes and the two other dimensions of S&T management which are the Public Research Bodies and Universities on one side and the Technopoles on the other; the former deals with scientific fields and disciplines, the latter is the geographical setting where research, teaching and industry work together;
- interaction between the programme and industrial research: the various working groups involved at one stage or another work as contact and discussion arenas for industry around technological research, in contact with public research;
- interaction between the programmes and the general socio-economic *prospective* work performed by the Commissariat Général du Plan: for example, links with the Industrial Strategy Groups (GSI) or preparation of the *Prospective 2005* colloquium;[28]
- interaction between programmes and the statistical system in order to develop all needed indicators for assessment, follow-up and evaluation, at each one of the four steps identified above: creation of an Observatory for Sciences and Techniques.

Towards new perspectives on the S&T policy through the strategic function

Obviously, much has still to be done before one can speak of a fully efficient and operational strategic function in French S&T policy; however unsatisfactory the method can still be, it is remarkable to note that it already appears to bring an operational way to face three of the major challenges of the French S&T policy of the coming years:

- the question of the priority areas for basic and public research; the identification, management, staffing and educational problems which go with it;
- the question of the relative financial weight of the classical programmes (PDT), that is space, aeronautics and electronuclear aimed at the production of technology by a few specific sectors, as opposed to the new diffusion programmes (*programmes mobilisateurs/prioritaires*) aimed at the production and diffusion of technology in a wider range of industrial sectors;
- the question of the European dimension, which might well be the ultimate margin of manoeuvre of the S&T system, that is its normal way of functioning in the not too distant future; the similarity of the method used at European level (ESPRIT, RACE . . . programmes) with the one developed as a strategic instrument in France should facilitate the European-wide

evolution of the French S&T system.

Being faced, and not hidden any more, problems become challenges, and then new perspectives for the S&T policy, to be addressed in the only sensible way, that is strategically; from the work and experiments of the past five years, there now exists an operational method for that, which performs the needed strategic function, and which is built around the concept of a programme such as defined here.

Notes and references

1. The other being 'social' capacity to change micro- and macro-social functioning so as to transform the promises of technology into industrial realities and into economic performance. See J. Lesourne and M. Godet, *La fin des habitudes*, Seghers, Paris, 1985.
2. We do not consider the Soviet case, where there is a gap between the technological level of civilian activities and that of the armaments industry.
3. We can also see in technology solutions which would also bring about organizational or social—even cultural—changes. Science and technology operate equally well as myth and as ideology.
4. See the document *Technologie– Croissance–Emploi*, Documentation Française, Paris, 1983.
5. This is what J. Irvine and B. Martin, *Foresight in Science: Picking the Winners*, Frances Pinter, London, 1984, pages 1–13, call 'research on basic research'.
6. Sometimes referred to as innovation policies, which form an important part of S&T public policies.
7. We could mention in this regard the competition between Eureka and the SDI or the problems of the service sector for the next session of GATT.
8. On this subject, see the current work of the OECD Division of Science, Technology and Industry.
9. Irvine and Martin, *op cit*, reference 5.
10. The 1982 planning reform did not modify the basic principles of the Plan. It adapted the modalities of the Plan to take account of the increased role of the regions as a follow-up to decentralization reforms.
11. On French planning, see *Rapport au Ministre du Plan et de l'Aménagement du Térritoire, Réforme de la Planification*, La Documentation Française, Paris, 1982; on the IXth Plan, see Senhazi and Odenda, 1984.
12. Which is close to PPBS (Planning–Programming–Budgeting System) developed in the same period in the USA.
13. X. Greffe, "L'évaluation des activités publiques, recherches économiques et sociales", *L'évolution des politiques sociales*, No 13–14, 1985, Documentation Française, Paris; J. P. Nioche, "De l'évaluation à l'analyse des politiques publiques", *Revue Française de Sciences Politiques, 32*(1), February 1982.
14. See 1982 studies by the Commission du Bilan, Documentation Française.
15. See *op cit*, reference 11, pages 63–66.
16. Colloquy proceedings are in J. P. Nioche and R. Poinsart, "L'évaluation des politiques publiques en France", *L'évaluation des Politiques Publiques*, Economica, Paris, 1984.
17. *Ibid.*
18. M. Godet, *Prospective et planification stratégique*, Economica, Paris, 1985. See article by M. Godet in this article.
19. Which we will simply refer to as 'methods' in what follows.
20. Law 82-610, 15 July 1982.
21. *Colloque national sur la recherche et la technologie*, Documentation Française, Paris, 1983.
22. See the convincing arguments of W. Kennet, "Futures and government; combating the new philistinism", *Futures, 16*(5), October 1985.
23. Annex report to the LOP, Part 2, chapter 1.
24. In France most public research is carried out not by the universities but by the public research bodies such as CNRS, CEA, INSERM, CNES, INRA, etc.
25. Part of it is published: see *Collections Etudes MRT*, SOST, Documentation Française, 1985.
26. National Assembly, No 2745, Annex to verbal proceedings of 6 June, pages 35–36.
27. *La stratégie de la recherche et du développement technologique*, Collections Etudes, MRT, Documentation Française, 1985.
28. *Prospective 2005*, Colloque National, 27–28 November 1985, Commissariat Général du Plan, CNRS (2 vols).