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"Biology has outgrown its old forms.
Can project management accept this challenge?"

Discussant : Magdalini **Kolokitha**

First International Euredocs conference. Transformations experienced by higher education and research institutions in European countries.

BIOLOGY HAS OUTGROWN ITS OLD FORMS. CAN PROJECT MANAGEMENT TAKE UP THIS CHALLENGE?

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Introduction.

The governance of French public research institutions has faced two major transformations in the recent years: its rationalisation through the key-words "relevance" and "accountability", and the development of research policies based on cross-institutional thematic networks. The introduction of new management tools hasn't explicitly been linked to the New Management rhetoric, but it also aims at fostering the responsiveness of these public bureaucracies.
This policy has taken the shape of the introduction of project management within the life sciences department of a major French research institution (the CEA, French Atomic Energy Commission)[1]. At the end of the 1990s, the Head of the Life Sciences Division defined four research programs which have nowadays a major impact on assessment and financing policies toward research units.

The recent research policies have induced transformations of the research and innovation systems which have only been studied at macro and medium levels so far. We thus focus on the implementation of new management rules **at the micro level, i.e. within the research units**. We assume the centrality of bottom up dynamics in the actual transformations, because we agree with the opinion that research units actually emerge as the "cornerstone for the management of science" (Larédo and Mustar 2001).
In fact, all research units at the Life Sciences Division are contractually linked with other research agencies. Hierarchical management has become more therefore difficult, since labs benefit from a relative autonomy and can make use of their multiple partnerships. How can a single research institution make them accountable for their activities? As a consequence, we see the introduction of project management as a "join product" (Reynaud 1989) between the institution and the research units and focus on the ability of the latter to redefine general objectives and to integrate management rules.

The Life Sciences Division is organised into seven departments. Our analysis is essentially qualitative and relies on an empirical study carried out in 2003 at one of them, the Cellular Responses and Dynamics Department (DRDC), located in Grenoble.

We recount the transformations of the management rules from the beginning of the 1970s, focusing on the last decade. We draw three periods in the government of science, characterized through the predominance of "peer management" **(I)**, "hierarchical management" **(II)** and finally "project management" **(III)**. For each period, we describe the main features of the institutional pattern and the organizational rules (budget allocation, assessment structures, employment policy…) and precisely analyse through a case study the impact of the reforms on the research unit strategies.

[1] The Life Sciences Division at the CEA has over 1000 permanent staff members, including approximately 700 CEA employees and 300 researchers and technicians from universities and other research agencies.

I. The predominance of "peer management" until the 1990s.

Prelude. How Biology was introduced at the CEA Grenoble during the 1950s.

The French Atomic Energy Commission (CEA) was created in 1945. It aimed at developing research activities on atomic energy, concerning both military and civil goals. The CEA Centre located in Grenoble was built in 1956 in order to accommodate large scale experimental facilities used in fundamental research on condensed matter (experimental nuclear reactor). Louis Néel, full professor at the University of Grenoble, who won the physic Nobel Prize in 1970, played a key role in this project.

Three factors explain why Néel introduced research in life sciences at the CEA Grenoble almost from the beginning.

- The will to develop the interface between biology and physics. The research units in life sciences would benefit from exceptional experimental research facilities. The purpose of this diversification was to understand the effect of radiation and toxin used in the nuclear industry on living matter.
- The growing expenditures dedicated at that time to fundamental and applied research, which allowed the CEA to diversify its activities, although its research policies did not define Life Sciences as a priority.
- The charisma of Louis Néel, who managed the CEA Grenoble with a great autonomy towards the Parisian Head (Pestre 1990).

A) The institutional pattern.

Basic research was carried out at the CEA Grenoble in three main fields: physic, chemistry and biology. The research units were monitored by a "Department of Fundamental Research" (DRF) which seemed to be "an island" within the CEA, apart from relevance constraints.

The research units in life sciences were pooled within the DRF in a so-called "Federation of labs", described as even more spared by any form of hierarchical control: the Federation was small and research in biology hadn't become a major stake for the CEA.

Many of these labs, including the one we studied (called BIO in the following), were founded by a full professor at the local university. The DRF provided these scientists with comfortable working conditions in terms of financial and human resources. At that time, the university was unable to compete with such institutional and scientific opportunities.

BIO was grounded in 1974 and undertook basic research in several areas of plant physiology. Like many other research units, it soon became contractually linked with the local university and with the main French Research Institution (CNRS: Centre National pour la Recherche Scientifique). These partnerships allowed it to diversify its financial support and its recruitment opportunities.

B) The organizational design.

These labs simply looked like any lab rooted in an academic context at that time: the management model appeared to be similar to the one used to describe the "Realm of Science" (Dasgupta and David 1994) or the "Mode 1 of Knowledge Production" (Gibbons, Limoges, Nowotny et al. 1995).

Three major features show evidence of this proximity.

- The labs were absolutely autonomous in choosing their research subjects and they took advantage of the lack of centralized control.

Some descriptions may be considered as caricatures and may not be taken literally; but the fable sheds a light on the weakness of the hierarchy in this institution.
For instance, one of BIO founders described us the "anarchy" which prevailed in the field of plant biology during the 1970s: *"When one walked through the Centre, one could see greenhouses where all kinds of plants grew, and even strawberries! The Department didn't exactly know what these cultures were for, but it actually didn't really care for it".*

- The DRF instituted no specific assessment structures for the labs themselves and the projects they carried out.

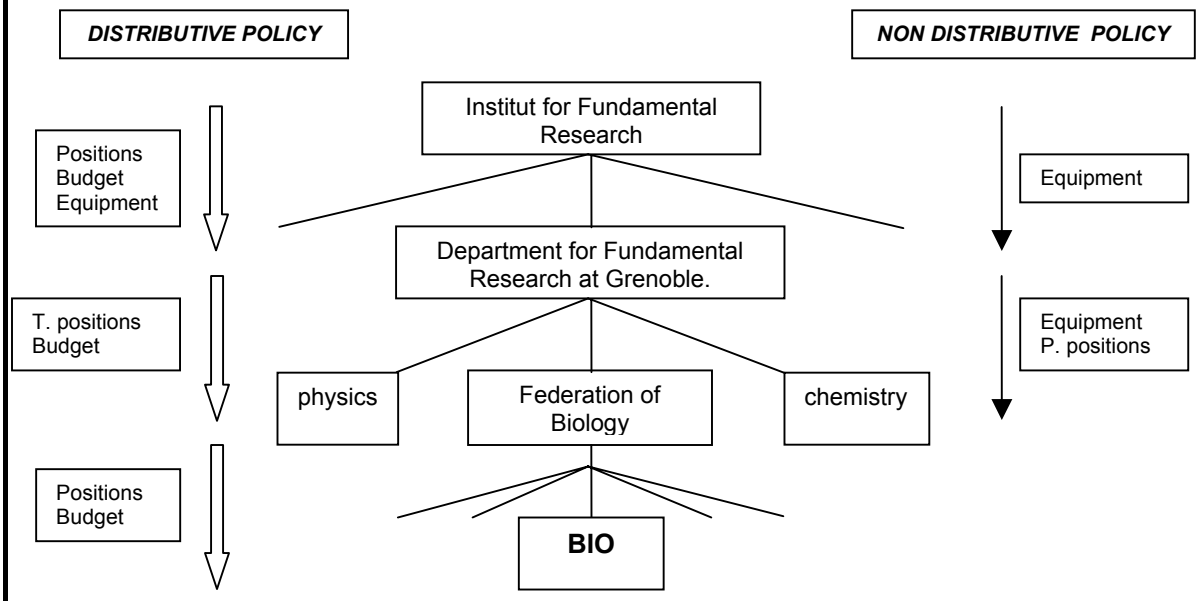
Scientists were individually evaluated by the institution who employed them (CEA, university, CNRS…) and their career path depended on criteria defined by these institutions (basically a mix of academic recognition and seniority). In a certain sense, the CEA implicitly delegated its assessment policy: it considered the contractual links between the labs and other research institutions as an indirect evidence for the criterion to which its requirement was limited, i.e. their academic competence.

- The financing and employment policies were rather "distributive" ones.

The Head of the Federation (chosen among the managers of the labs) shared the resources at its disposal (temporary and permanent positions, equipments...) so that every one had its turn and he didn't define specific criteria to allocate resources (Paradeise 1998). Academic excellence also gave labs weight and influence in these negotiations.
Thus, the units were very little threatened by institutional restructurations, unless they lost their academic recognition. In that case, the Federation and the DRF usually waited until the manager of the lab retired before restructuring or breaking up the lab.

Figure 1 illustrates this institutional pattern and the predominance of a distributive policy.

Figure 1. Life Sciences at the CEA until the 1990s.



T: temporary P: permanent

C) Work organization and collective identity.

BIO was founded by four full professors, each of them managing a team working his own research field. The founders, as well as other researchers, won scientific statures and the lab became widely recognized as a leader in its domain. This recognition contributed to shape a specific collective identity. This identity became strengthened by three features of the employment structure in this lab. First, the initial structure (four founders / four teams / four main research projects[2]) remained unchanged during at least 15 years and the lab grew up slowly.

Second, since French PhD Students can be recruited in the lab where they completed their PhD, many of them applied for a permanent position at BIO. Each team then developed itself by recruiting former PhD Students. These two first characteristics are linked to BIO's history and to management choices made by its PI.

The third one rather refers to the "epistemic culture" in life sciences (Knorr-Cetina 1999), which implies a strict division of labour (social as well as cognitive) and thus a stressed hierarchy. In fact, BIO's members learn during the socialisation period the formal and informal rules which organize the hierarchy and which belong to the shared professional identity.

Let summarize now. BIO's scientists describe the working collective which prevailed at that time as a "small family" or as a "small firm". The founders succeeded in preserving its stability and autonomy.

Scientific legitimacy was their main trump card, they used the institutional environment as a resource and the whole internal management aimed at keeping the cohesion of the research unit.

II. The reinforcement of the hierarchical management in the 1990s. The end of a "distributive policy"?

A) Facing a changing environment: the need for coordinated research.

- Since the 1980s, the life sciences have become increasingly competitive, at an international level[3]. This « struggle for discoveries » and the rush for publications encouraged a better research coordination between academic teams[4]. The expanding role of equipment thus called for the optimisation of means. Taken together, these two changes implied the constitution of "poles of excellence".

- The Life Sciences Division has developed its partnership policy and has thus contributed to a more general transformation, which started with the labelling process set up by the CNRS in the mid-1960s (from whom BIO benefited) and continued through the contract policy undertaken by the Ministry in charge of Higher Education in 1988 (Larédo and Mustar 2001 op. cit.). At the Life Sciences Division like in other French research institutions, "mixed" research units (i.e. contractually linked with universities and other research agencies) have become the rule.

- From "little" to "medium" science. The life sciences have faced growing investments, in a context of a very slow growth of the public expenditures provided to science[5]. "Medium size" instruments have become essential and have sustained a large part of the transformation of research and innovation systems in the life sciences, especially in the field of genomic[6] (Peerbaye and Mangematin 2003). These "cross boundary devices" often call for decision processes at the national level[7].
The new tools of investigation essentially concern biomolecular engineering and structural biology (mostly DNA sequencing, functional genomics, proteomics and bioinformatics).

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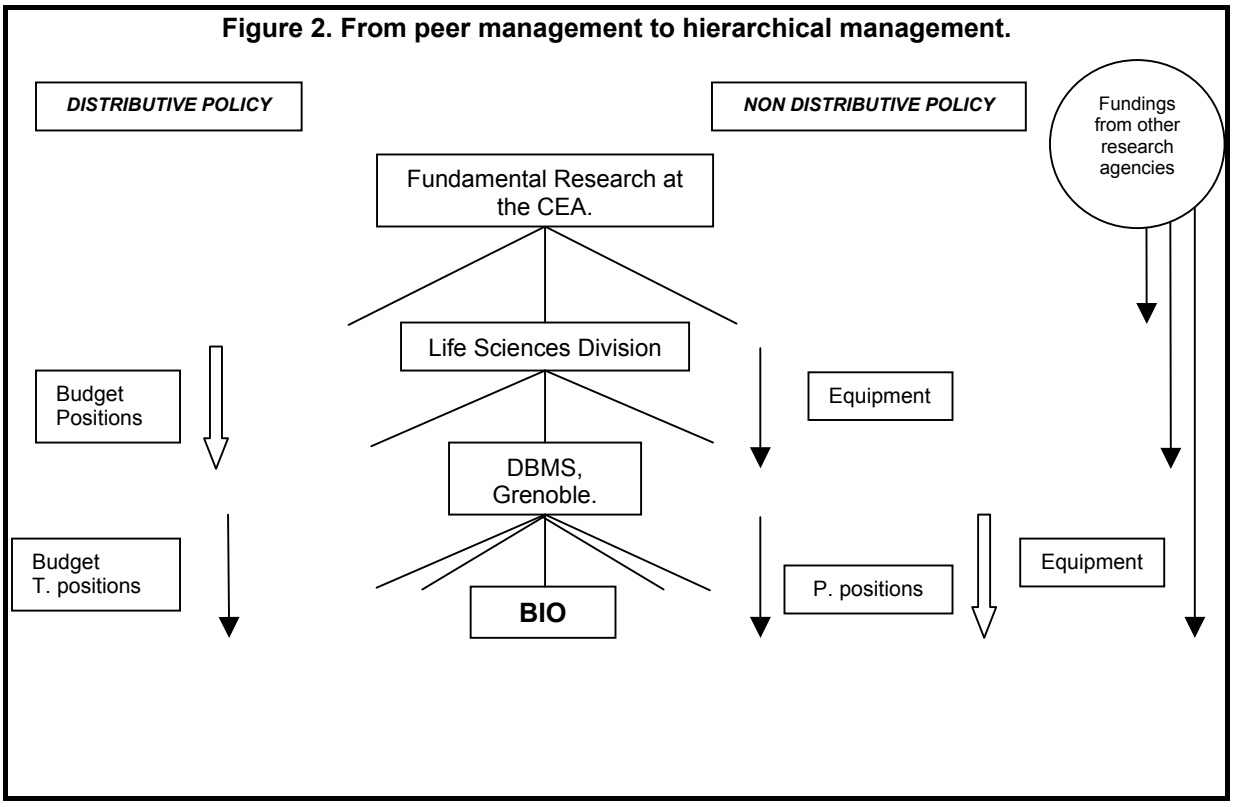
[2] The manager of the lab will be called « PI » (for « Principal Investigator ») in the following.
[3] The competition is linked to the fact that the mean life of a discovery has decreased, especially in molecular biology.
[4] This evidence increased the average number of authors in co-authorship in these research fields.
[5] Public research in France is financed by the BCRD (Civil Research budget and technological development) that, since 1982, gathers together the funds that France dedicates to civilian research. This budget is mainly used to finance the organisms placed under its sponsorship. The global BCRD grew slowly during the 1990s and the efforts were not focused on the life sciences. In the mid-1990s, a kind of compensation occurred and the Life Sciences became a priority in the allocation of the BCRD. Nowadays, they constitute the quarter of the budget. See: http://cisad.adc.education.fr/reperes/
[6] Genomics tries to explain the development, behaviour and diseases of organisms on the basis of the totality of their genetic information.
[7] Large Scale Research Facilities can be found historically in high energy physics, particle physics or astrophysics (e.g. the CERN: European Organisation for Nuclear Research). They imply a large body of scientists through transnational collaborations; the instruments require very high initial investments and maintenance costs. On the contrary, most equipments in Life Sciences are "medium size assemblages of collected instruments".

B) A new institutional pattern at the CEA.

1) The emergence of a national organisation for the life sciences at the CEA.

In 1990, the research carried out in the life sciences were gathered at the national level in a “Life Sciences Division”. The Life Sciences Division was organized into seven departments, which represent the local management level. At the CEA Grenoble, the Department of Structural and Molecular Biology (DBMS) then replaced the former “Federation” and “Department of Fundamental Research”. This reform set an end to an interdisciplinary arbitration at the local level.

Figure 2. From peer management to hierarchical management.



2) The organisational rules.

- Did the research have to be “excellent” or “relevant”?

The Head of the Life Sciences Division introduced a specific assessment structure in 1991-1992, dedicated to each lab associated to the CEA. The impact of the structure seemed to remain limited and the assessment policy was still delegated to the academic communities every lab belong to.

- The labs faced a reinforcement of the hierarchical control and a restriction of their autonomy. Their development depended more on the priorities set by the department.

In fact, the DBMS aimed at managing the local development of the life sciences and at following its own research policy which would not simply result from the aggregation of the labs orientations.

The impact of the setting up of research priorities on labs seems to depend on the type of resources.

- Current resources.

The allocation of the annual budget (from the Life Sciences Division to the DBMS, then from the DBMS to the labs) remained almost "automatic" and wasn't linked to assessment's results.

- Equipments and "medium size" instruments.

Many of these instruments, although they are called "technological platforms", are not operated autonomously but they are hosted in an academic research team. The main reason for these linkages to the academic milieu is that the techniques aren't completely routinized and stabilized, unlike so-called "push-button" techniques. Their running remains closely linked to the research agenda of local scientists.

Thus, the localisation of these equipments became a major stake for the labs at the DBMS, because hosting an instrument was a great opportunity to strengthen their legibility towards the institution and towards their scientific community and therefore to get further resources[8].

- Employment policy.

Temporary positions. They essentially concerned doctoral and post doctoral research grants. The Life Sciences Division allocated every year a global amount of grants to the department; the DBMS then selected the labs which would benefit from them. The labs formally competed with each others for these grants, on the basis of their research projects, but the allocation of the temporary positions remained a rather distributive one and every lab got a grant on its turn.

Permanent positions: a "bottom up" procedure, based on the candidates' excellence.

The executive of the CEA told the Life Sciences Division every year how many researchers it could recruit. A "bottom up" procedure then followed two stages. The first one took place at the department's level. Potential candidates competed to be selected by the head of the department. The second one opposed the elected candidates at the national level, among whom the head of the Life Sciences Division recruited the new researchers. Until the 1990s, the Life Sciences Division didn't audition the candidates but the head of the department himself presented their work and defended their cause. Thus, his position appeared to be crucial in the competition.

To sum up, the financing policy for medium-size research facilities and the employment policy for permanent positions led to a differentiation between labs and removed the financing policy from a "distributive" one.

C) Changes at the "micro level".

[8] A good example of the well-known "Mathew effect" described by R. Merton: Merton (1973).

Did all labs have to face the same changes? What were the exact consequences on BIO for instance? Our field work led us to establish a large range of consequences of this new policy on the development of labs. BIO belongs to those that seemed to be neither threatened, nor favoured by the transformations of the institutional pattern and the organizational rules.

- The lab didn't get tenured positions from the CEA during this period, but the majority of its students still found permanent positions at the local university, at other public research institutions or in the private sector. The DBMS still allocated grants for its PhD Students and post-doctoral researchers.
- Neither the work organisation nor the professional identity of the scientists seemed to face transformations due to the new context.
- The lab remained autonomous by choosing its research fields and it kept aside from the debate on the localisation of the "medium size" equipments. It doesn't mean that BIO didn't take part to the major changes in the mode of knowledge production in life sciences. In fact, it benefited from the technological progress through multiple collaborations: the new instrumental logics are not determinant to understand the way it defined its position within the CEA. New orientations in molecular and structural biology were simply added to old ones in biochemistry and physiology.

Until the mid-1990s, the activity reports showed evidence of BIO's independency: the presentation of all research projects was not connected to a research policy carried out by the CEA or by the Ministry in charge of research. BIO's legitimacy appeared to be settled in its academic recognition. The local synergy almost restricted itself to the sharing of instrumentation (Nuclear Magnetic Resonance, Cristallography, Biomolecular Engineering) with other CEA research units.

Conflicts emerged incidentally between the organisational and the professional rules and usually opposed the head of the department and the PIs. They happened when the "gentlemen agreement" or the "tacit content" settled between them became questioned / debatable. One example sheds a light on the weakness of the hierarchical control on BIO.
In return of its autonomy, the lab was expected to participate to the co-definition of the department's research strategies. The head of the department tried to find an intermediary solution between a distributive policy and the imposition of its priorities upon the research units. Several boards were dedicated to implement this "bottom-up" policy. A way for a PI to give voice to a disagreement (which can have several causes and meanings) was to refuse to participate to these boards or to co-elaborate the policy. For instance, he still sitted in the board but didn't take part to the discussion and didn't make any proposition; or he let the head of the department know afterwards about his scientific orientation, whereas he should have asked for his agreement before taking any important decision.
The department's answer to this kind of obvious contestation of its scientific and managerial legitimacy consisted in recalling its hierarchical prerogatives. In the case of BIO, it announced the suspension of the annual budget "as long as the relationships between BIO and the department would remain confuse"[9].

[9] Official correspondence between BIO and the DBMS, 1993.

Provisory conclusions.

- The Life Sciences Division delegated the concrete implementation of its general research policy to the departments. At their level, they had to encourage local synergies and to reinforce the visibility of the research site. In fact, the reforms led to a kind of bureaucratisation of the management and to the intensification of the hierarchical control.
- The intermediary hierarchy (i.e. the department) didn't always succeed in defining scientific orientations and in legitimating its supervision. Some labs like BIO kept working on their former research subjects and put their scientific excellence forward to negotiate resources. They took advantage of their multiple institutional associations to prevent the scarcity of resources.
- The implementation of hierarchical supervision seemed to reach its limits. The assessment structure regularly denounced the "inertia" of the labs and the difficulty to impulse a coordinated research policy.
- The management tools introduced during this period could even produce undesirable effects and strengthen the collective identity built around the research units (and within the units, around the research teams).

III. Taking a managerial bend?

A) The national context.

1) The predominance of "strategic science" (Rip 2002) and "thematic networks" (Massardier 2003) for public policy.

The tendencies that emerged in the 1990s have become more pregnant during the last years. Research policies have faced a broad transformation, linked to the advent of "strategic science" (Rip 2002). This definition of the knowledge production, which combines relevance to specific contexts and excellence, has become widely-held in the life sciences, especially in the medical sciences.

The public policy in these domains relies upon the main idea that the institutional boundaries do not offer an appropriate frame for defining and financing the research projects. Thus, it aims at encouraging collaborative or "cross-boundary" projects. The Ministry in charge of research and technology, as well as the main research institutions in life sciences, provides financial support to large national research programs[10]. The scientific teams (mostly academic but sometimes industrial ones as well) then compete to be "labelled" / recognized as a participant of these programs.

We can thus try to characterize the differences between this research policy and the previous modes of French research funding. The public policy set up after 1945 was described as the "French

[10] E.g. « Comité de coordination des sciences du vivant » (Coordination Board for Life Sciences); the Genopole Network. See http://rng.cnrg.fr/. The "Genopole Program" allowed creating centres for genomic research, gathering public sector research laboratories, biotechnology firms and universities. The Genopole network

Colbertism": "mission oriented" research institutions carried out so called "grands programmes" in their field (e.g. space, agriculture, computer sciences, medical sciences…). On the contrary, the new research policy relies on "thematic" or "projects" networks which ignore institutional frontiers and design new spaces for the research carried out.

2) Redefining the legitimacy of life sciences at the CEA.

- At the end of the 1990s, the CEA has redefined its global missions and its priorities for civilian research[11]. It has to face two major issues: the stagnation of the public expenditures dedicated to its civilian research[12] on the one hand; the necessity to perform "relevant" research on the other hand.
Life Sciences have good trump cards in the global interdisciplinary arbitration, in comparison to the rather "old" disciplines like physical sciences, but the chief executive officer of the CEA has delivered a clear message. The research carried out in these fields must be related to the core missions of the CEA and to the problematic of nuclear energy.
- The Life Sciences Division has then defined its missions as "to understand the effects of radiation and toxic compounds resulting from nuclear activities in order to determinate the structure and functioning of the living matter" and "to develop new tools of investigation in biology thanks to the techniques generated by nuclear energy".
These two goals are well summarised by the following term "through nuclear energy, for nuclear energy" ("par le nucléaire, pour le nucléaire").

B) Project management to favour the responsiveness of the Life Sciences Division.

1) The national research programs.

The Life Sciences Division has elaborated five research programs which represent the concrete expression of its new missions.

Figure 3. The national research programs.

1. **radiobiology**. Characterizing the early effects of low doses of radiation.
2. **nuclear toxicology**. Describing the mechanisms involved in the transfer of radionuclides or heavy metals between the outer environment and living organisms.
3. **nuclear medicine and functional imaging**. Developing new tools and methods for imaging and to applying them to the functional study of organs.

includes seven sites bearing the Genopole label. See the EMBO review of the French Genopole System, january 2003.

[11] This redefinition has partly taken place in the context of the negotiation of the "contract" that linked it to the French government.

[12] See : *rapport de la cour des comptes* (2003).

4. **labeling, biomolecular engineering and structural biology**. Developing new tools of investigation in biology.

The definition of these programs has introduced major changes in the institutional pattern and the definition of the research policy.

- The Life Sciences Division now refuses to finance research projects which are not directly linked to the four national programs.
- The departments are not any longer considered as the best "intermediary spaces or actors" to implement the research policy.
- The pertinent spaces to define research strategies and to allocate resources are rather national ones, built on scientific networks. The programs aim at enabling the structuration of these spaces more than imposing it[13].

Let us develop the second aspect. The decisions taken at the department's level foster local synergies, but the relevant outlines of the scientific community may not correspond to these frontiers. The research units at the DBMS for instance may not share the same research interests and belong to separate research communities (in consideration to their thematic, to the equipment they use…). The juxtaposition of these research entities comes from the history of biology at the Centre, although it has been reduced during the 1990s. As previously stated, it makes it difficult for the department to find a way out of a "distributive policy" and to legitimate a "non distributive" arbitration.
This new orientation doesn't mean that the Life Sciences Division totally removes the definition of local strategies: the departments have to precise the way their priorities are in keeping with the general pattern of the research policy. Thus, the DBMS became the DRDC (Cellular Responses and Dynamics Department) in 2002. Its new denomination aims at better describing its activities in relation to the missions of the Life Sciences Division[14].

The introduction of project management is thus based on the separation between the "administration" of science, which is still carried out at the department's level, and the "policy" of science, which the Life Sciences Division is mainly in charge of.

2) Transformations in the allocation of resources.

[13] See, for instance, the research in Nuclear Toxicology that has been carried out at the CEA for many years. Its goal is to analyse the biological effects of natural or artificial radionuclides found in the environment.
In 2001, the CEA initiated the "Nuclear Toxicology program". At the beginning of 2004, the program was extended to other research agencies in the life sciences to federate the national community in this field. Steered by the CEA and supported by the Ministry for Research and New Technology, this second phase ("Environmental Nuclear Toxicology) concerns 15 broad projects.
[14] The research orientations at the DRDC are: metals in biology, nuclear toxicology, radiobiology and the cellular biology interface and new technologies. A scientific board evaluates at the department's level the pertinence and the quality of the research programs.

Current resources.

- The department still allocates the annual budget to the research units, but the policy isn't a distributive one any longer: the total amount of the current resources is allocated in relation to the four national programs.

The Life Sciences Division defines a "cost pro researcher" involved in each national program and the annual budget thus results from a simple arithmetic rule[15]. Furthermore, the Life Sciences Division sometimes allocates consequent subsidiary budgets which are always totally linked to the participation to the national programs.

The more the research units get involved in the national programs, the more resources they get from the Life Sciences Division. This policy increases the differentiation between them.

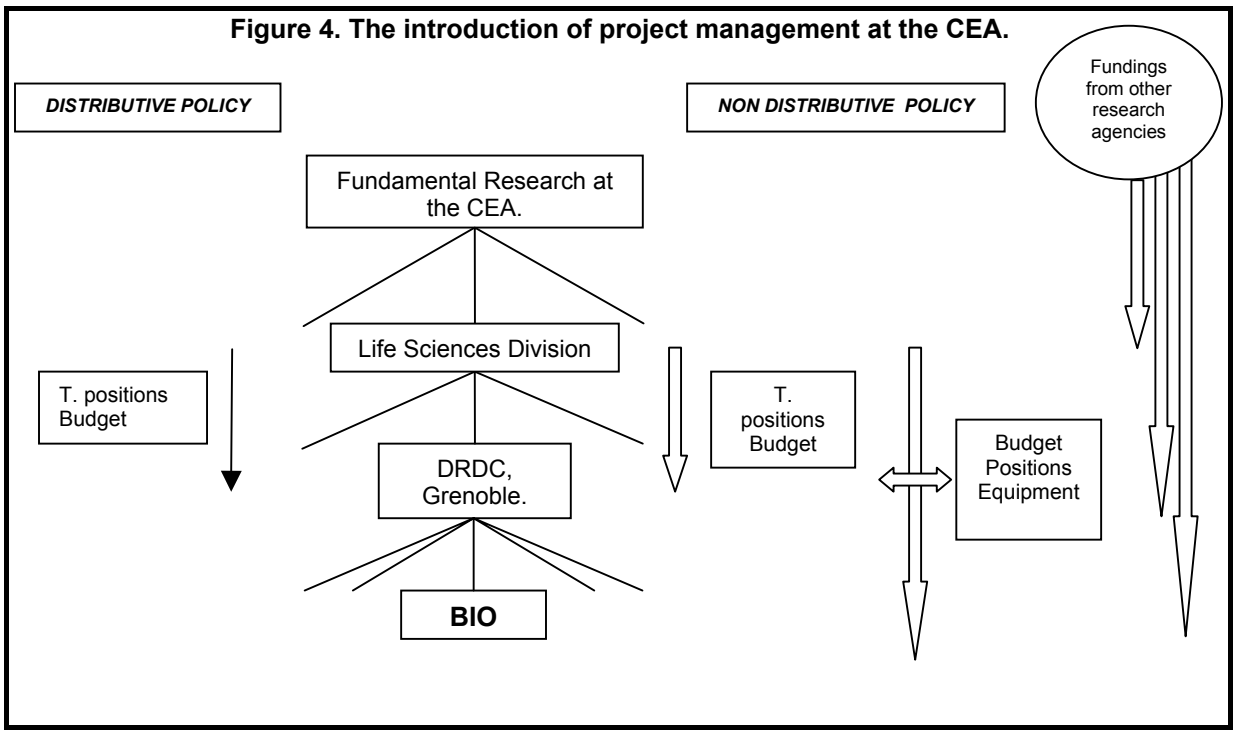
The financing policy for medium-size instruments keeps following the same logic.

Employment policy.

Permanent positions. The two stages of the procedure remain unchanged, but since the end of the 1990s the candidates are auditioned at the national level. This audition sets up a national competition in which the department seems to lose weight.

The first criterion for the Life Sciences Division to recruit the candidates is not their excellence, but the integration of their research project in its scientific priorities. The same preoccupations appear to advice the choice of the candidates for *doctoral or post doctoral positions*.

Figure 4. The introduction of project management at the CEA.



C) Entering the "black box" of the transformations.

While describing the new management rules, we have insisted on the "top down" procedures on which the implementation of the research policy is based. But we have also suggested that the concrete outlines of the scientific priorities aren't imposed upon the research units, but defined with them in a "bottom-up" dynamic. The national programs are vague enough to allow multiple translations, in the sense of the sociology of translation (Callon 1989).
In that sense, the introduction of project management may be considered as a "join product" between the research units and the institution (Reynaud 1989). Two main features characterize the negotiations and the collective decisions which support the institutional reforms within BIO:
- These reforms only represent one dimension of BIO's global dynamic. Thus, the main problem is not to deal with this single reform but to combine it with other major issues, concerning the scientific and institutional position of the lab (e.g. the research policy of the CNRS; the position within the research field of vegetal biology at a regional and national level…).
- The identity of the working collectives is globally disturbed by these reforms, but the individual and collective strategies are not similar among the categories (the temporary scientists: PhD students and postdoctoral researchers; the permanent technical staff, the permanent researchers, the PI).

These categories do not share the same interests and they have unequal resources in the negotiation and the social regulation within the lab. Thus, their position towards the definition of new rules can be almost antonymic.

1) Two "passive" categories in the negotiation.

Researchers on temporary positions. Although they are central in the scientific strategies (because they perform most of the experimental work in the life sciences), they don't take part to the negotiation of the rules. The work organisation in this discipline is rather hierarchical and the temporary staff doesn't choose its research objects. Furthermore, this category is not involved in long-term strategies since corresponding people are only making a short stay in the lab.

The *technical staff* takes part to the discussions but its position in the negotiation seems to be a rather dominated one. Like the temporary staff, this category doesn't really participate to the definition of the research fields. Thus, many of them show a "resistance to change" similar to the one frequently observed by less qualified workers facing a technological or an organisational change (Sainsaulieu 1993).

2) The permanent researchers: individual and collective strategies.

[15] (Number of researchers involved in program 1) * (cost pro researcher in program 1) + …+ (Number of researchers involved in program 4) * (cost pro researcher in program 4). See: budgetary notices since 2000 for

The permanent scientists are directly concerned by the institutional reforms. Those of them who are employed by the CEA may have to account for their involvement in the new research policy; but even the scientists employed by other research institutions (mainly the university and the CNRS) may use the introduction of project management as an opportunity to redefine their position within the lab.
In fact, a few of them choose to switch totally from their former research object and to work on the thematic "Nuclear Toxicology". As a result, they get consequent funding as well as grants for PhD and postdoctoral researchers.

However, the majority doesn't want to reorient radically its research, but shares a collective responsibility for the financial resources BIO gets from the Life Sciences Division. The major stake for these scientists is to modify the work organisation and the research projects in order to maximize the amount of resources allocated by the Life Sciences Division without too much disturbing the existing teams and without imposing scientific reorientations.
This balance implies to partly reconceptualize the research programs and to redefine the outlines of the teams.

3) The central position of the PI.

The PI appears to be the central actor in this regulation, because he holds an intermediary position between the lab and the Life Sciences Division and thus performs the mutual adjustments between the "local" and the "central" levels.
The project management first enables him to emancipate the lab from its direct hierarchy (i.e. the department): in fact, a large part of the negotiations takes place between the PI and the head of the Life Sciences Division.
Second, his major stake is to preserve BIO's financial and human resources[16], but also to manage its global evolution with regard to its plural configuration. As a consequence, he has no interest in "converting" the whole lab to the research programs of the Life Sciences Division, because it would make it difficult to situate the lab towards the other financing institutions and towards its scientific community.

He then follows a dual policy. On the one hand, he strongly supports the will of a few permanent researchers to create a team dedicated to "Nuclear Toxicology", because this initiative ensures BIO's position within the CEA. On the other hand, he co-produces both with BIO and the Life Sciences Division an extensive definition of the programs (especially of "Nuclear Toxicology" and "radiobiology"), so as to matching the general orientations of the Life Sciences Division without upsetting the former research subjects. In this way, the negotiations lead to "cross learning" between the institution and the research units (Hatchuel 1996).

BIO and other labs we studied.

"Radiobiology" and the research carried out at BIO.

At the beginning of 2000, the permanent staff seemed to be quite anxious because he thought that the main part of the research carried out at BIO had "nothing to do the radiobiology program". Their central argument was that plants are resistant to radiation exposure. How would it be possible to characterize the radiation-induced damages on them?

After discussions with the head of the Life Sciences Division, the PI explained that plants are definitely an interesting biological model insofar as their resistance constitutes a particular cell response. Research in radiobiology, defined as the understanding of cell responses to several stresses, thus included large parts of cell and molecular biology and of BIO's thematic.

Conclusions

The introduction of project management at the Life Sciences Division can be seen as an attempt to find a way out of a "peer management" or a "distributive policy". In fact, the financing and employment policy has introduced a new kind of government of science, in which the hierarchy establishes its own criteria to differentiate the research units and to foster those of them which follow its scientific priorities.

This reform also owns up the lack of relevance of direct hierarchical control upon the research units, insofar as their institutional and scientific position, relying on multiple partnerships, enables them to get it round.

When analysing the negotiations and decisions at the micro level, our purpose is not to establish whether the project management strengthens the control upon the research units or limits their autonomy. It is rather to analyse its impact on the way the labs justify their choices. We also want to outline that the reforms can significantly affect the research units configurations, depending on the labs characteristics.

In BIO, the PI has remained a central actor and he has kept his strategic capacity to negotiate the changes both towards the lab and the hierarchy. He has succeeded in preserving the unity of the lab because there has been a collective agreement about keeping its identity and finding a balance between continuity and change. The situation may be rather the opposite one, as other case studies have showed us: project management enables teams to exceed their direct hierarchy and thus increases risks for the unit to split.

[16] At the beginning of the 2000s, the CEA budget represents 1/3 of the annual current resources of the lab (which does not include wages and infrastructure costs).

References

Callon, M. (sld.) (1989). *La science et ses réseaux. Genèse et circulation des faits scientifiques.*, Paris: La Découverte.

Dasgupta, P., & David, P. (1994). "Toward a new economics of science". *Research Policy*, vol. 23, p. 487-521.

Gibbons, A., Limoges, C., Nowotny, H., Schwarzman, S., Scott, P., et al. (1995). *The new production of knowledge, The dynamics of science and research in contemporary societies*. London: SAGE Publications.

Hatchuel, A. (1996). "Coopération et conception collective. Variété et crises des rapports de prescription." In De Terssac, G. & Friedberg, E. (sld.), *Coopération et conception.*, pp. 101-121. Toulouse: Octares.

Knorr-Cetina, K. (1999). *Epistemic Cultures : How the Sciences Make Knowledge.* Cambridge: Harvard University Press.

Larédo, P., & Mustar, P. (sld.) (2001). *Research and innovation policies in the new global economy : an international comparative analysis.*, Northampton, MA: Edward Elgar Pub.

Massardier, G. (2003). *Politiques et action publiques.* Paris: Armand Colin.

Merton, R. K. (1973). *The Sociology of Science.* Chicago: University Press of Chicago.

Paradeise, C. (1998). "Pilotage institutionnel et argumentation : le cas du département SHS du CNRS". In Borzeix, A., Bouvier, A. & Pharo, P. (sld.), *Sociologie et connaissances : nouvelles approches cognitives.*, pp. 205-228. Paris: CNRS éditions.

Peerbaye, A., & Mangematin, V. (2003). "Life Sciences Large Scale Research Facilities : what are the effects on technology transfer dynamics?" *EGOS Conference*. Copenhagen.

Pestre, D. (1990). "Louis Néel, le magnétisme et Grenoble. Récit de la création d'un empire physicien dans la province française 1940-1965." *Cahiers pour l'histoire du CNRS*, vol. 8, p. 1-188.

Reynaud, J.-D. (1989). *Les règles du jeu. L'action collective et la régulation sociale.* Paris: Armand Colin.

Rip, A. (2002). "Regional Innovation Systems and the Advent of Strategic Science". *Journal of Technology Transfer*, vol. 27, Special Issue on regional innovation systems, p. 123-131.

Sainsaulieu, R. (1993). *L'identité au travail.* Paris: Presses de la Fondation Nationale de Sciences Politiques.