The use of foreign examples in research policy

Public funding for nanoscience and nanotechnology in France

Séverine Louvel, Matthieu Hubert, Translated by Peter Hamilton

In **Revue française de sociologie Volume 57, Issue 3, 2016**, pages 473 to 501

ISSN 0035-2969
ISBN 9782724634693

The English version of this issue is published thanks to the support of the CNRS

The Use of Foreign Examples in Research Policy
Public Funding for Nanoscience and Nanotechnology in France

Séverine LOUVEL
Matthieu HUBERT

Abstract. This article examines the influence of major international paradigms on nanoscience and nanotechnology funding policies (*nanoS & T*) pursued in France during the 2000s (1999–2013). It is concerned with how foreign examples become exemplary (in the sense of *"exemplar"* as used by Kuhn 1990) to the extent of being regarded as public policy solutions. Using extensive qualitative research in the field of nanoS & T, the article shows that the paradigmatic value of foreign examples derives from the processes of "editing" (Sahlin and Wedlin 2008), i.e., de-contextualization and re-contextualization which establishes their relevance for certain dimensions of science policy. It highlights three key approaches to this editing work—one which creates an example of a prototype for public policy, one that lists comparable examples more systematically to define a concept, and finally one which borrows from management techniques—and identifies the key actors in the development of national programmes and the creation of local innovation clusters in nanoS & T.

Keywords. FOREIGN EXAMPLES—NANOSCIENCES AND NANOTECHNOLOGY—PUBLIC POLICY PARADIGM—PUBLIC RESEARCH—RESEARCH AND INNOVATION POLICY—RESEARCH FUNDING

Foreign examples are frequently used to justify the research and innovation policies[1] carried out in France. Thus, the national programme of "investments for the future" (Programme des Investissements d'Avenir) was presented as an "*MIT à la française*"[2] and the parliamentary discussions that preceded the reforms of the French research system in 2005 questioned the "lessons to be drawn from a foreign model" (the United States) (Périssol 2004). In addition, the branding of 71 competitiveness clusters aimed at promoting synergies between academic research and industry appears to be a French version of such clusters flourishing in all technologically advanced countries (Blanc 2004). These foreign examples embody in their discourses international research and innovation policy paradigms that define the problems that national actors must address and the solutions to them that they have

Translated by Peter Hamilton with the support of CNRS-INSHS.

1. Research and innovation policies became institutionalized after the Second World War in most industrialized countries. They refer to the way in which States, as well as infra- or supranational actors (institutions, local authorities, international organizations) use scientific and technological means in the service of political, economic and social objectives (Henriques and Larédo 2013).

2. Speech made by the French Minister of Higher Education and Research, 4 July 2011.

available. In this sense, they are presented as "standard examples" or "exemplars" defined as "solutions to concrete problems, accepted by the group as paradigmatic, in the ordinary sense of the term" (Kuhn 1990, p. 397).[3] However, beyond mere rhetoric, the question arises of how some foreign examples become exemplary and guide decision-making in the funding of research.

This article proposes to study the process of "editing" (Sahlin and Wedlin 2008) of foreign examples, in other words the processes of decontextualization and recontextualisation by which certain actors involved in scientific policies are able to place them in a national or local context. It aims to answer the following questions: which actors can construct the paradigmatic value of certain foreign examples? By whom, for what purpose and with what consequences are these "edited" examples thus deployed? These questions are particularly sensitive in a part of the public sector where both national and local policies must take into account the highly internationalized nature of scientific activities and are at the crossroads of seemingly contradictory rationales: on the one hand, in terms of the internationalization of the scientific elite, international competition for research and innovation, uncertainty about the most effective science policies to adopt are all factors that can foster mimicry between countries and the dissemination of ideas in occupational networks (DiMaggio and Powell 1983); but, on the other hand, the great diversity of the instruments used for financing research[4] demonstrates the absence of universal "recipes" in this area.

Although it is often asked, the question of the use of foreign examples in scientific policies has been little studied. It re-energizes some classic questions in sociology[5] about the understanding of the interorganizational, intersectorial or international circulation processes of practices and ideas. Some authors explain this circulation by the morphology of social networks that link "promoters" and "adopters" (Coleman *et al*. 1966, Burt 1987).[6] Others point out that ideas in circulation have gained international legitimacy in societies marked by forms of cultural homogenization (Strang and Meyer 1993). These approaches criticize a diffusionist view of the circulation of ideas and practices (based on direct exchanges) and highlight international organizations (Godin 2002), peer networks (DiMaggio and Powell 1983) or epistemic communities (Haas 1992) which constitute the range of sites for the construction of the legitimacy of the ideas and the processes of their diffusion. They have been used to report on the circulation of instruments (indicators, norms, good practices, etc.) such as "institutional rules" (Meyer and Rowan 1977) or "scripts" that provide general and unformalized prescriptions (Meyer, *et al*. 2007). This circulation of instruments or scripts is often based on an example that embodies them,

3. Thomas S. Kuhn (1990) proposes the notion of exemplar to remove the ambiguities of the term paradigm (Kuhn 1972). He defines a paradigm as a "disciplinary matrix" in three dimensions: "symbolic generalizations" (such as definitions and laws), "heuristic models" and "exemplars". T. S. Kuhn (1990) would prefer to replace the notion of paradigm with that of disciplinary matrix, and to reserve the term paradigm for "exemplars".

4. That we observe both in terms of project financing (Lepori *et al*. 2007) and the creation of local clusters (Bresnahan *et al*. 2001).

5. Especially in sociology of organizations, political sociology or sociology of innovation. In political science, *policy transfer studies* pose similar questions (Dolowitz and Marsh 1996, Delpeuch 2008).

6. For example, the classic study of the diffusion of the prescription of tetracycline among physicians (Coleman *et al*. 1966). Reanalysis of the data by R. S. Burt (1987) shows that the diffusion is stronger between practitioners in position of structural equivalence in the network than between those who are in direct contact.

whether in the form of a success story (Strang and Macy 2001) or by reference to a leading country (Haveman 1993).

This article looks at the role of foreign examples in the adoption and implementation of financing policies by focusing on a particular area: nanosciences and nanotechnologies (nanoS & T) (see Box 1). As a result, the changes discussed are probably less open and controversial than those concerning the global architecture of the research system[7] that are likely to initiate a paradigm shift (Hall 1993, p. 282).

Box 1.—*The main scientific and technological issues of nanoS & T*

For the last thirty years, the nanosciences and nanotechnologies (nanoS & T) have been the subject of numerous studies in physics, chemistry, biology, engineering sciences and also at the interfaces of these disciplines. They arouse high expectations because of the particular properties of matter at the nanoscale (the millionth of a millimetre). From a scientific point of view, this research concerns the fabrication, observation, manipulation and modeling of nano-objects, as well as the understanding of their properties and interactions with the environment. From an industrial point of view, they make it possible to create a wide range of applications in the fields of energy, materials, biomedicine, computer science and telecommunications. They have also been criticized for the risks they pose to health, the environment, the respect of privacy or the possibilities of transformation of the human species (Agence Nationale de la Recherche; French National Research Agency 2012).

The almost simultaneous emergence in the world of what are described as "nano" policies with generally similar architectures (Larédo *et al*. 2010) makes this sector particularly relevant for studying the use of foreign examples in funding for research. Moreover, France lends itself particularly well to such questioning. It made nanoS & T a priority in the early 2000s, and constitutes an active contributor to the field (2nd in Europe and 6th in the world in numbers of publications over the period 1991–2005 [Kostoff *et al*. 2007]). Launched in 2005, the main national project funding programme (the P-Nano Program of the National Research Agency) complies with international standards in this area and has similar goals to programmes launched in most countries in the OECD.[8]

In addition, some local nanoS & T support policies appear to be inspired by American examples (Massachusetts Institute of Technology—MIT, California Institute of Technology—Caltech, etc.).

Finally, the article focuses on the nanoS & T support policies adopted in France between 1999 and 2013.[9] It is based on research materials (semi-structured interviews and archives) collected between 2005 and 2015 concerning the national and local components of these policies. The authors collected them within the context

7. For example, the creation of the French *Agence nationale de la recherche* (ANR) in 2005, which entailed the import of project management and evaluation techniques from the US National Science Foundation; the launch of the "Investments for the Future" (*programme des investissements d'avenir*) programme prepared by a report by two former French prime ministers, which abounds with references to world-class "campuses of excellence" (Juppé and Rocard 2009).

8. These national programmes combine five objectives: development of research, infrastructure, training, technology transfer and "responsible innovation" (Larédo *et al*. 2010, p. 48).

9. In 1999 the first national programme in nanoS & T was launched (the RMNT). In 2013, the ANR's "nano" programme disappeared in the total overhaul of the agency's programming.

Box 2.—*Resources and methods*

This article is based on research materials that the two authors have collected since 2005 on nanoS & T policies in France (1999–2013), in the context of several studies: a doctorate in sociology examined in 2009 (survey conducted in Grenoble between 2005 and 2009, ANR Lodysénano) (Hubert 2014, Hubert *et al*. 2014), and post-doctoral research (survey conducted in the Paris region in 2010, ANR Nano-Innov) (Hubert *et al*. 2012), ANR project (survey conducted in Toulouse, Grenoble and the Paris region between 2010 and 2013, ANR Hybridtrajectories) (Louvel 2015 2016), and finally, a targeted survey conducted in 2015. It uses the survey results relating to the national and local nanoS & T funding policies.

1) *At the national level*

- Contractual and competitive financing of projects (unspecified or thematic) since 1999 by the Ministry in charge of research (under different titles) then the National Research Agency from 2005 to 2013;

- The financing of shared resources (instruments, buildings and experimental infrastructures) within the network of large technological platforms for basic technological research (RTB network);

- The financing of programmes to promote "responsible innovation," through considerations of its ethical and social consequences and public participation ("Nanos et Société (*Nano and Society*)" activities of the P-Nano and Nano-Innov programmes; by the Commission Nationale du Débat Public (National Commission for Public Debate)).

The analysis of national policy is based on approximately 25 interviews with successive programme managers and members of the programme committees (5 interviews conducted between 2005 and 2010—ANR Lodysénano and Nano-Innov, 7 interviews conducted between 2010 and 2013—ANR Hybridtrajectories 13 interviews conducted in 2015, some with actors already interviewed), and on the analysis of archives (reports of programme committee meetings, calls for projects, official reports, etc.).

2) *At the local level*

The financing of two innovation campuses in Grenoble: MINATEC (specialized in micro and nanoS & T); GIANT (which brings together nanoS & T, energy and health sciences).

The analysis of this local component is based on interviews and observations carried out in Grenoble between 2005 and 2009 (as part of a doctorate in sociology) plus three field surveys (interviews, observations, collection of archive material) conducted between 2009 and 2011 in the context of Masters dissertations (Genin 2011; Libersa 2011; Polo 2009) and 6 interviews conducted in 2015 with managers of local centres and programmes, as well as with initiators of international benchmarks.

The survey conducted in 2015 sought to limit post-interview reconstruction bias in several ways. We systematically compared the points of view of several actors for each aspect of the policy and for each period studied; we asked interviewed actors to comment on the previously collected archives, as well as on the comments made (by themselves or by other actors) during previous interviews.

of a number of surveys conducted in Grenoble, Toulouse and the Paris region (see Box 2).

The first section reviews contemporary paradigms in research and innovation policies, in the sense of a "matrix" (Kuhn 1972) or a "framework" (Hall 1993), as well as the sociological questions raised by how they are manifested by certain examples—in particular, how, with which actors and with what content do these acquire relevance and legitimacy? The second section discusses the process of "editing"

(Sahlin and Wedlin 2008), through which some examples have been used in French policies aimed at organizing the national coordination of nanoS & T and the setting up of local innovation poles. We differentiate between three major approaches to this process: one that describes a foreign example in order to establish it as a prototype for public action (prototypical editing), another that lists comparable examples to define a concept (comparative editing), and a final one that borrows from a particular management tool (mimetic editing). These approaches produce three complementary forms of internationalization of science policies for nanoS & T and differ both in the content of what circulates among countries and in the actors and networks of this process of internationalisation.

An erosion of the national policy framework for research and innovation?

The advent of major international paradigms

The research and innovation policies that have been institutionalized since the end of the Second World War are part of major international paradigms that emerged successively[10] and are now combined in national, but also infra- and supranational, policies. These paradigms are understood as "disciplinary matrices" (Kuhn 1990, p. 396) or as systems of ideas and instruments (Hall 1993, p. 279) that propose a set of relatively consensual problems and solutions. They are based on propositions stemming from philosophy (for example, the freedom of science, the place of science in democracy) and political economy (for example, the definition of science as a public good) as well as on instruments for measuring science and its impact (Borràs and Biegelbauer 2003).

In the 1960s, the OECD was a major player in the emergence of a paradigm where it is the central State that identifies and coordinates priorities (Henriques and Larédo 2013).[11] This paradigm is opposed to that of the "Republic of Science" characterized by a lack of national coordination and the full autonomy of the agencies that fund scientific communities (Elzinga and Jamison 1995). For two decades it inspired the policies of member countries through the national assessments that the OECD conducts. Its adoption was facilitated by a reference to the United States that combines "a dialectic of the example, the model and the threat" (Bouchard 2007, p. 17) and relies on the construction of a statistical apparatus (Godin 2002). This paradigm has been amended since the 1960s, but it still guides national policies in many OECD countries where, for example, national strategies follow planning exercises. On the other hand, the policies of funding agencies—which are growing everywhere—are defined in interaction with scientific communities (Van der Meulen

10. The very use of the terms "scientific policy" then "research policy" and "research and innovation policy" is concomitant with the advent of international paradigms in this area (Pestre and Jacq 1996).

11. In emerging countries, international organizations (the World Bank and some regional organizations) have played an important role in disseminating institutional models in which the contribution of science and technology to development depends on State action (Invernizzi *et al*. 2014, pp. 227, 231).

and Rip 1998) but respect national priorities.[12] Finally, the European Research Area has been translated into a limited Europeanisation of the agendas of the agencies and organizations of the member countries (Larédo 2009, p. 29).

This paradigm has been challenged, since the 1970s, by a conception of research and innovation policy that emphasizes coordination by networks in order to foster innovation (Ulnicane 2015). This second paradigm postulates that innovations stem neither from freely conducted scientific research nor from technological priorities defined by the State, but from "interaction loops" that public bodies must facilitate and protect.[13] Its application has taken two directions: the reorientation of national policies towards the financing of collaborative research linking academic and industrial actors (for example, the "labelling" and financing in France of competitiveness clusters and of the *Carnot Institute* network for partnership research); the weakening of national policies for the benefit of subnational levels (especially local authorities financing innovation poles within objectives designed to increase regional attractiveness) and supranational levels (for example, the European Union) as well as industrial strategies.[14]

Embodied paradigms? The process of editing foreign examples

Why (and for which actors) do some foreign examples appear to be answers to the central questions of scientific policy paradigms (the "independence" of experts, the "transparency" of evaluation, the "competitiveness" of calls for projects, etc.)? Devised to analyze how local politicians use examples when creating a science park in the Stockholm region (Sahlin-Anderson 1996), the notion of "editing" has been taken up and developed to describe social processes of selection and reappropriation through which knowledge flows (Sahlin and Wedlin 2008).

The purpose of editing is to write and shape "versions" of this knowledge, in other words, reformulations that take them out of their original situation and reposition them into a context of action. As with the notion of translation (Callon 1986), it focuses on the transformation of ideas and examples as they circulate and is opposed to diffusionist approaches (Rogers 2003). However, the perspective is distinctly different from the sociology of "*translation*" because it focuses on the social constraints of decontextualization and recontextualisation that weigh on "editors" (managers, decision makers and reformers, but also, depending on the case, social partners, representatives of civil society, consultants, media, international organizations, etc.) when they are choosing examples and producing "versions." In this perspective, the analysis of these constraints is mainly influenced by decision theories—which emphasize the limited rationality of the actors and the constraints of meaning and plausibility that weigh on their actions—and institutional sociology

12. With the notable exception of the *National Science Foundation*, the leading federal funding agency in the USA (Kleinman 1994).

13. This paradigm has been the subject of a major literature in the social sciences: Triple Helix (Etzkowitz and Leydesdorff 1997); Mode 2 transdisciplinary research (Gibbons *et al*. 1995); clusters (Porter 1998); national and local innovation systems (Lundvall 2010). In particular, the "Triple Helix" model, which describes the relationships between public authorities, companies and universities and their role in innovation dynamics, has been discussed in many places (Shinn 2002): NSF, CNRS, OECD, NATO, European Commission, Emerging Market Authorities.

14. This paradigm can be linked to the "Network governance" narrative (Ferlie *et al*. 2008) presented as an essential source of inspiration for public policy reforms in recent decades.

(conformism, identification rationales, social legitimacy of certain ideas, etc.) (Sahlin and Wedlin 2008).

The editing of foreign examples in French policies for nanoS & T

Some policies for nanoS & T put into place in other countries give rise, in France, to versions produced by a group of editors (parliamentarians, scientists, consulting firms, embassy scientific attachés, civil servants of the ministry in charge of research, leaders and managers of research programmes). The writing of these versions and their use in scientific policies takes three forms. First, they are part of a rationale that uses the description of an example as a prototype for public sector action. Editing takes place here in independent activities concerned with forecasting and recommendation in the field of science policy. It feeds into the general thinking of ministerial decision-makers and research institutions rather than providing a policy solution. After this, editing aims to define a concept of public action based on the systematic comparison of several examples and their *benchmark*. It is produced by political advisers who use this concept for its ability to arouse interest, convince and build consensus. Finally, the writing of versions is part of a mimetic rationale for identifying problems and similar solutions in other countries in order to replicate them in the national context. The editors here are policy makers (programme or platform managers) looking for operational answers and management tools.

Prototypical editing: the National Nanotechnology Initiative, prototype of a major programme for nanoS & T

In France, unlike other countries, the American National Nanotechnology Initiative (NNI), launched in 2001, was not an inspiration for the launch of the national policy for nanoS & T.[15] However, references to the NNI were multiplying from 2002. They were part of monitoring and forecasting studies in the field of science policy and came from various editors: senators of the French Parliamentary office for technology assessment (OPECST 2003, 2004), civil servants and advisers in the administration (Ministry of Youth, Education and Research 2004, Roure and Dupuy 2004), scientific institutions or collectives (Academy of Technology 2002, Academies of Science and Technology 2004, Bernier *et al*. 2005), consulting firms (Carlac'h and Hemery 2004), officials in the French Embassy in the United States (Herino 2005). Inspired by the same official sources,[16] these reports describe in very

15. French programmes date from the late 1990s or early 2000s: Réseau des Micro et Nanotechnologies [Micro and Nanotechnologies Network] (1999); Action Concertée Incitative Nanosciences [Concerted Incentive Action on Nanosciences] (2002); RTB network (2003) (ANR 2012, p.17). These initiatives respond to the investment and resource concentration needs identified by the international scientific communities, but are not inspired by, or even predated by, foreign examples. They inherit a French institutional pattern organized around autonomous institutions and which traditionally divides the roles between "fundamental" research (mainly under the aegis of the CNRS) and "technological" research (mainly under the aegis of the CEA).

16. Presentations and reviews by government agencies such as the National Research Council or the National Science and Technology Council.

similar terms the NNI as the prototype of a "great programme" for nanoS & T unparalleled in the world,[17] whereas it is in fact more of a "forum" that coordinates the programming of some fifteen independent agencies (National Science Foundation, National Institutes of Health, Department of Energy, etc.), which freely use their funds to finance projects in nanoS & T (Reillon 2011, p. 19). They identify this major programme by characteristic features that they describe as issues that are important to provide a national response (pooling resources, coordinating initiatives and funding, proposing a "vision" for "responsible" development of science and technology).

Report writers use the NNI in two types of arguments.[18] While these fuelled lively scientific policy debates at this time, they had very little influence over nanoS & T funding decisions. First of all, the reference to the "major American programme" aims to give some urgency to the thorny issue of interinstitutional coordination between research operators (CEA, CNRS, universities, etc.) that is not specific to nanoS & T but crucial in this transversal field. The reports of OPECST and the Academies of Science and Technology propose the creation of a "French NNI" in the form of a major inter-ministerial programme: the "NanoTech programme" (OPECST 2004, p.112) or the "National Agency for Nanosciences and Nanotechnologies" (Academies of Science and Technology 2004: pp. XXXIII–XXXIV). They justify the importance of "taking the initiative of a major programme" (ibid.) by using the rhetoric of a "geo-comparativist lag" (Bouchard 2007) in relation to the United States. This gives weight to the "critical mass" argument, according to which only a national or even European action plan[19] could finance investment in nanoS & T (OPECST 2004). Although the leaders of the nanoS & T programmes in public research institutions did not intend to create a "French NNI," this proposal contributed to recurrent questioning over the institutional arrangements that would allow the large-scale action of the "State as facilitator" of cooperation between research organisations (Lanciano-Morandat and Verdier 2005), to which the project of the national funding agency provided a global response:[20] "Indeed there were these 2004 reports. It was a recommendation but not a political decision of the institutions. But, finally, what was happening on the nanos was very general. The ANR had it on the drawing board and this idea of a major transversal nanos programme had materialized within the ANR. That was the answer to the multiplication of institutional layers" (Head of department at the CEA then head of the "*matière et information*" department at the ANR from 2005 to 2009). The national programme for nanoS & T created in 2005 at the ANR merged the previous initiatives without being inspired by the organization of the NNI. It was less a question of taking up foreign strategic agendas than of retaining a sufficiently broad definition of nanoS & T to structure interdisciplinary communities, in a situation where the strong growth of the ANR's budgets ensured

17 "With $ 14 billion invested, the NNI is now the largest federal funding program for R & R since the space program" (Reillon 2011, p. 1).

18. All the reports quoted above insist on the first type of argument, the second being of variable geometry.

19. The term "critical mass" appears eleven times in a European Commission communication entitled "Towards a European strategy for nanoS & T", 12 May 2004, 30 pages. The reference to the United States appears twenty times. In addition, French investments are often compared to those of the "two predominant poles" that are the United States and Japan (Ministère de la Jeunesse, de l'Éducation Nationale et de la Recherche 2004).

20. The French Délégation Générale à la Recherche Scientifique et Technique [General Delegation for Scientific and Technical Research] played this role in the 1970s, but with limited budgets (Aust and Picard 2014).

a certain durability of the programme (2005–2008).[21] With this in mind, the P-Nano programme funded a large share of exploratory research (on the basis of very large tenders) and aimed to "detect weak signals" within scientific communities.[22]

Secondly, some reports (OPECST 2004, 2006, Roure and Dupuy 2004, Ministry of Ecology and Sustainable Development 2006) refer to the NNI's promotion of the "responsible development" of nanoS & T (in other words, research which at an early stage includes the analysis of health and environmental risks as well as social and ethical questions). They use this reference in particular to support the financing, in France, of research in the humanities and social sciences: "It should be noted, however, that 1% of the federal sums allocated to nanotechnology research must go [NB: in the NNI] to research on social and ethical implications. [...] It is therefore expected that in this area too, the US will take the lead." (Roure and Dupuy 2004, pp. 28–9). In particular, the report of Françoise Roure and Jean-Pierre Dupuy (ibid.) highlights a European "vision" of the use of nanoS & T directly opposed to the "vision" of the NNI which is of transhumanist inspiration.[23] However, ANR's scientific programming includes the issue of science-society relations almost exclusively in response to local and national issues. Indeed, research on the risks and the "impacts" on society were mainly financed in reaction to radical protests that were gaining momentum throughout the decade: firstly in Grenoble[24], then nationally, with the disruption or the impediment of a good part of the public meetings organized by the *Commission Particulière du Débat Public*. The head of the ANR's "Materials and Information" department chose to involve scientific researchers in SHS (trs. *sciences humaines et sociales*; social and human sciences) with some critical actors in civil society[25] who, although they shared the same rejection of the transhumanist vision of the NNI and of an instrumentalisation of the SHS in the service of the "acceptability" of nanoS & T, diverged strongly in terms of their understanding of science-society relations (education, communication, debate or co-construction):

21. P-Nano is attached to the "materials and information" department of the ANR. It has a budget of 35 million euros. P-Nano funds all research that "targets the construction, study, or manipulation of structures, systems, or objects that are typically less than 100 nm in size and whose physical, chemical, or biological properties are specifically derived from that nanoscale size."

22. Notes from a participant in the P-Nano Sectoral Scientific Committee, at the meeting of April 3, 2008, describing the analysis of all submitted projects (including those rejected) with a view to identifying emerging themes. The sectoral scientific committees are advisory bodies that "inform the scientific programming of the ANR" (Guide to the organization and functioning of a sectoral committee, May 10, 2007, document ANR / GUI-AMu-MG-100507-01- 01).

23. Transhumanism advocates the use of science and technology to improve the physical and cognitive performance of humans. The NNI coordinator (Mr Roco) promoted SHS research and dialogue between researchers and the "public" to overcome social resistance to the project (Roco and Bainbridge 2002). The European vision was formalized in the Nordmann report (2004) at the request of the Foresight Division of the European Commission's Directorate-General for Research. It emphasizes the co-construction of science and technology, the goals of social welfare, and the driving role of SHS (Nordmann 2009, p. 291). This vision guided the design of the science-society dialogue by the European Commission (see European Commission Communication, "Towards a European strategy for nanoS & T", 12 May 2004, p.3).

24. Especially the criticism coming from the Grenoble group PMO (*Pièces et main-d'œuvre*; Parts and Labour), which intensified with the approach of the inauguration of MINATEC in 2006.

25. Including the president of the public organisation "60 million consumers [*60 millions de consommateurs*]", the president of the VivAgora NGO and the vice-president of the OECD working group on nanoS & T (co-author of the report Roure and Dupuy 2004).

"There were not many presidents of SHS in a committee on technological research. They (i.e. the officials of the ANR) had a terrible fear of arguments about nanos. What mattered was that we are able in this committee to have a dialogue about future directions with people who encouraged a fairly critical vision." (SHS researcher chairing the P-Nano Sector Committee from 2007 to 2009). In addition, the sectoral scientific committee's discussions concerning the integration of SHS research into a hard science programme are running short, given the very limited number of responses to calls for tenders: "We had a small ethics and science committee. The problem was that the pool of people likely to present projects on nanos and society was very limited. And very soon the potential project leaders were in the committee and we played musical chairs. Whoever wanted to introduce a project resigned from the committee" (SHS researcher member of the P-Nano Sector Committee in 2008).

Thus a version of the NNI example was established around 2002–2004 in reports that rely essentially on the publicly available and summary information contained in the US programme documents. It fed into the evaluation and foresight exercises that were multiplying to not only support the growth of nanoS & T but also to reflect more generally on the changes in the national research system. It made the NNI a prototype for public action, highlighting issues of resource pooling, interinstitutional coordination and for encouraging "responsible" research. On these different subjects, the nanoS & T, by their interdisciplinary and transversal nature, are presented as an emblematic sector of the major issues facing all national policies. By its very nature, this editing process has had very weak direct effects on science policy. Indeed, it simultaneously highlights the similarity of the questions and the diversity of the answers adopted, thus favouring discourses that, while comparing systems, simultaneously warn of the impossibility of transposing foreign solutions. The identification of common issues with the undisputed leader in nanoS & T did not lead to imitation, but fed into a broader policy debate (Dobbin *et al.* 2007, p. 453).

Comparative Editing: Defining the Innovation Campus Concept

A second form of the editing process systematically compares several examples to highlight the characteristics that explain their success. The examples are thus "theorized" (in the sense that causal relations are formulated from them, see Strang and Meyer 1993, 492) to arrive at the definition of a concept supposed to guide public action. This form of editing is directly connected to the construction of the argument in favour of a science policy. It combines identity issues (such as inclusion in a small club of world-class campuses) with operational objectives (obtaining funding, building international partnerships). It is the process carried out by strategy and communication advisers that science policy makers choose to select the examples, define the concept, mediate it, and build its articulation with the project to be carried out.

The construction of the Grenoble centre for innovation in nanoS & T (MINATEC and GIANT programmes)[26] is explicitly based on the definition of such a concept, that of an innovation campus. This definition is supported by an international

26. MINATEC (trademark registered in 2001 by the CEA, the French Alternative Energies and Atomic Energy Commission) is an "innovation campus" (or *science park*) in the field of micro- and nanotechnologies inaugurated in 2006. The GIANT project extended the MINATEC principle from 2006, initially bringing together 6,000 researchers on nanotechnologies, energy and health, and involving eight partner institutions.

comparison of an atypical magnitude and clearly presented as a "benchmark," in other words as a work of identification of exemplary cases with which to compare and explain differences in performance. In the early 2000s, the director of projects (Jean Therme, then director at the CEA LETI)[27] appointed a scientific advisor to work on such plans, who was commissioned to spend ten years on a "tour" of scientific and technical centres throughout the world (involving over sixty visits to more than twenty countries) (Morabito 2014). Chosen because he was not involved with any of the institutions concerned (including the CEA) and his "fresh" perspective on a question on which he was not a specialist, Marcel Morabito (professor of law, former rector of the Academy of Grenoble) produced four successive benchmark studies concerned with: the governance of the main centres of excellence in nanotechnology; the impacts of the 2008 economic crisis on these centres; emerging countries; and the links between research and industry. These benchmarking studies benefitted from the logistical support of the CEA's communication services, and also of MINATEC (technology watch, organization of "tours," etc.) and the technical expertise of LETI members (including the director of MINATEC, who took part in some of the foreign visits).

While emphasizing, with the help of agro-ecological metaphors (soil, ecosystem, cross-fertilization, culture, etc.), the complexity and the non-reproducible nature of the successes observed abroad, these benchmarks led to an international definition of the innovation campus. First, it is defined in cultural terms. The importance of entrepreneurial culture is fully embodied in the figure of the scientific and institutional entrepreneur, whose individual leadership leads to success (Morabito 2014, p. 60). Second, international examples are reduced to a few basic principles. These constitute "templates" or frameworks for evaluating activities (Sahlin and Wedlin 2008, p. 231); they offer a grammar of project development, without venturing to deliver ready-made recipes. These principles are essentially part of a rationale of decompartmentalization, accessibility and integration. They draw, for the innovation poles, the outline of a connectionist model (Boltanski et Chiapello 1999): "I went to present the main trends to the *Presqu'ile* committee:[28] a grouping of skills and resources in physical ecosystems; a close connection between basic research and technological research; a desire to bring science and society together [...] Second, the architectural quality, corners of conviviality everywhere. And then the proximity between the actors" (Mr. Morabito). In this connectionist vision, common workplaces,[29] associated with material infrastructures and a solid entrepreneurial culture, ensure the mixture of cultures that makes the major innovation clusters successful: "You need a unique crucible, and this crucible must be a melting pot in which disciplines, cultures, research styles meet to create innovation. This magical place is the scientific polygon" (J. Therme, speech at the commemoration of the 50th anniversary of CEA Grenoble, May 2006).

27. LETI is the microelectronics laboratory of CEA Grenoble. With a staff of 1,700, it employs three quarters of those in MINATEC (*source* : *http://www.leti.fr/en/Discover-Leti/About-us*).

28. The *Presqu'île* ("peninsula") or the "scientific polygon" refers to a geographical area located northwest of Grenoble, where, in the second half of the twentieth century, (public and private) research centres and large European projects were located. The "Presqu'île project" is led by a "partnership committee" chaired by the economic assistant of the city of Grenoble and two vice-presidents, including a local elected councilor and the director of CEA Grenoble (Jean Therme) (Libersa 2011, 73, 117).

29. Jean Therme illustrates his public presentations with virtual images of the future MINATEC centre.

By decontextualizing local projects and placing them within a more general definition of innovation campuses, promoters can relegate a local history of obstacles, oppositions and controversies to the background (Hubert *et al*. 2014 83–95). Presented as a characteristic of major world campuses,[30] the research/teaching link signifies the culmination of a project initiated in 1985 but blocked due to lack of funding. Similarly, the continuous dynamisation of "downstream" (innovation) by "upstream" (basic research) is a LETI response to the desire of the CEA management to profoundly restructure its activities because they are deemed too close to those of the industrialists. Finally, the lack of a legal structure for MINATEC is presented as favouring the flexibility of partnerships and the reactivity of the actors (Libersa 2011, p.50). However, this was decided after the failure of a previous project (the Zone de Haute Technologie [High-Tech Zone], Delemarle 2007, p. 146) because of issues over location, but also of organization and distribution of powers. More broadly, the definition of a "MINATEC model" as a space for collaboration[31] disposes of governance issues, which are potentially conflictual and likely to block the rapprochement between the institutions concerned (Delemarle 2007, p. 164).

The MINATEC research teams welcome the definition of the concept of innovation as an external communication operation which, as such, does not reflect any of the very concrete problems they encounter in pooling resources and strengthening their partnerships (Hubert 2014). While some researchers are ironic about the "Travelling salesman function" of the management team, they recognize its effectiveness. Locally, the strategic use of these benchmarks is something staged in numerous meetings:[32] "All these trips had the objective of developing arguments with partners, elected officials, central authorities. When we developed the GIANT project in 2008, we went on the road with Jean Therme and the architect and we had a choir with three voices. I began by giving the international vision, Jean Therme explained to them "this is what we want to do on the local level" and the architect made aesthetic poetry out of the project that took shape" (Marcel Morabito). The editing of the concept of innovation campus also relies on the reference to prototypes.[33] In particular, among the examples likely to illustrate the fundamental characteristics of the campus of innovation, the promoters of MINATEC and GIANT regularly quoted the one best known by their audience: "Like MIT, we have a technopolis in the heart of a city. [...] We have critical mass, 120 hectares, 20,000 people, like MIT, and reception areas all around for businesses." (Jean Therme, speech at the commemoration of the 50th anniversary of CEA Grenoble, May 2006).

30. The director of MINATEC defines the campus as a "mini-ecosystem" of innovation created around its main technological and collaborative research laboratory, LETI, to which training components have been added (an engineering school of the National Polytechnic Institute of Grenoble: Phelma), basic research (laboratories of the INPG and the Institute of Nanosciences and Cryogenics of the CEA and UJF) and companies (rental of premises and creation of joint research teams between industrialists and the CEA).

31. "MINATEC is not a legal entity: it is only a site, a registered trademark and a method of organization based on an agreement signed by all the organizations present on the site, which provides for the appointment of a director and a steering committee." (Guibert 2011).

32. "The development of the strategy behind MINATEC is contained in a set of 102 presentations that span from the end of 1999 to the beginning of 2002 (the signature of the MINATEC framework agreement)." (Delemarle 2007, 78). The argument is developed especially for local authorities that finance the 150 million euros of buildings: *http://www.minatec.org/minatec*.

33. As defined in the section on prototypical editing.

This definition of the innovation campus strikes a chord with elected officials and local manufacturers.[34] Indeed, it fits quite conveniently into the continuity of shared interpretations of the success of previous projects. First of all, the unifying figure of the entrepreneur is a very consensual one and was embodied in the twentieth century in the central role of the “three Louis’s” (Merlin, Néel and Weil) in local development (Libersa 2011, p. 58). Moreover, the supposed virtues of innovation campuses confirm the relevance of the “Grenoble model” as a historical precursor in the matter: “For more than 150 years, Grenoble has owed its success to a Grenoble ecosystem that connects research-university-industry, public and private actors, in effective partnerships and as generators of innovation.”[35] The idea appealed to local actors because it connected the “entrepreneurial city” which is characterized by “the discourse of competition and the market, including in terms of image and identity, the political priority given to economic development issues and the attraction of investment, of population flows and favoured social groups” (Le Galès 2003, p. 287). In the GIANT project, the link between the innovation campus and urban development serves a policy of attractiveness of the territory for internationally mobile actors (students, scientists, engineers). Moreover, beyond its contribution to the argument in favour of projects, the concept of innovation campus provides guidelines for their achievement: a visibility strategy (the definition of MINATEC as an “innovation campus”[36], a big advertising budget, a dedicated team, the presentation of the activities required in order to reach the critical size of world centres[37]); a steering committee of international experts;[38] architectural design and internal activities (aesthetic quality of buildings, spaces for conviviality, unifying events,[39] construction of housing near the scientific quarter of the *Presqu’île,* at the confluence of the Drac and Isère rivers); public accessibility (opening of a visitor centre in 2010).[40]

The Innovation Campus concept is also used with international partners. It aims, initially, to include MINATEC and GIANT in the closed circle of world centres of excellence, and then, in a second stage, to take a leading role. This club rationale is not devoid of strategic ambitions, foreign counterparts being potential contractual partners.[41] The many international visits (about 150 in total in fifteen years, within the framework of benchmarks and activities of the director of Minatec) make

34. Manufacturers do not directly finance MINATEC but contribute through the rental of workspaces and especially through collaboration agreements with the site’s laboratories (LETI in particular).

35 Editorial in the brochure *Presqu’île scientifique* signed by the mayor of Grenoble and his deputy mayor for the economy.

36 The very choice of the term “campus” stems from an analysis of terms used abroad and a desire to differentiate itself from the more technology-oriented technology park model.

37. “We consolidate the budget of all partners present on the site for reasons of international visibility.” (Guibert 2011).

38. Creation of a “visionary board” composed of 13 international experts on the model of some “committees of the wise” (for example, the advisory board of RIKEN in Japan).

39. Including “MIDIS MINATEC”, weekly conferences followed by a buffet for 300 to 400 people.

40. The design of this space was based on a comparison of about 20 science or visitors’ centres of major international campuses. It focuses on informing visitors at the expense of activities where they could play a more active role and debate nanoS & T (Polo 2009).

41. This goal is essential for LETI, for which 75% of its budget comes from contract research. In this respect, the promotion of MINATEC and CEA Tech Grenoble tend to overlap with each other.

the work of the campus visible and present it as something avant-garde. They play the role of advertising campaigns that provide correctives for CEA's image abroad (whose activities are often closely associated with nuclear power). The ambition of leading an international club was concretized in 2012 by the creation by GIANT of a "High Level Forum," which includes 17 international delegations. Presented as a place of exchange of ideas around the concept of innovation campus,[42] this event aimed to sustain the "community" identified during the benchmarks and to forge new partnerships: "When you have the chance to meet one of the founders of Apple or the director of the JPL,[43] it would be absurd to lose these contacts. The more this community meets, the more friendships we create that lead to contracts. At the last High Level Forum, GIANT and NIMS, which is the National Institute of Materials Science in Japan, signed a convention" (Marcel Morabito). Lastly, international visits such as the reception of foreign visitors aim to widely disseminate the "Minatec concept," including in less technologically advanced countries, and to make the local innovation campus the subject of international benchmarks. This ambition is embodied in the creation of the role of director: "I am non-executive. I am here to meet delegations interested in this model, and I welcome about one a week. I took this post of director because it is an international one. Minatec visitors, and especially the Japanese, ask 'where is the director?' We communicate at the shop-window about Minatec; you have to personalise things." (Director of Minatec) The visits of foreign delegations, while promoting the exchange of information and good practices, also promote the potential of the campus by demonstrating it or by providing a "commented exhibition" (Rosental 2009, p. 235).[44] The dissemination of the "Minatec concept" also relies on a formalized offer of expertise whose medium-term objective is to create "a global network of Minatec-certified R & D centres that would share expertise and best practice."[45]

Mimetic editing: the borrowing of management tools

While the first two forms of the editing process operate to extend generality from one or more examples, the third aims to borrow a management tool to reuse it directly in the local context. It is no longer a process used by observers or advisers, but by "operational" actors (managers of national programmes, schemes or targeted actions in innovation poles) confronted by a problem and looking for an innovative solution. Such actors then use an example for its heuristic value, where uncertainty about the best solution tends to favour analogical reasoning (identification of similar problems and transposition of adopted solutions) as well as the experimental dimension of the editing process (testing a technique already identified as effective abroad). By definition, the sources of inspiration are very numerous and

42 The forums focused on the governance of research (2012), its commercialization (2013), and new areas of innovation (2014)*: www.giant-grenoble.org/en/discover-giant/110-high-level-week/813-high-level-forum*

43. *Jet Propulsion Laboratory* (Pasadena, USA): NASA laboratory managed by Caltech and responsible for the construction and supervision of NASA's unmanned space flights.

44. Delegations that involve political leaders also pursue diplomatic goals. This was the case of the visit of the Argentine Minister of Research in March 2014, received by his French counterpart, which marked the launch of bilateral cooperation programmes.

45. Since 2013 MINATEC has been commercialising its services under the name of "MINATEC-Nanolab": *http://www.40-30.com/groupe/minatec-nanolab*.

the choice of a technique implies a certain confidence in its relevance, whether it comes from the undisputed leader (the United States) or one that the policy makers for nanoS & T at least know how to operate (in the absence of being able to evaluate its effects in its original situation). From then on, they have two ways to identify examples they can borrow: firstly, they can imitate a leader—in this case the United States—whose success seems to be clearly evident (Haveman 1993); secondly, they can import foreign techniques where they are familiar with their operation (resulting from their own mobility or from international collaboration).

Firstly, French policy makers may copy two aspects of American policies: they identify rules and management tools as long-term success factors for the NNI or some of its programmes; they copy alterations in scientific priorities, convinced that the United States sets the international tone in this area. On the one hand, they borrow certain management tools from the world leader who benefits from several years of advance and is therefore supposed to have tested and validated their effectiveness. In particular, unlike their predecessors, the two leaders of P-Nano from 2008 to 2012 were inspired by the US policy for nanoS & T to justify the existence and ensure the financial sustainability of their programme. They relied on direct exchanges with their counterpart at the National Science Foundation as well as on the important editing process carried out by American agencies on their strategies, via the drafting of strategic agendas or *roadmaps*: "I did not find such structured and explicit strategy documents for other countries. To obtain financing, you have to convince Congress and get yourself set up to do the lobbying. And they all have these relationships." (P-Nano Programme Manager 2010–2012).

Unlike the version of the NNI that circulated as a public policy prototype between 2002 and 2004, P-Nano officials in this case go into the content and the workings of the NNI in order to precisely identify the fiscal and economic dynamics of the NNI and its priorities. They were influenced by the transversal structure of the NNI to construct the coherence of their policy and justify the level of public investment in nanoS & T:[46] "When I summarized research in Nano at the ANR, I collected up all the nano research projects funded from non-targeted programs […] I took the entire nanos value chain, just as in the NNI. I consolidated the numbers and included infrastructure, basic research and technological or collaborative research. It allowed me to recover funding from ANR management by showing that our vision of financing this vast topic of nanoS & T was really coherent. I was increasing my budget every year. Not in the programming phase, but in the negotiation phase." (P-Nano Programme Manager 2007–2009). In addition, they define the specific contribution of their programme and legitimize its place in the funding agency[47] by positioning it on a "technological maturity" scale developed by US agencies.[48] The organization of technology platforms also involves the importation of certain solutions from the

46. The first presentation of this consolidated budget appeared in the ANR 2010 call for projects.

47. The nano programme accounted for around 50% of the nanoS & T budget consolidated at the ANR level. This presentation could no longer fully support the P2N program after 2010. Its transversal nature weakened it at a time when the agency was reducing its thematic programmes in favour of the open ended "programme". The annual budget of the nano program thus reduced from 40 million euros in 2008 to 34 in 2009, 33 in 2010, and 22 in 2011.

48. See the *Cahiers de l'ANR* concerning NanoS & T (2012, p.26). The *Technology Readiness Level* scale was developed by the US Department of Defense and NASA. It defines a continuum from the most fundamental research to industrial innovations.

American leader. Thus, in the late 2000s, the RTB network harmonised the invoicing of its platforms by following its American counterpart:[49] "We visited three American infrastructures. Our equipment invoicing system was inspired by how they invoice for each piece of equipment in the cleanroom. In the beginning, we went astray a bit by charging only for the time it was used." (director of a technology centre since 2004). The European Nano-Characterization Laboratory established in 2013 is directly inspired by the NNI-funded Nanotechnology Characterization Laboratory (NCL), whose infrastructure it describes as being its "mirror-image." Its technical and administrative procedures are similar to those of the NCL: "We will need several levels of analysis and duplicates for each analysis, so quality control is a real headache. They have ten years of experience. During the first two years, we will send engineers and technicians there to learn about specific techniques. Training will also be provided on the overall management of this infrastructure, and on samples and quality-control" (Head of the European Technology Platform for Nanomedicine). Nevertheless, the rules of the European Commission dictate that it must be financed as a dispersed infrastructure (unlike that of the NCL which is centralized):

> "In the first phase of the project of this nanocharacterization infrastructure, when I came back from the United States, I was saying "we're going to have to copy and paste." This is what I started to negotiate with the Commission as chairman of ETPN [European Technology Platform for Nanomedicine]: "we need to build a single site, so where can we put it in Europe?" We could have done that in 6 months. But the idea of making a big centre, to focus the money, is not what is done in Europe (i.e, the EU). There is always the golden rule: it doesn't matter what the project is, [there must always be] three partners, three countries minimum. So we have 7 platforms that exist today, with their buildings and equipment, and we are trying to organize ourselves. There is a single point of entry. After that, where will my sample go, who will do what, it's invisible. It's a black box. It's as if everything is in the same building except that in this case, the sample will go to Switzerland, Norway, England, Ireland, Italy, etc." (Idem).

On the other hand, those in charge of the P-Nano programme pass on certain reorientations of American scientific programming. This type of imitation vis-à-vis the North American leader comes in the context of conflicting discussions among the actors of science policy for nanoS & T as to the definition of tender submissions. Members of the P-Nano sectoral scientific committee defend the definition of thematic priorities, while others claim to maintain a "bottom-up" logic of structuring scientific communities: "At that time [N.B. in 2009–2010] we tried to define the areas on which we could put an emphasis. In other words, (to see) whether we are covering gaps or speeding up areas with big opportunities. Let's make choices so that we can focus our efforts for a long enough period. This rationale was not completely shared in the Sector Committee." (Vice-Chair of the P-Nano Sector Committee in 2009). Those who defend the strengthening of a rationale for earmarking or targeting funds are far from considering the NNI as the model to follow, and they criticize its inadequacy in the French context: "One of our issues in 2010 was how to say that we had to get out of it [NB: out of following the NNI agenda]. At the French level, with limited resources, gaping holes in terms of skills, we had to think about it. We were sick of programmes that are useless because they try to do everything. It's the French specialty." (Chair of the P-Nano Sector Committee from 2007 to 2009). Nevertheless, the reference to the North American leader influences certain strategic

49. It thus follows the recommendations of the international expert committee (set up by the French Ministry of Research) which annually evaluates the network.

directions that the leaders of P-Nano take, convinced that the United States defines the international technological agenda.[50] In particular, keeping a close eye on the NNI agendas confirms, according to them, the relevance of the thematic evolution of P-Nano, now renamed Programme Nanosciences, Nanotechnologies et Nanosystems (P3N) in 2009: "I reconfigured the programme to give it a nanosystems dimension that was missing when we read the NNI strategic agendas. It also took into account industrial demands coming from the ministries or manufacturers on the steering committee." (P-Nano Programme Manager 2007–2009).[51] This also confirmed the need for an application turnaround: "It was noted in a series of documents published on the occasion of the 10th anniversary of the NNI,[52] that the United States had said: we have done a lot of upstream research work; now we have to start seeing their effects. We quickly reorganized our themes to follow this rationale. If the Americans see it this way, we cannot escape it either." (P-Nano Programme Manager 2010–2012). In 2009, for example, developments in the NNI confirmed the abandonment of the objective of structuring communities that had justified the creation of the P-Nano program in 2005, as well as the reorientation of the new P3N program towards applied research. This switch towards applications continued in 2010[53] because of the general policy of the agency. The (more fundamental) theme of nanoscience is now attached to the non-specific programme (which now represents 50% of the ANR budget) and P3N has become P2N (Nanotechnologies and Nanosystems).

Borrowing from more diversified sources results from the professional experience of programme managers who thus operate a form of "network bricolage" (Baker *et al*. 2003).[54] Consequently these actors are able to spot some foreign solutions quite fortuitously, either as a result of their monitoring or reviewing activities in the field, contacts with foreign colleagues or prior professional experience. These borrowings are fairly targeted and rely on a relatively detailed knowledge of the system. They relate to elements that, like the project evaluation criteria, fit easily

50. Members of the sectoral committee of P-Nano criticized this follow-my-leader attitude and perceived a lack of originality in science policy: "If you're not very pro-European, if you want to take some distance from things, you don't look close to home. You'll look at the catalogue of our big brother in the United States. This is one of the strengths of what Roco [N.B. Director of Nano Programmes for the NSF and NNI Co-ordinator] did by constructing his technological generations [N.B. allusion to NNI "roadmaps" that describe potential developments in nanoS & T]. He provided an intellectual framework for thinking about what programmes to have." (Chairman of the P-Nano Sector Committee from 2007 to 2009).

51. The references to foreign examples appear in the 2009 call for projects: "All the strategic roadmaps today insist on the 'system' or even 'system of systems' dimension that must be taken into account." (Call for Projects 2009, p.5).

52. These documents establish the advent of a "nano 2" phase (2011–2020) "dominated by an R & D ecosystem driven by socio-economic considerations" (Roco *et al*. 2010, chapter intro., p. 42). The *Cahiers de l'ANR* devoted to nanotechnologies (2012, pp. 15–6) uses this analysis to introduce the "new era" for nanoS & T.

53. Co-financing by the Directorate General of Armaments (Direction Générale de l'Armement), a full partnership programme with industry.

54. Ted Baker *et al*. (2003, p. 265) define *network bricolage* as the building of a range of instruments from pre-existing networks.

55. The lack of flexibility of French programme managers prevents them from undertaking more structural reforms: "Roco [N.B. the NSF Nano Programme Manager and NNI Coordinator] had an envelope of 20% of the budget at his discretion. I have proposed this to the ANR, but it has always been refused. Before funding anything, the steering committee of the programme must agree. The ISO 9001 process removes all clientelism but is a bit rigid."(P-Nano Program Manager 2007–2009).

into the national architecture, while respecting the procedures in place:[55] “For the calls for projects for the Nano-Innov initiative[56], we included patents in the research indicators. They required two patents per million euros of grant-funding. I found that in the California regional projects when I was doing bibliographic and scientific monitoring at the ANR. In Singapore they also are asking for patents in the research indicators.” (P-Nano Programme Manager 2007–2009). However, despite the technical dimension of the measures tested or the circumscribed nature of the changes introduced, these experiments do have a political dimension, and their initiators are seeking, both at their own level and indirectly, to transform the research system and its operating standards. Thus, in the nanoS & T field, the borrowings have more particularly concerned dimensions of scientific policies for which statements of failure were often put forward, such as the “insufficiency” of technological transfer from fundamental research: “The researcher is sometimes a little bit in his own ivory tower, in the process of gilding the lily. [...] Sometimes, forcing a system changes the intellectual paradigm and people are wired differently.” (2007–2009 P-Nano programme leader, on the introduction of patent indicators based on California and Singapore). Similarly, in terms of science-society relations, a failure of participatory experiments of the “public debate” type led the MINATEC leaders to entrust training and the opening up of laboratories to the “general public” to a director formerly responsible for “nanoS & T education” at an American university.[57]

*

* *

The major international paradigms in terms of research and innovation policy play a role in the definition and implementation of the nanoS & T financing policies deployed in France in the 2000s (calls for tenders for research projects, infrastructure financing, creation of local innovation poles). At the scale of this sector, we show that the internationalization of science policies is not the product of explicit recommendations produced by international actors—which favour isomorphism by their coercive action (DiMaggio and Powell 1983) -, but borrowing from examples of various geographical origins, among which North American policies are at the forefront. Our research shows that the editing processes of different versions of examples (Sahlin and Wedlin 2008) is essential to this form of internationalization of scientific policies in France, both from the point of view of the identification of which international examples to borrow and their inscription in an institutional and political context. We differentiate three major editing methods depending on the actors involved (editors and “users” of the editorial process), the content of the editing and its objectives (from the setting in debate of a policy to the reorientation of a funding programme). However, these three terms are not mutually exclusive. For example, during a comparative editing process, the description of a

56. Nano-Innov was a 70 million euro programme launched in 2009 as part of the French government’s “Recovery Plan” (Plan de Relance).

57. The head of the “nano @ school” and the “Minatec Summer Programme” has been running an educational programme for seven years in the United States funded by the National Science Foundation (Genin 2011) and was deliberately recruited to put similar projects in place. She was influenced in this by her American experience on several points (students can experiment on the site; training in using the experimental approach is part of their curriculum).

prototype can illustrate a research project rationale or give substance to the proposed concept.[58] The search for foreign solutions that motivates mimetic editing can benefit from the description of a prototype[59] or an earlier comparative editing.[60] A comparative editing process can produce a new model (or concept) that will inspire prototypical or mimetic editing when it is implemented in another national or local context.[61] In this sense, the editing of foreign examples feeds an incremental evolution of international models of research and innovation policy, without necessarily involving a paradigmatic shift (Hall 1993, p. 282).

This research opens up two lines of reflection on the actors, the mechanisms and the contents of the internationalization of science policy. First of all, it allowed us to identify the constraints of decontextualization and recontextualisation that weigh on the borrowing of foreign examples in scientific policies. In the policies for nanoS & T, these constraints are present whether the examples are described as prototypes, systematically compared in order to define a concept of public action, or copied to borrow a management tool. In all three cases, the process of editing aims to solve the paradox that it is difficult, if not impossible, to imitate foreign competitors, but useful, even necessary, to be inspired by them. It allows the examples to be used in a purely ceremonial way (Meyer and Rowan 1977) to legitimize policies that are also the result of national (or subnational) rationales, or within the production of an argument intended to convince investors, either in the implementation of a policy. Whatever the circulating content, the edition of foreign examples in a way accentuates the isomorphism or formal resemblance between the policies of different countries. However, while the first works on institutional isomorphism insisted on the socio-political logics that push organizations of the same field to resemble each other (DiMaggio and Powell 1983), the processof editing emphasizes the construction, by multiple actors, of the conditions of this isomorphism, the dimensions on which the similarity bears, and the uses that are made of it.

Thus, the description of a prototypical example brings to light issues of scientific policy (the coordination of initiatives, the pooling of technological means, the encouragement of research on the "impacts" of science and technology in the case of nanoS & T). The search for similarities then focuses less on public action solutions to be imported as a "turnkey" than on new elements of the framing debates around the national management of research in the field of nanoS & T (and even beyond) following the launch of the first French programmes. Comparative editing, on the other hand, is created from a set of similar examples systematically compared to produce a global concept of public action (in this case the concept of "innovation campus"). The construction of similarities between the local situation and this global solution

58. We have mentioned earlier that the promoters of the Grenoble innovation pole in nanoS & T often cite MIT to illustrate their concept of innovation campus.

59. One might wonder if the multiple descriptions of the NNI as a prototype for public action could also help to reinforce the sense of US leadership and the relevance of importing North American solutions.

60. Thus, the benchmarks conducted within the framework of the Grenoble innovation poles allow them to identify and import specific approaches.

61 Thus the "MINATEC model", the result of a process of comparative editing, became the prototype which inspired the creation of competitiveness clusters (Blanc 2004). It also supplies the exchange of best practice within the framework of the High Level Forum and the supply of services to facilitate its transposition (mimetic editing) for emerging countries (for the MINATEC-Nanolab product offer, see section on comparative editing).

is based on the presentation of a new international environment within which it would be necessary to be integrated to remain in the techno-economic competition. Comparative editing aims to identify a "rational myth" (Hatchuel 1998) and representations of success much more than a model to imitate. This rational myth is anchored in a very vague formal substratum (the various "components" of the campus) from which collective dynamics and learning must develop. Finally, mimetic editing deals with partial borrowings (a theme from a strategic agenda, a procedural element from a call for tenders, a platform organization rule, etc.) from which the editors copy the original formulation. This type of importation corresponds to the unique situation of mimicry encountered in the case of nanoS & T. It consists in drawing on a range of instruments that can be directly transferred—without having necessarily been evaluated or systematically compared—and finding their utility on a case-by-case basis, depending on the readjustment of the programmes and the need to justify their sustainability—in demonstrating, for example, the coherence of a transversal programme through consolidation of its budget, or promoting technology transfer through patent criteria.

Furthermore, at the scale of the scientific and technological sector, we observe a certain complementarity between the three major modes of circulation of the ideas identified in the sociological literature (Dobbin *et al*. 2007). Underpinned by different types of social exchange, they correspond to distinct ways of establishing the relevance and legitimacy of the examples that will be edited. The first is a tendency to "follow the herd" vis-à-vis the undisputed foreign leader (ibid., P.452). In the field of science and technology, as in other fields, the United States has been the reference point here since the beginning of the twentieth century (Charle 2003). In nanoS & T policies, the influence of this leadership takes two forms: on the one hand, US federal policy when represented as a prototype is very present in scientific policy debates (but does not influence the decisions taken); on the other hand, programme leaders are turning to the United States to import management approaches. American examples circulate thanks to the monitoring of their research activity by French editors (on the internet, through contacts with US officials or international visits) and by their American counterparts, who provide a form of economy in the search for information and in the production of arguments. Thus, for nanoS & T, the choice of the United States as a leader (rather, for example, than Japan or Germany), comes partly from the information constraints that weigh on editors.[62] A second mechanism in the international circulation of nanoS & T policies is the "theorization of solutions by experts" (Dobbin *et al*. 2007, p.453), which favours normative isomorphism, in other words a compliance with the practices and ideas of collaborating and competing countries (DiMaggio and Powell 1983). The analysis in terms of editing processes highlights how these experts—in the policies for nanoS & T, strategy and as communication advisers—construct the similarity between peers, notably by systematically comparing foreign examples with a view to benchmarking and the identification with a "club" (comprising the world's major hubs in nanoS & T). While

62. As evidenced in particularr by the search for examples of "editable" foreign policies (because already "edited" by their promoters): "Despite the profusion of documents, it is impossible to make quantitative comparisons: the documents only offer partial visions, the data do not cover the same elements, the share of personnel costs varies considerably. The scope of the task that aims to compile a quantitative synthesis including researchers involved, infrastructure, etc. is such that no scientific department of an embassy that had been asked to do this wanted to make this synthesis for the country within its own jurisdiction. (Académie des Technologies 2002, p. 37).

the comparative editing of the examples allows the ideas (the concept of innovation campus) to circulate without direct contact, it also reinforces a club rationale that facilitates, in return, direct contacts between its members (world-class innovation campuses). Finally, a last form of circulation is the adoption of a foreign system in use in what is seen as a similar situation (Dobbin *et al*. 2007, p.453). The analysis in terms of editing emphasizes here the power of mimicry, since indecision over the best solution as well as the relatively technical character of the problem being encountered both favour analogical reasoning (identification of similar problems and the search for solutions which work elsewhere). In this case the editors are those responsible for programmes, medium-sized agencies or technology platforms that borrow examples on the basis of their personal networks or experience. Thus practices circulate for reasons of structural homology (Burt 1987) or through direct contacts. If the identification of the system can be rather fortuitous, its importation supposes a sufficiently precise knowledge, as well as an appreciation, on the part of the person in charge, of its relevance and its effects.

Although we have been primarily concerned with the scientific policies conducted in France in the context of this article, several observations lead us to argue that this form of internationalization is not specific to the latter, but is also operating in others national contexts. Thus, while the description of the NNI as a prototype for public action uses the old argument of the "French lag" vis-à-vis the United States to plead in favour of a major programme (Bouchard 2007), a reference to this "lag" is also very obvious in other national and European documents,[63] and testifies to the more general importance of the American example in the science policy debates in the field of nanoS & T.[64] Moreover, the definition and implementation of the international concept of innovation campus can be interpreted as the deployment, in France, of a form of internationalization of scientific policies much in evidence abroad—in particular through the intermediary of consulting firms in technological management[65]—and also motivated by the concern for a "national catch-up" on a mode of organization present in technologically advanced countries.[66] Lastly, the recurrent exchanges between programme managers in several countries[67] also underline that the search for "best practice" among professional networks is a quite widely-shared concern among these actors, and that it is not limited to the French case.

63. In addition, the reference to the United States appears twenty times in the European Commission's Communication "Towards a European strategy for nanoS & T", 12 May 2004, 30 p.

64. In these debates, the reference to the example of the NNI is all the more central since its launch came at a time when the vision of the predominantly economic role of science and technology was becoming stronger in Europe (the Lisbon European Strategy on the "Knowledge Economy" was launched in 2000) and in the United States (Johnson 2004).

65. For example, the International Triple Helix Institute founded by Henry Etzkowitz. He theorized the dynamic interactions between public authorities, scientists and industrialists as a "Triple Helix" (see note 14) and works with science parks, public authorities, companies and universities: *http://www.triplehelix.net/*.

66. See the Minatec-Nanolab proposals for emerging countries (section on comparative editing).

67. Bilateral exchanges initiated to strengthen inter-agency collaboration on certain programmes (such as the European Research Area Networks—ERA-NET—tenders jointly launched by several national agencies); or broader exchanges organized by international bodies for reflections and lobbying on science policy (for example, the "Science Europe" association, which brings together representatives of 47 European funding agencies*: www.scienceeurope.org*).

Séverine LOUVEL

PACTE—Sciences Po Grenoble
Institut d'Études Politiques de Grenoble
1030, avenue centrale
Domaine Universitaire—38400 Saint-Martin-d'Hères

Epidapo
UCLA Institute for Society and Genetics
Box 957221, 3317 Life Sciences Building
621 Charles E. Young Dr. South
Los Angeles, CA 90095-7221—USA

severine.louvel@iepg.fr

Matthieu HUBERT

Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET)
Universidad Nacional de Quilmes
Departamento de Ciencias Sociales
Roque Saez Peña 352
B1876BXD Bernal—Argentine

matthieu.hubert@conicet.gov.ar

General Bibliographic References

AUST, J., PICARD, E. 2014. "Gouverner par la proximité," *Genèses* 1: 7–31.
BAKER, T., MINER, A. S., EESLEY, D. T., 2003. "Improvising firms: Bricolage, Account Giving and Improvisional Competencies in the Founding Process," *Research Policy* 32(2): 255–76.
BOLTANSKI, L., CHIAPELLO, E., 1999. *Le nouvel esprit du capitalisme*. Paris: Gallimard.
BORRÀS, S., BIEGELBAUER, P., 2003. *Innovation Policies in Europe and the US: The New Agenda*. Aldershot: Ashgate.
BOUCHARD, J., 2007. "Le retard, un refrain français," *Futuribles* 335: 48–72.
BRESNAHAN, T., GAMBARDELLA, A., SAXENIAN, A. L., 2001. "'Old Economy" Inputs for 'New Economy' Outcomes: Cluster Formation in the New Silicon Valleys," *Industrial and Corporate Change* 10(4): 835–60.
BURT, R. S., 1987. "Social Contagion and Innovation: Cohesion versus Structural Equivalence," *American Journal of Sociology* 92(6): 1287–335.
CALLON, M., 1986. "Éléments pour une sociologie de la traduction. La domestication des coquilles Saint-Jacques et des marins-pêcheurs dans la baie de Saint-Brieuc," *L'Année Sociologique* 36: 169–208.
CHARLE, C., 2003. "Les références étrangères des universitaires. Essai de comparaison entre la France et l'Allemagne, 1870–1970," *Actes de la Recherche en Sciences Sociales* 148: 8–19.

COLEMAN, J. S., KATZ, E., MENZEL, H., 1966, *Medical Innovation*. New York, NY: Bobbs-Merrill.

DELEMARLE, A., 2007, *Les leviers de l'action de l'entrepreneur institutionnel: le cas des micro- et nanotechnologies et du pôle grenoblois*. Paris: Laboratoire Techniques, Territoires et Sociétés, Doctoral thesis.

DELPEUCH, T., 2008. "L'analyse des transferts internationaux de politiques publiques : un état de l'art," *Questions de Recherche/Research in Question* 27: 1–69.

DIMAGGIO, P. J., POWELL, W. W., 1983. "The Iron Cage Revisited: Institutional Isormorphism and Collective Rationality in Organizational Fields," *American Sociological Review* 48(2): 147–60.

DOBBIN, F., SIMMONS, B., GARRETT, G., 2007. "The Global Diffusion of Public Policies: Social Construction, Coercion, Competition, or Learning?," *Annual Review of Sociology* 33: 449–72.

DOLOWITZ, D., MARSH, D., 1996. "Who Learns What from Whom: A Review of the Policy Transfer Literature," *Political Studies* 44(2): 343–57.

ELZINGA, A., JAMISON, A., 1995. "Changing Policy Agendas in Science and Technology" dans S. JASANOFF, ed., *Handbook of Science and Technology Studies*. London: Sage.

ETZKOWITZ, H., LEYDESDORFF, L., 1997. *Universities and the Global Knowledge Economy: A Triple Helice of University-Industry-Government Relations*. London: Cassel Academic.

FERLIE, E., MUSSELIN, C., ANDRESANI, G., 2008. "The Steering of Higher Education Systems: A Public Management Perspective," *Higher Education* 56(3): 325–48.

GENIN, M., 2011. *Un dispositif pédagogique innovant à la croisée des mondes de l'éducation et de la recherche scientifique: le programme Nano@school*. Grenoble, Mémoire de Master de L'IEP.

GIBBONS, A., LIMOGES, C., NOWOTNY, H., SCHWARZMANN, S., SCOTT, P., TROW, M., 1995. *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies*. London: Sage.

GODIN, B., 2002. "Rhetorical Numbers: How the OECD Constructs Discurses on S&T," Montréal, Project on the History and Sociology of Science and Technology Statistics, *Working Papers* 19.

HAAS, P., 1992. "Epistemic Communities and International Policy Coordination," *International Organization*, 46(1): 1–35.

HALL, P. A., 1993. "Policy Paradigms, Social Learning, and the State: The Case of Economic Policymaking in Britain," *Comparative Politics* 25(3): 275–96.

HATCHUE,L A., 1998. "Comment penser l'action collective? Théorie des mythes rationnels" dans R. DAMIEN, A. TOSEL, eds, *L'action collective. Coordination, planification conseil*, Besançon, Annales Littéraires de l'Université de Franche Comté, pp. 177–202.

HAVEMAN, 1993. "Follow the Leader: Mimetic Isomorphism and Entry into New Markets," *Administrative Science Quarterly* 38(4): 593–627.

HENRIQUES, L., LARÉDO, P., 2013.. "Policy-Making in Science Policy: The "OECD Model" Unveiled," *Research Policy* 42(3): 801–16.

HUBERT, M., 2014. *Partager des expériences de laboratoire. La recherche à l'épreuve des réorganisations*. Paris: Éditions des Archives Contemporaines.

HUBERT, M., CHATEAURAYNAUD, F., FOURNIAU, J.-M., 2012. "Les chercheurs et la programmation de la recherche: du discours stratégique à la construction de sens," *Quaderni*, 77: 85–96.

Hubert, M., Jouvenet, M., Vinck, D., 2014. "Politiques "de l'innovation" et transformations des mondes scientifiques. Le pari des nanosciences et nanotechnologies à Grenoble" dans J. Aust, C. Crespy, eds, *La recherche en réformes : les politiques de recherche entre État, marché et profession*. Paris: Éditions des Archives Contemporaines, pp. 79–108.

Invernizzi, N., Hubert, M., Vinck, D., 2014. "Nanoscience and Nanotechnology: How an Emerging Area on the Scientific Agenda of the Core Countries Has Been Adopted and Transformed in Latin America" in M. Eden *et al.,* eds., *Beyond Imported Magic. Essays on Science, Technology, and Society in Latin America*. Cambridge, MA: MIT Press, pp. 223–42.

Johnson, A., 2004. "The End of Pure Science: Science Policy from Bayh-Dole to the NNI" dans D. Baird, A. Nordmann, J. Schummer, eds, *Discovering the Nanoscale*. Amsterdam: IOS Press, pp. 218–30.

Kleinman, D. L., 1994. "Layers of Interests, Layers of Influence: Business and the Genesis of the National Science Foundation," *Science Technology Human Values* 19(3): 259–82.

Kostoff, R. N., Koytcheff, R. G., Clifford, G., Lau, Y., 2007. "Global Nanotechnology Research Metrics," *Scientometrics* 70(3): 565–601.

Kuhn, T. S., 1972. *La structure des révolutions scientifiques*. Paris: Flammarion.

Kuhn, T. S., 1990. *La tension essentielle. Tradition et changement dans les sciences*. Paris: Gallimard.

Lanciano-Morandat, C., Verdier, E. 2005. "Les politiques nationales de r-d et d'innovation (rdi) : pour une analyse comparée en termes de conventions d'action publique" *Cahiers de Recherche Sociologique* 40: 11–46.

Larédo, P., 2003. "Vers un espace européen de la recherche et de l'innovation" in P. Mustar, H. Penan, eds, *Encyclopédie de l'innovation*. Paris: Économica, pp. 665–91.

Larédo, P., 2009. "La recherche européenne et les enjeux des nouvelles sciences dominantes" in J.-P. Leresche, P. Larédo, K. Weber, eds, *Recherche et enseignement supérieur face à l'internationalisation. France, Suisse et Union européenne*. Lausanne: Presses Polytechniques et Universitaires Romandes, pp. 27–50.

Larédom P., Delemarlem A., Kahanem B., 2010. "Dynamics of Nanoscience and Technology: Policy Implication," *STI Policy Review* 1(1): 43–62.

Le Galès, P., 2003. *Le retour des villes européennes. Sociétés urbaines, mondialisation, gouvernement et gouvernance*. Paris: Presses de Sciences Po.

Lepori, B, Van Den Besselaar, P., Dinges, M., Poti, B., Reale, E., Slipersaeter, S., Thèves, J., Van Der Meulen, B., 2007. "Comparing the Evolution of National Research Policy: What Patterns of Change," *Science and Public Policy* 34(6): 372–88.

Libersa, M., 2011, *Politiques locales, économie du politique. Représentations et discours de la presqu'île grenobloise*, Grenoble, Mémoire de master de l'IEP.

Louvel, S., 2015. "Ce que l'interdisciplinarité fait aux disciplines: une enquête sur la nanomédecine en France et en Californie," *Revue Française de Sociologie* 56(1): 69–97.

Louvel, S., 2016. "Going Interdisciplinary in French and us Universities: Organizational Change and University Policy" in E. Popp Berman, C. Paradeise, eds, *The University Under Pressure*. Bingley: Emerald Press, pp. 329–59.

Lundvall, B. Å. (ed.), 2010, *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*. London: Anthem Press.

Meyer, J., Ramirez, F., Frank, D., Schofer, E., 2007. "Higher Education as an Institution" in P. J. Gumport, ed., *The Sociology of Higher Education: Contributions and Their Contexts*. Baltimore, MD: Johns Hopkins University Press, pp. 187–221.

Meyer, J. W., Rowan, B., 1977. "Institutionalized Organizations: Formal Structure as Myth and Ceremony," *American Journal of Sociology* 83(2): 340–63.

Nordmann, A., 2009. "European Experiments," *Osiris* 24(1): 278–302.

Pestre, D., Jacq, F., 1996. "Une recomposition de la recherche académique et industrielle en France dans l'après-guerre, 1945–1970 : nouvelles pratiques, formes d'organisation et conceptions politiques," *Sociologie du Travail* 38(3): 263–77.

Polo, C., 2009, *Communiquer éthiquement en situation d'incertitude : quelle(s) ouverture(s) au grand public pour un pôle de recherche en nanotechnologies? Exemple des relations publiques du centre MINATEC, activités "Science & Société,"* Grenoble, Mémoire de master 2.

Porter, M., 1998. "Clusters and the New Economics of Competition," *Harvard Business Review*, November–December: 77–90.

Rogers, E. M., *Diffusion of Innovations*. New York, NY: Free Press, 5th edn.

Rosental, C., 2009. "Anthropologie de la démonstration," *Revue d'Anthropologie des Connaissances* 3(2): 233–52.

Sahlin, K., Wedlin, L., 2008. "Circulating Ideas: Imitation, Translation and Editing," *The Sage Handbook of Organizational Institutionalism* Los Angeles, CA: Sage, pp. 218–42.

Sahlin-Andersson, K., 1996. "Imitating by Editing Success. The Construction of Organizational Fields and Identities" in B. Czarniawska-Joerges, G. Sevón, eds, *Translating Organizational Change*. Berlin: De Gruyter, pp. 69–92.

Shinn, T., 2002. "Nouvelle production du savoir et triple hélice. Tendances du prêt-à-penser les sciences," *Actes de la Recherche en Sciences Sociales* 141: 21–30.

Strang, D., Macy, M. W. 2001. "In Search of Excellence: Fads, Success Stories, and Adaptive Emulation," *American Journal of Sociology* 107(1): 147–82.

Strang, D., Meyer, J. W., 1993. "Institutional Conditions for Diffusion," *Theory and Society*, 22(4): 487–511.

Ulnicane, I., 2015. "Broadening Aims and Building Support in Science, Technology and Innovation Policy: The Case of the European Research Area," *Journal of Contemporary European Research* 11(1): 32–49.

Van Der Meulen, B., Rip A., 1998. "Mediation in the Dutch Science System," *Research Policy* 27(8): 757–69.

References—Primary sources

Académie des Technologies, 2002. *Les Nanotechnologies : enjeux et conditions de réussite d'un projet national de recherche*, Report by the Académie des Technologies' workgroup.

Académies des Sciences et des Technologies, 2004. *Nanosciences—Nanotechnologies*, Report by the Académie des Sciences sur la Science et la Technologie n°18, carried out with the Académie des Technologies.

Agence Nationale de la Recherche, 2012. "Les nanotechnologies : un nouveau paradigme," *Les cahiers de l'ANR*, 5.

Bernier, P., Cognet, G., Coouvreur, P. *et al.*, 2005. *Nanosciences et Nanotechnologies. Une réflexion prospective*, Report for the Mission Scientifique, Technique et Pédagogique du Ministère Délégué à la Recherche.

Blanc, C., 2004. *Pour un écosystème de la croissance: rapport au Premier ministre*. Paris: La Documentation Française.
Carlac'h, D., Hemery, Y., 2004. Étude prospective sur les nanomatériaux. Study by Développement & Conseil pour le Compte du MINEFI/DGITIP/SIMAP.
Guibert, J.-C., 2011. "Un grand campus d'innovation technologique: de MINATEC à GIANT," *Le Journal de l'Ecole de Paris du Management* 87: 37–44.
Hérino, R., 2005. "Les efforts de Recherche & Développement en Nanotechnologies aux USA." Report by the Mission pour la Science et la Technologie de l'Ambassade de France à Washington.
Juppé, A., Rocard, M., 2009. *Investir pour l'avenir. Priorités stratégiques d'investissement et emprunt national*. Paris: La Documentation Française.
Ministère de la Jeunesse, de l'Éducation Nationale et de la Recherche, 2004. *Le financement des nanotechnologies et des nanosciences. L'effort des pouvoirs publics en France. Comparaisons internationals*. Report by A. Billon, J.-L. Dupont, G. Ghys.
Ministère de l'Écologie et du Développement Durable, 2006. *Nanotechnologies, nanoparticules : quels dangers, quels risques?* Report by the Comité de la Prévention et de la Précaution.
Morabito, M., 2014. *Recherche et innovation. Quelles stratégies politiques*. Paris: Presses de Sciences Po.
Nordmann, A., ed., 2004. *Converging Technologies for the European Knowledge Society*. Brussels: European Commission.
Observatoire des Micro et Nanotechnologies, 2010. *Veille sociétale appliquée aux nanosciences et nanotechnologies*, by B. Hennequin, D. Delacoux.
Office Parlementaire d'Evaluation des Choix Scientifiques et Technologiques (OPECST), 2003. *Rapport sur l'évolution du secteur des semi-conducteurs et ses liens avec les micro et nanotechnologies*, by C. Saunier (senator).
Office Parlementaire d'Evaluation des Choix Scientifiques et Technologiques, 2004. *Nanosciences et progrès médical*, by J.-L. Lorrain, D. Raoul (senators).
Office Parlementaire d'Evaluation des Choix Scientifiques et Technologiques, 2006, *Compte rendu de l'audition publique du 7 novembre 2006 sur "Les nanotechnologies : risques potentiels, enjeux éthiques*. by H. Revol (senator), C. Birraux (deputy).
Périssol, P.-A., 2004, *Avis au nom de la commission des affaires culturelles sur le projet de loi de finances pour 2005 : recherche et nouvelles technologies*, 1864, Tome x.
Reillon V., 2011, *Dix ans de nanotechnologies aux États-Unis—Histoire, bilan et perspectives du programme National Nanotechnology Initiative*. Report by the Mission pour la Science et la Technologie de l'Ambassade de France à Washington.
Roco, M. C., Bainbridge, W. S., eds, 2002. *Converging Technologies for Improving Human Performance. Nanotechnology, Biotechnology, Information Technology and Cognitive Science*. Arlington, VA: National Science Foundation.
Roco, M. C., Mirkin, C. A., Hersam, M. C., 2010. *Nanotechnology. Research Directions for Societal Needs in 2020*. WTEC Panel report.
Roure, F., Dupuy, J.-P., 2004. *Les nanotechnologies: éthique et prospective industrielle*. Paris: Conseil Général des Mines.
Taylor, J. M., 2002. *New Dimensions for Manufacturing: A UK Strategy for Nanotechnology*. London: Office of Science and Technology.