Research Report Learning Capacities in Public-Funded Research Systems

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1 INTRODUCTION

The research project tackles the complex problem of understanding learning capacities and their similarities and differences in modern public-funded research systems (PFRS). This is done in order to better explain variations in the adaptation of these systems when confronted with the numerous challenges of research and technological innovation nowadays.

These objectives need two clarifications: first, what do we mean when we speak of a public-funded research system and, second, how do we define learning capacities?

1.1 Public-funded research system

In the report of the European research project TSER "Changing Structure, Organisation and Nature of European PSR Systems", directed by Jacqueline Senker from SPRU, public sector research is defined as covering "those institutions for which the major source of funds is public; and which are in public ownership or control (or have converted to private ownership since 1980); and which aim to disseminate their research. It also covers the organisations of officially recognised charities or foundations which raise the majority of their funds from the general public, and whose main activity is research" (Senker 1999). While this definition is largely inspired by OECD definitions and remains very empirical oriented, we would like to develop a more theoretical point of view concerning the public-funded research systems.

In general, research funding is conceptualised in terms of a confrontation of two functionally differentiated systems, the political and the scientific system. Policy-makers have an interest in making scientists do something they think could be useful for society or for their own purposes. The literature has also revealed that in order to influence scientists, often intermediary agencies (funding agencies, research councils, etc.) have been set up that are delegated the task of public research funding (Braun 1993; Rip 1994). We believe that these different layers (policy-making, intermediary agencies, scientific research) are not layers apart but can be considered as a "hybrid system" that develops by its own logic and by its own structures and interrelated actions.

All actors in the system are united by the common logic of producing new knowledge in diverse research fields (fundamental/applied) as well as by the structure of public financing. This structure links all (corporate) actors in the system to the political business cycle and to the political logic of revenue allocation. Opportunities and constraints in the development of research activities are largely defined by political considerations. Privately funded research systems, by contrast, are bound to the logic of economic considerations though the production of new knowledge is also a common logic of institutions in this system with a stronger emphasis on the application of knowledge.

We speak of a "hybrid" system because actors within this system are often part of broader functional differentiated systems (in case the scientific and the political system) and are carrying with them the inherent "scripts", "norms and values" and interests of these systems. The unity of the public-funded research systems is guaranteed by the common interest in the production of (new) knowledge.

Hybrid systems as the public-funded research system are, however, structured in a complex way exactly because different functionally differentiated systems are working in unison. This can only be done if there is "boundary work"(Gieryn 1995) or intermediation. The coordination of functionally differentiated systems needs "objects" (idem) and "organisations" that can function as intermediaries and stabilisers between often conflicting demands. Boundary objects "allow members of different communities to work together around them, and yet maintain their disparate identities" (Guston 1998: 29). More important for our purposes are "boundary organisations" (Guston 1998). Guston sees boundary organisations in a similar way as "one route to stabilization. Boundary organizations are institutions that straddle the apparent politics/science boundary and, in doing so, internalize the provisional and ambiguous character of that boundary" (ibid.: 30). Successful boundary organizations will "succeed in pleasing two sets of principals and remain stable to external forces astride the internal instability at the boundary" (ibid.). According to Braun, funding agencies can fulfil the role of a boundary organisation because they are able to stabilise both the claims of science and politics by developing a certain autonomy though taking care of the communication of demands from both sides (Braun 1997).

We will not elaborate in more detail the concept of boundary organisations. It suffices to notice that the hybrid public-funded research systems need a boundary that couples in a structural way the "*operational level*", scientific research and its organisations to the political level. All organisations on the boundary must in one way or other link the scientific and the political system though their tasks, functions, and interests may differ in doing so. A fundamental distinction in this respect is the one between the "productive side of the boundary" and the "reflexive side of the boundary".

On *the productive side of the boundary*, we find all organisations that engage themselves in the production of new knowledge, either by distributing funds or by managing or representing research organisations and institutions. In this way, , the Swiss National Science Foundation (SNSF) and the Max-Planck-Gesellschaft (MPG) or the CNRS (Centre National de la Recherche Scientifique) belong to the productive side of the boundary. On *the reflexive side* – we will come back to the role of this aspect below – there are organisations dedicated to the task of analysing and evaluating the functioning of the public-funded research systems and to propose changes to the existing structures, procedures, and routines. Here we may find diverse organisations as the German Wissenschaftsrat, the Dutch Adviesraad voor Wetenschapsbeleid (AWS) or the Swiss Council for Science and Technology (SCST).

In sum, the boundary has the function of coupling differentiated systems that are united in the common purpose of financing the production of new knowledge and of stabilising conflicting perceptions, interests, and demands. If one adds the diverse structure of organising the research policy at the political and the operational level in OECD countries, the diversity and complexity of public-funded research systems is easily comprehensible. Learning does, therefore, take place in a complex system, at several levels with different functional tasks.

1.2 Learning capacities

This brings us to our second clarification: What do we understand by learning capacities?

If we take three of the most influential definitions in public policy literature, the one by Hugh Heclo[1], by Peter Hall[2] and by Johan Olsen and B. Guy Peters[3], some common sense features of policy learning and some differences emerge:

- *Learning is linked to experience*. Olsen and Peters speak explicitly of "experiential learning" (1996: 5-6). Learning cannot take place if there is no lesson drawn from past experiences in the light of new information.
- *There is change or at least there are attempts to change*. For Heclo, learning is the result of a change, i.e. an enduring alteration in behaviour. Hall and Olsen/Peters are more prudent. For Hall learning is both a "deliberate attempt" to improve the policy process and finally the policy change that occurs because of such an attempt. The outcome is therefore directly linked to a process of dealing with experiences and improving the organisation. This demonstrates that learning is not equal to policy change but is only indicated, as Hall says, when one can demonstrate that the change is directly linked to deliberate attempts of improvement. Olsen and Peters differentiate very clearly between two understandings of learning (1996: 6): first, learning is an *outcome* and an *accomplishment* ("in terms of improved knowledge, skills, performance, and preparedness for the future"). Learning has taken place and it can be observed by changes that have taken place in knowledge, skills and performance. Second, learning is the *process* "through which experience is consulted and acted upon". In fact, both points of view cannot – according to us – be dissociated from one another: By saying that learning is the outcome or an accomplishment one has difficulties to distinguish learning from policy change in general. Policy change may be based on other factors like, for example, power and force, a new government with a different party ideology etc. Only if policy change can be reduced to a learning *process*, i.e. a process based on an evaluation of past experiences in the light of new information, can we say that learning has occurred.
- Both Hall and Olsen/Peters see *learning as an instrument to improve the functioning of an organisation or of policy-making*, Heclo does not. His definition is neutral in this sense and equals change in behaviour caused by a stimulus and learning. He does not say why actors should react and how they would react. The other authors clearly define the

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[1] "Learning can be taken to mean a relatively enduring alteration in behaviour that results from experience; usually this alteration is conceptualised as a change in response made in reaction to some perceived stimulus" (Heclo 1974)

[2] Learning is a "deliberate attempt to adjust the goals or techniques of policy in the light of the consequences of past policy and new information so as to better attain the ultimate objects of governance. Learning is indicated when policy changes as the result of such a process" (Hall 1993: 278).

[3] "Learning may be defined as the ability to detect and correct errors and thereby to improve the functioning of an organization" (Olsen and Peters 1996: 4).

> "stimulus" as the detection of an "error" and as the "consequences of past policies" respectively. We will follow in this report this last interpretation of learning. Learning has always had the connotation of improving something, of changing something (see also (Etheredge 1985)). At least, the actors must take action because they think that they will improve the situation by changing institutions or instruments. Learning is not equivalent, however, to successful problem-solving. Actors want, of course, solve a problem when they are involved in a learning process but the result may be inadequate to solve the problem, because wrong theories have been used or wrong lessons have been drawn from the past. And it is quite imaginable that problems are solved while no learning has taken place.

So for us, *learning is experiential, it aims at improving the functioning of policies and organisations respectively by changing skills, performance and knowledge*.

Howlett and Ramesh (Howlett and Ramesh 1995: 176) introduce on the base of Peter Hall another important analytical dimension addressing different *types of learning*. In his definition Hall speaks of the adjustment of "goals and techniques". It is exactly this difference between goals and techniques, which distinguishes two very different types of learning processes. Changing the goals of policy-making needs a changing environment of policy-making (e.g. radical governmental policy change; economic crisis) and usually is accompanied by a redefinition of concepts, the introduction of a new paradigm and a different preference ordering of actors. "This is the most fundamental type of learning, which is accompanied by change in the thinking underlying the policy" (idem). Howlett and Ramesh designate this type of learning as "*social learning*" finding its origins *outside* the policy process and implying usually a far-reaching discourse among a large number of different policy communities. According to Hall, this is "3rd order learning" leaving behind "normal policy-making" and revolutionising existing policy-making. It will be clear that this type of learning is difficult to achieve. Sabatier has, by discussing advocacy coalitions, given an illustration of what kind of factors and processes must be available to implement a paradigmatic learning process (see for example (Sabatier and Jenkin-Smith 1993). We will see below that research policy-making has been confronted by this type of radical change in the thinking underlying the policy. Hence, we deal in our study exactly with social learning and not normal policy-making.

First order and second order learning processes in "normal policy-making", on the other side, concern "techniques" of policy-making, i.e. the "settings" and the "kind" of instruments used. Changes concerning techniques are the result of "*endogenous learning*", of reflections on the effectiveness and efficiency of policy instruments, of "*lesson-drawing*". "This type of learning originates within the formal policy process and affects the choice of means or technique employed by policy-makers in their efforts to achieve their goals" (Howlett and Ramesh 1995: 176). The origins of this type of learning are seldom found outside the policy process. Learning occurs by assessing goal-means relationships and the principal aim is improvement of the policy process by changing the settings or the kind of instruments.

So, when we speak of *learning capacities*, we mean more in particular all formal rules and regulations on the one hand (the "hardware") and norms, scripts, causal stories and structures

of consensus-building on the other hand (the "software") that allow social learning in public research funding.[4]

1.3 What is a policy-regime?

Our research is thus on social learning capacities in public-funded research systems. This implies a fundamental revision of existing arrangements in public-funded research systems. We will speak henceforth of a fundamental revision of the existing "*policy-regime*" in public-funded research systems. The notion of a regime allows more in particular to grasp at the different analytical dimensions that are entailed in the processes of social learning.

A policy-regime consists of three elements: the "policy-design", "regulatory structures" and "operational" or "performance structures" and a forth element that we will add to the traditional definition of a policy-regime, that is the reflexive institutions.

1.3.1 Policy-design

The *policy-design* has been discussed by (Dryzek 1993), (Linder and Peters 1991), (Ingram 1990), (Varone 1998), (Narath 2002) and others. It represents the analytical dimension of intended and purposeful action in policy-making, albeit not of rational processes. As most of the time a multitude of actors on different levels of the system are involved, the design may be the sum of a number of purposeful acting organisations with, however, unintended consequences. Dryzek defines policy design as "the process of inventing, developing and fine-tuning a course of action with the amelioration of some problem or the achievement of some target in mind" (Dryzek 1983: 346; quoted in Varone 1998:14). The reader will notice the affinity with the concept of learning: Policy-design aims at the solutions and of achieving some goals as learning is addressing problems on the base of past experiences with the goal of improving the functioning of organisations.

In order to avoid confusion in notions, we would rather like to follow (Knoepfel 2001); see also Nahrath, (2002**:** 13-4) who consider the policy-design as a set of different dimensions of *governance* in a certain policy field, i.e. the "software" that underpins regulatory actions and other forms of political intervention. In particular, these dimensions are the:

- problem-definition and the objectives of the government;

- causal hypotheses and stories underlying political intervention in the field;

- instruments used;

- rules and regulations as well as the designation of institutions of implementation;

- designation of social groups that should change their behaviour as a reaction to the intervention;

- designation of other groups affected in a positive or negative way by political intervention.

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[4] Healy is using the notions of hardware and software in the context of his concept of "collaborative planning" in a similar but not identical way (Healey 1993: 200).

The policy-design structures the way, how government is acting and intervening a given policy field. It is the software because it entails the ideas, the causal stories, the perceptions, the assumptions etc. that form the base of political action.

At a given period, the policy-design has characteristic features, which make up the coherence of the regime. Usually, there is a paradigmatic view in a policy-regime concerning two dimensions of the regime, i.e. policy ideas how the resource in question (the land, roads, labour market or, in our case, knowledge) should be treated in order to realise certain objectives (like the production of new knowledge; innovation). Usually, studies on research and technology policy are only referring to this dimension. However, there is a second dimension, that is policy ideas how government should intervene in a given policy field. Most of the time, these policy ideas are not restricted to one policy field but comprise most policy fields. In this they are the, as Jobert and Muller (1987) state, "*référentiel global*" of state action while the more concrete belief about how to influence the resource in question is the "*référentiel sectoriel*". A policy-design is always made up of these two causal belief systems that have immediate implications for the other dimensions like the use of instruments and the designation of groups or the setting up of implementation arrangements. The change of a policy-regime can entail either the change in the belief system on one of the two dimensions (simple policy-design change) or a simultaneous change of both belief systems (complex policy-design change). In our case, we are confronted with such a *complex policy-design change* that takes place in all OECD-countries and which has a universal character.

Social learning can only be set in motion if there is a change in the policy-design. This is, however, not the end of the story. The change in the policy-design is not yet a change in the policy-regime. Policy-regimes entail at least two other analytical dimensions and structures respectively, which have to be changed: the regulatory and operational structures.

1.3.2 Regulatory structures

In the concept of the "*actor-centred institutionalism*" (Mayntz 1995), (Scharpf 1997), regulatory structures and governance structures respectively are conceived as all institutions and organisations that take part in the regulation, management and intervention of resources in a given policy field. Operational or performance structures entail all institutions and organisations that are directly engaged in the production of the resource in question. We regard both levels as the "hardware" of a policy-regime, while the policy-design is the "software" underlying governance and performance structures.

In our conception of social learning, we can expect a divide between changing policy-design on the one hand and regulatory and operational structures on the other hand. The "hardware" usually is difficult to change given the path dependency of its developments and the interests involved in the maintenance of the organisations linked to these structures.

This concept is not very different from the one adopted by Senker et al. where a converging trend of "policy-makers' belief systems" (i.e. the paradigm change in the policy-design) is confronted with path dependent arrangements in each country that differ from one another. Differences in adopting the new policy design, i.e. differences in learning capacities, are therefore to be attributed to this kind of path-dependent structures (see Senker et al. 1999: 52). We will go one step further and ask if there are different ways and different points in time be-

tween countries in adopting a new policy design. Social learning is not only the realisation of a policy design given rather rigid regulatory and operational structures, it is also the capacity to change the policy design in the first place.

Two further considerations should be added at this point: first, we believe that regulatory structures have a decisive influence on social learning capacities but we find in theory and practice different types of regulatory structures, which should be explained. Second, in theories on governance one rarely discusses a fourth analytical dimension of importance, i.e. the reflexive capacities of policy-regimes.

In their actor-centred institutionalism, Mayntz and Scharpf proposed "variants" of "sectoral regulatory structures" that are the outcome of the strength of societal and political actors. They differentiate between corporatism, colonialisation, etatism, market and networks as governance models. We are convinced that the relationship based on power between the state and the scientific community in our countries under scrutiny (France, Netherlands, Germany, and Switzerland) can explain some of the variations we find in learning capacities. Our four countries fit well into a typology of four different models:

Table 1 Strength of the State and Strength of the Scientific Community

	Strong State	Weak State
Strong Scientific Community	Germany *Balance of Power* *Fragmentarisation*	France *Delegation*
Weak Scientific Community	Netherlands *Etatist - Consociational Model*	Switzerland *Liberal - Consociational Model*

There are two dimensions: the strength of the state in terms of its capacity of intervention into society and the strength of the scientific community expressed in terms of reputation and recognition in society. As we have not developed clear operational standards, we treat the classification as a heuristic device the utility of which must be proved in explaining the learning capacities between countries. At first sight, it seems odd to place France under the class "weak state" but our investigations has clearly demonstrated that, at least in research, France has not a state with a high intervention capacity or a large room for manoeuvre manifested in a high institutionalisation of political agencies of research (see for this already (Krauss 1996); (Braun 1997)). This is different for Germany and the Netherlands.

Unlike the Mayntz/Scharpf model (Mayntz and Scharpf 1995: 25), we will not use general labels yet for the different types but only indicate some general differences in the relationship of the state and science in the diverse countries. The strong position of both sides in Germany give way to "corporatism" in the Mayntz/Scharpf model, which does not confirm our view of the working of relationships in Germany in the scientific context. We consider the relations in

terms of a balance of power and a fragmentarisation of the system, where we find some cooperative devices that do, however, seldom function as a corporate device. In France, delegation to the scientific community of research policies has been most of the time the predominant structure exactly because of the low degree of institutionalisation of research in the state apparatus. Both the Netherlands and Switzerland are characterised as small countries by their consociational political culture though in different ways. We will see how the difference between a strong and a weak state has manifested itself in this respect.

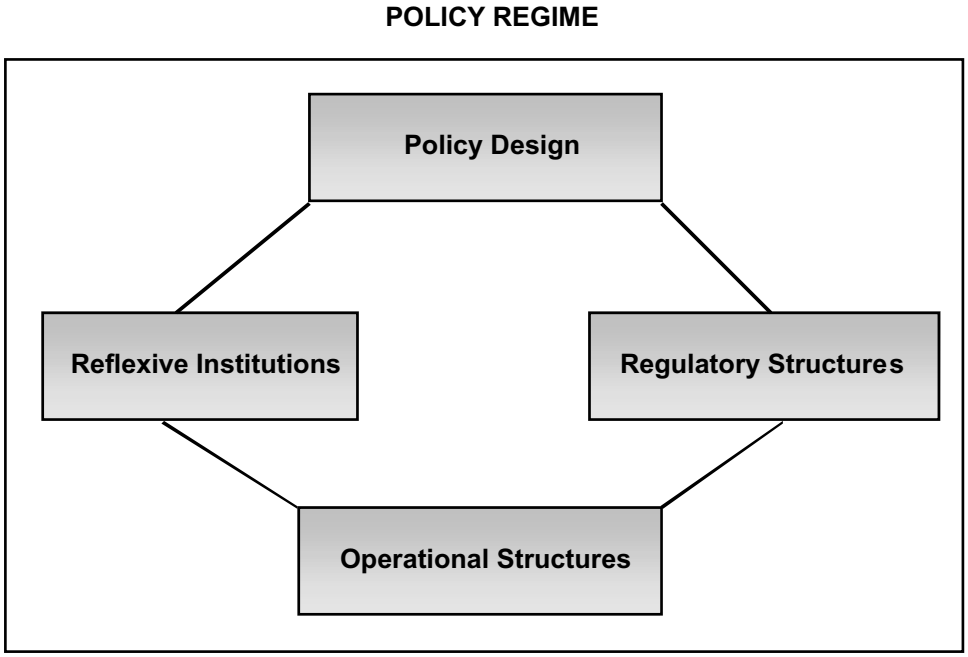
We contend – but this has to be verified – that these different regulatory structures influence the learning process or more precisely, how a new policy design is developed and implemented.

1.3.3 Reflexivity and reflexive institutions

Regimes have policy-design, regulatory and operational structures. However, all systems also have in general developed mechanisms of reflexive behaviour. This is the *cognitive dimension* of governance. By reflexivity, we mean the capacity of systems to "reflect" on their own behaviour, their structures, and problems and the attempt to find solutions to problems. Reflexivity is therefore an integral and important part of learning. Most studies of governance have not paid attention to the fact that usually systems have set up some institutions and/or procedures that have the explicit function to "reflect" on the functioning of the system. In research these are, as shown above, for example the scientific councils that advise government. In the context of policy-regimes, reflexivity is an essential fourth element, in close interaction with the policy design and certainly a decisive part for learning capacities of system. It is important to know, then, what kind of reflexive institutions countries have set up, what degree of "density" of these kind of institutions we find, how they are connected to the policy-design and to the regulatory and operational structures. Moreover, we need information about how public-funded research systems have used their reflexive capacities in order to adapt themselves to new challenges and to implement policy-design change and ultimately policy-regime change. In order to learn to know this, we have investigated more in particular into the reflexive institutions in each country. We contend that reflexive institutions and capacities may have an important role to overcome resistance among policy-makers, regulatory agencies and scientific institutions with regard to change by the building of a consensus based on argumentation and persuasion. Reflexive institutions are essential for "*rational*" learning processes.

Policy-regimes are, therefore characterised by four analytical elements and not three.

Figure 1 Components of a Policy-Regime



We regard policy-regime change as a learning process and not as an evolutionary and unintended result. Regime change means, first, to actively re-design the existing policy-design, often by using the reflexive capacities available in the public-funded research systems. The re-design occurs after major contestations of basic causal beliefs about either state intervention or the management of knowledge or both. The re-design strives for the introduction of new objectives and problem definitions, new instruments to realise the new objectives and a redefinition of the groups in question the behaviour of which have to be changed to realise the new objectives. It may also entail a redefinition of beneficiaries of policy action.

After the re-design of the policy design – more or less contested – regulatory structures and operational structures have to be modified. This engenders resistance by actors who are the losers of such a process and the support of those actors who can profit from the new policy-design. The type of regulatory structures is decisive, how the new policy-design can be made accepted among regulatory agencies and scientific institutions. Only after the regulatory structures and operational structures have been changed more or less conform to the new policy-design, can we speak of a policy-regime change.

In our study we want to know, therefore, who has taken up new ideas in the policy discourse on research funding and how these new ideas have been put on the agenda and finally how they have been translated in the development of a new policy-design. We want to know what kind of resistance the new policy-design has found on the level of regulatory and operational agencies and how this resistance has been overcome or how it has contorted the original intentions of government. These data should give us sufficient information to judge on the learning capacities of the four countries in questions.

1.4 Some preliminary hypotheses on learning processes

One should mention our expectations at the start of the research project concerning likely variations in learning capacities between the four countries we had chosen. In fact, the choice itself was inspired by such expectations. Our expectations were based on the hypothesis that the institutional embeddedness (regulatory and operational structures) and the political culture (consensual – adversarial) should make a difference.

(1) In fact, we opted for two federal and two unitary countries because it seemed obvious that divided political power in federal systems could block the necessary coordination in research policies or, in any case, would make it more difficult than in unitary systems to develop a common policy design. Unitary states (especially under the Westminster regime or in terms of Lijphart "majoritarian democracies") seem to have the advantage of quick top-down decisions. Besides the "concentration" or "dispersion" of (political) power in a country, the degree of "institutional complexity" seems to influence the coordination capacity and, hence, the learning capacities. A large number of institutions with different competencies both at the regulatory and operational level engender higher transaction costs than institutional flat structures with a low number of institutions. Higher transaction costs are detrimental to coordination efforts and learning capacities. A country with concentrated regulatory powers, flat regulatory and operational structures would be the most likely to quickly learn and change the system. By contrast, dispersed powers and complex regulatory and operational structures seem to reduce learning capacities. If we take a quick glance at our countries, the classification could be the following:

Table 2 Characteristics of Policy-Regimes in Four Countries

	Regulatory Powers	Regulatory Institutions	Operational Structures
Germany	Dispersed	Complex	Complex
Netherlands	Concentrated	Complex	Complex
France	Concentrated	Flat	Complex
Switzerland	Dispersed	Complex	Flat

There are no equal cases on these three variables. It seems that Germany is a case with negative foreboding for learning capacities while France seems to have at least at the regulatory level some advantages. The Netherlands must face high transaction costs, while Switzerland might find it difficult to change its policy design given the dispersed and complex regulatory structures.

(2) The second dimension we have chosen was the *size* of the country. The rationale behind this choice is political culture. We contend that the smaller a country, the more close-knit net-

works between the different players are and the easier it becomes to find a consensus on conflicting policy strategies. The two small countries we have chosen (Switzerland and the Netherlands) have, moreover, a long tradition of a consociational political culture that underlines this point. By contrast, in France and Germany we find a stronger adversarial culture between actors, which should it make more difficult to build up a consensus and to realise a new policy design on short notice.

If we add this dimension to point 1 we see that Germany is confirmed as a particular case where it seems unlikely to find quick learning processes while Switzerland might be helped by its consociational features to find a consensus despite the dispersion of powers and complex regulatory features. France might find considerable difficulties in implementing the policy design. The Netherlands might overcome their complex structures by consensus-building without, however, reducing transaction costs. The worst, immobility, can, however, probably be overcome.

The following table summarises for each country our suppositions:

Table 3 Expectation about Learning Capacities in Four Countries

	EXPECTATIONS
Germany	Immobilism expected both on the regulatory and implementation level. Low learning capacities
Netherlands	Quick changes in policy design possible, though transaction costs in building up a consensus on the regulatory and implementation level. Immobilism, however, is not to be expected.
France	Policy-makers should be able to react quickly on challenges, but might have considerable difficulties in realising the policy design on the operational level.
Switzerland	Switzerland needs time to change a policy design but will, eventually, find a consensus. The operational structure is very favourable to implement the new policy design.

1.5 Frameworks of discussion

Our study can be situated within three frameworks of discussion:

First, the study takes up the discussion originating in the early book of Hugh Heclo on the two dimensions of political action: puzzling and power (Heclo 1974). While power has been at the centre of most studies, "puzzling" or the role of policy ideas is only gradually gaining ground (see: (Braun and Busch 1999); (Fischer 1993)). It is our intention to use both dimensions in this study and ask for their explanatory value.

Second, one sees a trend in governance theory to treat learning as a central notion. Instead of hierarchical top-down models of state action, the new idea becomes to "enable" actors to learn and adapt themselves by self-government to challenges. The role of the state becomes alike to

a facilitator and monitor. Our study takes up these "soft dimensions" of governance and attempts to demonstrate its usefulness.

Finally, we intend to learn to know, by way of comparison, how the Swiss public-funded research systems can ameliorate its adaptation capacities or if it can be – quite on the contrary – a learning model for other nations.

1.6 Structure of the report

Our analysis attempts to understand how "*responsiveness*" as the notion best expressing the paradigm change that is taking place, is gradually introduced in public-funded research systems.[5] This will be done in several steps:

We will present in chapter 2 a general overview of the paradigmatic changes occurring since the 1970s.

In chapter 3, we will demonstrate the pressures having led to a change in the causal belief systems of research policy-makers during the 1970s. It will become clear that the new ideas circulating in policy research discourses need a new policy-design conflicting with the existing one. In addition, one sees that these pressures have been universal though countries have reacted differently in time and content to these pressures. Countries start to build up their research policies and to develop new institutions or instruments that can promote a stronger "social responsibility of research".

Chapter 4 is dedicated to an analysis of transformations taking place on the performance level of research, i.e. in the project funding of technological innovation and in the institutional funding of research institutions.

The introduction of a stronger responsiveness to economic and societal demands in funding agencies on the intermediary level is the subject of the chapter 5.

Chapter 6 is dealing with the special role of "reflexive institution" for the learning processes taking place in the countries.

Chapter 7 summarises the main finding with regard to the paradigm change and the role of learning capacities in this process.

2 CHANGING PARADIGMS

Our research has corroborated what is largely developed in the literature on science and technology policy during the 1990s: There is a fundamental shift in the scientific and political discourse on *how scientific knowledge can contribute to technological innovation.* Less stressed, though, is the concomitant *change in causal beliefs on state intervention*. In the terminology of Bruno Jobert and Pierre Muller these changes can be seen as a change in the "référentiel sectoriel", which characterises the beliefs about how to deal with the resource in a given policy field, i.e. in the research sector on the one hand and a change in the "référentiel global" on the

[5] When we speak of responsiveness we always mean responsiveness to social, economic, or political demands.

other hand (Jobert and Muller 1987). The "référentiel global" expresses general beliefs about the role of the state in society and, hence, about how the state should intervene into society. It is clear that different policy sectors must adapt to these general changes in the philosophy of state intervention. We can therefore expect that the paradigm change with regard to state intervention will manifest itself in the policy design of research policies. We will describe in this chapter the general features of these paradigm changes and their consequences for the policy design in research policies.

One should see these features as a general change in policy discourses influencing the discussion in all OECD-countries, without pretending that each country was taking up the changes at the same point of time or in the same way. However, we have found evidence that no country could escape the radiance of the new star and has reacted in one way or other by revising its existing policy design.

2.1 Changing the "référentiel sectoriel"

The profane background of the changing paradigm on knowledge creation and innovation has been economic.

The "new growth theory" as well as "evolutionary economics" has very much influenced political decision-making on technology policies in the 90s (Lipsey and Carlaw 1998);(Romer 1994).

This means, first, that technology is now seen as a substantial factor of economic growth and international competition. More concretely, it is not just technology, but the *innovation* of processes and products which counts. The "innovation paradigm" (Borrás 2000)becomes the background of state action in research policy.

Linked to this change in the view of the creation of economic growth is the rise of *generic technologies*, which gives rise to a more immediate linkage between technological research and basic/applied research (see also (Braun 2002)). Generic technologies need basic knowledge and they cannot as such be immediately applied, but application is very near at hand. This is why it becomes increasingly important that research on generic technologies brings together basic scientists, probable users, technicians, applied scientists etc. The time between invention and application is much shorter than before. Biotechnology, for example, is the direct fusion of science and techniques. The "mode 2" approach has described this development already in 1994 and stated that we see a move from a "knowledge generated in disciplinary cognitive context to knowledge created in broader transdisciplinary social and economic contexts". The "interaction mode" replaces the traditional "government- science compound" as well as the linear model of innovation. This has profound implications for the institutions that are built on the "old order". Vested interests must be overcome and institutions must be opened up. One important element Metcalfe and Georghiou stress (Metcalfe and Georghiou 1998: 93), is that generic technologies and innovation in general today need more and more collaboration and cannot be restricted anymore to one enterprise.

At the same time, there is no need to install new and permanent institutions at the interface of science and technology. Generic technologies are constantly moving and changing. Applications can be found in one area and after that in another. This explains the need for flexible ar-

rangements in research, which are created at one time and can be dissolved at another. Therefore, the "institutional funding" as a research policy instrument becomes outdated. One finds less eager to create new research laboratories than to organise medium-term and long-term collaborative "centres" which will disappear once they have fulfilled their functions. Such centres can also be created within the contexts of universities, which is important, because universities now have the chance to also become a player in the technological game.

Another important consequence, raised by Martinsen (Martinsen 1995), is that the role of the state in organising the process of innovation begins to change. While the state could just take into account the "high risk area" of basic research in the "linear model" of innovation, he is now invariably drawn towards the market by also organising and financing the interlinkage. At the same time, the state cannot any longer just invest in individual enterprises. The "collaborative mode" (see above) necessitates a broader orientation and the need to organise (temporary) collaboration between some enterprises, specialising on some aspect of applying generic technologies.

The way, however, the state is involved, changes. First of all, one must see that research and technology policy is still the policy field where state intervention is accepted and even wished for by most participants. Especially at times of globalisation and harsh competition, the liberal state cannot be an option. However, while before the state protected industries from international competition, he now is actively encouraging technological innovation to make domestic enterprises more competitive. In a period of globalisation, protection is not feasible. The key point is that economic (evolutionary) theory now recognises the influence of context conditions for technological innovation. This brings the state back in. As the influential OECD Sunquist Report from 1988 wrote (quoted in Martinsen 1995: 18-9):

> *"The new technologies are not a force originating from outside the economic system – they are created, developed and diffused in response to economic demands and constraints. Similarly, the impact of technical change is inseparable from other societal developments; its economic dimensions cannot be isolated from its social dimensions. What is involved is a set of interacting influences, in which history, culture, outlook and values carry just as much weight as economic factors"*

If social and political context matters, the state can do a lot to influence these conditions in a favourable direction.

Encouraging innovation means, however, not, as in the classical linear model of innovation, to invest into promising enterprises, "pick the winners" etc. but to create favourable conditions of innovation. This is the major turn of state action in research and technology policies. A "rationalisation" of policy action takes place in which evaluation, control, the creation of infrastructure conditions, and the facilitation of self-organisation plays a major role. New Public Management is an integral part of this development and exemplifies this strife for rationalisation and the increase of efficiency in the administration and in the management of affairs. The "new management philosophy" is instructing the state how to create amenable conditions for innovation. A model of selfregulation with accompanying security measures helps to optimise and rationalise technological innovation (Martinsen 1995: 20).

The model behind the new mode of state intervention is the idea that self-regulation, (limited) autonomy, and motivation guarantee the flexibility and capacity to act. The state should not intervene but to make actors in the research system "fit" for globalisation. He is facilitating.

The following variables are supposed to demonstrate main causal factors that have influenced research policies in the 90s:

- *Globalisation* is the main factor explaining these changes in policies. The intensified competition and the necessity for advanced countries to find comparative cost advantages by technological innovation plus the impossibility to protect domestic industries (GATT, etc.), force states to develop new strategies for successful competition. Moreover, there is a rising possibility for domestic enterprises to use other places abroad for research depending on the conditions countries are offering. This reinforces the need to create a favourable context for research investments, an attractive infrastructure, and a flexible and highly educated labour force. The state must take into account a large number of context conditions for technological innovation, including the education system, in order to foster favourable conditions for economic growth. Often enterprises have reacted by closing down research laboratories and concentrated on short-term investments in research to solve short-term problems (Metcalfe and Georghiou 1998: 87). This gives the state again the task to take care of establishing also long-term research. International collaboration is another aspect of globalisation, among scientists, among funding organisations and among enterprises.

- The *end of the Cold War w*as of importance because it reduced the investments into defence research, above all in the major countries like USA, France and Great-Britain with more room for policy-makers to invest into civil research. On the other hand, new strategies had to be found to integrate military technology research into civil technology research. At the same time, environmental and health issues come to the foreground of policy attention and most countries are focusing research programmes on these issues (next to generic technologies).

- The *economic crisis* is the major factor that explains, above all in Europe, the turnaround in policies. Increasingly it was believed that welfare has become a question of economic growth and competitiveness. This "predominance of the economic" has contributed to the decline of the redistributing welfare state into an "innovation-facilitating" state. The answer to the economic crisis is, of course "science, technology and innovation".

- The *third phase of industrial revolution* (see Martinsen 1995: 13) means that we are entering a new age, the knowledge society, with a different mode of production. Again, science and technological innovation become the main focus of policy makers to survive in international competition.

- *Budget deficits* become a main problem since the 1980s until the mid-1990s. This period is characterised by an austerity regime and a new conservative way of keeping the balance of public finances. At the same time, costs in research are rising considerably. In the overall run, one can see that the government share in research expenditures has declined on average from 50% in 1975 to 33% in 1995 (OECD 1998a). In the 1980s, business investments declined as well, but rose again in the 1990s, while government investments were on average stagnating in OECD countries. This also holds for basic research. Universities had to suffer most of less

funding from governments with in due consequence a re-orientation in research to more short term and market research (triple helix). The OECD (OECD 2001: 7) fears nevertheless that austerity will have consequences above all for traditional disciplines and those researchers not contributing to economic growth.

- Budget deficits have certainly influenced the new reference point of state action – *efficiency* – but again, rationalisation and other ideas like clientele orientation have certainly also contributed to the overall stance of governments to distribute money according to efficiency (and effectiveness) criteria. Two key words are used here: *accountability* and *responsiveness*: Scientists and research organisations are required to make clear for what they will use their resources and if it meets societal or economic demands, if they use the resources in an efficient way, and what the results will be measured by performance criteria.
- *Concerns and needs of society* have become more prominent in research programmes, next to generic technologies. Technology assessment is one outcome of this preoccupation. Increasingly, it is demanded that scientists open up their black box to the public and choose their programs in order to respond to the needs of society.
- *Human resources* have become a central concern for organising the knowledge society
- *Evaluation* is the most prominent instrument in order to meet efficiency criteria and legitimate research funding.

Research in public-funded research systems has undergone significant changes due to these causal factors:

In *universities* one finds clearly a tendency to do research with more economic relevance, especially after public funds have often been cut down substantially. This seems to change today (Senker et al. 1999: 54), but the general tendency, to find resources from other sources, remains. The linkage with industry becomes important; most universities are creating own enterprises nowadays; they establish technology transfer offices etc. Metcalfe and Gheorghiou (1998: 88) clearly state that universities in the 90s become a component of national innovation policies "and research funding is increasingly expected to yield exploitable benefits". At the same time we see everywhere that "*centres of excellence*" are installed, above all in technological research. The OECD describes the advantages (OECD 2001: 8): a concentration of financial means; priority-setting is possible; interdisciplinarity; industry can cooperate; knowledge from abroad can be integrated, it is a much more flexible structure (often outside faculties and disciplines). They are also flexible in the sense that they can be dissolved after a time.

Public research laboratories see their role decreasing, while at the same time they often must change their research topics in order to survive. The TSER project and our own research demonstrate that public research laboratories must today compete for resources, which were before guaranteed by one ministry. Today other competitors may apply for the same resources. This increases uncertainty for public research laboratories. Finding other resources, contract research, a stronger cooperation with universities and a much more flexible structure have become the hallmarks of change. New public management ideas have been widely introduced (see also Metcalfe and Gheorghiou 1998: 87). Institutional funding has been substantially reduced.

In sum, this overview demonstrates that *research funding* is changing everywhere. Above all institutional funding is considerably reduced (OECD 1999: 36), a fixed-term contract funding is preferred; interdisciplinary research is "in", and above all, specific networking research programmes are established. Public-funded research systems are therefore under extreme pressures to adapt. It is not just causal theories on how research and innovation functions (the "référentiel sectoriel"; the change from "mode 1" to "mode 2") but also how the state should intervene in society ("référentiel global"), which changes. Both changes of causal ideas reverse the "policy-design" at hand and, hence, the "policy-regime" as such.

We want to understand how the public-funded research systems have dealt with this pressure and the need to re-arrange their policy-regime. The way in which regime change is taking place (or not) will reveal the specific learning processes in these countries.

3 CHANGING THE POLICY-DESIGN: PROGRAMMING RESEARCH IN THE 1970S

Without any doubt, the "référentiel sectoriel" is already changing in the four countries since about the mid-1960s. The background was an increasing concern of policy-makers with regard to the social and – increasingly so in the 1970s – of the technological relevance of science. Since then, the debate on how to make scientific research (both basic and applied) responsive to concerns of the "environment" is never-ending though the stakes are different. In the 1980s, one sees a growing concern for technological innovation with a stronger emphasis on the link between the public-funded research system and industry. The 1990s are characterized by a more profound and paradigmatic change as described in the previous chapter. The linear model of innovation gives way to the interactive model with profound implications for the organisation of the link between industry and the public-funded research system. Horizontal coordination becomes the main issue.

Our research demonstrates that no country can finally escape from these ideational changes. All countries are starting to revise their policy design in the 1970s. This does not mean that each country changed its causal, beliefs, its instruments, its regulatory and operational structures in the same way. These differences interest us here in order to evaluate the learning capacities of countries. Let us start with the transformation of the policy-design taking place in the 1970s.

The development of science policy was characterised until the 1970s by the creation of research institutions on the regulatory and operational level and, since the 1960s, in a number of OECD-countries by the creation of research policy institutions at the political level. The 1970s have two general characteristics: first, there is a general tendency to demand more "*relevance*" (above all for the environment, in energy research, general social and political problems) and, second, the instrument to do so is, first, a strengthening of project funding in the form of programme grants and, second, a stronger emphasis on social relevance in institutional funding. The new "philosophy" is well reflected in several volumes of the OECD (OECD 1968);(OECD 1971); (OECD 1972); (OECD 1973); (OECD 1974). The publication of these volumes does not as such proof the diffusion of ideas but it is clear that similar ideas are in the "air", discussed in the fora of the OECD and "available" for integration into policy concepts and for implementation in the policies of the countries.

The starting position of our countries in terms of institutional governance has been quite different: Germany and France had already created political entities to develop a science policy in the early 1960s while Switzerland and the Netherlands had not. France failed – though there were efforts of programming – to implement the new policy while Germany succeeded in part. Both the Netherlands and Switzerland were able to develop new priority programs but the Netherlands decided to create new governing bodies and to reorganise completely its operational and governing structures while Switzerland simply added priority programs to the tasks of its main intermediary funding body, the Swiss National Science Foundation (SNSF). How can these differences be explained and what does it tell us about learning capacities?

3.1 A new policy-design emerges

If one looks more closely, one can confirm that everywhere five topics of a new "active research policy" appear since the 1960s leading to a new policy design and institution-building. These are:

- the demand for a closer connection of scientific research and societal problems;
- the causal belief that technological innovation can promote economic growth;
- priority-setting and steering by a professionalisation of science policy and the set-up of "reflexive" advisory bodies;
- "programming" research by defining thematic priorities;
- intergovernmental coordination to concentrate forces.

In principle, this list of general objectives remains on the political agenda for a long time but accents are shifting and above all the role of government in this process has been modified frequently.

In each country one finds, above all on the political level, actors who take up these ideas of an active research policy. The publications of the OECD are read and discussed. In addition, one finds everywhere "scientific entrepreneurs" with an interest in the strengthening of research and an interest in more applied-oriented research. They are actively collaborating with the political administration in order to prepare the turn in policy design and the necessary changes in the "hardware" of the research regime.

It seems to us that "*party-control*" as a variable has played an important part in the development of the active research policy. More in particular, this refers to the role of *social-democracy* in the process. The whole period between 1965 and 1975 can be seen as a social-democratic "conjoncture" (Braun 1986)**;** where Keynesian economic policy, planning ideals, equality, democratic participation, and transparency became guiding ideas in the "policy core" (cf. (Sabatier 1988) of policy-makers. The "référentiel global" of state intervention was a social-democratic one and integrated not only social-democratic parties themselves but also other parties. One has to understand this "ideational embeddedness" of public policy action in order to see how research policy was in particular influenced by these ideas. Countries governed by social-democratic parties in this period were, of course, particularly sensible to these objectives. Three of our countries were ruled by social-democratic parties though in coalition with other parties: Germany from 1969 to 1982 (with a social-democratic minister of research); the

Netherlands from 1973 to 1977 and from 1981 to 1982 (with a social-democratic minister of education and a minister without portefeuille); Switzerland has a permanent coalition and a "consensus-government". Nevertheless, during this period (1960-1973) a socialist minister was responsible for education and research. Conservative parties ruled only in France until 1981. We will see that a major turn into the direction of an active research policy took place only then, 10 years after the other countries.

Our first finding would thus state that party-control could matter in research policy, above all when it concerns a new policy design. It needs, however, a "conjoncture", i.e. a more general and encompassing ideational framework to translate party programmes into sectoral policies. This will happen once again in the 1980s when a "neo-liberal" "conjuncture" becomes prevalent with again consequences for research policy. *The transition in the 1970s to the programming of research has, in any case, been inspired by "political ideas" and not by a change in the "référentiel sectoriel".*

A second point to mention here is the *problem-pressure* forcing countries to re-think their policy designs:

The four countries we have chosen all considered their economic position in terms of *economic competitiveness* and technological innovation as inferior to the United States while they were gradually entering the most serious recession after the Second World War. Especially France and the Netherlands described their situation as serious in this respect. Three other problem pressures were added:

- The pressure from "*democratisation*" articulated by new protest movements asking for more transparency and participation with effects on the management of the scientific system;
- Pressure stemming from the oil crisis in 1973, already articulated by the "Club of Rome" in 1969 concerning *energy and environmental problems* with ensuing discussions on the "technocracy" and "risk-character" of scientific research
- Financial pressure: the economic crisis led to an increase in the state *deficits* to levels of unknown extent, which raised the sensibility of policy-makers to more efficiency in public policy sectors.

These pressures were felt in all countries and challenged the existing policy regimes in public policy fields.

Social-democratic "conjoncture", social-democratic party-control and a considerable problem pressure contributed together to the re-design in policy-making, trickling down in due consequence to the different public policy sectors. A new policy design in research policy-making – comprising the elements sketched above – emerged but this does not yet mean learning capacities and reforms. It is decisive how the new "software" could be made compatible with the existing "hardware" by either strengthening certain parts, changing parts of the system, or by replacing the whole machinery of government.

3.2 Adapting regulatory structures to the new policy-design

In this section we want to show two things:

(1) Demonstrate the difference between countries with established regulatory structures on the political level (Germany and France) and countries starting more or less from the scratch (Netherlands, Switzerland). The "institutional legacy" created at this point of time determines the future paths in research policy.

(2) Discuss how exactly the programming of research has taken place under these institutional conditions.

3.2.1 Institutional legacy and institution-building

When the period of programming research started – let us say about the beginning of the 1970s – our four case studies were differently equipped to match the new demands: France and Germany already had structures amenable to take up the active policy while the Netherlands and Switzerland had not. This resulted in a profound difference in the process of regime change: France and Germany could – in principle - do with existing institutions while the Netherlands and Switzerland had to engage themselves in "institution-building". In both groups we find, however, differences in outcomes: France failed to implement the new "programming activities" because the existing institutions where not functioning while Germany developed an active policy without, however, much success. The Netherlands were changing their hardware completely, while Switzerland strengthened parts of its hardware.

The following table proofs the difference between the two groups by showing the institution-building activities. We regard 1965 as a breaking point. On the left we find the regulatory institutions already existing and on the right hand side the institutions created after 1965:

Table 4 Research Institutions before and after 1965

	Institutions before 1965	Institutions 1965-1975
Netherlands	ZWO	RAWB; new research division; minister without portefeuille; Interdepartmental coordination committee
France	DGRST; CNRS, CCRST	-
Germany	BMBF, German Science Council ; DFG; MPG	BMBF > BMFT; Project Funding Agencies
Switzerland	SNSF, CRUS, CERS/CTI	SSC; OFES; CUS

***Acronyms*: see overview table**

When the discourse on science policy began to change – the creation of the OECD and the first report Piganiol in 1963 might be a good indicator of the changing discourse and the turn to a more programmatic research policy (Piganiol 1963) – neither in the Netherlands nor in Switzerland do we find political regulatory institutions or reflexive institutions. The main pillars in science policy were on the "boundary", i.e. the funding agencies ZWO (Netherlands) and SNSF (Switzerland), which were both deeply anchored in the scientific community. This meant that these two countries had to develop political strategies on how to either use these institutions within the framework of an active policy or how to set up new bodies. In fact, both countries decided to do both but in a different way.

A major difference between both countries was the *territorial structure*: Switzerland being a federal country while Netherlands belongs to the class of unitary countries. Ministry of education, culture and science (OCW) in the Netherlands was in principle responsible both for universities and research organisations, the federal government in Switzerland had no competence at all until 1968 to interfere in education and research except for its own polytechnics. The education ministry in the Netherlands had certainly to find an understanding with the different ministries active in research but without any doubt, it was the heavy weight in the political system. The federal government in Switzerland needed a compromise with the cantons. Most of the discussion on research policy since the 1960s until 1983 – the adoption of the research law defining the tasks of the federal government in research – are on these attempts to "get the federal government in", something even the cantons wanted given their lack of money in financing the universities.

This highlights another important dimension, i.e. the *differentiation of the operational structure*: Countries usually have internally differentiated their public-funded research system by using universities and extra-university research institutions as a base for funding. The mix, however, differs with consequences for research policy-making.

Table 5 Operating structures in four countries

	Universities	Extra-university research institutions
Netherlands	X	X
France		X
Germany	X	X
Switzerland	X	

The table above demonstrates in a stylised fashion where research is overwhelmingly taking place. Switzerland and France are antipodes as France has – especially in the 1960s and 1970s – its research base in extra-university research institutions while Switzerland is overwhelmingly relying on universities. The Netherlands and Germany have a relatively equilibrated mix of both kinds of institutions.

Coming back to the case of Switzerland, this demonstrates that the territorial question between the federal government and the cantons had to be resolved: if universities were – and still are – the predominant place for research and if they are administered by the cantons, the federal government cannot rely on the construction of alternative institutions in order to develop its own research base – as in Germany for example – but must find access to the regulation of universities. Here, however, the territorial division of power made it particularly difficult to do so. Gradually, the federal government succeeded in obtaining the rights to finance the infrastructure of universities and to create its own research institutions. The first option meant to only participate while the cantons retained the main prerogatives and competences in matters of universities. This created the necessity to set up an coordinating institution that was supposed to develop a consensus in university policy questions. The second option was seldom used by the federal government. *The implications of this was that federalism structured*

in many ways the options of an active research policy-making: first, research policy is – until today – a joint object of decision-making between federal government and the cantons; regulatory structures must contain cooperative institutions (in case the CUS) to develop a common policy, and the power of the central government in research policy-making is seriously restricted. Not only because of federalism (industrial interests and economic liberalism also played a role) but above all because of federalism, the federal government could not develop powerful political agencies or even a ministry to manage the new policy design. The territorial division of power strengthened the role of the intermediary body, the SNSF, and, therefore, most of the efforts were directed to how the federal government could influence policy-making within the SNSF.

Federalism also promoted the creation of the "reflexive institution", the SSC (Swiss science Council). A "reflexive institution" was considered as essential in the framework of an active research policy and one sees everywhere the rise of such institutions. Particular to Switzerland is the decision to integrate most political and other forces within the institution. While the RAWB (Advisory council for science policy) in the Netherlands, created at about the same time, was purely an affair of scientists that could advice government, the SSC was an arena which should develop a vision on the problems and solutions in research policy and at the same time create a consensus among the different forces in the public-funded research systems. Such a reflexive institution becomes a boundary institution with the double task of informing policy-makers and finding a consensus on the policies to be adopted. Once this is done, decisions by the SSC can have a high authority because everyone knows the recommendations are what the majority of actors think.

It is interesting to mention that in the other federal country of our study the German Science Council was constructed in a similar way which supports the hypothesis that it is "divided government" and cleavages that favour the creation of reflexive institutions as political arena.

The Swiss federal government succeeded in creating in the end a small "Office for Education and Science" within the Department of the Interior without, however, being able to strengthen its position in such a way that it could firmly represent and set through the interests of the confederation. Institution-building in Switzerland meant therefore during this period very much the development of cooperative institutions and the active influencing of the main regulatory body, the SNSF in research.

The Netherlands did not have this problem of a territorial division of power. Here, institution-building meant to create for the first time a unity responsible for research. That unity was situated within OCW. In order to strengthen the position of this unit a minister without portefeuille was nominated in 1972 who stayed until 1982 when the Ministry of Economic Affairs became a key actor for technology policy. The decision to create such a unity was simply a decision of the Cabinet and needed no further approval. The only problem was the powerful position of OCW. It was not envisaged – and never was – to create an autonomous research ministry as in Germany. OCW succeeded in maintaining its prerogatives in matters of education and in the organisation of research, which had the advantage – as already mentioned – that the responsibility for universities and extra-university research institutions were under the same roof. This enhanced without any doubt the coherence of policy-making.

Institution-building on the political level was therefore much easier in the Netherlands than in Switzerland. For both countries it was, however, essential to also change the existing regulatory institutions, i.e. the funding agencies.

In Switzerland, we see a gradual process of strengthening somewhat the position of government in the SNSF by obliging the organisation to accept political representatives in decision-making bodies of the SNSF. In this way, the SNSF became very much a similar corporatist body as the SSC. In addition, the SNSF was obliged to publish regular reports on its policies, which strengthened the information base for a more active policy. Finally – and this we will discuss in the next chapter – the SNSF became the main agency for programming research as early as 1974. While the federal government therefore failed to establish a strong political centre for implementing the new policy design, it succeeded in instrumentalising the main reflexive and funding institution in the system.

The Netherlands had the same intentions: In order to program research, priority-setting and programming within ministries did not suffice. A transformation of both the operational and regulatory structure, i.e. the ZWO, was discussed in the first "White Paper on Science Policy" in 1974. The difference with Switzerland is that it took quite some time before ZWO became an "intermediary agency" with "responsiveness" as an explicit task and it needed a re-foundation of the organisation (which became the NWO (Netherlands organisation for scientific research) in 1988) before the formal structures were built to do so. Despite a much stronger authority – the ZWO was a quasi-public organisation created by law; the Swiss SNSF is a private foundation – the Dutch government did not succeed for a long time to reform the institution. The first major reform was the reorganisation of extra-university technological institutions (TNO (Netherlands organisation for applied scientific research)) in 1985 as well as of the universities (1985). And this despite of similar procedures of consensus-building: Switzerland used the "corporatist structure" of the SSC to build up a consensus among a majority of actors concerning the programming of research. This task was simply added to the existing tasks of the SNSF by creating an additional division. In the Netherlands, the demand for more responsiveness met much more resistance and it seemed necessary to re-build the organisation completely before such a task could be performed. This does not mean that the ZWO did not also undertake some responsive mode funding. Since the beginning, intentions of policy-makers were more far-going and this needed a more fundamental reorganisation of the institution. The proposals were developed in the "White Paper" after an extensive consultation of all levels of the public-funded research systems. The final formulation of the policy happened, of course, in the political system, here other political institutions like the General Accounting Office, and the Finance minister had their say. Nevertheless, the attempt to construct a consensus on the new policy was there. Evidently, this did not suffice to immediately reform existing institutions.

One further explanation could be that Dutch policy-makers had alternatives because ministries could themselves embark on priority-setting and funding programs, something that was not possible for the federal government in Switzerland. This explains the stronger problem pressure for the Swiss government while the Dutch government could wait to reconstruct the whole system.

One lesson about learning which follows from this process of institution-building in the two countries is that the change of a policy-regime is not only structured by existing regulatory and

operational structures but also by its embeddedness in more encompassing political features like the territorial distribution of power or the organisation of democracy. The Swiss example is a case in point. The solution found – the creation of the SSC and the reorganisation of the SNSF – can only be explained by these structural features. Another lesson is that – certainly under circumstances of multiple veto-points and veto-actors – a consensus culture is an asset though it is not a sufficient condition to install new institutions as the Netherlands have shown. Despite of their efforts to construct the new science policy on the base of an extensive bottom-up mediation process, the Netherlands had difficulties to reform their structures, while Switzerland succeeded at least in developing a functioning structure for programming research. Deliberation failed, however, when it came to institution-building in favour of the federal government.

France and *Germany* differ from the Netherlands and Switzerland because they already had political agencies when the new policy design began to emerge. Nevertheless, the situation in both countries differed considerably, when the 1970s came. The public-funded research system in France had and still has a peculiar structure because of a weak university structure in research and a strong extra-university structure (see table 6 above) with the CNRS as the "heavy weight" on the boundary between the scientific system and the political system. The story of the CNRS started already in the 1920s (see (Braun 1997). When the CNRS was created in 1939, it had become a "corporatist institution" where the "Haut Comité" within the CNRS was supposed to define research policies. On the political level, genuine political institutions – except for the different ministries promoting research by way of specialised extra-university research institutions – were not created before the rise of the V. République, at the end of the 1950s. It is the stronger executive-oriented "référentiel" of the new republic which introduced both an advisory body in research for the government (the CCRST) as well as a small division, the DGRST, which was supposed to coordinate the research policies of different ministries but which developed quite early – in comparison with their European counterparts – program funds by imitating the American model. This division was reduced in importance by integrating it into the industry ministry in 1960, exactly at the moment when other countries were attempting to create their independent political institutions. France did not – until 1981 – think about creating an independent research ministry. The reasons for this were probably quite strong individual ministries opposing the creation of a new competitor, the still strong intermediary role of the CNRS and, finally yet importantly, the organisation of high technological research in a number of specialised and important research agencies like the CEA (Commissariat à l'énérgie atomique) and ONERA (Office national d'étude et de recherche aéronautique) (see also (Krauss 1996). France had therefore a special and deviating development from the three other countries: It had a small and innovative coordinating agency even somewhat before the creation of the German research ministry, which – it must be admitted – could never really fulfil the task of coordinating the different ministries but which developed nevertheless some interesting research initiatives, above all in the field of industrial research. This demonstrates that France was relatively quick in changing its institutional structure when the new policy design started to emerge but – and this makes the difference – it stopped this experiment at the very moment when the new policy design became intense and most other countries were developing new regulatory structures. At this moment, France had to do more or less with a fragmented landscape of ministries, not too much interested in research, and strong and relatively autonomous agencies on the boundary like the CNRS and the CEA,

which were delegated scientific and technological research. The primordial role of these "grands organismes" is very well recapitulated in 1986 by Arvanitis, this is after the social-democratic transformation which envisaged to integrate these institutions more closely into the political design:

> *"Dans ce secteur d'activités, plus que dans tout autre, l'Administration est confrontée à une multitude de grands appareils, organismes de recherche …ou agences …qui jouissent dans la réalité d'une très grande autonomie et disposent d'une influence considérable. Face à une Administration à laquelle les moyens organisationnels et intellectuels font défaut et qui est bien souvent déchirée entre une multitude de services aux logiques et aux intérêts différents, les* Grands Organismes *disposent d'un monopole quasi absolu de l'expertise et d'une continuité qui leur permet de faire aboutir leurs projets à long terme »* (Arvanitis 1986).

This should cause difficulties for setting up the programming of research. Probably, if a social-democratic government had been in office in the 1970s, the active role of the DGRST would have been continued. As it is, the conservative government opted for a different strategy.

Germany was almost as quick as the French with regard to the setting up of a genuine political institution of research. In 1962, the first research ministry was set up. In 1969, the new social-democratic/liberal government merged this unit with education but in 1973 the research part of the ministry became independent. In installing an autonomous research ministry, Germany has been unique. The creation had far-reaching consequences for research policy-making, as there was a corporate actor with "standard interests" in defining and extending its domain, with a "natural" propensity to foster its own research institutions and to develop the programming of research. At the same time the creation prepared a profound "division of labour" between the scientific organisations and intermediary institutions already there – like the DFG and the MPG -, responsible for the promotion of basic research on the one hand and a ministry that was supposed to engage itself in technological and industrial research but which saw it also as its task to guarantee the basic infrastructures for basic research. This inherent conflict – intensified by the blurring of boundaries between basic and applied research – became a constant tension in the public-funded research systems. Of course, the ministry was confronted with opportunistic interests of different other ministries also engaged in research and in the concert of these ministries it was not a very strong one. Nevertheless, the advantage was to have one corporate actor that could defend the interests of research in the budget appropriation each year.

The strong position of a number of extra-university research institutions – above all the Big science institutes (GFE), the Fraunhofer Institutes, and the institutes from the "Blue List" – must be attributed to the existence of such a ministry that needed a research base in order to strengthen its domain competence in the public-funded research systems. At the same time, it contributed to a strengthening of the differentiation on the operational level by opting above all for the promotion of these extra-university research institutions while the universities were mostly an affair of the Länder.

Germany had therefore already a corporate actor – though in changing organisational contexts but finally autonomous in 1973 – when the new policy-design came up. It had, moreover a "reflexive" institution, the German Science Council ("Wissenschaftsrat"), since 1957, organised – as shown above – in a similar way as the Swiss Science Council. Only, the internal or-

ganisation is – until today – much more formalised and corporatist: there is a scientific chamber and a political chamber that both must approve the propositions made by the secretariat and the different advisory committees.

In addition, Germany was setting up a coordinating device between federal government and the Länder in 1969, the so-called "Bund-Länder-Kommission" (BLK), which – among others – should discuss the promotion of research and more in particular the financing of extra-university research institutions. In contrast, in Switzerland there exists no institution that coordinates both territorial actors regarding the funding of extra-university research institutes. Given the important status of these organisations and the importance as a power base for the research ministry, this means a permanent need for cooperation between the federal government and the Länder in matters at least of institutional funding. *Given the difficulties to find a consensus on reforms in most matters of extra-university research institutions until today, the federal structure in Germany is responsible for structural conservatism in the organisation of the public-funded research systems* (Braun 1997); (Winnes and Schimank 1999); (Stucke 1993). The CUS in Switzerland – as the coordinating body between the territorial entities – deals with university questions and has certainly also considerable difficulties to find a consensus on research policy matters. Given the predominant position of the cantons in the financing of universities, the federal government is, however, much weaker in this institution than the BMFT in the BLK.

So, when the new policy-design was emerging, Germany had on the one hand a territorial division of competencies that were supposed to be coordinated in the newly created BLK and a dual structure of competence in basic and applied research organised by intermediary organisations on the one hand and the ministry on the other. Already in the 1960s, these distinctions became more a restriction than an asset: The creation of the "Sonderforschungsbereiche" (SFB; special research areas) in 1967 is a case in point: The problem was that the research ministry considered the university base as insufficient for the kind of programs it wanted to launch in research. The response was weak mostly because of strong disciplinary thinking at the level of the universities. As the federal government had no direct possibilities to change this, it had to refer to the main funding organisation of the universities, i.e. the DFG. With considerable difficulties, it succeeded to convince the DFG – as formal hierarchical mechanisms do not exist – to accept a new program managed by the DFG but decided upon in special boards together with representatives from the federal government and the Länder. This was the first time, the ministry succeeded in obliging the DFG to accept "directed funds". Usually, the DFG refused to accept such money out of fear to be instrumentalised. This example demonstrates that the cleavages in Germany caused considerable transaction costs and a lot of consensus-building to set up a new policy in universities. Any new policy for extra-university research institutions met usually the resistance of the Länder. These cleavages on two dimensions – territorial and scientific – explains the structural conservatism of Germany in the public-funded research systems. This does not at all say that programming has been impossible. We will come back to this question in the next chapter.

To conclude this section we may summarise the findings as follows:

In the Netherlands and Switzerland, we see a process of institution-building in reaction to the new policy-design given the "flat", rudimentary and science-prone regulatory structures. Switzerland succeeded relatively quickly to adapt by reforming its main funding organisation

while the position of the federal government in research failed to be strengthened despite of the creation of some new institutions. The Netherlands used a reform of its political institutions without endangering the prerogatives of existing ministries to make institutions conducive to the new paradigm. The reform of regulatory and operational structures took however quite some time before it was institutionalised. Germany and France already had conducive structure for the setting up of research programs but France ended its institutional innovation at the moment the new paradigm became relevant and lacked therefore the necessary institutional features. It did not, in addition, attempt to create other new institutions. Germany, by contrast, strengthened its research ministry in this period and had the institutional means to realise the aims of the new policy-design. In suffered, however, from a double clivage, that hampered the implementation of an active research policy.

One can conclude that, nevertheless, Germany had a conducive structure to learn quickly to adapt the new objectives, while the situation in France was unfavourable. In principle, the possibilities of a learning process were cut off. Switzerland used in part existing structures which should allow for quick learning while Netherlands embarked on a longer process of "learning by doing", of a constant institutional reform.

What did these institutional prerequisites mean for the programming of research?

3.2.2 The programming of research

Let us start with the case that had the most unfavourable conditions for implementing the programming of research, France.

France

As we have already stated, the DGRST had already implemented since the early 1960s some "actions concertées" financed out of its own (small) budget (Braun 1997). These programs were mostly directed to industrial research and were initiated most of the time by scientifical entrepreneurs dissatisfied with the disciplinary conservatism within the CNRS. The sum of money was not important but the measures were regarded as a success. It was even possible to obtain the cooperation of the CNRS in one new research field (molecular biology) and to build up this research field in France (Gaudillière 1992). These programmes went well as long as there were sufficient resources to distribute. When a fiscal crisis set in, resources for the DGRST were cut down and it was finally integrated into the industry ministry. With this, it lost its function as a coordinator of research and its reputation as an innovative and relatively independent institution. This explains perhaps why the new ATP (actions thématiques programmées) set up in 1971 were more or less a failure, in particular in getting the CNRS involved.

The ATP were program funds – based on the experience of the former "action concertées" – that envisaged to orient scientists, in particular also in the CNRS, towards the general objectives of research. It was no problem, given the experience of the former DGRST, to launch such a programme. The problem was to make scientists cooperate and here the particular operational structure of France comes in. It would not have been sufficient to address the programmes to the universities, which were perhaps easier to govern given the direct influence of the education ministry, but universities did not have the same quality of scientists as the

CNRS and also some other of the "grands organismes"[6]. The integration of scientists in the CNRS was therefore imperative. Two obstacles were to overcome: First, the pregnance of the "Comité National de la Recherche Scientifique", known as "Comité National", which is composed of scientists and strongly inclined to defend the disciplinary interests, inside the organisation of the CNRS. Despite of efforts of Currien and others, this orientation was not really changed. Second, all scientists in the "grands organismes" are public employées with a tenure. There is no need for these scientists to accept resources from outside as long as their career is guaranteed out of the institutional resources of the CNRS. In addition, one finds in general a profound distrust of large parts of the scientific community to the programming of research, which curtailed the "freedom" of scientists.

There is no need to elaborate this example. It can be briefly summarised by saying that the only attempt of programming during the 1970s, the ATP, failed out of a lack of a strong political structure, a general decline of interest of the government for research and the existing operational and regulatory structure that favoured the interests of the scientific community. It is therefore justified to contend that the 1970s were the "black years" of French research. Based on former experiences but confronted with a more unfavourable institutional structure (lack of a strong political centre), *France failed to learn* and finally abandoned initiatives of the programming of research, which was, by the way, an alien element in the overall hardware and software of the system: the French system is based on institutional funding and delegation but not on the "American" logic of temporary research projects initiated by the political system. The programming of research must therefore fail and one of the lessons for the new social-democratic government in 1981 was to reform the extra-university research institutions and to strengthen the political centre. Lessons were drawn, therefore, but only by a new and more active, social-democratic government.

Two additional features can be added that might explain the failure in programming despite of already existing experience and knowledge: Switzerland has demonstrated how important reflexive institutions can be in setting up the programming of research. In France, the CCRST was never able to develop a similar authority as in Germany and Switzerland. A possible mistake in the set-up of the CCRST was perhaps that only scientists participated in this body. Scientific authority alone can, however, not create a consensus in the public-funded research system. The corporatist structure of the German and Swiss Council seems, at first hand, better to do this though one should be aware that there is a trade-off involved: *The more corporatist such a reflexive institution becomes the less "reflexive" it might be.* This is because all recommendations will be, of course, compromises and not purely outcomes of rational argument. On the other hand, these recommendations have sufficient legitimacy – and still the aura of "reflexivity" – to be heard by most actors in the system. In addition, one should not underestimate the "informal function" of such an institution, i.e. the trust between the actors of the public-funded research systems that can be created by regular contacts within these bodies. The more distant location of the scientific CCRST to political means was not functional to raise the reflexivity of the system or to convince the CNRS or other actors of the necessity to foster the programming of research.

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[6] Due notably to the the teching duty university professors have to fulfill, which is not the case for the researchers belonging to "grands organismes".

Finally, the concentration of the French government on "high politics" issues in the promotion of research, i.e. on key technological areas, dampened the eager to also introduce programming in the more basic oriented research or in other areas.

We see that a concentration of power and a strong centralist tradition of the state do not guarantee the introduction of an active research policy. The "empty" political centre gave institutions on the boundary a predominant role in the formulation of research policies. As these institutions were often directly linked to the scientific community, it was particularly difficult to convince these actors of the merits of more social responsiveness of research. The political centre was therefore weak and not strong.

Germany

The story in Germany is completely different. Given the existence of a differentiated ministry of research, the introduction of programme funding was no major obstacle, at least as far as project funding is concerned. Gradually, programme funding become more important since 1968 (Winnes and Schimank 1999) and as long as money was flowing generously into the public-funded research system, the proliferation of programme funding continued. Uncontrolled proliferation resulted, however, in an increasing internal fragmentation of the BMFT, with different departments responsible for different funding programs. Each programme fund developed its own implementation structure with networks on the operational level of research that had a profound interest in the maintenance of these programmes (Winnes and Schimank 1999). In addition, a fragmentation between those departments responsible for institutional funding and those responsible for programme funding emerged contributing further to the rather incoherent character of research policy.

The organisational base of a research ministry was sufficient to promote programme funding which became the important instrument – imitated from the American model –. The disadvantage was that such an organisational base was also amenable to the development of vested interests that could emerge in this way. The interesting story is that the federal government attempted to correct this uncontrolled expansion of funding programs and to create more coherence and efficiency in the use of funding. Two instruments served this objective: one was the creation of so-called "project agencies" ("Projektträger") that were delegated the task to organise the funding programs. These agencies were usually situated outside the BMFT, mostly in one of the big science institutes. Officially, this should reduce the influence of vested interests on the BMFT and also reduce somewhat the political control in programme funding. In reality, the BMFT kept very much the authority to decide on the funding of programmes and the project agencies were not much more than a "secretariat" under the formal authority of the Ministry. The second reform was the attempt to cut down on advisory committees linked to the programmes and to cut down in general on the number of programmes. For the social-democratic government democratic transparency was an important aim. Figures show that the government did not succeed in reducing neither the number of programmes nor the number of committees. The active policy had created its own children that were now grown enough to develop their own life, difficult to control. However, this development was the result of the rather unproblematic introduction of programme funding in the wake of a more active research policy, something that has not been possible in France.

Except for this development, another problem arose because the programmes could not always be clearly distinguished from basic research thereby endangering the relationships with the DFG that felt a threatening of its domain in the funding of research. The BMFT either had to renounce to these kinds of projects or find an agreement with the DFG, mostly in the form of directed funding given to the DFG. This remained, however, more the exception than the rule so that the ministry was hampered in its development of research programmes.

A more programmatic approach concerned also the extra-university research institutions. As the big science institutes were financed for 90% by the BMFT and only for 10% by the Land where the institute was located, these institutes were the main point of attack for the BMFT. It should be added that they also received the most substantial sums of money given the high cost for laboratories, machineries etc. used in these institutes. The problem was that these institutes were created in a period where atomic research, space research, and other "big science" topic had been of relevance. A more active research policy meant however a shift in orientation to topics of "social responsibility", i.e. energy, environment, social problems etc. Since the 1970s, one sees therefore also attempts of the ministry to re-orient the big science institutes into the direction of the new funding programs. Another policy design shift was the introduction of "global steering" as a new intervention concept vis-à-vis the big science institutes. Global steering contained already ideological elements of new public management thinking, i.e. the reduction of state intervention to the developments of global strategic orientations and operational autonomy of research institutions. In the literature all these attempts are in general judged as failures: the big science institutes were able to resist – like in France – major reorientations in their research topics and global steering was refused as a much too strong and interventionist policy of the BMFT (Winnes and Schimank 1997; (Hohn and Schimank 1990). The main success during this period can be seen in the creation of the Fraunhofer Institutes, financed for 40% by the federal government and the Länder, that should link public funded research and industrial innovation. As additional money was invested into these new institutes, this created no major refusal by other organisations.

This brief summary demonstrates that the existence of a research ministry was conducive to the implantation of the new policy-design in the research policies of Germany but that the execution of these new ideas generated new problems and could in part not be realised because of a strong resistance potential on the operational level. The universities, in addition, were a problem for the BMFT as already described as they were not yet "fit" for the new ideas and because the BMFT had no direct access to the working of these institutions. One cannot say that the federal government in general and the BMFT in particular did not react to perverse developments like the uncontrolled proliferation of programmes or the out datedness of the big science institutes. These learning processes were however not successful because the internal fragmentation of its own ministerial structure and the strong resistance potential of the big science institutes made it impossible to develop a transparent and efficient active research policy. The overall regulatory and operational structure is deeply divided along several lines (between scientific and political agencies, between the federal government and the Länder, between programmes; between public-funded research and industry), which leads the German Science Council in 1975 in its system analysis to the diagnose that a coordinated policy of priority-setting is lacking in Germany. There are many activities that attempt to implement the new policy-design but these activities create successive problems and are often encountering difficulties during the implementation process. The overall reform capacity of the

BMFT was not sufficient to really induce a "regime change" in this sense. The new programme structures were integrated into the new system but did not sufficiently spread among all institutions to induce an overall shift in orientation.

Netherlands

Programming was – in contrast to the two countries above – the result of a "big bang", i.e. a comprehensive effort to develop and institutionalise a new policy-design. The "White Paper" in 1974 was the sum of an encompassing survey with regard to problems and solutions in research policy where most of the relevant actors in the public-funded research systems were heard. The new policy design was built on this survey and the consensus building processes it involved and thus confirms the "polder-model" culture of the Netherlands (Rip and Meulen 1998): any major change in policy design or priority-setting in general is prepared by an extensive aggregation process where the scientific institutions (like the Royal Academy and the ZWO at this time) and the emerging sectoral councils played a major role. The government has, of course, the final say on what it wants to accept. One should not confound the polder-model with a "democratic voting model". The process is important: concerned groups are participating, the government gets all the informations necessary to take its decision and can adjust its position in discussions with the actors on different levels and different institutions. There is therefore a consensus building logic within the model but once the process has terminated, the government will decide on the base of its political interests without, of course, violating too much the recommendations emerging out of the process. It should be clear, however, that there is room for interpretation of the government: the aggregation process seldom produces one voice in the scientific community. There are differences and the government can use these differences to choose in its favour. The polder-model is therefore a consensus-based system but with a hierarchical potential left to the government. The "big bang" would, however, not have been possible, if it had not been a "grand coalition" at this time, which was reform-oriented and dedicated to an active, and interventionist policy. It needs a consensus in the "political stream" (cf. (Kingdon 1984)) to change the existing policy-design.

One finds in the "White Paper" most of the points we have discussed as characteristics of the new policy-design: intergovernmental cooperation, priority-setting by political institutions, and the promotion of social relevance among the agencies on the regulatory and operational level. The intention to improve economic competitiveness was also mentioned. At this time energy, environmental and social topics were, however, at the foreground and to be included in the newly created priority programs of the government to be implemented by the education ministry with its minister without portefeuille. OCW became the institutional center for the implementation of the new priority programs. The attempt to generate, first, a quasi-autonomous entitity within OCW by establishing a minister without portefeuille, did not succeed mostly because the upcoming "technological turn" at the end of the 1970s transferred most of the priority programs to the Minister of Economic Affairs (EZ) leaving OCW with only a small set of programmes at the moment. The minister for research was dismissed. This left OCW and a rising EZ to take over responsibilities for the public-funded research system. OCW was the main coordinating ministry, bundling the research proposals and offering the research budget to the parliament. That gave it a central role without, however, the possibility to intervene into the policies of other ministries. The "great divide" between EZ and OCW for

example seemed to have been overcome only at the end of the 1990s. The advantage of OCW was, as mentioned, that it had influence on the extra-university research and funding institutions and on universities. This was, nevertheless, very important in order to develop a coherent policy and not to play out one side against the other. This explains why universities were much earlier under attack than in the other three countries.

Already in the "White Paper", the lines of the new policy-design were clear in this respect: the mode of knowledge production in the public-funded research systems had to change including the universities. The failing economic competitiveness and ailing industries put an emphasis on the relation of the public-funded research systems and industry, utility and social relevance were regarded as orientations of all organisations within the public-funded research systems. The White Paper developed a clear programme in this sense: the mentality and organisational culture of public funded organisations had to change in order to implement the new policy-design. This reform program was announced and gradually (above all in the 1980s) it was implemented against the resistance of organisations and the scientific community. The possibility to do so was linked on the one hand to the centralised structure of the state – no territorial clivage could protect these institutions – and on the other hand, these institutions had no legal status that protected them in the same way as the German DFG or the Swiss SNSF. All institutions were created by a law and any law could change their mode of functioning or even dissolve these institutions. The dependence of research and funding agencies in the public-funded research system of the Netherlands on governmental decisions is therefore quite strong and demands at least that these agencies take into account what the government wishes if it does not want to loose its financial resources.

Why did the government not opt for an inclusion of the new priority programs within ZWO? Partly, because some of the programs were technological oriented and this was not the domain of the ZWO and partly because domain competence of OCW demanded that political institutions should implement a political programme. The existence of a strong ministry with some experience in dealing with research institutions forbid therefore the solution of the Netherlands, i.e. to transfer competencies in this respect to the existing funding agency.

Since the beginning then, programming research meant in the Netherlands two things: to introduce politically implemented priority programmes of research and to reform the organisations in the public-funded research systems in such a way that utility and responsiveness become one of their points of reference. This is comparable to Germany where the BMFT attempted to at least re-orient the big science institutes without much success however and it is comparable to France where the government attempted to reform the "Comité National" within the CNRS and to induce scientists of the grands organismes to accept programme funds. Switzerland has introduced programme funds by changing the mode of functioning of its funding agency without, however, attacking other institutions in the research system.

Learning in the Netherlands in the 1970s consisted therefore in a radical turn by introducing a "science for policy" discourse where new instruments (priority programmes) and reforms (utility orientation of organisations) were announced. The visibility of the declaration (a White Paper) and the consensus building process before gave the turn a lasting and influential character that was – despite of changing governments – never abandoned. The introduction of priority programmes was not difficult (though much more difficult to do it in an efficient way) but

the reform of the "mentality" of organisations a much more difficult one. How this was achieved, is part of the next chapters.

Switzerland

Switzerland is similar to the Netherlands in that it also seeks to build up a consensus before it introduces major reorientations. In this respect, the creation of the SSC with its corporatist structure was the device to do so. While the Netherlands launched a survey on all levels of the public-funded research system, Switzerland delegated the task to sketch the outlines of a new policy design to the SSC where the major actors came together. The SSC is a representative institution, while the Netherlands prefers a bottom-up aggregation process. This does not say that Switzerland does not know such an aggregation process. The participants in the SSC will not vote for certain points of view if it was not checked with their base and, on other occasions, if there are new propositions, let's say by the federal administration or the SNSF, a long process of distributing a first report to all important actors is initiated (Braun and Benninghoff 2003). In 1973, however, it was the publication of a special report on the Swiss research system, which led to the initiation of programme funds.

One should recall that, in contrast to the three other countries, Switzerland had no education or research ministry on the federal level. The creation of the OFES (Federal Office for Education and Science) happened during this phase of introducing the new policy design and was partly a consequence of it. So, when priority programmes were discussed as a necessary instrument in an active research policy, the only actor that could have taken over this task was the existing, scientifically anchored, SNSF. Switzerland had not the possibility – because of federal structures and economic liberalism – to create a "dual structure" – scientific and political – to implement priority programmes. This is why the federal administration attempted since the 1960s to incorporate the SNSF in a more fundamental way into the implementation of political objectives (see above). This notwithstanding, it remained difficult in 1973-74 to convince the SNSF to take over the task of implementing new priority programmes (the later PNR (National research programmes)). It was only the threat mentioned in SSC report that one could think of creating other agencies more sensible to the transfer process and social relevance, which induced the SNSF to react and, in order to maintain its domain competence, to accept the priority programmes by reforming its organisational structure (the creation of "department IV" for oriented research).

The delegation of priority programmes did not forecome further struggle between the scientific community and political representatives – all represented within the SNSF -. There was a debate on how to decide on priorities and the newly created OFES attempted more than once to influence the process of priority building. The decision to delegate such programmes to the SNSF was, however, never taken back and has become path-structuring: As the new mode of programming functioned reasonably well and respected a certain balance of power between the scientific community and political interests, the set-up of new programmes (in 1988 the "priority programmes" (PPR); in 1997 the new "centres of excellence" programme (NCCR – National Centre of Competence in Research) followed the same procedure and logic. There have been modifications (see below) but Switzerland has maintained its "flat structure" in this respect by not organising programming research on different levels but to use one institution on the boundary in order to satisfy political interests. One should state very clearly, that this was

a path quite different to the set up of the active research policy in other countries and certainly one that allowed less "politicisation" than in the case of the three other countries where political actors had an interest in conquering a domain in research policy. Until today, the administrative capacities of the federal government have remained feeble so that the "boundary" still is the focus in research policy.

One should add that this solution had other advantages: it lowered the costs of political administration and did not destabilise existing power relationships by installing a new and powerful political actor. Switzerland has found therefore an equilibrium solution in short a while, France had no solution at all (immobilism), Germany was confronted with "implementation slack", and the Netherlands worked slowly but steadily on a transformation of its public-funded research system.

3.3 Conclusions

In sum, then, we see that the new policy-design took hold in all countries and manifested itself in the programming of research by, first, the set up of programme funds and, second, by first attempts to re-orient research institutions and funding agencies into the direction of social responsiveness. While France had been the forerunner in this policy, it lost momentum at exactly the moment when the new policy-design became the most virulent in the other countries. This prepared the "big bang" in 1981 when the new social-democratic government installed a new policy regime.

We also see that attempts to remodel the "hardware" at the same time reveal the "paths" the learning process has to follow in the future: In France, it is the lack of a political centre and the heavy weight of the CNRS that structures all future alternatives in research policy; in Germany the dual structure of scientific and political institutions on the one hand and of territorial cleavages on the other hand is clearly emerging; in the Netherlands the polder-model is established and remains the main device to develop future policies. This model integrates a bottom-up aggregation and political decision-making. In Switzerland, finally, the solution is a flat structure in research policy where the SNSF plays the main role as a research agency and as a consensus-building device among conflicting forces.

Only in the two small and consociational countries do we find the emergence of an encompassing view on the new policy design and a vision on its implementation. In Germany the new policy-design is integrated and elaborated within the confines of the emerging research ministry. The overall analysis of the Science Council of 1975 is already too late to function as a sparking plug to institutionalise the new policy-design. France must wait until the 1980s to develop such an encompassing view.

Though the new policy-design took hold everywhere, the policy-regime did not change in the same way:

- In Germany, it was not really necessary to change the hardware, at least at the regulatory level. It had a conducive structure in the form of a research ministry that was able to integrate the new policy-design in its tasks. Difficulties caused extra-university research institutions and universities, i.e. the operational level. The control of universities was difficult because of the two main cleavages in Germany: the scientific – gov-

ernment divide and the federal divide. It was the DFG and the Länder that had main responsibilities in funding the universities. Each attempt to develop programme funding at this level was confronted with the necessity to coordinate the policies of the research ministry with those of the DFG and the Länder. The big science institutes had a considerable resistance potential among other things because the research ministry needed these institutions in order to mark its domain vis-à-vis the other institutions.

- Switzerland succeeded in modifying quite quickly its regulatory structure by simply adding new functions to the existing scientific funding agency. This happened with a large consensus and some threat potential concerning the domain position of the SNSF. This means that Switzerland did not revolutionise its policy regime but modified parts of its system to make it function into the new direction.
- The "big bang" in the Netherlands announced a new policy regime which eventually was established. In this case political interests in the public-funded research systems were strengthened. Without any doubt, the Netherlands envisaged the most far-going reform among the three countries.
- In France we find no new policy regime until 1981. The integration of the new policy-design in policy routines remained feeble because of a lack of conducive institutions.

4 INTRODUCING "RESPONSIVENESS" ON THE PERFORMANCE LEVEL

4.1 Introduction

Programming research along the lines of an "active research policy" was only the beginning of a long process of transformation in the policy design and policy regime of countries. Social responsiveness as a key word for objectives in research policies of the 1970s was first accompanied and then almost replaced by "economic relevance" and "economic utility" respectively in the aftermath of the first transition of research policies. Responsiveness to "user needs" became the battle cry of policy-makers in the 1980s until today. This transformation was due, as described in chapter 2, by the difficulties of European countries to cope with the challenges of globalisation in terms of economic growth and the "new growth theory" explaining the comparative advantage of technological innovation to research policy-makers. Again, ideas were "in the air" and one sees that all countries were reacting to this challenge, mostly by bringing public-funded research systems closer to industry and by integrating science policy more closely into innovation and industrial policy. In fact, industry policy became – instead of paying subsidies to ailing industries – the promotion of new technologies. While this policy opened up new ways to promote the cooperation of public-funded research institutions and industry, the next step, the more fundamental transformation to a "mode 2" knowledge production, was even more radical. While still insisting on responsiveness, the reforms envisaged were more fundamental and concerned not only project funding – the major instrument in the 1980s – but also the agencies on the operational and regulatory level. The internal logic of these institutions had to be changed such that a permanent interaction of the public-funded research system and industry would be possible. In contrast to the period where the "technol-

ogy paradigm" prevailed, the 1980s, and still a more linear idea of knowledge transfer was upheld, it now was interaction and the organization of a permanent exchange between the fundamental research trajectory and the technological trajectory, which was the main objective of policy-makers. This needed, as described in chapter 2, a fundamentally different mentality of agencies and organizations in the public-funded research system: the "new governance of innovation" needed strong and flexible organizations with responsiveness as one mode of functioning.

Reforms since the 1980s envisaged therefore to continue to introduce "responsiveness" into the public-funded research system by, first, developing a stronger cooperation between the public-funded research system and industry for the sake of technological innovation by using project funding (chapter 4.2) and, second, a more fundamental reorganization of the institutions at the operational level (chapter 4.3) and of the regulatory structures (chapter 5). We will use in this chapter different reform projects in countries that will reveal to us how the countries have attempted to learn in applying strategies to promote responsiveness in their public-funded research systems. The different ways how it is done will show us in what way path dependency and other constraints have influenced the choice of policy-makers and how "innovative" policy-makers have implemented the new policy-design.

4.2 Strengthening economic responsiveness: project funding[7]

4.2.1 When and who?

The end of the 1970s and beginning of the 1980s were the turning point in "economic responsiveness" in all the four countries. This is without any doubt due to the enormous economic problems especially European countries were facing in the aftermath of the oil price shock and the ensuing stagflation processes. High labour costs, rising prices and high unemployment as well as an increasing competition on the world market in many European industries created the breeding grounds for a re-assessment of technological capacities. This also meant a new industrial policy that abandoned subsidy policies and that envisaged to create a better transfer potential for technological knowledge at the use of key technological industries.

We found that all countries were taking notice of these challenges and were revising their stance in matters of technology policy. The most important issue became – given the shorter trajectory between basic research knowledge and technological products – how public-funded research institutes (universities and extra-university research institutions) that were at the forefront of basic and applied research could be brought nearer to industry. If we speak of "economic responsiveness" in this chapter, we mean the promotion of a closer cooperation between the public-funded research system and industry. Economic responsiveness now became the predominant objective and began to shift social responsiveness to the background.

The *Dutch* began to focus on technological innovation since 1979. This was the result of a general re-orientation in economic and industrial policy prepared by an independent expert

[7] We will deal in particular with the IOPs (innovation-orientated research prgrammes) and LTIs in the Netherlands, the "Verbundforschung" in Germany, the "PPR" and the PRN in Switzerland and the ACI in France.

committee (the "Wagner committee") and the Scientific Council for Public Policy (WRR). Technological innovation became the key for success according to these bodies. The overall aim became to develop early technological knowledge in important areas to have technological advantage and to strengthen the export. A pro-active industrial policy – meaning the selection of key technological areas – should become the key to economic competition. The Christian-democratic/liberal government accepted the recommendations of the bodies. Linking the science base to industry was one of the principal aims in this respect. The focus on technological innovation was accompanied by a general change in the "référentiel global" concerning state intervention: The "active research policy" approach of the former government gave way to a less interventionist and framework setting policy. This characterized above all the policies of the Ministry of Economic Affairs that became responsible for the promotion of technological knowledge.

It is interesting to briefly compare the countries with respect to their "référentiel global". As we have stated in the preceding chapter, the social-democratic "conjuncture" had stimulated in all countries ambitions to install an active and comprehensive research policy though abilities to do so were different. The rise of the neo-liberal "conjuncture" since the mid-1970s dampened the eager of interventionist efforts and gave more attention to more liberal and framework-setting policies. This had implications for the research system. One can contend that the rise of the Christian-democratic/liberal government in Germany in 1982 and in the Netherlands in 1977-1981 and again since 1982 changed the political context and the policy-design in these countries. Switzerland, traditionally more liberal, installed nevertheless in 1983 – as a retarded outcome of previous attempts – a new research law that obliged the federal government to formulate clear research policy goals and to take care of a coordinated and rational research system. In its working, however, the liberal approach predominated. The major exception is France where the socialist party won both the presidency and the majority in parliament in 1981. The programmatic of this government was in the beginning clearly Keynesian-based and interventionist in its reform attempts. In sum, when "economic responsiveness" became the principal concern of policy-makers, the Dutch and the Germans were influenced by a "neo-liberal" "référentiel global", while the French introduced interventionist rhetoric and the Swiss were obliged to implement a stronger planning character of research policies. We will see in how far this has influenced the policy-design.

In *Germany*, the change in government in 1982 was clearly a shift in the intervention rhetoric of the government though one sees already a shift in the mode of financing of the BMFT from the mid-1970s onwards. The creation of the project agencies was a first sign of a research ministry that endeavoured to reduce its direct engagement in programme funding. Protests of industrial interest groups then led to a shift from a directed mode of funding to more indirect modes of funding like the use of tax credits and, above all, the setting up of so-called "Verbundprojekte", i.e. compound and network projects respectively (see below). In 1982, the federal government promoted a policy that wanted to overcome structural imbalances in industry and ameliorate the framework conditions of technological innovation. "Context steering" becomes the right term to characterise the intentions of this government (Stucke 1993). The state should be a mediator, an initiator, or catalysator of innovation but not more. This meant that the funding of research on the base of thematic selection became less and less an option. Cooperation between the public-funded research systems and industry became a major aim for the research ministry.

France had, as stated in the preceding chapter, failed to install an active policy at the end of the 1960s. Instead, research policies seemed to have been delegated completely to the intermediary organisations during the 1970s. The story is somewhat different though when it comes to technology policy. It has already been said that here France had developed a number of large scale technological projects that fostered "national champions" in key areas like nuclear energy, space, and information technology. These policies were managed by several research agencies and supervised by the cabinet or the industry minister. Like in Germany, then, France had its experiences in technology policy but one finds nevertheless a shift in the overall concept with the rise of the new socialist government. The "traditional Colbertism" (Baumgartner 1994; Larédo and Mustar 2001) that characterised the strong nexus between the administration of the state and some large (state) enterprises was increasingly discredited while the role of SMEs became a major concern in all states. The new government attempted to develop new instruments for these enterprises with the help of ANVAR (Agence nationale de valorisation de la recherche), the transfer agency of the government, which had already been created in 1967. The "White Paper" of 1981, which was the base of the new research and technology policy, stipulated in addition a number of new and smaller "technological programmes" that were inspired by the Japanese VLSI and the English ALVEY programme both oriented to a stronger interlinkage between public-funded research institutions and industry.

The White Paper was an important base of the new policies as was the *Colloque* held in 1982. The Colloque was the attempt to integrate all relevant actors in the formulation of a new research policy by creating a forum of discussion. This form of policy-making was not new and used already in the history of France. In particular, the Colloque of Caen that reformed the universities (1966) is a well-known example. The different colloques serve to generate knowledge about the problems and solutions in the field as well as to create a consensus on the broad lines of the government policy. In this, it is comparable to the process preceding the White Paper in the Netherlands. The new government attempted therefore to follow a "bottom-up" line of policy-making instead of the traditional Colbertist way to decide alone.

This bottom-up aggregation was pursued next to the creation of a new Ministry of Research and Technology, which, for the first time demonstrated the willingness to bundle the various political forces and to formulate a coherent policy. The new research policy of the 1980s was therefore the result of a double "big bang", the colloque and the new Ministry responsible for the formulation of research and technology policies. Therefore, the new socialist government ended on the one hand the Colbertist style of policy-making in technology policy but it created at the same time the institutional prerequisite of a stronger and more coherent and coordinated research policy. The creation was not, however, linked to a stronger interventionism. The new instruments administered by different agencies were indirect instruments and when they were direct funds (the "programmes technologiques") they were formulated together with scientists and industrialists. In addition, the administrators in the new Ministry were most of the time scientists working part-time.

Switzerland finally lacked almost completely an institutional base for technology policy in the beginning of the 1970s. There was just one agency, the CTI, that distributed some money for technological research. The crisis of several key industries in Switzerland forced policy-makers to re-think the traditional liberal attitude of the state vis-à-vis a support for industry. This was the background for the creation of a departmental working group and, thereafter, of the development of new "impulse programmes" for the technological promotion of industry. The

CTI received some of this money and became gradually more important as more money was flowing in favour of technological promotion. One should understand that the sums distributed by the new programmes were still very modest in international terms but they were a beginning and marked the interest of the federal government to be more active in industrial policies. Nevertheless, it was constrained by the protests of industrialists who refused each form of intervention in this respect and the people who refused the adoption of a risk guarantee for innovation the federal government wanted to give to SMEs in the development of new technologies (in 1985). One sees in the 1980s a gradual expansion of programmes in favour of technological knowledge. The implementation was delegated to either the CTI or – with concern to the PNR – to the SNSF. This does not mean that the federal administration did not try to influence the formulation of thematic fields and the implementation of programmes. We will come back to this below.

In sum, this demonstrates that the Dutch and this time also the French needed a fundamental reflection, a "big bang" to reform their policy-design with regard to the collaboration of the public-funded research systems and industry while the Germans and the Swiss acted more incremental. The German research ministry was subject to several pressures to modify its predominant direct funding approach and turn to a more indirect approach in technology promotion. The Swiss found eventually a consensus among the political elites to make technology policy a subject of great importance while it was almost completely absent before. The step towards a more active technology policy took, however, quite some time and was modest in comparison with the other countries.

Industry had an influence on the technology policy everywhere: In the Netherlands, they were industrialists that – together with scientific experts – who formulated the new industrial policy (the "Wagner committee" In Germany and Switzerland, industry played a restrictive role: in Germany the protests of industrialists against the competitive asymmetries the direct funding policy of the research ministry created led to a revision of this instrument. In Switzerland, we find traditionally a profound mistrust of (above all the big) enterprises concerning state intervention. This has without any doubt kept the level of government intervention low.

In the end, there is more convergence than divergence in the new policy-design. Even in France the kind of policy instruments are not fundamentally different from the other countries. The orientation to SMEs and to more indirect funding instruments with a more restrictive role of government can be found everywhere.

4.2.2 The programmes

The following comparative description serves to learn to know about converging and diverging learning capacities of the four countries in matters of project funding directed to "economic competitiveness" and economic "responsiveness" respectively. We will treat the problem in five sections: First, we want to know about the kind of projects the countries have implemented and what type of learning is involved in these projects. Second, we will ask how the learning process – or in other terms how the new projects – was initiated, i.e. what has been the decision-process and the kind of actors involved within this process. Do we find advocates and adversaries? Third, the set up of the programme and the mode of implementation will be presented. This discussion – based on comparative tables – will serve to, fourth, explain simi-

larities and differences in the programming of research in the 1980s and 1990s. Finally, we will ask what our results mean for learning.

4.2.3 Types of Learning

In the first chapter, we have developed the notion of learning. It is useful to come back to this discussion in order to distinguish between different types of learning linked to the creation of funding instruments we will discuss below. The usual distinction of types of learning was "social" and "normal" learning. Our concept of policy-design explained that there are two central elements of the "software" of policy regimes: the causal theories concerning the intervention of the state in certain matters and the instruments that are used for this occasion. We think it useful to cross-tabulate these two dimensions of causal concepts and instruments. Causal concepts are in addition distinguished according to the learning concept in (1) a fundamental change in thinking underlying the policy; new causal theories of intervention; change in preferences; (2) normal policy-making implying no change in the thinking underlying the policy. The instrumental dimension has three values: (a) a new instrument is set up without former experiences in this field; (b) an existing instrument in the country is changed with regard to objectives and contents; (c) an existing instrument in the country is modified according to parameters of implementation.

This results in a six-fold table with different degrees of difficulties to learn:

Table 6 Degrees of Learning

	New Instrument	*Change in instrument*	*Modification of instrument*
Paradigmatic change in objectives	6	5	4
Normal policy-making	3	2	1

It will be evident that a new causal theory will always be more difficult to realise than a reform where the basic thinking of policy intervention has not changed. This is why our estimation of difficulties of learning, expressed in ordinal ranking, values all change in this category as more difficult than in the other category. In addition, we see it as being more difficult if there are no experiences with instruments in these matters and new instruments must be constructed than if there is already an instrument, which can be used for the reform. However, the change in objectives of an instrument is more difficult than to change only the parameters of implemen-

tation.

In the following table, we have summarised all relevant instruments of "economic responsiveness" in the 4 countries. The figure in the last row indicates the degree of difficulty of learning.

Summary Table 1: Description of Programmes

CH	Impulse Programmes 1978 ; 1982 ; 1986	Reflects a gradual change in the stance of the federal government concerning technology innovation: more active than before in order to save crisis industries; Some new measures are implemented but a part of the money is given to the Technology Agency using the same instruments as before; no instrument really needed a complete overhaul of existing models. The success of the first programme leads to replication. We estimate that the first impulse programme had to overcome strong resistance of industry and conservative political forces and can therefore be regarded as a "new thinking" in research policy.	**5/4**
	National Research Programmes (PNR) 1985	The PNR, set up in 1974 were since the beginning conceived as an instrument for responsivity, both social and economic. Only in the 1980s, however, the technological focus set through and became an important part of the instrument. There was no need to change the objectives of the instrument. Some parameters for application had to be modified. Therefore, endogenous learning sufficed.	**1**
	Priority Programmes (PPR) 1992	This instrument could profit from the experiences of the PNR and Impulse Programmes but it added some new elements, above all directed to long term cooperation, intra-systemic and inter-systemic. Japan´s cooperation programmes between industry and academia were example. There was no general change in thinking but new objectives that changed the outlook of existing instruments.	**2**
	National Centres of Excellence (NCCR) 2000	Was based on a critic of the functioning of the PPR and used main objectives but different parameters of implementation.	**1**
FRG	"Verbund-Projects" 1984	The new programme developed between 1980 and 1984 refers to an already existing programme. The difference is the inter-systemic character of the VP. However, a general and profound shift from directed funding to indirect modes of funding based on a change in the intervention philosophy of the government: from interventionism to framework-setting; from thematic steering to structural steering.	**5**
	Leading Projects 1995	Are based on the Verbund-Projects; Modify parameters of intervention	**1**
FRANCE	Programmes technologiques 1982	Minor change in philosophy of state intervention : from Colbertism to a more collaborative mode of cooperation. But already a close collaboration between state and (nationalised) industries. Example of ALVEY followed. Inter-systemic cooperation stressed. Nevertheless new instruments needed. More indirect mode of funding.	**3**
	Research Tax Credits ; Aides à l´innovation (ANVAR) 1979	Minor change in philosophy of state intervention : from Colbertism to a more collaborative mode of cooperation. But already a close collaboration between state and (nationalised) industries. Nevertheless new instruments needed. More indirect mode of funding.	**3**
	Thematic Research and Technological Innovation Networks 1990s	Continuation of technological networks. Stronger emphasis on networks and interaction. Modification of instrument .	**1**
	Actions Concertées d´Incitation 1999	Prior programme in the 1960s ; stronger emphasis on cooperation between public-funded research system and industry; no different philosophy from technology programmes. But a much stronger intervention of the Ministry. > from "tutelle administrative" to "tutelle scientifique"	**5**
NL	Innovation-Oriented Programmes 1979	Continuation of priority programmes created in 1974 but stronger economy-oriented and new constructed in 1979. First programmes launched in 1982. Link between public-funded research systems and industry stressed; key technological area. General change in intervention philosophy from active research policy to framework-setting	**5**

	Leading Technological Institutes 1996	Continuation of IOPs. Stronger emphasis on interaction and long-term network construction. Modification of instrument	**1**

The overview demonstrates that the more fundamental changes (4 and higher) happened in the 1980s (and in the 1970s in Switzerland) while the 1990s are characterised more by a modification in the parameters of existing instruments. More in particular one can state three periods:

- Period 1: The 1970s > This is the time where forerunners of the new instruments in the 1980s are coming up where often the focus is less on economic than on social responsiveness.
- Period 2: The 1980s > Based on existing programmes but often with changes in the objectives and often linked to a change in the thinking of causal theories, new instruments are created. Switzerland is late in developing its priority programmes with similar objectives (1992). Given the often important changes, this period should be the most difficult for installing learning processes.
- Period 3: The 1990s > There is a general shift in objectives more focused on interaction and long-term knowledge creation but this does not need new instruments. Only minor changes in existing instruments are necessary. The learning process is therefore much easier than in the 1980s. One can expect a rather smooth introduction of these instruments.

One sees an astonishing *convergence* in the time of creation and in the objectives of most instruments. The VLSI programme in Japan and the ALVEY programme of the UK are mentioned repeatedly as the basic models that have inspired the set up of the new instruments for technological innovation. The following overview summarises the contents of the major programmes.

Summary Table 2 Contents of Programmes

		1980s.	1990s
CH	Impulse programmes	Success criterion: establishment of new and independent research structures and stable cooperation relationships between industry and economy. Help ailing industries by research and technology development. Strengthen education in areas of industrial interest. The development of key areas is seen as necessary to have a combined effect of research activities, application and education in this area. The development of key areas is seen as necessary to have a combined effect of research activities, application and education in this area.	

	PNR	Introduced in 1974 and directed to relevant questions of society. Only later technology-oriented objectives are added. These are "applied-oriented" but in general not yet "industry-ready". The ultimate aim is however to find application in industry.	
	Priority Programmes (PPR) 1992	Coordinate research efforts in universities; make networks; interdisciplinarity; Alvey as model; collaboration between industry and public-funded research system; priority areas defined by policy-makers; long-term research	
	National Centres of Excellence (NCCR) 2000		Attacking lacking transfer of knowledge; priority areas; created partnership of industry and science; create interface universities – industry; build centers of excellence in the form of networks; Interdisciplinary research; very long-term and basic research with bridges to application; concentration of resources; better distribution of tasks between institutions
FRG	"Verbund-Projects"	Inter-systemic cooperation between industry and public-funded research system; key technology areas; pre-competitive research; SMEs are the object; lasting cooperation and self-organisation of research envisaged	
	Leading Projects 1995		Identify strategic research areas and create innovation networks; concentrate resources; quicker transfer within these networks; less direct money for industry; public-private partnership
FRANCE	Programmes technologiques ; Tax credits, Innovation subsidies	Alvey as example ; directed to SMEs ; objective : develop synergies between actors. "Encourage heterogeneous actors to jointly identify competences of future strategic significance and develop co-operative activities which will allow them to acquire and exploit these competencies; cooperation industry - academia	
	Thematic Research and Technological Innovation Networks	.	Continuation of technological networks. Stronger emphasis on networks and interaction. Indentification of technological problems; define research projects and develop new products; public-private partnership
	Actions Concertées d´Incitation		Develop coordination in fragmented research system in politically defined priority areas; open up public-funded research system to industry and society; support the rise of new research groups in areas; link to innovation networks; support start ups of academia; interdisciplinary, problem-oriented; overcome rigid existing research structure

NL	Innovation-Oriented Programmes	Innovation at the centre; create new and experimental knowledge in promising fields of technology; foster strategic research in universities; create link between industry and universities; rely on collaborative ventures; pre-competitive areas of knowledge creation.	
	Leading Technological Institutes		Long-term research at the interface of academia and industry; lasting anchoring of research networks; enterprises in the centre: formulate main areas; integration of stakeholders; virtual institutes instead of real institutes; Criteria: recognisable institutes that are centrally managed or concentrated in a single location; each institute will focus on a single cohesive area of basic-strategic research; an area that will have been selected in close cooperation with knowledge intensive companies; will employ leading international researchers and be given top quality equipment; include an educational component; flexibility and interdisciplinary activities will be key features of research work; substantial commitments will be expected from the companies involved, both in terms of funding and active involvement in the running of the institutes

Though the two instruments used in the two periods are not fundamentally different, the objectives are slightly different. While in the 1980s, policy-makers attempted to bridge the gap between academia and industry on the presumption of the linear model of knowledge transfer they did so in the 1990s on the basis of a "circular" or "interactive" model. The former model still insists on an active state that is involved in thematic priority-setting and in creating the opportunity for industry to work together with academia in order to transfer knowledge. The new model insists much more on the self-organisation of networks between industry and academia and the idea that it is necessary to have a long-term relationship between key actors. The networks are responsible for the whole knowledge production and innovation chain.

The overview explains that there are no real differences in the general objectives underlying the instruments in the 1980s and 1990s. Convergence of causal theories and instruments, in short of the policy-design seem to prevail. One finds minor deviances like for example Switzerland that needs a longer time to implement the first coordination schemes. In addition, there are perhaps differences in the way policy-makers are developing priority areas (see below). However, seen from a general angle, we do not find the divergences we would expect given the different starting positions we described in the previous chapter. The economic pressure, the

"new growth theory" and key models like AVSL and ALVEY as well as a general shift into the direction of more neo-liberal modes of state intervention seem to explain this convergence. The OECD has, without any doubt, also played a role in the diffusion of the knowledge in the organisation of state – industry research relationships.

We want to know, however, how countries managed to make the change and if there are significant differences in the set up of new instruments given the different types of learning. Given the different paths countries have followed in developing a research policy, we can expect differences in learning capacities here. What were the learning processes of country in the use of project funds?

4.2.4 The initiation of new instruments

The following overview demonstrates the differences between countries:

Summary Table 3 Initiation of Programmes

CH	Impulse Programmes 1978 ; 1982 ; 1986	1975 > Initiation by a working group of the department of economy under direction of the president of the Technology Agency (TA). Task > offer solutions in R&T for ailing industries. Parliament accorded 5 Mio SFr (more than the budget for the TA). For the first time not only research but also development projects were allowed to finance > was important later for the permission of the TA in 1982 to also finance development projects; This was the base for the funding of industry-oriented research projects in the future; 1977 > new crisis of industries > department elaborates a number of technology initiatives in concertation with industry organisations; directed to SMEs. This became the Impulse programmes in 1978 adopted by parliament and a model for future programmes. The ideas and development came above all from the Office for Questions of the Economic Cycle (Amt für Konjunkturfragen) within the department of economy. Difficulties > in pre-parliamentary hearings employers criticised state intervention > led to the reduction of number of inititatives. In the end 24 Mio for the TA for 4 years and other measures. Total 63 Mio. SFr. Protest of branch organisation against TA money: SMEs do not want money from the state. Parliament accepted nevertheless. Since then it was easy to adopt such urgency measures in times of crisis. But parliament decides to which branches money should go. Discussion on competition distortion of these measures. But accepted. In the 1980s technology becomes key word. European Union became a key actor and accelerator in this respect. Since 1987 is technology transfer (not policy) a prime activity of the government according to announcements: increase competitiveness. The credits for the TA rose from about 4 Mio in 1975 to 40 Mio in 1989 and more than 80 Mio from Industry while this was 1 Mio in 1975. The impulse programmes fixed – according to the model of COST – that 50% of research must be paid by industry. Was seen as guarantee for interest of industry (something which the German BMFT had to learn in the early 80s). The clause of 50% also important to overcome resistance of liberal politicians against research funding for industry.
	National Research Programmes (PNR) 1985	In this case there was no initiation because this happened in 1974. By and large, industrial topics became more relevant > mood of the time. This needed no new decisions but only new procedures to integrate industry in the decision-making. Decision-making on choice of topics is very much a corporatist bargaining among a large number of actors streamlined by the political stream.
	Priority Programmes (PPR) 1992	At the beginning of the 1990s there are two initiatives: the parliament asks the government to analyse existing structures of applied research, define the problems and develop structural improvements. A more efficient and effective structure is demanded by the parliament. At the same time the former president of the ETH and now secretary of state for research, Ursprung, proposes, after a Japan visit, to introduce long term projects to develop oriented research in key areas of scientific development. This fell on fertile grounds because since the law on research in 1983, there was the assignment for the federal government to create effective instruments for interdisciplinary research. With, in addition, the pressure of an economic crisis and the support of the Swiss University Conference, the federal government decides to build up a new programme which was introduced in 1992. This project is presented to parliament and quickly accepted. The themes were selected very rapidly within the ETH, proposed by researchers, and taken up by Ursprung and within the FNS. There were no general aggregation procedures. Technology is of course a most important item in this but also the development of social sciences. This time, it is envisaged to give the federal polytechnics the authority to implement the programme but only after protest of the FNS it is decided to give each half of the projects. Final decision on priority areas is taken by parliament. The difference with the PNR is above all the longer duration of projects.

	National Centres of Excellence (NCCR) 2000	In 1995 the parliament asks the government again to develop a report on how to improve the research system with the aim to rationalise the system and make it more efficient. Time and again the parliament is important for the introduction of responsiveness in the system. General concern for having a very long term research that can more deeply anchor new established priority areas in industry and universities. Important considerations of funding agencies: how to mobilise parliament again for these kinds of projects in a time of budget cuts; how to integrate better universities. An international expert study initiated by the SSC finds > The PPR have not functioned well until now: they are lacking anchoring > lesson-drawing. The network-building is still lacking between universities. The SSC had to struggle to get an evaluation. The NSF accepts the criticism and develops within its own reflection group the proposition to transform the PPR into a centre of excellence programme. This is presented in 1997 to the secretary of state for research who takes up the idea. The NSF had a profound interest in a new programme because the threat of budget cuts needed a mobilisation of parliament which could contradict the federal government in this respect. This is actually what happened several times. In addition, the evaluation group criticised the division of authority between the federal universities and the NSF. This gave opportunity to ask for the sole authority of running the programme. And the NSF wanted to change the former top-down process of decision-making into a bottom-up one. In addition, the NSF wanted a stronger financial participation of universities in the programme in order to allow for a better integration of the programmes > this is one of the lessons drawn: only a financial participation – both from industry or universities – guarantees the anchoring of new programmes. The Sonderforschungsbereiche of the German DFG and the American "Science and Technology Centers" served as a model. The proposition of the OECD to build up "competence centers" was taken up. The NSF project was presented to all relevant actors for discussion. Both the parliament and the secretary of state were in favour of the project. The "science and research group" of the federal government discussed matters in its own reflection group and gave the instrument a broader view > an instrument to strengthen and to transform the research in domains of strategic importance for the country. In order to win the parliament, it was integrated that networks should demonstrate links with potential users.
FRG	"Verbund-Projects" 1984	Austerity > concentrate resources. Increasing criticism of industry interest groups about competition distortion by direct funding policies. Intervention by Ministry of Economy in favour of more indirect methods of funding. New mode of intervention by new Christian-democratic and liberal government: less interventionist role of the BMFT. Organise innovation by science and industry; Existing Verbund-model for cooperation in scientific system: interdisciplinarity; Sonderforschungsbereiche of the DFG creating interdisciplinary centres of excellence in thematic area within university. The Verbund-Project signified a general change in the funding philosophy which took about 10 years. Changes happened within the Research Ministry but were influenced by criticism from outside (industry; other Ministries) and a change in government philosophy of intervention plus how to cope with fewer resources. The new programme existed next to other traditional ones but became predominant in the long run. The scientific system played a minor role in the process though the DFG supported the general outlines. Instead the relationship between the Ministry and industry seems to have played a more fundamental role for the shift (diverging interests of industry: keep also direct funding). Austerity considerations and blame avoidance were important considerations. Existing models for imitation (Japan, UK) played an incentive role. Adversaries could be found within the research administration of the Ministry among those departments responsible for direct funding, loosing their competence. The problem was: steering vs. blame avoidance for the bureaucracy.
	Leading Projects 1995	Stronger concentration of funds on promising key technologies. Consortia of public-funded research institutes and enterprises should develop new technologies up to the stage of application. Refinement of the idea of Verbund-Projects developed in house; no major conflicts or discussions known;
FRANCE	Programmes technologiques 1982	Installed after a White Paper on Research in 1980, in the Research Law of 1982, on the base of ALVEY model, 7 technological programmes are established. There are former examples like the "Plan Construction" (from 1971) and some agencies like the COMES for solar energy that had already established similar programmes.
	Research Tax Credits ; Aides à l´innovation (ANVAR) 1982	ANVAR became more and more an agency for technology transfer. Again, in the aftermath of the Research Law of 1982, the more indirect programmes were installed.
	Thematic Research and Technological Innovation Networks 1998	Like ACI (Action concertées Incitatives) created by the CCIRST, an intergovernmental coordination body set up by the Minister for Research in 1998 .

	Actions Concertées Incitatives (ACI) 1999	Initiated by the socialist research minister Allègre who installed an interdepartmental research committee. This committee developed the new ACI. The main preoccupation was the lack in coordination between fragmented research structures concerning priority areas. The next committee (CIRST II) defines the priority areas for the ACI after "discussions with scientists" (within the Conseil National de la Science), enterprises as well as the main research organisations and the different ministries. A forum with scientists and enterprises was created to discuss matters. The ACI were initiated in 1999 after failure of a former programme in 1997 which should stimulate oriented research within the CNRS; after that the CNRS was asked to reserve 20% of its money for such research. But this measure was taken back as the research ministry now wanted to define itself these areas on a more national level. A lot of resistance against this "interdisciplinary" and "problem-oriented research" from scientific community.
NL	Innovation-Oriented Programmes 1982	After the introduction of priority programmes developed within OCW, the "technology turn" starting about 1979 developed more technology-oriented programmes which were based, however, on the example of priority programmes. As OCW was first responsible, this initiated first contacts between the Economic ministry and OCW. In 1981 it was decided to transfer technology policy to EZ because of its better links with industry. EZ had, however, no research administration yet. This made it imperative to include actors from the outside in the formulation and implementation of the programme. No IOPs were developed within OCW. This gave the possibility to experiment with new formula within EZ. Decision processes on IOPs were then first taken within EZ and had to be presented to parliament, which had the final say.
	Leading Technological Institutes 1996	Nota Knowledge in Action decisive for new vision. Enterprises are threatening to go outside the country: therefore structures to link enterprises and science necessary to make enterprises stay. Companies can contract out their basic research needs to research institutes. This idea for new technological institutes, co-financed by industry and government was initiated by the Minister of Economic Affairs as a way to orient public research toward industry needs, and to circumvent the laborious and inconclusive processes of science policy. Initially the aim was to raise new institutes, in research fields suggested by industry, and with funding sufficient to launch them into world top rankings. Opposition from academe (including NWO and KNAW) and, less explicitly, the Minister for Science Policy (who argued successfully that research excellence cannot be made but has to be nurtured through time and that one should take advantage of the existing strengths of public sector research) as well as the necessity to have some selection and implementation procedure, forced the Minister of Economic Affairs to be more cooperative and link up with usual procedures. Also the available budget was too small for three new initiatives. Consequently the Minister of Economic Affairs in cooperation with the Ministers of Agriculture, and Science Policy solicited proposals from consortia of industry, academe and public research institutes. After a double evaluation process, with evaluations by a consulting firm and by a "traditional" peer committee, the Minister decided to finance institutes for food technology, metallurgy, polymer research and for telematics.

What can we learn from this overview?

What were the reasons for change?

Both in the Netherlands and in Switzerland the fundamental changes were initiated by a severe economic crisis and the perception that the existing passive industrial policy or the subsidising of ailing industries could no longer be a long-term solution for failing economic growth. This perception was enough in Switzerland to launch immediate measures by the federal government and the adoption of these measures in parliament in 1977. While the "exogenous shock" sufficed in Switzerland, the Netherlands – like Germany and France – needed in addition a change in government: In the Netherlands and Germany, conservative governments took over

office and installed a neo-liberal mode of policy intervention with repercussions for science policy-making. In France, however, a socialist government adopted a new philosophy in technology policy. The differences in the outset of the new technology programmes directed to the cooperation of industry and the public-funded research systems are, however, negligible. In the Netherlands and Germany, the arrival of a conservative government was important, though, because the former socialist and interventionist attitude would perhaps not have been changed if the former leftist governments would have stayed in power. Both in Germany and in France the crisis feeling seems to have been less visible than in the other two countries.

This leads to the conclusion that major turnarounds in the use of instruments must be initiated by a change in exogenous factors, as Sabatier has explained in the case of advocacy coalitions (Sabatier 1988): the "policy core" will only change if very strong influences from outside – like economic crisis and a change in government – induce such a change.

The Netherlands and France needed, in addition, a more profound analysis of the situation in the form of a report by a "reflexive body" (Netherlands) or a "colloque" (France) in order to find convincing arguments and solutions for existing problems. The PNR in Switzerland had been developed in the same way already in 1974 and in Germany, the Science Council had criticised in 1975 the state of the art of research. In the case at hand (the "impulse programmes" in Switzerland; the compound projects in Germany) there were, however, no new encompassing analysis to launch the new instrument. All countries used this instrument of "reflection" and, in France, of "discussion", to find a common denominator on research policy-making. In the Netherlands, the report of the WRR had proposed the IOPs as one possibility to reform industrial policy and the colloque in France formed the base for the decision of the socialist government in the form a new research law, comprising the new instruments (technological programmes).

In Switzerland the "impulse programmes" needed no new reflexive analysis as they were urgency measures for the help of ailing industries. The programmes did not change, in addition, the instrument, though they created some new ones, but added more money to the funding programmes of the Technological Agency.

We see that, with regard to the later changes in instruments (type-1 or type-2 learning), when a change in the policy core was not needed, neither a profound feeling of economic crisis nor a change in the party colour of governments was necessary. The changes in the 1990s were adjustments of existing programmes with the aim to ameliorate certain structural deficiencies and, above all, to install long-lasting networks. The reasons were, therefore, a stronger interaction orientation on the one hand and the deficiency of existing programmes to promote such an interaction orientation. It did not need a major revision but only a redefinition of parameters of existing programmes or, at a maximum, a redefinition of objectives of existing programmes.

Who were the key actors for change? Were there veto-players?

Instrumental change in *Switzerland* is an affair of „high politics", i.e. not only an affair of a ministry or one agency deciding on the implementation of new ideas but an affair for all agencies in the political system and on the boundary. One sees for example that in all cases presented here, the parliament was a decisive institution even when it did not actively participate in the policy formulation. All instruments that need a certain budget line must be endorsed by

the Parliament. The constraint of actors in the research system to convince the parliament of the necessity to use additional resources or to install a new instrument has its implications for the thinking on the instrument, when to present and how to present the topics. The parliament can be an important ally against the federal government that, as responsible executive, was often inclined to cut down budgets including the budget for research. Parliament resisted several times in this respect. One has, of course, to pay a toll in order to have the Parliament as an ally, i.e. one has to present and integrate general concerns of society in the developing of research issues. Having the Parliament as an ally means to strengthen the role of relevance in the funding of research. The instruments presented here were all instruments to ameliorate the relevance of research.

Neither the Parliament nor the federal government cabinet are presenting new propositions in research. In the political system, the federal offices attached to one of the very broadly defined ministries are responsible for the development of new policy designs. Since the beginning of the 1990s, the new "Groupement de la Science et de la Recherche" (GSR; Group for Science and Research) with the State Secretary at its head, plays an additional coordinating and initiating role. In the formation of the new NCCR, the state secretary did not initiate but take up existing ideas on reform and transformed them into a somewhat broader scheme conducive to a general change in the research system. The Ministry of Economy was at the start of the development of the new impulse programmes in 1975 and the OFES, the office for Education and Science participated as one of the actors in the definition of themes for the PNR.

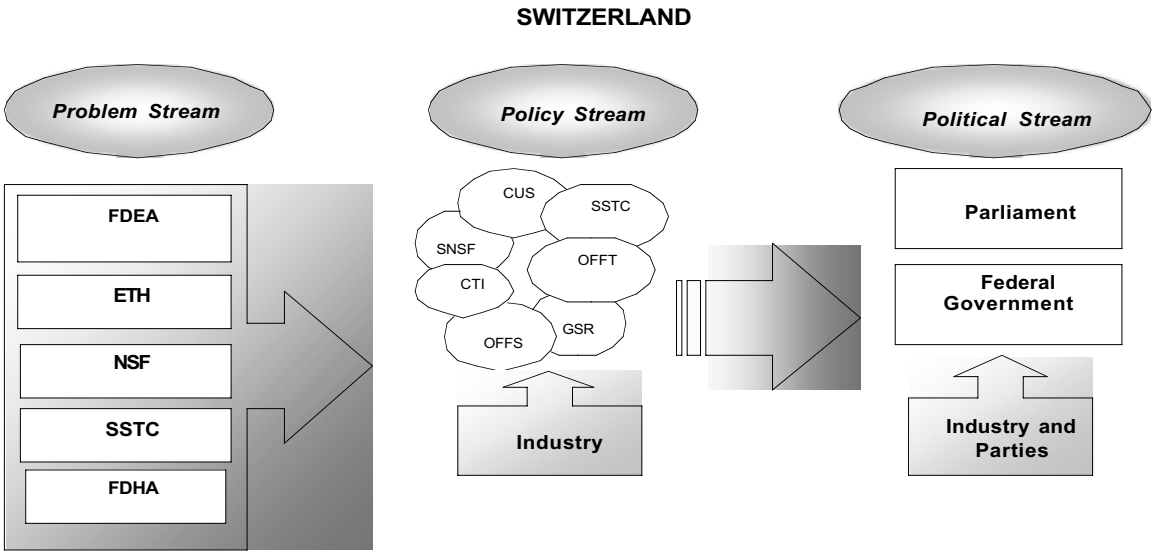
Intermediary organisations have their role in the development of new instruments in Switzerland. In principle we have four intermediary organisations of importance on the boundary: the SNSF, the Technological Agency CTI, the SSC, the Council of the Federal Polytechnics and the CUS. Except for the CTI, all boundary organisations had their role in the "*problem stream*" (cf. (Kingdon 1984), i.e. in the process of raising problems on the agenda of research policy-making. The SNSF was decisive for developing the new NCCR in the 1990s, while the PPR was an initiative coming from the Polytechnics. The SSC was important most of the time in insisting on an analysis of problems of the system and on evaluating programmes and institutions.

This list demonstrates that there is not one actor in Switzerland that can raise problems and present new solutions but several actors. In this way, the power of agenda-making is *diffused* in Switzerland. The reason for this is, without any doubt, the lack of one overriding, powerful actor, above all the lack of one powerful ministry responsible for research. The GSR is a very small unit in the federal administration and, in general, the federal administration is rather weak in personnel and power. This explains that a consensus is searched for instead of imposing certain solutions. The forum to do so, the "*policy stream*" (i.e. the arena where solutions are looked for and discussed), consists therefore of a number of actors with no overriding powers reserved for nobody (see figure below). The forum is based on communication and deliberation between all actors. If a new instrument is launched the reactions of different actors are gathered and the issuing institution attempts to correct its propositions according to the degree of resistance. Only the final version – after compromise-building – is presented to the federal cabinet and to the Parliament. These institutions can also participate as actors in the policy stream but in general they remain outside. Actors within the policy stream are required nevertheless to also find out if there will be any resistance in the adoption of the propositions in the "*political stream*", i.e. in the political decision-making arena. In this sense, the policy stream

and the political stream are narrowly connected.

Of course, streams are analytical categories and useful to distinguish between different functions in policy-making but in reality it is people from different streams are interacting directly, i.e. streams are not necessarily temporarily ordered. In addition, institutions can change positions in different streams. We think, nevertheless, that we find a group of institutions that remain the core group in the policy stream. Actors in the problem stream, however, vary, as has been shown.

Figure 2 Actors in Switzerland



Again, it should be stressed that in Switzerland it is not the individual power resources that matter most, though they can be important. It is the capacity of corporate actors to build coalitions and find arguments to overcome resistance in implementing new policy designs. The "*art of coalition-building*" is a decisive capital for actors in Switzerland. Solution finding is an informal process where the Federal Offices, the boundary organisations, the GSR, the SSC and the CUS take part. The prerequisites for coalition-building are good in Switzerland as we find a lot of double and triple functions of actors in boundary organisations which are, at the same time, at the centre of most negotiations. The CUS is important for the finding of a federal consensus. In addition, the consociational culture is an important ingredient in this process. It is a kind of "*habitus*" actors have developed and use to overcome resistance of other actors.

Such a system does not need "*veto-players*". It is built on "voice" for everyone and a low potential for exclusion. If corporate actors have about the same potential to act, everybody can bring in his interests and it needs deliberation procedures and coalition-building to find a solution for the problems at hand. As there are no formal voting procedures, decisions are not taken on a majority base. They are developed in the process of deliberation between different actors. Veto's can be overcome in this system, but there is a strife to avoid the face-to-face confrontation to do so. This is why the deliberation process is long and the outcome is almost

always a compromise between most interests.

Take the example of the confrontation between the Polytechnics and the SNSF in the setting up of the PPR. The initiative was taken by the Polytechnics but the domain interests of the SNSF had to be taken into account. This is why a compromise with regard to the management of the PPR was developed that was acceptable for both sides. When the reports of the SSC and of international evaluation commission on the deficiencies of this system was published later on, it was also easy to change the system and give authority to the SNSF alone.

The system is not only open to "insiders" but also to outsiders. Industry has access to the public-funded research systems. This was evident in the procedure for setting up the "impulse programmes", when even pre-parliamentary hearings were necessary to develop urgency measures during the economic crisis. This was, however, a special case where research policy measures were a part of a broader package of measures. In pre-parliamentary hearings, interest groups, above all from industry, have a significant power. This is demonstrated in the curtailing of some measures and the adoption of the 50% co-financing regulation for programmes of the CTI. Representatives from enterprises are also participating – in majority – within the managing board of the CTI. Here, they have regular and important influence on how to distribute the money. As the CTI is participating also in other, general affairs of research policy and has direct links with the OFFT (Federal Office for professional education and technology) and the Ministry of Economy, industrialists indirectly also have an influence in other policy matters though here the voice of the other agencies will in generally be more important.

Switzerland has, *in sum*, a system of actors with multiple corporate actors, frequent interlinkages by double functions, a high diffusion of powers and the lack of clear veto-positions. This system works according to the logic of consensus-building and deliberation. As the community is quite small in Switzerland, actors can use face-to-face contacts to build up compromises on new instruments. In such a system, new ideas can come from everywhere but they must fall on fertile grounds, i.e. there must be a general feeling that there is a problem at hand and needs change. In this case, things can advance quickly in decision-making, if it does not need a more encompassing change in politics which has to be presented within the four-year general budget of the Ministry of Interior and of Economic Affairs. If there are no fertile grounds, actors have to take a lot of time to prepare grounds for a consensus and may fail. As it is, the time between discussion in the problem stream and adoption in the political stream has not been too long in Switzerland in the programmes under scrutiny: about one year for the PNR (National research programmes) and the PPR, about 3 years for the impulse programmes and about 4 years for the NCCR.

This does not mean that the Swiss system is, in general quick in reacting to problems. Direct democracy can be a major constraint: for example, a risk guarantee for technological innovation in enterprises was refused in the 1980s by the people. The law on research was refused in 1978 and it took 10 years between the acceptance of a federal competence in research and the adoption of the research law in 1983. The research law was then decisive to built up the PPR because in the law the task to build up interdisciplinarity by federal policies was defined. On the other hand, the revision of the PPR after only a few years after its introduction demonstrates that the Swiss are willing to learn. Evaluation procedures have become an important means to learn in this respect.

Germany has a very different system.

The obvious difference of Germany with Switzerland is that decisions on instruments are a matter of the research ministry. The cabinet and the Parliament have, of course, to endorse the budget of the research ministry but they do not interfere in the process of policy formulation and they do not initiate new instruments. The research ministry is at the same time the arena where problem definition, solution finding and decision-making takes place, as far as it concerns funding instruments directed to technological innovation. The same unity of streams holds with regard to basic research. Here it is the DFG (Deutsche Forschungsgemeinschaft) which is responsible and which has the authority to decide what to do and how to do it. This does not mean that these institutions are "operationally closed". The research ministry is represented within the DFG and the research ministry has not only regular contacts with the DFG but will respect the kind of labour division between political and scientific funding that has evolved in Germany.

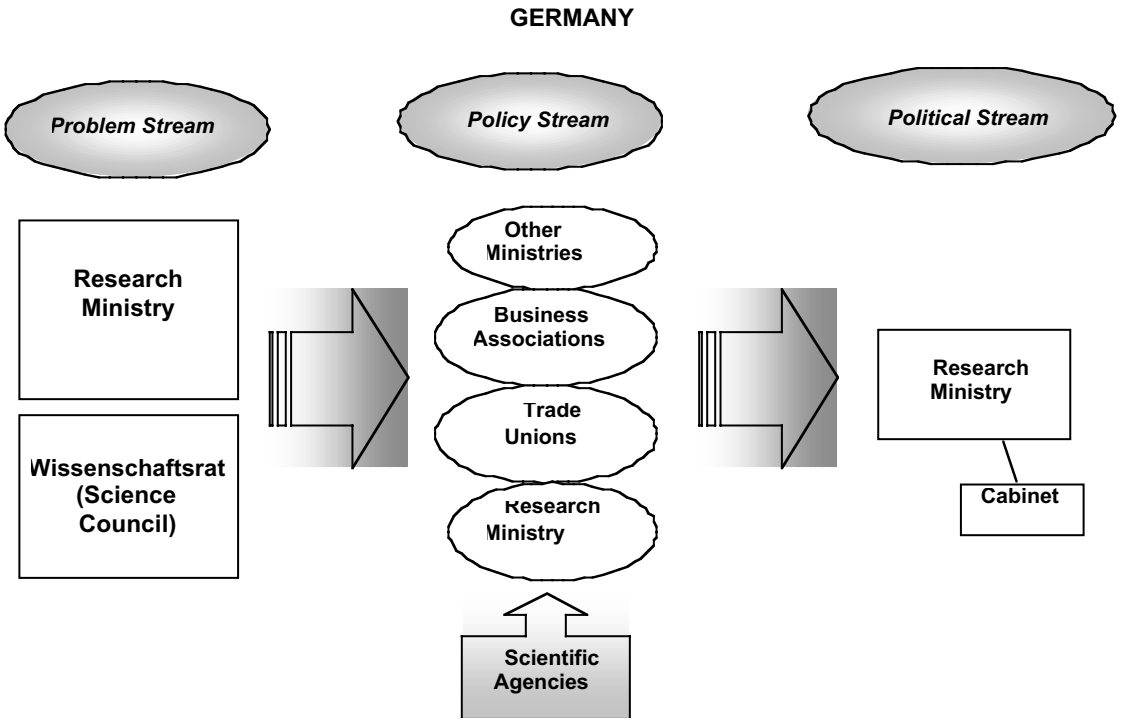
With regard to the two instruments discussed in our context, the scientific institutions – DFG or MPG for example – have not played an important role. The two instruments were initiated within the context of the BMFT (Bundesministerium für Forschung und technologie) - later BMBF (Bundesministerium für Bildung Wissenschaft Forschung und Technologie). In the process of policy formulation different actors had, however, "voice": as it concerned above all the stimulation of new technologies the Minister of Economic Affairs had an interest in the project and insisted much on more indirect methods of funding. Business interest groups (and later in the stage of programme formulation also trade unions) were invited to reflect on the set up of new funding instruments. Without any doubt, the negotiation process with industrial organisations had a decisive impact on the instrument, both on the contents of the new "Verbund-Projects" as well as on the overall composition of funding instruments (maintain also direct funding projects). One could call this process of policy-formulation a "corporatist" concertation where official interest groups and the state negotiate in order to implement certain public policies. It is astonishing to what extent the research ministry tried to find a consensus with business groups. While in Switzerland business representatives are integrated within a boundary organisation like the CTI, in Germany we find official bipartite or tripartite negotiations to implement the new instrument. In Switzerland, the initiation of a new instrument is an encompassing process bound within consociational features of decision-making. In Germany initiation of a new instrument happens within one organisation but in corporatist exchange with relevant actors from outside. The important point is that research policy-makers in both systems need the cooperation of beneficiaries (in this case industry) but it is organised in different ways. In Germany a number of corporate actors are excluded from negotiation, e.g. the scientific organisations. In Switzerland most corporate actors are included in the process. This is of course to be explained by the delegation of implementation to funding agencies outside the political system which needs an inclusion of these agencies. The "divide" of political and scientific funding in Germany makes such an inclusion not necessary.

This does not mean that the DFG is excluded from discussion. The divide creates the necessity for the research ministry to also find the cooperation of the DFG to effectively implement the "Verbund-Projects". As the projects need the cooperation of universities and industry, the activities of the DFG in developing interdisciplinary and innovation-oriented research within universities becomes an important activity. The BMFT has the possibility, for example, to influence the programming of the so-called "Sonderforschungsbereiche" (SFB) dedicated to interdisciplinary centres of excellence within universities because both Länder and

federal government representatives are financing these projects and participate in the selection committee. It can be seen that the SFB are often contacted to participate within the "Verbund-Projects". This means that the BMFT needs a certain inclusion of the DFG – not in the phase of the initiation of the project – once the Verbund-Projects have been installed. This does not mean any veto-power for the DFG but it gives the possibility to discuss matters with the research ministry.

The ideological shift from a more activist stance to a more liberal and indirect mode of funding has been an affair of lobbying of industry, of influence by the Ministry of Economic Affairs and by a new cabinet dedicated to a more neo-liberal policy in general. The hierarchical ordering within the BMFT makes it possible that a new minister and new state secretaries reorient the general philosophy of funding within the ministry by, for example, creating new divisions, setting up new instruments etc. The learning process is therefore initiated from the outside but takes place within one institution, the research ministry while in Switzerland it needs a process of diffusion among all relevant actors to make new ideas predominant.

The overall process to implement the new "Verbund-Projects" took about 10 years if one counts the first attempts in the mid-1970s. This is quite a long process. The explanation for this is probably that in order to change the routines of one organisation, in this case the ministry, it needs a number of external influences and the pressure from "high politics" to initiate major reforms. The failure of the reorganisation of the "advisory bodies" mentioned in the previous chapter is one example how difficult it is to break up existing structures. The general re-orientation of the federal government was a decisive event in this case. It was helped though by new "models" emerging in Japan and the UK that were regarded as exemplary and as good examples of how to organise the collaboration between the state and economy. One can clearly discern the influence of these models on the politics of the research ministry (Lütz 1993).



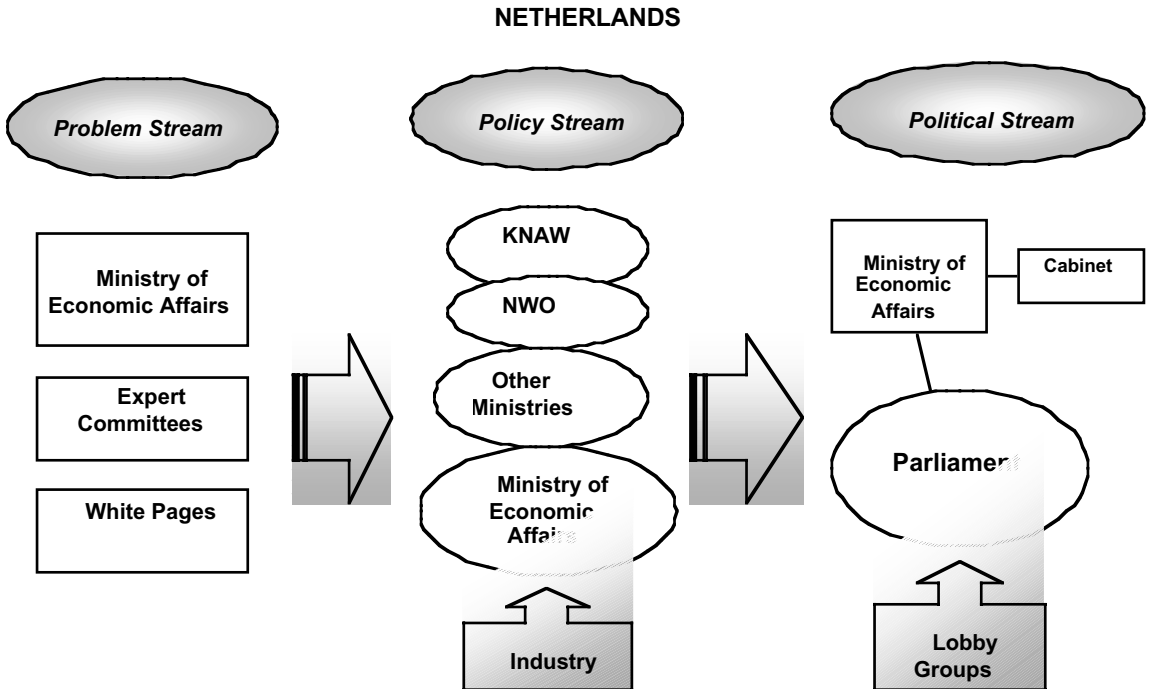
In the *Netherlands* the initiation of the "innovation-oriented projects" (IOP) is, as in Germany, the result of a general re-orientation of the government concerning state intervention in general and how to approach industrial problems in particular. New and convincing ideas were presented in expert bodies and adopted by the governmental coalition as a point of departure for future policies in this area. The setting up of the IOPs was a direct outflow of the WRR report and the decision of the cabinet to use this instrument for an improvement of industrial innovation. In this case, one does not find an extensive hearing of different parties concerned as it was the case with the White Paper in 1974. The only conflicts at hand were the allocation of "property rights" concerning the implementation of the IOPs. While it was OCW, traditionally responsible for research, in the beginning, the new government in 1982 decided to transfer the IOPs to the economic ministry. One should see the difference here with Germany: there an autonomous research ministry existed that was responsible for research while OCW in Netherlands was a "polyvalent" ministry very much oriented towards the management of basic research. As it was decided not to keep the minister without portefeuille for research, the Economic Ministry that had no experience at all in these matters seemed to be the right place for implementing the programme. One can imagine that the decision to transfer the programmes caused a lot of conflicts and negotiation between the two ministries. The final decision was taken in the Cabinet.

While the decision at the beginning of the 1980s was taken without inclusion of other actors this was different in the 1990s. Again, a White Paper announced fundamental reforms, which inspired the economic ministry to re-think the working of the IOPs. In addition, there was the obvious problem that for the initiation of new research areas relevant for innovation, IOPs seemed to have worked well but that the more long time establishment of cooperation between industry and the public-funded research systems remained a problem. The revision was therefore both a reaction to a deficiency of the instrument as well as the outcome of a new spirit in research policy-making. This time, the announcement of the new programme met considerable resistance by other actors. In contrast to Germany, both scientific agencies and ministries opposed the proposition. The result was a compromise that integrated the preoccupations of scientific agencies and the ministries. This demonstrates that – as in Germany – a ministry cannot act unilaterally but needs a certain consensus within the political system and, what is more, also with scientific boundary organisations that are responsible for the management of extra-university research institutions and for the financing of universities. In this, the Netherlands are more comparable to Switzerland: new instruments are discussed by all actors in the research system.

The parliament also seems to have a more prominent role than in Germany, at least when it comes to the 1990s: the economic minister has the right to select the topics but it is up to the parliament to accept this proposition or not. In the case of the LTI, the proposal as such was not accepted and the parliament changed the number of themes. In the initiation of the programme, however, the parliament did not play a role.

The story of the LTI demonstrates, moreover, that even "1-type learning" can be painful, if basic interests of other corporate actors are violated. Hierarchical decisions taken by one ministry, seem therefore not to function in the Netherlands. More than in Germany, the "policy

stream" is enlarged by a large number of corporate actors. Agenda-making, however, is, as in Germany, taking place within one institution, the responsible ministry. That makes a difference to Switzerland. The political stream finally includes the parliament stronger than in Germany and more comparable to Switzerland.



It is difficult to designate where the power of decision-making is found in *France*. The peculiar structure of a feeble political administration – even though from times to times autonomous research ministries are created – with nevertheless claims for the authoritative allocation of "material and immaterial values" and a tradition of strong public-funded research institutions with delegated tasks of designing and implementing research policies, causes a permanent combat for and reorganisation of competencies. One of the few means to bring together the different and fragmented actors is the "colloque", i.e. a kind of "public hearing" where everybody can make propositions concerning the future of research policies. These colloques function like the "Etats-généraux", like a parliament, though it is the cabinet, which decides in the end about which propositions are accepted and which not. It is this procedure, which – though one sees shifts in instrumental use before – initiated the introduction of new instruments directed to the SMEs instead of national champions in technology policy. The set up of the new technological programmes was integrated and announced within the new research law of 1982 that formed the essence – based on the selection of the socialist government – of the "colloque". In this way, one can say that the re-orientation was a coordinated and institutionalised, one-time effort of different forces in the research system to develop a new research policy. Legitimised in this way, the new programmes, which were managed either by the industry ministry or by different research institutions, were implemented.

Nevertheless, there had been similar experiments of technological programmes before, either

initiated by the government ("Plan Construction", 1971) or developed within one of the "grands organismes" (COMES). The "colloque" and the law only strengthened these efforts to develop a stronger cooperation between industry and the public-funded research system and made them first priority for innovation policies.

The events in the 1990s reveal another feature of policy innovation in France: The ACI (Action concertées Incitatives) were the result of different failures of the research minister to make the research of the CNRS more responsive. One sees – as already said – a research ministry that has the authority to decide – if need be – autonomously on research policy strategies and the introduction of new instruments. On the other hand, the ministry is dependent on the cooperation of the CNRS. Without this cooperation, the efforts of the research ministry must be in vain, as most basic research is organised within the confines of the CNRS. Technological innovation needs this research to become successful. The ministry was oscillating between delegating the responsibility of setting up responsive research to the CNRS itself and to organising an incentive programme that would induce researchers in the CNRS to accept a more responsive attitude in their research behaviour. The point is that the research ministry has a rather weak administration that could not until now develop an experience and a know-how as well as sufficient standing that could establish the ministry as a key actor comparable to the German research ministry. Activities and policies depend to a large degree on the minister taking office and his attitude concerning an active or a passive stance in research policy. The responsible minister at the end of the 1990s, Allègre, was interventionist and activist. He created a number of new advisory and decision-making bodies that should improve the decision-making capacities of the ministry. The problem is that as soon as the minister is replaced by another minister, these structures are abolished, or remaine but inactive like the CNS, and policy intentions can change considerably. In such a way, no institution can become a "heavy weight" in research policies.

Nevertheless, the ministry has the power to initiate new products and decide them within the confines of the political system. Actually – and this confirms the examples from other countries – no policy in public-funded research systems is decided in a unilateral and isolated way. A consensus is searched for and legitimacy is needed to defend new policy lines. This is why the minister created a new advisory body with scientific representatives and why a forum with representatives from industry, research organisations and scientists was used to discuss problems and solutions. Even though the minister might have had the result – the creation of the ACIs – already in his had, he has to take into account that no project can succeed that will meet overt resistance of implementers and beneficiaries. The decision taken was, however, clearly inspired by a minister looking for more capacities to design research policies. In this way he was intruding into the domains of competence of the "grands organismes" and was confronted with resistance.

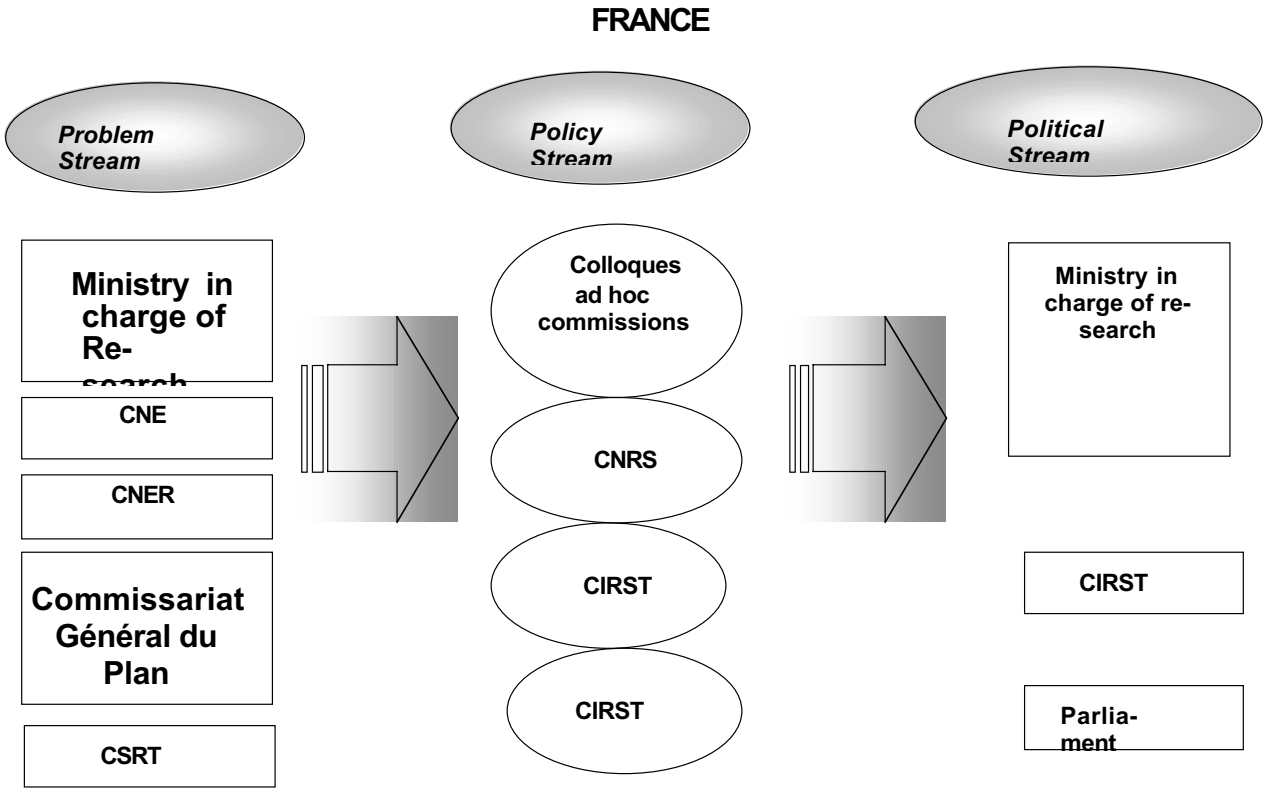
Though parliament has to adopt the budget of the research ministry and in this way also the new programmes, one does not find a significant inclusion of parliamentary interests into the decision-making. Research policy-making is an affair of the executive, i.e. of the cabinet and depending on the strength of the research minister in the cabinet, of the research minister. In contrast to Germany, the research ministry is, however, working within different actor constellations: While in Germany a "division of labour" has evolved between political and scientific funding, there are no such clear delimitations and arrangements of domains of competence in France. This makes that both sides – in this case the CNRS and the research ministry – have

to pay attention to the moves of the other side that might trespass their domains of competence. While in Germany conflicts are resolved by bargaining based on mutual recognition between for example the DFG and the BMBF, in France conflicts are resolved by unilateral decision of the research ministry and implicit resistance by the CNRS afterwards. This is rather a policy of "thrust and riposte" with all uncertainties about the outcome that it entails.

Policy innovation is therefore possible in France and, given the authority of the executive, perhaps more quickly than in other countries. However, this is not the end of the story. The "colloque" in 1982 has demonstrated it: policy-makers know that the construction of an overall consensus – which is difficult given the fragmented structure – will increase the chances of success of new policy measures. What is lacking though, is a permanent institutionalisation of consensus-building. Policy-makers create deliberation institutions ad-hoc, when need be and they are forgotten afterwards. This often gives the impression of a government that instrumentalises such institutions to create legitimacy for action than to really accept structural access and "voice" of boundary organisations and operational organisations in political decision-making. In addition, the lack of continuity concerning the position of research within the government and the changing attitude of research ministers shifts decision-making powers to and fro: between the government and grands organismes. Again, policy innovation is possible but it may fail in the end in France.

These structures explain that the time to innovate in France can be very quick but that changes in instruments often occur, according to circumstances, failures and changes in government.

In terms of "streams", one can state that problems are put on the agenda by the research ministry, while solution finding is a more elaborate process still occuring within the confines of the research ministry but with inclusion of a number of actors within specially created "reflexive institutions" and "deliberation forums". Final decision is clearly taken by the cabinet and endorsed by parliament.



In sum, we see the following features in countries:

Table 7 Actor Constellations and Policy-Innovation Capacity

	Actor Constellations	Policy-Innovation Capacity
Switzerland	A large number of actors in problem and policy stream; no clear centre; no real veto-players; diffused powers; parliament important in political stream; Inclusion; Art of coalition-building; the system learns not just one institution	Innovation can be quick if there is a general basic consensus; good chances for implementation; this is independent of "paradigmatic" and "normal" policy-making
France	In-built schism in the system between political agencies and intermediary organisations responsible for regulation and research; no division of labour between political and scientific funding; high fragmentation of institutions; lack of continuity of political agencies; polarisation if there is a strong research ministry; lack of centre if there is no strong research ministry > delegation; Research ministry is a veto-player, so is the CNRS; "thrust and riposte" instead of long-term cooperation; experiments possible because of delegation and fragmentation; research ministry predominant in problem stream; no regular participants in policy stream, ad-hoc inclusion; cabinet decides in political stream	Policy-Innovation can be quick; but implementation may fail;
Germany	Labour division between political and scientific funding; multiple veto-players; Research ministry predominant in all streams, learning within one organisation; "corporatist" inclusion in policy stream of beneficiaries; "voice" for scientific organisations; Strong pressures from outside needed to change organisational routines	Profound innovation takes quite long as they meet organisational resistance; pressure from outside important; "normal policy-making" by contrast easy and quick
Netherlands	"Divided government" > two ministries with important potential in research; ministries play important role in all streams; "experts" – but also given other examples of policy innovation all other actors ("bottom-up aggregation") – integrated in problem stream; policy stream includes most actors; ministries and parliament decide in political stream; ministries are veto-players, other actors have veto-potential if they build up coalitions; no thrust and riposte but compromise-building or hierarchical decision by ministry;	Innovation takes some time because of expertise and compromise-building process. This even holds for normal policy-making.

As expected, we see different configuration of actors in the four countries and one has to explain learning on the base of these structural features and paths the countries are following. In a nutshell, one can summarise the qualities of each "system of policy-innovation" perhaps like this: Switzerland learns in an encompassing way because of a multi-polar actor constellation with diffused powers; France is learning in a system with fluctuating centres of power and a high degree of polarisation while systematic inclusion strategies are lacking; Germany compartmentalises learning because of a system with "divided powers" between political and scientific agencies where actors have a high degree of veto-power, learning is limited to the re-

search ministry and inclusion occurs by "corporatist bargaining" either with industry or within the confines of the Science Council; the Netherlands learn within a system with a strong power centre but a multi-polar constellation where boundary organisations have "voice".

4.2.5 Implementation of programmes

Learning is not confined to the initiation of projects but also how to implement them. In what way do our countries also develop different ways of organising the implementation of programmes?

Summary Table 4SEQARABIC : Implementation of Programmes

Switzerland	Impulse Programmes 1978 ; 1982 ; 1986	A part of the programme was given to the TA. The priority areas were defined by parliament after pre-parliamentary hearings where industry had voice. The TA is at that time an organisation with voluntary and part-time members from science and industry, presided by the president of the Amt für Konjunkturfragen. A strong representation of industry is searched for (majority). Choice of members according to technology branches. There is interlinkage with other funding organisations (participation of key actors like NSF; ETH; SSC). Departments are assisting in meetings. The TA has a small secretariat. The TA has by principle been passive in its activities. Demands come from industry and science (Bottom-up concept). Only the impulse programmes have changed this > partly funds by top-down model > defining key areas. The standing committee decides after one of their experts has reviewed (with help of external experts) on application. Usually unanimity prevails. This decision is transferred as a recommendation to department of industry. Frequent evaluations of its work and of its projects. Top-Down model wants to have a larger radius of influence than individual projects: bundling of forces. The 50% clause is handled flexibly
	National Research Programmes (PNR) 1985	Government has decisive influence on choice of topics, but SSC and NSF have their influence in the process. Choice was – as it was politicised – open to consociational bargaining with a large number of interest groups (bargaining model). This resulted in a large number of topics that were integrated into a programme; though industry was reluctant in the beginning, by and large they begin to cooperate. Since then always at least 2 industry-oriented PNR. Industrial organisation is now officially included in selection procedure. The selection process becomes more and more complicated > new actors are coming in (also the TA) and it is the cabinet that finally decides on topics; in the beginning stronger bottom up model > propositions from the bottom and then a discussion in working groups of the NSF where scientists have majority but all other actors are also represented; in the 1980s the government intervenes early in the selection process and also adds own topics which were accepted only after long bargaining processes with the NSF; Selection process is an encompassing and comprehensive aggregation process with strong influence of science and government. The government takes the final decision. Once the programme adopted, the NSF is responsible > establishing expert group > implementation plan > scientists have majority but other actors are presented > 2-3 years for start > long negotiation processes. Once published researchers can apply > take ´s another 1-2 years.
	Priority Programmes (PPR) 1992	The selection procedure is top down with parliament being responsible for the final decision which has not been the case with the PNR. Amounts of money are curtailed by parliament. This top-down mode has later been criticised because of a lack of sufficient research capacities to be used in the programmes and a mixed approach is followed for the NCCR, the follow-up of the PPR. In fact, it was the Council of the federal polytechnics that had developed the topics with a clear orientation to the needs of industry. It is the SSC who proposes also a programme on the social sciences.
	National Centres of Excellence (NCCR) 2000	Selection process is a mix of bottom-up and top-down > all researchers can apply as long as they demonstrate their willingness in developing a network and a centre of excellence. The topic is not important at the moment. The SNF alone is responsible for first evaluation > international experts make propositions > FNS gives short list to government > government selects in the end 11 and then 14 projects. This procedures caused considerable trouble because of discontent of losers in the scientific system.

FRG	"Verbund-Projects" 1984	Learning process in the beginning: first attempts were bilateral Verbünde where the state financed public-funded research institutes for 100%. Industry was not enough involved and institutes could keep to their domain. Since 1984, the official start industry is required to pay 50% of costs. The BMFT is responsible but project agencies are delegated the task to implement the programme. These agencies serve as "communicator", "information filter", "contact place"; "organiser" but BMFT takes all final decisions. These project agencies are "boundary agencies" but closely linked to the political system. They are like a "firewall" before the BMFT. The formulation of the programme in more detail was part of a "corporatist" negotiation process between industry interest groups, depending on the programme between scientific associations and the Ministry. Points of discussion were the mode of financing, number of participants, and criteria for allocating funds. Compromise between these groups. Combined Top-Down and Bottom-Up approach in the formulation of thematic fields: expert groups as top-down procedure and "expert talks" ("Fachgespräche") as bottom-up procedure. In the last one again representation of industry but also of trade unions and of scientists. Review procedure includes again enterprises and trade unions > "techno-corporatist" organisation. Double delegation: Project agencies are responsible, but Verbund is led by a coordinator chosen by the partners of the Verbund (industrialist possible).
	Leading Projects 1995	No information;
FRANCE	Programmes technologiques 1982	
	Research Tax Credits ; Aides à l´innovation (ANVAR) 1982	
	Thematic Research and Technological Innovation Networks 1990s	
	Actions Concertées d´Incitation 1999	ACI only stimulating measure. Financed for 4 years: after public-funded research institutes must integrate these activities. Money is distributed by two funds within the research ministry: FNS (oriented basic research) and FRT (technological research). A director of the programme is nominated aided by a scientific council: last one participates in evaluation etc. Management by research institutes and universities. Close collaboration with the Research and Technological Innovation Networks needed. ACI are a political instrument. The actual choice is made by the ministry, despite of discussion procedure and recommendations by the CNS (Conseil national de la science). Adversaries: "grands organismes": ACI are large sums that are now lacking for own use. Decisions too political. Ministry takes the position of an own research agency. Very shortly after, the acceptance of the ACI seems to be low as the CSRT announces. It is recommended to transfer more resources from the ACI to grands organismes. Against the "tutelle scientifique" of the ministry > change of mode of intervention Only the FRT is generally accepted: existed since 1959 > its task was transformed and adapted > directed more to industry > less resistance by scientists. .

NL	Innovation-Oriented Programmes 1982	Economic ministry had a long history of passive cooperation with industry; in addition no research administration; search for scientific entrepreneurs and network-builders in key areas; The first IOP in 1982 was supposed to take up the promising developments in biotechnology at this time and create strategic research at universities and other public-funded research institutions as well as to institutionalise links between industry and these university researchers. Biotechnology was a field where only few scientists were working in though recently the first national association of biotechnology researchers had been set up. It was, what is more, also an interdisciplinary field of action combining biological and technical sciences. In the beginning, it was intended to only accept propositions linking these two fields, but this claim was relaxed after it became clear that one would not find enough researchers. How was the programme set up? The beginning was the outsourcing of a pre-study on biotechnology to a private consultant bureau. The study was then discussed with a group of key actors from science and industry, which later on became the *program committee* responsible for the implementation of the IOP. This committee set up a program. Before the program was publicly announced, EZ took considerable efforts to discuss with Dutch enterprises the willingness to participate in the fields stipulated within the program or if other more relevant topics should be integrated. The pre-study served also the aim to identify the key actors in biotechnology research at universities. Enterprises were also asked to identify the research teams they considered as relevant for cooperation . The independent program committee – where EZ was of course represented – attempted to find scientists with a high reputation as well as industrial stakeholders with a scientific background who should constitute this committee. Quite in the tradition of the polder-model, the selection took its time because the ministry paid also attention to "proportionality": the most important sectors and organisations should be represented. The committee was alone responsible for the IOP and free to change priorities and instruments. It had the right to allocate funds, even before the program was definitively adopted; it had to develop the policies concerning the program, discuss matters with the ministry and monitor the programs. Only the sum of money invested in IOP was, of course, under authority of the ministry. The ministry itself had representation within the committee. This construction of delegated competence with substantial freedom from political interference, and the lucky circumstance that biotechnology was already an area of interest also for a number of basic researchers, created a fertile governance structure to implement the IOP in biotechnology. For Rip and Nederhorst, this model is a valuable alternative, a "middle course between dirigisme and laissez-faire". The program committee operated on the boundary between the economical, the scientific and the political system as a kind of "fixer": out by the government" . The learning process is for example demonstrated by change in procedures of priority-setting. The committee wanted more responsiveness to industrial needs. To this end "interviews were held with eight major companies on a strictly confidential basis, and the results were transformed into preferred themes of research…..A new element was that the companies were also asked to identify good research teams …The Program Committee then published the list of preferred themes of research, and specified for each theme the core groups identified by industry". There was also a change in the set up of the Program Committee. As the Committee was conceived to have an overarching and neutral position the special interests of industry were often not sufficiently represented in the decisions. This is why, after 4 yours two committees were set up, one, the overarching Advisory Committee Biotechnology and, two, a special committee for industrial biotechnology". While there were almost no rules and standards in the beginning, neither for the handling nor for monitoring, these standards were developed in due course and formed after some years the base for the implementation of new programs. Today the procedures are more elaborated and more professional:.it was the committee, in close contact with the scientific community and industry, that was able to *learn*, to "continually repair and add to the rules of the implementation game that has been set out by the government".
	Leading Technological Institutes 1996	Procedure as follows: tender for key technology areas > 18 propositions > evaluation on scientific and technological merits; 6 consortia are allowed to write proposals. 4 chosen by a committee of "Wise Persons" (3 persons) who give proposal to minister. Minister accepts insisting on quality rather than political choice. Parliament refuses however insisting that all 6 proposals are accepted with themes of relevance for the parliament. The two new ones are grouped under a different name: innovative research clusters.

In order to understand the learning capacities in countries we must distinguish between two functions in the implementation process: While the previous sections discussed the initiation and formal establishment of new instruments, the next step is the more precise selection of

topics within the different programmes (*thematic selection*), and, finally, there is the actual running of programmes. The competency to run the programme is important because here learning processes take place how to detect deficiencies and ameliorate the programmes. It is therefore of interest who has the right to "act" while the function to select topics is the "right to decide".

With regard to the "right to decide" we can distinguish between three different ways of selection. The "bottom-up" way would be to let scientific or industrial actors choose the general themes while policy-makers endorse the selection without interfering; the "top-down" entails a selection by government of the relevant topics without integrating the advice of other actors. "In-between" are procedures where for example a first selection is held by scientific or other actors and policy-makers choose among this selection according to own criteria. Another example are dual procedures: one part of the programme is selected according to bottom-up the other according to the top-down logic. Learning is, of course, different depending on the way of selection.

With regard to the "right to act" there are different possibilities: policy-makers can keep a large control on the process by either implementing the programmes within own organisations or organisations that are closely linked to policy-makers or they can delegate the implementation to boundary organisations that become the main institution for learning. Our comparison demonstrates that both the Netherlands and Switzerland use "fixers" (cf. (Rip 1986) while Germany and France prefer a tighter control on implementation. In addition, one finds that France prefers top-down procedures, Germany and Switzerland "in-between" procedures while the Netherlands prefer bottom-up procedures.

In more detail, the Ministry of Economic Affairs in the *Netherlands* decided since the beginning – partly because of a lack of experience and administration, partly because of a liberal administrative culture – to delegate the IOP to a programme committee and to accept a bottom-up procedure of theme-finding, notably among industrial enterprises. While broad thematic fields were defined in advance on the base of expert reports and only the more precise kind of projects within these fields (e.g. biotechnology) were proposed in a bottom-up manner, the LTIs were defined completely by propositions from industry and science. The minister of Economic Affairs was prepared to accept the projects finally selected by a "Committee of Wise Men". To him it was more important to have "quality" than to impose politically preferred projects. In this sense, it was a pure bottom-up procedure. Only the parliament broke with this way of selecting themes and added – as said – two programmes that had been set aside before because of insufficient scientific quality.

The delegation to the programme committee abandoned most rights for the ministry. Certainly, a representative of the ministry participated in the committee and the budget had to be defended by the minister before the parliament, but all details, the actual handling and even funding decisions were decided within the committee alone, composed of scientists and industrialists. Inclusion played a prominent role within the committee as representatives were chosen on the principle of proportionality to have all relevant industrial branches represented. When this did not suffice, two committees instead of one were created in order to have industry better presented in the decisions. Rip and Nederhof (Rip 1986) have circumscribed the role of this committee as a "fixer" that is there to "continually repair", modify rules and adapt, in short that is there to learn. This kind of delegation with large authorities given to a "boundary"

institution seems to have worked particularly well. It is the position on the boundary, at the interface of science, industry, and politics, and the function to find a consensus, to effectively implement the programme, which obliges the participants of the committee to learn by doing.

The willingness to delegate powers to non-political institutions has also prevailed in the 1990s when a committee of three "wise persons" – not being part of the political system – had the right after a scientific and industrial review to make the final selection among proposed LTIs. As said, the ministry accepted this decision without further redue.

One can compare the position of the Dutch programme committee in some way with the Technology Agency in *Switzerland.* The CTI has the same role of a "fixer" with regard to the implementation of technology policy. It is situated on the boundary between the political system and industry and science. Daily affairs are delegated to the CTI. The major difference is the lack of final funding decisions. Even though the responsible ministry of economic affairs might only endorse the propositions of the CTI, it has the authority to decide. The CTI functions as an inclusive agency with a clear majority for industrialists. As already described, there are representatives from all relevant research actors, including the government. This is why compromises found within the agency have a good chance of being accepted at the higher level. Procedures of self-evaluation fulfill the function to demonstrate to government the effectiveness and efficiency of the organisation. Learning processes are therefore happening within this organisation between actors from all systems.

Concerning the other programmes, *Switzerland* has experimented with several procedures of defining thematic fields, but always within the confines of "in-between" procedures. The PNR were constructed in the beginning by a bottom-up procedure in the scientific field while the government was authorised to make the final selection. It changed to a procedure where the government insisted on adding its own preferred areas and with the PPR to a rather top-down procedure where the parliament became the decisive institution to select and define the topics. The new NCCR came back to the initial procedure of the PNR and – without giving any suggestions in the beginning – demanded applications from scientists. The SNSF had to organise the scientific peer review, but it was the ministry that, in the end, decided what kind of projects would have the highest priority. One can imagine that all these "in-between" procedures took quite some time. Moreover, once the topics were chosen, programmes had to be defined in more detail and to be prepared for official announcement. Here, the government relied again on the SNSF as a boundary organisation. The SNSF, already equipped with a special division for directed funding, created expert groups that had the task to work out the details and to review the incoming applications. Within these expert groups, scientists had the majority but other actors, including the government, were represented. Again, the inclusive principle is manifested in this way.

The role of the SNSF in these procedures is important. Again, one can describe it as a fixer that, however, is limited by the right to decide of the government. The Swiss were less prepared than the Dutch to give up this final authority of the government. The SNSF is the implementing agency but at the same time, it serves as an arena between different groups represented within its bodies and expert groups. Again, it is here, where compromises are built that structure the choices of government without determining it.

It is interesting to see how the *big countries* have dealt differently with these matters. The German research ministry had already created project agencies that now became the main im-

plementing organisation for the "Verbund-Projects". Project agencies had clearly the "right to act" but not to decide. Not being integrated within the scientific community nor in industry, these agencies lacked the inclusive character of the institutions described for the Netherlands. Working in these institutions were often former officials from the research ministry. The way to integrate industrialists and scientists happened according to two different ways, one described as more bottom-up (expert forums), the others more as top-down (expert groups). The research ministry defined the broad thematic fields in the beginning and these groups served as the second selection, to find more detailed topics that could be officially announced for research proposals. Only concerning the more precise procedures how the programme should function in an administrative way (number of participants, who finances how much etc.), another procedure of inclusion was chosen, i.e. the corporatist inclusion of industrial and scientific interest groups as described in the previous section. Only here, the research ministry was prepared to negotiate its conditions of work.

After the choice of more detailed topics, the programmes were announced and the official networks within the programme founded. A programme coordinator from the participants was responsible for daily affairs of the project helped by the project agencies. Its task was therefore the daily management of the project but no other more relevant decisions on the programmes.

The research ministry thus used "double delegation" in order to implement its programmes while keeping the right to decide at the highest level. Project agencies were the implementation agency directly dependent and directly linked to the research ministry (see for this (Braun 1997). This direct linkage made it more difficult to include relevant actors within the decision process. The CTI in Switzerland by contrast functioned as a committee with a majority of industrialists. The project agency is an administration where expert groups are added temporarily to define a topic. Expert groups do not have the same freedom as the institutions and organisations mentioned in the other groups. It is political choice that determines finally, what is selected. Only the expert forums are more built up in a bottom-up way to allow a stronger input from industry and science.

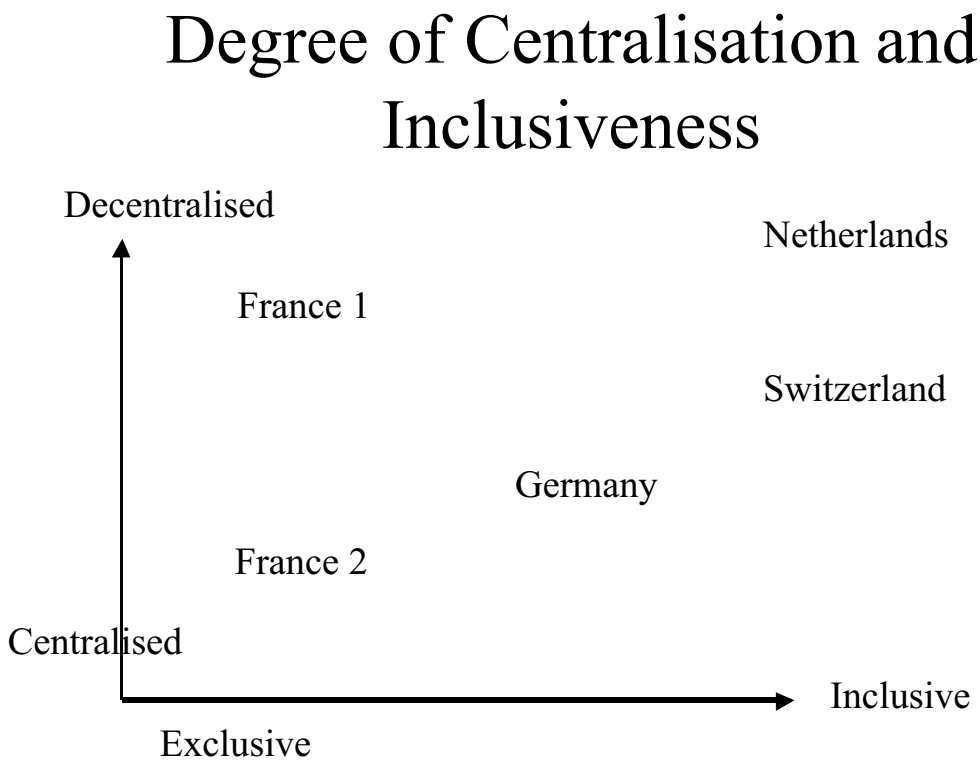
This description demonstrates that neither project agencies nor the programme coordinators can be regarded as "fixers" managing the interface and learning to adapt the programme. Important property rights are withheld from these institutions and the inclusion is for the most part less strong than in the other countries with the notable exception of the corporatist procedures. These procedures, however, function according to a different logic: they do not use individual representatives of industry or science but corporate actors. There is no inclusion within the daily decision-making of the project agencies but informal ad-hoc talks to find a compromise. The structure of implementation as such is not thought as an inclusion procedure. That is the difference with the two smaller countries.

France has two ways to implement programmes: the first one is delegation to rather autonomous "grands organismes" that become fully responsible for the development of the programme, funding decisions and even research decisions as these agencies most of the time dispose of own research laboratories that can execute programmes. ANVAR became the responsible agency for funding directed to technology innovation in SMEs and could function relatively independently in developing programmes. If, however, a programme was ended or a new one was set up remained a decision of the government.

The second way is the more political one, somewhat comparable to Germany. It is the research ministry, which is responsible for formulation and implementation. Instead of project agencies, in the case of the ACI the research ministry used to "funds" within its institution to distribute money. The location of these funds makes the direct connection to political interests even more clear. As in Germany, the daily affairs of an ACI are delegated to a programme director chosen among the participants. This director is responsible for the coordination while the research agencies participating are running their own administrative affairs. Funding decisions remain with the funds that are, in turn, controlled and guided by the research minister. This is the most clear top-down model though forums and the CNS (Conseil national de la science) were used to define the contents of the programme. One does not find the similar inclusion of industry or scientist actors within the funds as in the small countries. It seems that the research ministry is even more closed in this respect than the German one.

This comparison reveals two different way to structure learning processes in the implementation of instruments: a decentralised and inclusive one vs. a more centralised and less exclusive one. One sees also gradual differences in this respect: the most decentralised and inclusive are the programmes of the Dutch economic ministry, then follow the Swiss examples. Germany is more inclusive and a bit more decentralised than France as far as it concerns the programmes we have discussed. France has, however, two ways to set up funding: the other way, delegation to the grands organismes, corresponds to the "fluctuating ways" to distribute powers in research policy we have discussed before: in this case almost complete authority is given to these institutions which do not belong to any ministry but which know of course formal links with these ministries. They have, nevertheless, a considerable degree of freedom in dealing with matters. So, France can, again oscillate between a rather decentralised and a rather centralised way to set up programmes.

On the two relevant dimensions we have discussed – the degree of centralisation or decentralisation; the degree of inclusiveness – we could, in sum, position the countries in a very summary and stylistic way like this:



Bottom-up procedures with a high inclusion of the "field" are preferred by the Ministry of Economic Affairs in the Netherlands. Switzerland is inclusive in a comparable way but maintains a moderate degree of decision-making power of political agencies. France knows, as discussed, two different ways a more centralised one and a decentralised one. Germany has chosen for a medium way.

Learning occurs differently according to these conditions: "Fixers" represent an inclusive way of learning, integrating and balancing different rationales of systems. The relative autonomy of these kinds of institutions fosters a rather long but accommodating way of learning where the consensus constructed helps to change the status quo. More centralised modes can, of course, more easily announce policy innovation but they may meet considerable resistance in implementing the projects. In addition, information for learning might be lacking as this way is less inclusive than the other one. Changes can be more abrupt and radical while the former way prefers gradual change.

4.2.6 Summary

We have endeavoured in this part of the chapter to find out about the timing and the type of learning involved in the setting up of new instruments linked to the "technological turn" in research policy-making. It was demonstrated that there was an astonishing convergence both in terms of timing and type of learning between the four countries though Switzerland was

running somewhat behind in setting up the cooperative types of instruments. We found indications that the diffusion of models developed in Japan and the UK have contributed to this convergence as well as the "new growth theory" and a "neo-liberal turn" of governments in the beginning of the 1980s. We are not capable to prove the causal influence of these factors but they appear in the discussion of countries and seem to have relevance. From this we can conclude what seems fairly obvious if one is familiar with the general development of research policies: the introduction of new instruments are almost always influenced by models elsewhere which are considered as best practices at this time. The OECD plays a major role as a "diffusion machine" in this respect. There is more convergence than divergence in research policies despite of different traditions and structures. In this research policies seem to be different from many other policy field where differences are more important than similarities (e.g. social policies; unemployment policies; fiscal policies etc.). We are still missing convincing studies that show how these diffusion processes take place but one can imagine that the role of the OECD, leading countries in technology like Japan (and the USA) and close-knit networks of funding administrators who frequently meet each other at several occasions contribute to such a convergence. In addition, research policy-making is not a field which is highly contested in party politics, with the exception of ethical issues that are now raised in relation to genome research. A lack of polarisation favours a policy developed by an administration that seeks to raise the effectiveness of instruments by using "best practices" developed elsewhere. These are just ad-hoc explanations but it would be worthwhile to develop new research studies in order to develop more rigorously the question how diffusion processes occur in research policy-making.

We found, nevertheless, that the more fundamental and paradigmatic changes that the introduction of the new instruments implied in the 1980s could not just be adapted as such by administrative decision but needed pressure and changes outside, i.e. economic crisis and a change in government. We have not controlled for cases where these phenomena were not present but for our cases at least one of these factors was present. The "normal policy changes" in the 1990s, by contrast, did not need such exogenous changes to be realised.

Despite convergence in the timing and contents of new instruments, we have revealed different structures of learning in the four countries. In a strict sense, we cannot deduce from these structures different learning capacities though one could make guesses. Instead, we can show *how* countries learn and base our final conclusions on learning capacities in an inductive way on these observations.

The important differences and similarities were summarised before in the text. Let us conclude with some final remarks: Though there are important differences, above all with regard to regulatory powers (concentrated or dispersed), we think that the two consociational and small countries Netherlands and Switzerland have striking affinities in dealing with policy innovation. Not surprisingly, they rely more on inclusion and consensus-building than the two larger countries. This means the need for comprehensive processes of information generation, discussion and negotiation, and elaborate ways of aggregation and decision-making. Both countries do it in quite different ways, the one with a stronger representation of political forces (Netherlands), the other with a system of diffused powers (Switzerland). Both countries also demonstrate a more important role of the parliament in research policies though this is for the Netherlands a phenomenon of the 1980s. Both countries are also prepared to delegate institutional innovation to "fixers", i.e. boundary committees or institutions that are the interface

between the operational and the regulatory level in the public-funded research systems as well as between industry and the public-funded research systems. The role of policy-makers is deliberately reduced[8]. What can this mean more in particular for learning capacities?

The obvious conclusion to us is that in such countries learning takes place as a communication process between relevant actors (action, reaction, deliberation). It cannot be only a single corporate actor who learns but it is the system as such that learns. All actors are integrated in the reflection process and decision-making. Once decided there is a quick diffusion of innovation possible. As usual, such a kind of innovation, which we will call "*deliberative learning*", will take time. Our hypothesis, stated in the context of Switzerland, was that the duration of the learning process in this case depends on the degree of consensus already existing. If it is high, learning may nevertheless be quick. Otherwise, it is not.

It is most important to insist on the structural feature of inclusion in these countries (see for the Netherlands extensively (Meulen and Rip 2001). These countries have institutionalised communication and cooperation in manifold ways, among others by double mandates, personal connections between corporate actors. Inclusion is therefore guaranteed and it is a web that encompasses the whole public-funded research system. In Germany – and this brings us to the larger countries – inclusion also exists, but it is of a different kind and, above all, not institutionalised within the research ministry. The German research ministry – as the French one – attempts to maintain a high degree of authority in all phases of policy innovation. Inclusion there is in the policy stream but this occurs according to circumstances and it is organised in a corporatist way and not in a consociational way. This means that highly aggregated corporate actors negotiate with each other in order to find a compromise. France goes even further by neglecting all together continuous mediation institutions. In France, a consensus is build ad-hoc and then in a national way. Once circumstances changes, the mediation becomes neglected. There is no intermediary layer between the state and research actors that could balance forces and develop a tradition of consensus. In Germany, there is at least the Science Council that helps to build up a general consensus in important questions between scientific and political actors. Again, this is a rather corporatist way to learn as it is within one mediation institution organised in different chambers where learning takes place. In Switzerland and the Netherlands it is a process integrating corporate actors from all over with double memberships. One should underline that all countries attempt to build up a consensus, if need be. The difference with the smaller countries is that the larger countries do not install a nation-wide and encompassing consensus. What is more, both Germany and France are suffering from an inherent dualism of the research system that limits the scope of any consensus: in Germany we have spoken of a "division of labour" between political and scientific funding and in France of "fluctuating centres of power". It seems to us that these internal dividing lines in both countries make learning more conflictual and more difficult to organise. Domain competence becomes more often and easier a matter of discussion. Domain conflicts are a permanent undercurrent of research policy discussions. Of course, we find domain conflicts also in the smaller countries but here bridges have been built up in an institutional way to overcome these divides and to find solutions that correspond to problems and not to find solutions that are influenced by the domain

[8] This is true for the Ministry of Economic Affairs. The education ministry has a more interventionist tradition. Here it depends among others on the attitudes and policies of the responsible minister how "reduced" policy-makers are (see (Dresner 2002); (Braun 2001).

conflict. In this way the way of learning both in Germany and France – despite of significant differences – may be called "*conflictual learning*".

We will see more in particular, if our first impression in this sense is right when we discuss reforms of the regulatory structures. For the moment, we think that deliberative and conflictual learning may be the two types of learning capacities we find in the four countries. These different types have not resulted in very different instruments given the convergence in policy innovation. They may, however, influence social learning in the sense of the implementation of the new instruments. France has shown that conflictual learning has disadvantages because it fails to integrate the important implementation agencies while programmes in Switzerland and Netherlands are in general considered as a success. Germany has developed the Verbund-Projects successfully but has problems above all in reforms of operational structures, the subject we will now turn to.

4.3 Institutional funding

In most countries public-funded research systems are based at the operational level on universities *and* on extra-university research institutions. Programme funding is mainly directed to individual researchers or research groups, institutional funding pays research institutions in order to have organisations at hand that are capable of engaging researchers and provide the necessary infrastructure for research. In order to introduce "responsiveness" into the public-funded research system, these research institutions have a primordial role because of their capacity to influence the reputation-cycle of researchers and their capacity to allocate resources internally to areas of preference. This authority of selection makes research institutions a primary target of political intervention (Luhmann 1990: 676). Despite of this, policy-makers have for a long time focused on programme research to influence researchers' behaviour while research institutes remained relatively free in their choices, constrained of course by their "constitution", i.e. by the tasks defined as an overall framework of research action given to each research institute. This attitude of policy-makers has changed completely and research institutes have become a primary target of political intervention nowadays (see below). To understand learning capacities in research systems means therefore to be informed about the intentions, decisions, processes, and results with regard to this transformation of organisational attitudes towards more responsiveness.

4.3.1 Structure

Let us first have a look at the institutional, operational structure of public-funded research systems. We find two extremes with France relying above all on extra-university research institutions and Switzerland depending above all on universities. Germany and the Netherlands seem to be the most comparable as they are allocating their money to about equal parts between universities and extra-university research institutions. Nevertheless, the structure of both countries is not identical. In the Netherlands for example, there is no research ministry as in Germany with an interest in maintaining extra-university research institutions as its own power base. Even those institutes, which have been under authority of the education ministry, were transferred in the 1980s to either the KNAW or the NWO. Big science institutes are linked to different ministries. The Ministry of Economic Affairs has no own research insti-

tutes. Delegation is a much stronger organisation principle in this respect than in Germany. However, while in Germany delegation to, for example, the Max-Planck-Society has resulted in a very strong independence of management, the delegation to KNAW and NWO is not thought of as a complete position of independence. The links between these institutions and OCW are much stronger than between the German research ministry and the Max-Planck-Society. On the other hand, we find a hierarchical authority of the research ministry with regard to the big science institutes, as already discussed. This authority is, however, partly shared with the Land where the big science institute is located. Another difference between both countries is that the main funding agency in Germany has no own research institutes while the NWO in the Netherlands is responsible for several such institutes.

France has no separate funding agency but has given responsibilities of allocating money to different themes and researchers to a large number of "grands organismes". These institutions are therefore operating at the operational level and on the boundary. These institutions usually have rather strong links to different ministries.[9]

Switzerland is using extra-university research institutions as a subsidiary structure to universities. There are a few larger institutes performing direct services for political departments but this is rather an exception than the rule. In addition, these institutes are protected by intermediary structures (see below).

Learning is therefore based on quite different preconditions in each country. We find, nevertheless a clear convergence of ideas and policies, how to organise the existing institutions. To what extent did policy-makers in the countries perceive a problem of responsiveness with regard to extra-university research institutions[10]?

4.3.2 The problem of responsiveness

One can state that the problem of responsiveness has played a role in each country except for Switzerland. In fact, one can see three periods of policy regimes with regard to extra-university research institutions: the first period – in the 1950s and 1960s – is the construction of big science institutes above all in the field of nuclear research. The second period is characterised by the efforts of policy-makers to "re-orient" these research institutes as well as several others to a more programmatic research with new topics. In both cases, Switzerland follows the general tendency. As we will see, there have been discussions on the reorientation of nuclear research. Finally, since the 1970s, efforts begin to flexibilise the functioning of these institutions and to integrate them in more general strategic research plans. The major problems in countries was that most institutes had then already quite some experiences in there field, they were often very big, with a large number of researchers, equipment was expensive and the organisational structure was well developed. At the same time organisational slack seemed to present in all these institutions. To close them down was most of the time no option because of the sunk costs this would have involved. This is why governments in all countries, including Switzerland, began to think about better management strategies to overcome the organisational slack and to make extra-university research institutions more proactive.

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[9] This changed a little with the creation of a research ministry in 1982, implying that the "grands organismes" have from this moment on a double "tutelle", their "thematic ministry" and the research ministry.

[10] We will not deal with universities which are a topic apart.

One finds these discussions in France since 1982, when the new research law changed the juridical position of the "grands organismes" to make them at the same time less dependent in their operational functioning but also more dependent in terms of obligations written within the general constitution of these institutions. Since then, there have been permanent discussions, above all on the CNRS, how to make the "grands organismes" more responsive. The new constitution as such did not suffice evidently.

In Germany, the big science institutes were the targets of critical remarks, as already discussed, since the end of the 1960s. The first restructuring attempts – reorientation of topics; combat of "clientelism"; heavy and inefficient review structures – failed. Only since 1996, we find a new "élan" that also includes other public-financed research institutions.

In the "White Paper" of 1974, the Netherlands had stipulated their willingness to reorganise their public-funded research institutions to overcome organisational slack and to introduce responsiveness. The first changes were introduced in the mid-1980s but overall reforms continue until today at a steady and gradual pace.

In Switzerland the federal government had official authority to create own research institutes. This possibility existed before the federal law on research of 1983, but such kind of institutional research support was integrated in a national research policy framework only with this law, at a period when reform intentions became widespread everywhere. This gave Switzerland the advantage of learning from other examples and to institutionalise the new institutions in a flexible way. In this sense, Switzerland had the advantage of the latecomer though the story is a bit more complicated when we look into the details (see below).

4.3.3 Convergence

The mid-1990s are a turning point in reform attempts of government. Efforts have become much more determined and one finds a clear convergence in the design of reforms.

The turning point is felt in France since 1997 when the CNRS was confronted much stronger than before with an active research minister and serious reform attempts. One can locate the turning point in Germany in 1996 with a speech by the research minister on the reorganisation of big science institutes and in general on strategic research. Even though the Netherlands have continually reformed their extra-university research institutions, 1995, the date of the publication of the new White Paper, seems to have given a new impetus to government's determinedness to reform their institutions. We find a series of reorganisations since then. Finally, in Switzerland the turning point is not felt in the field of the extra-university research institutions but in the more important field of universities. Here, the network approach has launched the NCCR as a new instrument to link research in different universities together, in order to build up centres of excellence in different relevant areas.

If one compares the discussions, the rhetoric and arguments, above all in the 3 countries with a strong share of extra-university research institutions, a common denominator is emerging where "stronger responsiveness, openness to industry; more flexibility; strategic thinking, pro-active behaviour, and evaluation" are the key words. Without any doubt, one sees a new concept of organising research institutes emerging in the 1990s. More in particular, one can

briefly circumscribe the main ingredients of this concept in the following terms:

- The organisation in terms of research institutes is giving way to an organisation based on programmes and collaboration between research institutes. At the same time this collaboration is based on interdisciplinary research and not disciplinary research;
- Regularly, decision-making authorities responsible for different research institutes are reserving a share of their income for innovative research instead of distributing all money to their institutes;
- A diversification of funding is taking place. Institutional funding is becoming less important; programme funding and money from different sources is becoming more important;
- Interdisciplinarity is written in large in all policy designs;
- A more remote way of steering is announced, above all in the Netherlands and Germany;
- Contractualisation is introduced everywhere as the most adequate way to overcome organisational slack;
- Central powers are strengthened in organisations to react more quickly and more strategically;
- Researchers should have less tenure and show more mobility.

This model takes hold of most political administrations because it seems conducive to the new causal beliefs in the functioning of research institutions:

- They must be flexible in their potential to react to permanent changes on the intellectual market and on the funding market;
- Research must be more directly linked to problems of society and the economy: interdisciplinary research and programme financing are ideal to make extra-university research institutions work in this direction;
- More operational freedom enhances the efficiency of action;
- A better link to clients can be installed;
- Market and competition are better ways of organising research than security by public funding.

Despite of these profound critical remarks and the deep-going reforms envisaged, extra-university research institutions are seldom dissolved. Though there are intentions to integrate, if possible, extra-university research institutions into universities, the majority of institutions is maintained, because they are still seen as a necessary stock of knowledge in times of complex and rapid change. In particular the link between the basic knowledge and the technological trajectory can be better organised by these institutions, it is often believed, than by universities.

4.3.4 Developmental paths to reform

We find, therefore, a quite general and converging trend in our four countries, with a new

model emerging. We are interested, given the different structures and traditions, how each country has arrived at such a model. This should reveal us other particularities with regard to the learning capacities of the countries compared to the ones we discovered when describing programme funding.

Switzerland

Switzerland had no need to reform an existing system of extra-university research institutions with considerable organisational slack and a high degree of veto-powers as we find it in Germany or France. The reasons for this were primarily not due to a conscious choice of policy-makers but to, on the one hand, federal conflicts of domain competence and, on the other hand, direct democracy: it needed a careful campaign to install new competences for the federal government and a first attempt to introduce a federal research law – after a general acceptance of the right of the federal government to subsidise research in 1968 and then in 1973 – in 1978 failed. Only in 1983, the federal government obtained the right to create and organise extra-university research institutions.[11] So, the federal government could fix its rules at that moment, i.e. at a time, the new paradigms were already developing and a general neo-liberal mood was predominating in public policy-making in Europe. What is more, the liberal tradition of policy-making in Switzerland as well as the relatively feeble resources of the federal government in general did not lend itself to the establishment of expensive research institutions neither was there the intention to use research institutes as part of the federal administration. The four larger research institutes that developed research for the federal administration (the "Annexanstalten") were managed by the Council of the Federal Polytechnics and not by a ministry. The newly created group of research institutes according to article 16 of the research law of 1983 were clearly regarded as a "subsidiary" instrument to existing institutions where universities received the highest priority in the research policy of the federal government. This manifests a clear willingness to not build up own research domains but use the universities by a stronger influence of the federal government in order to meet the challenges of the future. While other countries were therefore confronted in the 1980s and 1990s with a strong extra-university research system while the advantages of universities in meeting up to recent challenges became clearly visible, Switzerland was lucky in having always relied on universities. While it was not a choice before 1983, it was a deliberate choice by policy-makers in 1983. There are no indications that bad experiences in other countries with extra-university research institutions played a role in this decision. In a way, the decision is path-dependent because universities had been for such a long time the only institutions at hand and it seemed not right or adequate to change this. In addition, this would have met strong resistance within the CUS, the university council of Switzerland. There was perhaps also less urgence for the federal government to build up such a new sector because the two federal polytechnics did in some way fulfil some of the functions of extra-university research institutions: they were technical-oriented with a strong sense for applied research and are, until today, of an excellent quality in

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[11] The right to create and organise extra-university research institutions does not mean that the federal government did not subsidise research institutions before. Since 1968 this was in principle possible. One finds therefore already the financing of several smaller research institutions and, above all, the federal government became responsible for 4 so-called "Annexanstalten", managed by the Council of the Federal Polytechnics.

international comparison. The federal government had, therefore, in the form of universities, assistance if it needed research efforts.

This does not mean that the federal government was able to "steer" the Council of the Polytechnics. As the federal administration is in general rather weak and because for a long time there were no strong political actors on the federal level that would have pushed forward a political research strategy, the Council was always rather autonomous in decisions though contacts with the federal administration were frequent. This has remained so even today. The Council has own research funds it can use for the development of own projects (Gessler 2002) and it has the responsibility for the "Annexanstalten". The federal government has clearly delegated the task of controlling these research institutions and of developing projects to the Council. If one sees the development in the way the Council has dealt with these institutions, one can notice for a long time a rather passive stance and a relative autonomy of the Annexanstalten. This has changed in the 1980s and above all since the beginning of the 1990s when new public management ideas took hold of Switzerland. Since then contracts have been developed with these research institutes and the Council has started to be more pro-active and strategic. Several discussions on the future of the Annexanstalten demonstrate that there are no guarantees of existence for these institutions in the existing form: integration into universities and a larger autonomy are discussed as well as the creation of a holding organisation. At this level, Switzerland has similar problems and solutions as the other countries.

The flexibility to reorganise extra-university research institutions is even more obvious in the case of the institutes subsidised by article 16. These institutions are financed – with the exception of four institutes regarded as of enduring national importance – on a temporary base. They are obliged to submit a budget every four years to the responsible Office and the state secretary for research. The parliament finally decides on the acceptance of these budgets. There are evaluations to make sure that existing institutes continue to have a task of particular importance which cannot be fulfilled elsewhere. If this is not the case, the federal government has the right to stop the funding ofsuch an institution or to condition its funding of this institutions to the integration of it within other existing institutions. One sees that in this case there is no guarantee at all that such institutions can survive. The perennial problem of closing down research institutes does not occur in Switzerland with the exception of the 4 institutes with special importance and the four Annexanstalten. But even here, the parliament (in the case of art. 16) or the Council of the federal Polytechnics can decide to abandon the financing of these institutions or to reorganise them. There is therefore a high flexibility in using the extra-university research institutions in Switzerland.

Without any doubt, Switzerland is learning how to organise the relationships between responsible bodies like the Council of the Polytechnics and research institutes in terms of public management. Switzerland is in line with developments in other countries. And it had to learn how to reorient thematically extra-university research institutions in the case of the "Paul-Scherrer-Institut", an agglomeration of former 7 research institutes specialised in nuclear research. According to the Swiss consociational tradition a long process of negotiation with propositions from the institutes, local politicians, federal government representatives and the Council of the Polytechnics took place that started in the 1970s and ended in the beginning of the 1990s with a compromise. This demonstrates that Switzerland is certainly not quicker in solving organisational problems in the public-funded research system. The advantage is, once again, that Switzerland did not need to reorient a large number of these kind of institutions.

The lack of a long existing and diversified extra-university research system made it easy for Switzerland to meet the model which is emerging in the 1990s in most OECD-countries.

France

France is the other extreme in terms of structure compared to Switzerland. We will only consider the reforms that concern the CNRS.

The first step, as already indicated, for a stronger responsiveness of the CNRS was the new research law in 1982. As already said, this marked the first step toward a stronger responsiveness of public-funded research institutions. The CNRS was a particular case because of its responsibility for basic research in general and its firm anchoring within the scientific community. The influence of the scientific community was even institutionalised in the Comité National, considered as the "parliament of science". At the same time – we discussed this – the legacy of the institution and its function linked the CNRS directly to research policy-making. For a long time, i.e. the creation of the DGRST (Délégation Générale à la Recherche Scientifique et Technique) in 1958, the CNRS was even conceived as the legitimate political research policy-making agency. This contradiction was always there. The new research law in 1982 attempted to clarify matters in demanding from all EPST (Etablissements publics à caractère scientifique et technologique) to work closely together with the responsible research ministry while granting more operational autonomy (among other things by a global budget) to these institutions. Nevertheless, the ambivalence concerning who is responsible for the administration of the central structures of research remained. It is interesting, though, to see that, already in 1982, France introduced a very "enlightened" administrative structure, similar to the new public management model, without, however, defining any contracts. The main point was the global budget, the CNRS had at its disposition from this time on.

Constitution and constitutional reality are two different things. This became clear in the further development of the politics of the CNRS. There is no need to repeat all the different reform projects in detail here. Since that time we see a pattern of reform and resistance, of stop-and-go that seems to endure until today. There are, however, important changes at the end of the 1990s.

The stop-and-go pattern is characterised by two controversial tendencies: One is the attempt of policy-makers to impose reforms on the CNRS, which, in due course, is not implemented. The other are reform projects developed within the CNRS, which are not taken up by the research ministry.

The first tendency can be explained by the internal structure of the CNRS as well as by the "competitive character" of relations with the research ministry. The research ministry had the authority to nominate all important positions within the CNRS. This was not enough to also set through reform projects even if a reform-minded general director or president of the CNRS was nominated. The internal structure was much too complex and decentralised to establish reforms in a top-down fashion. Under the director-general, we find the directors of the different departments within the CNRS and under the directors, there are the laboratories which have, traditionally quite some independence in their management structures. In addition, the National Council of the CNRS has "voice" in all decisions within the CNRS. One sees that a policy based on decrees would not function within such a scientific institution and it never

has. It needs the consent of researchers and department directors if the institution can be made more responsive. The recent contractualisation, introduced in 2002, might be the right way in this respect. As contracts force the CNRS to unite efforts and develop strategies to realise the goals defined in the contracts, there will be a stronger push towards more coherence and cooperation between the different parts of the organisation. On the other hand, it is clear that, still, the success depends in a general campaign to convince researchers within the CNRS to cooperate in the realisation of objectives. The results have still to be seen. The introduction of contractualisation took a longer time than in Switzerland or the Netherlands. Today it has become, though, the "golden rule" for developing a more flexible and programmatic-oriented public-funded research system. Former attempts to introduce the new public management in universities demonstrate, however, how difficult it is in France to introduce the new management strategy. Resistance come from two sides: from research institutions that do not want to cooperate in national research strategies because they fear to loose their autonomy in research and from the public administration that is afraid to loose its direct intervention capacity because of the larger operational freedom granted to research institutions (Braun and Merrien 1999).

The second tendency is caused by the "*discontinuity of political authority*": there are several instances in the history of the CNRS since 1982 where reform attempts within the CNRS are abruptly disrupted because policy-makers change strategies (either because of a new government or because of new constraints like budget deficits). There have been attempts within the CNRS to develop a more strategy-minded policy or at least to make propositions in this sense and to build up an inherent consensus on these points. Each time, however, a new government ends such reform attempts and a new reflection is started with new actors and without – and this seems to be the most astonishing and disquieting point we have found – making reference to former studies and reflections. Such ignorance is not always due to a change in party colours of the government. Even another minister of the same party can have a completely different way to deal with research policy issues. The frequent changes in the institutional position of the research ministry and the frequent changes of ministers as well as of nominated general directors and presidents of the CNRS, have made it impossible to develop a strong and consequent policy vis-à-vis the CNRS. This must be seen as the major structural problem of France in dealing with its extra-university research institutions: Given the size and the very strong anchoring of the CNRS within the scientific community as well as because of its "institutional legacy", only a long term policy can have a chance to eventually change the institution. It needs a policy elite that is willing to put pressure on the CNRS and that has a "project" to overcome the organisational rigidities. Otherwise, institutions will pursue their "paths". The contractualisation is a step in the right direction but it will possibly not be enough to introduce responsiveness as a second point of reference within the CNRS. This can be learnt from the Netherlands where we find a similar resistance of the NWO and where a consequent policy has in the end contributed to a change in identity of the NWO (see below).

Another feature is that a confrontational attitude of policy-makers vis-à-vis the CNRS is condemned to fail. The example of the policies under the minister Allègre, at the end of the 1990s, demonstrates that an interventionist and top-down policy will meet double resistance of actors within the CNRS. For the first time, the National Committee gathered all forces to resist such an attempt to steer from outside. The positive effect, however, has been that from this emerged a report with own propositions of reform that seemed reasonable enough. The new

minister, however, would not hear the outcome of these reflections and initiated new reforms. This example reveals that reforms within the CNRS are not originating from own needs and problem perceptions but are always a result of external political pressure. The reforms in 1988 undertaken by a reform-minded general director confirm this rule as the new director was chosen for his reform capacities.

Learning capacities in France seem to be particularly low when it comes to the reorganisation of extra-university research institutions into the direction of more responsiveness. The unclear domains of competence and a changing mood for intervention at the political level prepare the grounds for a "competitive mode of learning" without continuity. These seems to be a tendency to "reinvent the wheel", early reform attempts in the 1980s are interrupted by political decisions and the implicit resistance of the lower levels in the CNRS make radical changes very difficult. The necessary consensus for reform cannot be created in such a "thrust and riposte pattern". The outcome confirms this pattern: Until today there have been no major changes in the functioning of the CNRS – despite of far-going propositions - and the case of the ACI has demonstrated that there are still problems to make CNRS scientists behave according to a responsive mode. Without any doubt, one finds a stronger political pressure since 1997, like in the other countries. The contractualisation is the only visible outcome until now, which demonstrates that France has just started its reform process.

The propositions developed within the CNRS since 1997, which have finally served as the base for the contracts starting in 2002, demonstrate that France is approaching the "ideal model" sketched above. In the former study "CNRS-Avenir", initiated by the CNRS director C. Bréchignac under the pressure of the research minister, already a stronger coordination between the different departments and scientific council is recommended; more mobility of the personnel and less tenure become primary goals; and the Comité National is supposed to be organised along the lines of programmes and not disciplines. In the "establishment project" of 2001, which has been prepared by the foresight exercise "Reflexion Strategique" implemented in january 2001 by the new CNRS direction, three priority areas are installed, with a strong emphasis on the increase of responsiveness within the CNRS; a more pro-active attitude is demanded, as well as the construction of partnerships within the CNRS and with outside institutions. The new priority areas will be implemented on all levels of the CNRS and not remain just an announcement from above. This is, of course, a long-term project. Continuing evaluations will become a central part of the new "strategic research" to be developed.

Though these new fundaments of the contracts contain many elements of the new reform model, one is still not sure how the CNRS will be able to realise these objectives more concretely. There have been good intentions in the past of the CNRS and reform projects failed. It remains to be seen if the new form of contracts can more radically change the attitudes of researchers in the organisation and transform the CNRS into a "strategic" agency participating directly within the general research policy. One has to remember that there has been, again, a governmental change in 2002, which may forebode, once again, new reform projects. It has to be admitted though that the new contracts are the most serious attempt so far and the overall reform mood seems to enhance the chances of the project. In addition, these contracts have a time-horizon until 2005, which leaves small room for the actual government to embark on a completely different course. This progress in reform attempts must, without any doubts, be ascribed to the general change in the "referential global": new public management has become a legitimate intervention and organisation strategy in all fields of public administration. It is this

diffusion, which has driven reform attempts with regard to the CNRS further than before.

While France is, therefore, slowly converging with other countries concerning the contents of reforms, it seems to less impressed by best practices than other countries. Our studies reveal that foreign examples of institutional reform are only serving as trump cards in the discussions between actors but are not really evaluated and used in the reform projects. In this way, France still demonstrates its closed character.

There is one last point we should evoke in understanding learning capacities in institutional funding of France: This is the authority relationship between the CNRS and the research ministry. The so-called "tutelle" means supervision and surveillance but not explicitly hierarchical intervention (Braun 1994). Given the fundamental tasks ascribed to the CNRS in research policy, it would be difficult to install such a hierarchical relationship. Since the beginning, the CNRS was conceived in corporatist terms, i.e. as an institutionalised meeting place of the scientific community and policy-makers. As the state failed to develop an institutional base that could act as a representative within the CNRS, the CNRS gradually became more a body of self-organising fundamental research. Its function of contributing to research policy-making has, however, remained. One should therefore see the relationship as one of two heavy weights, which are – this was repeatedly said – often competitors because their domains are not clearly delimitated.

The power resources, the research ministry has vis-à-vis the CNRS are threefold: one is the budget and the second are nominations of key positions within the CNRS (president of the administrative council, director-general, directors of departments, one third of representatives within the Comité National). The third is the participation in the administrative council in order to discuss the budget and prepare recommendations for the research ministry. These are, of course, important powers if one wants to "irritate" (cf. Luhmann) the CNRS. In addition, the research ministry does not need the parliament to take short-term action in research policy as a simple decree suffices. Formal powers, then, are clearly top-sided but that does not give yet the right or the capacity to make the organisation behave in a certain way. As we have stipulated several times, the CNRS maintains a large room for interpreting the general policy lines of the research ministry and the decentralised structure contributes to further contingencies in the implementation of these policy lines. Moreover, such formal powers only lend real powers if the research ministry pursues a consequential and long-term policy strategy, which, as has been shown, has not been the case. Though the research ministry has, therefore, never explicitly developed the philosophy of a "steering at a distance" or of a "global steering" as in the Netherlands and in Germany, it depends on the cooperation of the CNRS to implement its policy lines. The contractualisation is seen as a way to better link CNRS and research ministry policies in a medium-term perspective.

Germany

We have already discussed the failure of reform attempts of big science institutes in Germany in the 1970s. This situation seems to be comparable to France: the big science institutes have an enormous size in terms of budget and personnel which makes that sunk costs to close them down are very high. Attempts to reorient these "dinosaurs", as critical tongues called them in the 1970s, failed, both because of internal resistance of the management and researchers and only half-heartedly intervention by the research ministry. The difference between the CNRS

and the big science institutes is that the big science institutes in Germany are directly under control of the research ministry and that they are not supposed to fulfil any major strategic coordination or regulatory functions in research policy. The relationship between the research ministry and the big science institutes is much more straightforward: the research institutes are the agents and the research ministry is the principal. Even in this case, however, there is no hierarchical intervention capacity: the "global steering"-philosophy developed in the 1970s and reiterated recently in the latest reform attempts, meant a combination of strategic guidance by the research ministry and operational freedom of the big science institutes.[12] This combination seems not to have other implications than in France: the "power of the purse" (with the federal government paying 90% and the Land where the big science institute is located pays 10%) gives an influential say in strategic decisions of big science institutes but the organisational structure and operational freedom of these institutions makes "a hierarchical and detailed political direction of research activities impossible" (Winnes and Schimank 1999: 135). This relative freedom of big science institutes is strengthened by an alliance between the responsible Land and the big science institute in question because each Land has an interest – because of employment, status, diffusion effects – to keep its big science institute.

This constellation – "global steering", double "tutelle" by the federal government and the Land government; the size and organisation structures of big science institutes; the big science institutes as a power base for the research ministry in a very differentiated and dualist public-funded research system – resulted in the same failure of reforms as in France. One has to admit though that, after the 1970s, the institutional reforms were less important for the research ministry. One sees a resurgence of the issue – and now it concerns not only the big science institutes but also the research institutes financed by both the Länder and the federal government (the so-called "Blue List Institutes") and, later on, even the Max-Planck-Society – in the mid-1990s. At the same time, the big science institutes are creating a stronger holding organisation the "Hermann-von-Helmholtz Gemeinschaft Deutscher Großforschungseinrichtungen" (HGF). This creation must already be seen as a reaction to an increasing political pressure on the big science institutes to become more efficient and responsive in times of severe budget crisis. A concentration of resources was need and clear priorities should be developed. The HGF was supposed to install more centralised powers and a stronger cohesion and cooperation between the different big science institutes. Such a holding organisation has somewhat ambiguous effects: on the one hand it allows an easier access of the research ministry to the big science institutes because the HGF can be used as a delegate and intermediary, which has more powers to realise objectives that have been agreed upon with policy-makers than the former "working association" (AGF). On the other hand such an organisation – and this was certainly the intention of the institution-builders in the big science institutes – can create a stronger identity of this type of research organisation and defend the interests better than dispersed big science institutes can. In this way, the HGF and its big science institutes has become much more a type of organisation comparable to the CNRS in France.

Things started to change already by the organisational reforms due to the reunification

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[12] We recall this philosophy: The state "lays down the overall research goals and the overall financial contributions. It setzs priorities, coordinates the activities of the research institutions, ensures an objective and effective evaluation and takes care for an economic and efficient use of public resources [..] within this framework applies the principle of independence and autonomy of the research institutions; in scientific and technological questions the decisive weight of the representatives of science and technology shall be insured" **(BMFT 1974).**

(Mayntz 1992; Stucke 1992; Stucke 1992). After a long process of negotiation, three former Academy Institutes of East Germany were transformed into big science institutes. This gave the opportunity to modernise the organisational structures of these institutions with the immediate consequence that the big science institutes in the West were confronted with obviously well functioning and modernised big science institutes in the East. This difference made it once again clear that organisational reforms could contribute to a better functioning of big science institutes.

The next step was the decision in the federal cabinet in 1996 to evaluate the big science institutes from a systemic point of view. Evaluation was delegated to the Science Council who already had some experience with the evaluation of research institutes and universities. In addition, the Science Council was predestined to also develop more comprehensive and encompassing views on the public-funded research systems in Germany. The demand to have a systemic evaluation was, nevertheless, something which was new. Until then, research institutes and institutes at universities had been evaluated from a micro-perspective, according to the scientific qualities in research. Now, the evaluation was expanded to develop a better understanding of the very differentiated research system and to reflect at the same time on the position of each type of research organisation within this system. Recent working groups in the Science Council are considering the problem how to introduce a more strategic orientation in the public-funded research system. The task of the Science Council was, therefore, this time not to see how the individual big science institutes function but how the aggregate, the group of big science institutes, is working and fitting into the public-funded research system[13].

The reason why this was delegated to the German Science Council was, without any doubt, also because of budget deficits but the willingness to impose a more thorough analysis of the different types of research organisations was certainly the most important consideration. Other evaluations were dedicated to the "Blue List" and – this could not be imposed – to the Max-Planck-Society and the DFG. There was therefore a new willingness to overcome the fragmented action of functioning in the public-funded research systems and for this "systemic evaluations" seemed to be the right way. The fact that this was done by the Science Council was important because any recommendations emerging from this body would have a high legitimacy because both scientists and politicians were participating in the decisions. The danger was much more that any recommendations would be based on the smallest denominator in the Science Council and thus radical reforms would be prevented. As it is, one can demonstrate that there have been more radical reform attempts in the beginning and that this was somewhat boiled down. Nevertheless, the result concerning the big science institutes was nevertheless a break with traditional ways of organising these institutions.

The research ministry had already started in 1997 to impose on big science institutes that they reserve 5% of their institutional funding to strategic purposes and distribute this money on the base of research applications. The procedures of allocation followed the usual peer review procedures. A special committee of the Senate of the HGF decided on the demands. It is noteworthy that this way of making the big science institutes more responsive did not work

[13] "to identify systemic deficits and thus reach conclusions on structural aspects and produce generally applicable recommendations. There, the concept of system evaluation clearly contrasts with the traditional approach to analysing and managing large-scale research, where the main focus was on the work of individual research centres" (Wissenschaftsrat, 2001: 1).

out. The strategic funds was stopped shortly after because the procedures of distributing the money remained within the usual "old boys network" style. Innovative projects were therefore seldom found. It was clear that a more radical change was needed in order to arrive at a more fundamental reorientation of the big science institutes. This was done on the base of the Science Council report.

The Science council recommended to "enhance the strengths of the HGF by focusing its work on high-profile activities and by improving internal coordination processes. For this to be achieved, the Science Council recommends fundamental changes to the structures and processes used for strategic decision making concerning the work of the HGF" (Wissenschaftsrat 2001). The way to concentrate activities on high-profile activities - which, by the way, meant simply responsive research activities – was conceived in terms of a fundamental restructuring of the mode of institutional funding: The individual big science institutes and their different research laboratories are maintained but, in order to obtain their funding they must learn to fit within broad programmatic lines that are developed by an elaborate process: Policy-makers can announce their thematic preferences, which are transferred to the Senate who launches an evaluation procedure in different committees. The Senate finally recommends on the basis of recommendations from this procedure what thematic priorities should be chosen and how much money should be distributed to these areas. The policy-makers as the financing institutions decide in the last instance on the budget for these research areas. It is then up to the big science institutes to apply for money within these research fields. In this way only 20% of the money is allocated by the former procedure of institutional funding in order to maintain the basic infrastructure within institutes. The other 80% are allocated in the form of programme funds. This does still not guarantee that no old boy networks will abuse the procedure but there are more safety nets involved in this procedure. The Senate remains, however, responsible for the selection of the projects. Together with the coordinator and in agreement with the directorates of the Helmholtz Centres, the President then prepares a proposal. Based on this proposition, the financing partners prepare their notification of award of funds to the Parliament, which must in the end decide on the budget (HGF 2001). In this way, the big science institutes have realised what was suggested in "CNRS-Avenir" as a major reform of the Comité National, i.e. to organise this council on the base of programmes and not disciplines.

Within the HGF, profound changes have taken place based on the recommendations of the German Science Council: the Senate has become a true centre with encompassing decision authority. The Senate is composed of the research minister and two research ministers from the Länder, external scientists, a large number of industry representatives, the finance ministers, representatives from the different boundary organisations, two parliamentary representatives and the president of the HGF who presides the Senate. In addition, guests can participate. One recognises that this is a corporatist body indeed with a large representation from all over the research system. In fact, the HGF itself is underrepresented, which gives hope that final decisions are not decisions avoiding confrontations with the interests of the individual big science institutes. In addition, it is obvious that the Senate cannot be seen as a pure body of presenting the collective interests of the individual big science institutes. It is a corporatist body where compromises are found between a large number of different interests. Industrial stakeholders are participating in the policy development.

The programme mode of funding was conceived in order to also enhance the cooperation between different institutes. Laboratories from different institutes can cooperate to apply for

funds. A former proposition by the Science Council to also allow other institutes from the Blue List to participate in the programmes was, however, refused. This demonstrates that resources are still treated as a "closed shop" with all dangers of the old boy network mentality that this promulgates.

In sum, one sees an astonishing turnaround of the treatment of extra-university research institutions, in particular with regard to the big science institutes, since 1997. Though one may be sceptic with regard to the actual results of the turnaround – it is still too early to see how it actually works – it is already clear that – similar to France – the reforms are more far-going than one could have imagined. Many points of the reform come, in addition, near to the "ideal model" we have sketched above. Above all the change from an institutionalisation of funding on the lines of institutes to a funding based on programmes seems to be a radical turn demanding a much stronger responsive and cooperative attitude of researchers and institutes. It is indeed in this way that one can think that the reform might succeed: while France has concluded contracts with the CNRS but has not changed its internal allocation structures, Germany has not introduced contracts but relies completely on programme funding. It seems to us that this can be the more promising road as it leaves no room to escape for individual entities and researchers in big science institutes to think in terms of responsiveness. Everything depends, however, on how the themes were won and formulated and how much responsibility is asked within these programmes. With this construction, Germany has – at least with regard to the big science institutes – followed the Netherlands which has already before introduced similar measures of responsiveness (see below).

Important elements of the turn were the adding of "modernised elements" within the group of big science institutes due to the reunification. This initiated a new thinking on the functioning of these organisations. Second, continuing budget deficits that forced government to think in terms of efficiency. Third, the willingness to think in terms of the system as a whole, which was, without any doubt, stimulated by the spread of "systems of innovation" theories. The systemic approach forced all actors to think in terms of the whole rather than in individual and egotistic categories. Fourth, the Science Council was an important institutional element. Without the compromise-building within this institution and, at the same time, its experience in delivering large-scale and encompassing studies, each reform would have failed. Fifth, it was certainly easier to reform the big science institutes which are overwhelmingly financed by the federal government than the other extra-university research institutions which are financed most of the time for half by the Länder. In this case, the research ministry had a predominant voice in the overall process. The big science institutes had already strengthened their unity and their voice in the reform process by setting up a more centralised organisation, the HGF. But this organisation became, after recommendations by the Science Council, a corporatist body that cannot any longer just defend the selfish interests of the big science institutes.

The learning process took a long time in Germany. This is comparable to France. Only the general reform mood since the mid-90s initiated a new élan that, this time was seized by policy-makers. The "systemic analysis" seems to have been the most important element in the learning process: it was new and innovative and prepared the common grounds for a more radical reform. In the end, the big science institutes could not any longer oppose the winds of change and had to adapt to the new features of research.

Again, we find similar elements compared to the ideal reform model: the reservation of money

for innovative activities was the beginning of reform attempts and the final programme funds follow this logic; the whole organisation is now funded on the lines of programmes thought the organisation as such has not been changed; the new thematic priorities demand more interdisciplinarity in funding; powers within the organisation have been centralised; and the state defends a policy of "global steering": the position within the Senate and the authority of the Senate within the programm formulation process is conceived in this sense: it ensures policy-makers of a considerable influence in presenting thematic priorities as well as of the final decision-making powers what should be accepted and how much should be paid. What kind of projects are proposed is a bottom-up process and the organisation of research remains the prerogative of the institutes. Though no special contracts are set up this can be regarded as an equivalent form of managing these institutions.

Netherlands

Project funding was one means to start up a narrower cooperation between the scientific system and industry in the Netherlands. Dutch policy-makers were, however, since the beginning well aware that this might not suffice. As long as the public-funded research institutions were cut off from other systems and as long as there were no stronger incentives than just a few program funds, one could not hope to structurally change the system. As in France and Germany, the diagnosis was very clear: The public-funded research system, including technology-oriented TNO, possessed research institutions strongly anchored in the scientific community and without any openings to user systems. Universities were heavily criticised as well as the main scientific funding organisation ZWO because of their disinterestedness in the utility of their products. With the "Nota Wetenschapsbeleid" in 1974 this attitude was no longer accepted. The science-push model was beginning to loose credibility and did never recover ever after. The policy aim was to open up research and funding institutions to user interests and introduce utility as a second point of organisational reference. This needed *organisational reforms* and – in the end – a *new governance structure* in the public-funded research system leading to more flexibility, responsibility and accountability. It is our impression that the reform intentions in the Netherlands have been – since the beginning in 1974 – more encompassing, directed to all public-funded research institutions, than in the other countries. It was actually a "system reform". The astonishing point is that this aim was pursued gradually with different governments and with persistence until today. There may have been modifications of earlier projects and strategies, but the original claim to "open up" public-funded research institutions, universities included, remained unchanged. "Strategic research", as van der Meulen and Rip have baptised this policy strategy (Meulen and Rip 2001), has been a permanent project of policy-makers in the Netherlands.

This aim was realised in several steps. Formally, the new statutes of universities, the TNO and the funding agency, the NOW, were all changed in the 80s under the Christian-democratic – liberal government. The big science institutes followed in the 1990s as well as the KNAW-Institutes. The time lag between announcement and achievement demonstrates the intense discussions these reorganisations induced. Even after reforms were accomplished, one can demonstrate that organisational adaptation to the new thinking needed again a considerable time. It is our impression that now, in the beginning of the 21st century, the reforms started in 1974 have indeed been accomplished and a new public-funded research system has been set in

motion. This means about 25 years of discussion, conflicts, formalisation, organisational reforms and change in the Dutch public-funded research system. The "polder-model" needs time but it seems that it is able to achieve profound institutional change in the end.

One should not hide that there was a second drive at work for organisational reforms in the public-funded research system, i.e. austerity measures. The wish to reduce the expenditure of the state led to a search for more efficiency and higher quality of state services and strategies that could realise this aim. The "new managerialism" seemed to be one means, more "goal-rationality" in the use of funding resources another. The new managerialism led not only to organisational reforms but also to a revision of the "principal-agent relationship" in the public-funded research system. Goal-rationality in funding demanded that the use of funding resources was linked to specific goals and that there was an evaluation in how far these aims were reached in the end. This meant a revision of the financial structures in the public-funded research system from an institutional and global funding model to a more directed mode of funding. This had implications for all research and funding institutions. More efficiency meant also a revision of the distribution of tasks and functions in the public-funded research systems. Research institutes should develop their own profile on the "funding market" as well as unite forces in order to make it possible to concentrate resources. Finally, similar to Germany, flexibility in organisational responses to an increasingly complex and changing environment became a preoccupation of policy-makers.

The lines of organisational reforms in the 80s were therefore set out: openness to user systems; a more efficient and flexible management, a stronger directed funding component, evaluation and specialisation and cooperation with other research institutions.

The organisational reforms of making research institutions more responsive started in the 1980s first with the universities, the TNO, and then the ZWO, which became the NWO. Recipes of how to do reforms were quick at hand perhaps because the Netherlands had their own intellectual resources in this respect and because of the long tradition of "corporatism", i.e. the guided delegation of public tasks to semi-private or private organisations, which was conducive to the new ideas of delegating responsibilities and granting operational autonomy.[14]

Though new public management was not yet en vogue, there were similar thoughts in administrative sciences in the Netherlands which were already propagated in the beginning of the 1980s (Kickert 1998). This turnaround in ideas of organising the state occurred at about the same time as the other important changes in the thinking on science and technology policy (idem: 18). The administrative turnaround envisaged the creation of private or semi-public "autonomous administrative units" (ZBO; "zelfstandige bestuursorganen"), which had to implement public tasks while the state remained responsible in last resort. Overall, 50 such new administrative units were created between 1983 and 1991 (idem: 28). The Netherlands have been very active in matters of a reorganisation of public administration: we find no less than 6 different propositions between 1972 and 1993, which discussed the efficiency and flexibility of public administration (Frissen 1998: 31-33). These propositions were not always along the same lines: we find more network-oriented propositions and more efficiency-oriented proposi-

[14] Frissen contends that the process of autonomisation is deeply rooted in the Dutch tradition of subsidiarity and corporatism. Similar kinds of independent agencies have already existed before. "Functional decentralisation" has always been an important feature of Dutch administrative organisation (Frissen 1998: 22).

tions with quite different recommendations. Nevertheless, a new steering philosophy was emerging in this context, which merged later on with new public management ideas.

Kickert resumes the new intervention philosophy by using the terms "steering at a distance" ("sturen op afstand") and "steering on the base of political guidelines" ("sturen op hoofdlijnen"). These terms began to dominate the discussions on state intervention and have remained so until today. The new philosophy can be seen as a paradigmatic change in the governance of public tasks. What exactly do the new terms mean in comparison to "tutelle" in France and "global steering" in Germany?

The main thought is to distinguish "steering" and "rowing" (see (Osborne and Gaebler 1992)), in Dutch between "bestuur" and "beheer". Political administration in ministries should, in the future, not any longer be concerned by *how to do it*, but only by *what to do*.[15] The knowledge of "how to do it" should become the rationale of the new independent agencies. Operational autonomy of these agencies was conceived to raise the efficiency of effectiveness of implementation of public tasks. At the same time, the public administration had more time to concentrate on the rationale of the political system, i.e. to develop guidelines in policy areas. Quite comparable to the "new public management", contracts with negotiated tasks for independent agencies should be concluded between the responsible ministry and its agencies (idem: 28-9). These contracts contained also the budget for a certain period. Until recently, however, the budget had to be approved each year by parliament. Today, there is a longer time-span of four years. The agencies obtained the right to decide on their own how they would like to use their financial resources ("zelfbeheer"). The budget based on capacities ("input") should be replaced by a budget oriented to the output, i.e. the performance of these agencies (idem: 68). More independence needed, however, also more control and therefore more information on the activities of agencies. A more elaborated, systematic, and regular information system on the activities of agencies was therefore created. Evaluation became a keyword and, in the long run, a standardised procedure for all research institutions.

The most important point perhaps, characterising the new governance, is the change in authority relationships between the ministry and independent agencies: The Netherlands fully adopted the system of "contracts". Contracts put agencies and ministries at an equal level to negotiate the conditions of the contract. Of course, independent agencies had no alternative and could not just step out of negotiations. Nevertheless, in comparison with hierarchy, a system of contracts gave agencies the possibility to bring in their points of view and search for a consensus with the ministry about goals and budget. One should not forget, however, that still both sides have different functions and that the contract only serves to make sure that policy formulation is linked in an effective way with policy implementation. For Kickert then "steering at a distance" meant nevertheless not less steering but just another way of steering (idem: 160-1). The overall rationale is to remove administrative inefficiencies and to foster flexibility and innovation. It is here, where the link with the research system can be made. The

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[15] This should, as Frissen explains, strengthen the political importance because now policy-makers can focus on the essence of politics: make decisions. This does not mean, however, that politics has more power: While at the one hand, politics can focus on decision-making, autonomisation also means less influence because there are processes of implementation which can not be directly steered and because new actors are entering the arena and developing policies together with the implementing agencies. It is exactly this last point which limits the political influence: network-building without the government makes it difficult to influence the processes within these networks (Frissen 1998: 28).

more complex environment, rapid changes in knowledge development and the imperative of societal and economic needs induce flexible and innovative organisation. The changing governance paradigm corresponded to this functional pressure and envisaged to create exactly the kind of public administration in general and the kind of public-funded research system in particular it needed to raise the productivity, quality, and efficiency of public services.

More concretely, the changes meant that the agencies received a global budget (no more distinction between salaries and other material expenditures) and that they could make medium- and long-term financial planning. A very important point is nevertheless that operational autonomy did not mean independence from budget decisions of government and parliament. The fixation of the global budget depended on the budget policy of government and parliament with the consequence that all these organisational reforms took place while austerity measures were enacted and the budget of agencies did not rise. If therefore the government decides to cut down expenditures, this has an effect on the budget of independent agencies. In this way, the medium- and long-term financial planning did not mean more independence and security for agencies.

The Dutch version of agency independence is therefore a very "*controlled autonomy*" and this should be kept in mind in order to understand the learning capacities in the Dutch public-funded research system. It is not intended to reduce the role of the ministry, above all not in the domain of OCW, which had a long tradition of state interventionism. The main policy lines and control by an intense interaction between agencies and the ministry remained the authority of the ministry. In a certain way, granting more operational autonomy was conceived to *have a stronger grip on agencies* in the public-funded research systems.

It seems to us that both the active and interventionist stance in France at the end of the 1990s and the global steering idea used in guiding the big science institutes in Germany are based on very much the same ideas. The intentions of research ministries has never been to abandon powers but only to have a more efficient and effective system which can be better guided by political rationales. Despite of this, the new "operational freedom" engenders without any doubt its own dynamics that might not correspond to these guiding intentions of ministries.

This overview demonstrates that the Netherlands were gradually developing both in terms of finances and regulations, a model which comes near to the ideal model described above. One can speak of one model because, despite of differences corresponding to the different functions of research institutions (more basic science oriented or more technology oriented), the reforms have changed most research institutions in a similar direction. A centralisation of decision-making powers has been realised everywhere in order to break with the strong "bottom-up" influence of the scientific community within these institutions; Contracts are concluded both with holding organisations and with research institutes; evaluation with external peer review is obligatory and sophisticated; financing is usually based on three financial streams: depending on the kind of research institution (basic research or not) global institutional funding is the first stream (often, as in Germany, not contributing more than 20% of resources), a second stream is negotiated directly with several ministries which are interested in the kind of research a research institute offers, the ministry is prepared to pay research infrastructure for the research it is interested in and offers programme funds; finally, research institutes must find their money on the "market", i.e. with funding agencies, industry, foundations etc.; holding organisations always have reserved some money for innovation purposes; interdisciplinar-

ity is, of course, valued very prominently in research proposals by institutes; collaboration with other institutes and with universities is strengthened and required.

One can say that the Netherlands have institutionalised this model to a much far-going degree than France or Germany, which have just started their new institutional models. There are permanent discussions and modifications but in general one can say that "strategic research" is part of the organisational culture of all research institutions today in the Netherlands. In this, they are certainly more advanced than the other three countries.

What explains this success? Several factors seem important:

- The most important push factor has certainly been austerity. The Netherlands followed a rigid regime of budget discipline since the beginning of the 1980s which had consequences for all public policy sectors. Efficiency was and is the buzzword for policy-makers both in the government and in parliament. With a determinate "political stream" in this sense, the research sector had no chance to oppose to the cuts in the research budget nor to the "efficiency measures" in institutional terms. The negotiations concerning the statutes and internal organisations, the contracts and finances were influenced by this superior principle of austerity.
- The second factor is without any doubt the strong centralist tradition which – and this is important – is linked to an extensive "voice" process in decision-making. Neither Germany nor Switzerland with their federal state dispose of such a centralised power as the education minister. France is lacking, on the other hand, the "voice" process in decision-making. It is probably this unique combination of centralism and "voice" that is conducive to an elevated level of learning. This centralism can be observed in the predominant position of the education ministry in the organisation of the public-funded research system and its interventionist tradition in regulating affairs both in education and research. If the ministry has decided on a strategy it has a large number of prerogatives to realise this strategy. This power is strengthened by the otherwise high fragmentation and even conflictive relations between boundary organisations. If these organisations do not unite and develop a common strategy vis-à-vis OCW, as it happened when the research minister wanted to unite all KNAW and NWO institutes into one research society (1995/1996), the ministry has important leeway to set through its intentions.
- "Voice" is, as said, an important part of the process of decision-making of the ministry, though. Boundary organisations have their say when strategic plans at the political level are developed and there are extensive and intensive negotiations at the administrative level between the organisations and the ministry to develop the more concrete strategic plans of the boundary organisations. The long and all-including aggregation process guarantees that all important forces are heard and – most of the time – also respected in the decisions of the ministry. Only seldom will research themes be imposed. This institutionalised "voice" is an important "cement" for the stability of the Dutch public-funded research system. A hierarchical strategy by OCW would have much less chances to be implemented. Even in the process of organisational reforms, therefore, organisations were not confronted as such with a decision by policy-makers, but it was a long process of negotiation which, in the end, resulted in the new organisational model. It was the cohesion of the central actor, the education ministry, though that

made it possible to realise a somewhat coherent model for most organisations in the research system.

· Without any doubt, the corporatist tradition of functional delegation has also played its role in making boundary organisations acquiescent to political "irritation". Taking public responsibilities and think in terms of public responsibilities belong to the "legacy" and "culture" of Dutch institutions, even though this may have played a lesser role in the research sector. There is less resistance in comparison to for example Germany, to accept public responsibilities as long as, of course, the state accepts "voice" and a certain degree of freedom of these institutions.

· Moreover, the frequent use of review committees in the reorganisation process, though not systemic, have helped to create a more "objective look" on the problems of the research sector. In addition, we find encompassing analyses and "White Papers" that stipulate the problems and general strategic lines to follow. It is difficult for the various boundary organisations to negate these reports.

4.3.5 Concluding remarks

Again, we find that regulatory policies in institutional funding are clearly converging between the four countries in question. Though there are differences in the timing of introduction and variations in the precise application, the ideal model of reform discussed in the beginning of the chapter can be found in broad terms in all countries. Even in Switzerland where extra-university research institutions are rare, new public management delivers the blue print for organisational reform. The three most important elements are:

- *A shift from institutional global funding to institutional programmatic funding*. This is the most obvious and dramatic in Germany, where the big science institutes receive 80% of their funding under the new formula. Part of the institutional funding in the Netherlands is defined on the base of commonly agreed programmes with ministries, another part is project funding on the "funding market. In France there have been several attempts to reserve some money for the responsive mode of funding. This formula did not succeed. Today the priority areas defined in the contract must serve this purpose. Switzerland, finally, uses programme funds to connect university research and concentrate it on promising areas. This can be regarded as institutional programmatic funding because universities are deeply involved in the management of these centres of excellence and a part of the money of the federal government reserved for university research is distributed in this way. In addition, it is a long-term programme.
- *Competitive funding* is the second element. A 100% funding by institutional public funds is no longer tolerated. Research institutes are supposed to find additional resources in competition with other research institutes. This is the most obvious in the Netherlands where ministries are allocating their research money in an open tender instead of giving it to "their" research institutions. However, big science institutes and other public-funded research institutions in Germany are equally supposed to find their money with funding agencies or other sources. In France such a process of looking for industrial and other money was first introduced in the more thematic oriented "grands organismes". It is still less obvious in the CNRS.

- *Evaluation*, finally, has become a common procedure policy-makers use in all countries to make sure that research organisations are working efficiently.

These three elements are supposed to create the necessary openness of public-funded research institutions to other clients than the state and to flexibilise internal decision-making.

The convergence in policy ideas and – finally – in the policy regime concerning institutional funding can very probably explained by a number of factors:

- In all countries the "référéntiel global" is changing: the state is supposed to intervene less directly but make sure that the research institutions "row";
- The diffusion of new public management ideas has structured policy ideas how to organise this process;
- Economic pressures and the comparative advantages of generic technologies in combination with ideas from the "systems of innovation" have made governments sensitive to the functioning and above all failures of the public-funded research systems;
- The OECD has played an important part in diffusing critical ideas and "best practices";
- Budget deficits have been a most important factor to think about efficiency and concentration of resources.

The encompassingness of the reforms still differs between countries, though: It is the most far-going in the Netherlands where all public-funded research institutions are falling under the new model. Germany has started with the big science institutes but attempts to define similar rules for the "Blue List" institutes and "strategic thinking" is even becoming a preoccupation of the Max-Planck-Society, though policy-makers cannot oblige this association to accept such reforms. The reforms in France have been more profound and far-going with regard to thematic research institutes. With the contract system for the CNRS all institutions seem to have been implied by the new thinking. The new public management model is relevant for the "Annexanstalten" but not for the other extra-university research institutions. They fall under another rule, which, in its implication, is comparable to the ideas of the ideal-model. New university laws also respect the contract model. Though we still find differences in the "system-wide" realisation of the model, it is obvious that no country sticks to the reform of just one research type. This is a general reform, even more general than only linked to the research system.

The timing of reforms has varied considerably. Though all countries (with the exception of Switzerland perhaps) were experimenting with reform ideas already in the 1970s, serious reform attempts occurred in the 1990s with one notable exception, i.e. the Netherlands. The Netherlands have gradually and steadily modified the system since the mid-1980s. Though it needed a second push in the mid-1990s, reforms are now accomplished as far as it concerns the ideal model. All countries needed this second push in the mid-1990s to more seriously pursue institutional reforms. This is evident in Germany where systemic evaluation starts in 1997. The introduction of the reform is 2002 and results are not yet there. It might take another 10 years before the new model will be installed throughout the system. France is a similar case because one can regard 1997 as the second push for instrumental reforms in the CNRS. The new system of contract also started only in 2002 though other research institutions can be

considered as more advanced in their attempts to introduce the new model. The network and centre of excellence idea came up in the mid-1990s in Switzerland. New public management reforms were realised in the 1990s. Institutional reforms have played a minor role, though, because of the underdevelopment of the extra-university research sector.

Why these differences?

The success of the new model in the Netherlands must be explained by a number of factors. One advantage the Netherlands had, was that they disposed already of intellectual organisation models that were familiar to the new public management model. This gave continuity to the process of reform. A second point was the long experience with "functional corporatism" practiced in several public policy fields. This kind of corporatism knew already functional delegation to semi-private and private institutions. It was and is part of the political culture in the Netherlands and can be used, with a high consent by all actors, in different fields and in different times. The affinity of this model with the new organisation ideas in the research system helped. So, structural isomorphy helped, without doubt, to give the Netherlands some advantage in organising the reform. A second important structural feature is the relation between policy-makers and boundary organisations, which has been described already with regard to project funding. We can induce from our analysis that two dimensions may be of importance for "social learning", i.e. the degree of centralisation of political decisions and the access of research actors to the political system, i.e. "voice". A typology demonstrates the differences between countries in this respect:

Table 8 : Variables for social learning

	Access to political decisions	
Decision-making powers	*No "voice"*	*"Voice"*
Centralised	France	Netherlands
Dispersed	Germany	Switzerland

It is the combination of rather centralised formal decision-making powers at the level of the education ministry – that is the main actor with regard to the organisation of the public-funded research system – and the developed "mediation system" (cf. van der Meulen and Rip) that creates both the possibility to react and to build up a consensus among actors. This does not at all mean that we always find a consensus in the Netherlands: there have been conflicts between policy-makers and boundary organisations abound but hierarchical decisions are not accepted in the Netherlands so that even if the ministry decides in the end and conflicts persist, the decisions will have been influenced by former discussions among all actors.

Finally, the Netherlands have used several times review committees and encompassing reports ("reflexivity") to create a consensus on reforms.

Switzerland is the only other country that had similar advantages but did not really need it: The federal structure and the liberal policy regime was conducive to a model of delegation and operational freedom of organisations. In addition, Switzerland bases its decision-making in a

similar way – as shown above – on intensive and extensive "voice procedures. In the case of research institutions such procedures are, however, seldom needed. We just quoted one example where a change in the orientation of a research institute took place along the lines of "consociational" negotiation. Switzerland had the blessing of being a "latecomer" – though not voluntarily – and could – in the case of research institutions financed under the art. 16 of the research law – avoid rigid procedures in the public financing of research institutes. In this way, Switzerland has never used the extra-university research sector as an important part of its research policy. Universities were the objects of policy-makers and here Switzerland was in line with the "second push" in the mid-1990s that resulted in the network and centres of excellence model we discussed in the previous chapter. Switzerland followed, therefore, a different path in institutional funding than the other countries.

We think that the difficulties of France and the late achievement of reforms can be ascribed to the combination of a high degree of political centralisation and the lack of "voice" in research policies. The formally considerable powers of the research ministry in France seduce policy-makers to use hierarchical powers in order to determine research policies in the "grands organismes". The main problem is that these powers are used in a discontinuous way and that they are not clearly delimitated from the powers of the CNRS. This pattern causes what we have called the "competitive mode of learning" in France resulting in a "stop-and-go"-policy that for a long time showed no results with regard to organisational reforms. The mean of nationwide "colloques" used several times launched a major organisational reform in 1982 but could not solve the problems thereafter. It was the "second push" in the mid-1990s and a very active and interventionist government that put reforms more determinedly on the political agenda and which led, in the end, to the contract system. The experiences in the past make it difficult to believe that the new formula will be implemented successfully. However, there are some elements in the contract systems that could break with the former "stop-and-go"-policy.

Germany has, without any doubt, difficulties in reorganising its public-funded research systems because of the federal structure and "distributive coalitions" deriving from this structure between research institutions and either the Länder or the federal government. There was no need to confirm this point once again in our study. Much of the belatedness of Germany can be explained by this structure. The dispersed character of political powers is certainly a disadvantage for encompassing institutional reforms. It is certainly somewhat exaggerated to say that there is no "voice" at all for the scientific community in political decision-making. The key institution for this is the Scientific Council. There is, however, no system that can aggregate the different opinions in the public-funded research system and this must be seen as a weakness in creating the necessary consensus in institutional reforms.

This having said we have clearly demonstrated that the Scientific Council has played a key role for the reform process that – belatedly – took place after the "second push". This was, however, due above all to the "systemic evaluations" of the different research types in the public-funded research system of Germany. We have stipulated that two processes may have been decisive for the turnaround: the one is the "alternative" that the Eastern big science institutes presented to policy-makers in terms of organisation and the second is the introduction of the systemic evaluation that gave the opportunity to think in terms of the whole. The Scientific Council was important to create the consensus among policy-makers and the scientific community concerning the necessary reforms. One of the intellectual influences on this process was certainly the discussion on the "systems of innovation" that made it clear to policy-

makers that only an encompassing policy, linking the different elements of the public-funded research systems in a sensible and rational way, could build up the technological innovation in Germany. These factors, plus the budget deficits and the economic crisis, were able to break through the impasse between the big science institutes and the research ministry before. In this sense, then, there was clearly a learning process on all levels of actors in Germany. As these systemic evaluations were copied with regard to the other types of organisations and as there is a profound reflection within the Scientific Council on the promotion of the institutionalisation of cooperation in order to develop an encompassing strategic research in Germany, this could have been an important turning point in the organisation of the public-funded research system in Germany. The implications for the other parts of the system must still be seen though.

These different components are found to a stronger or lesser extent in all four countries which confirms one more time that the new policy-design is gradually be transformed into a new policy-regime which cannot exclude the regulatory structures. The different steps to introduce the new model, the different paths are, however, diverging. See the following overview that summarises main events in the reform of funding agencies since about 1974.

Summary Table 5 Funding Agencies

	Types of funding	**Structure**	**Projects**
NWO	▪ Own research insitutes ▪ main second money flow funder for universities implying ability to steer univerity research	▪ ZWO : bottom : multitude of legally independent foudations and their research commitees based on the disciplinary configuration of the scientific community.Centre : weak governing board. Decision : decentralised. « old boys network ». Necessity to reform legal structure. ▪ 1988: NWO: Hybrid organisation with considerable complexity. Foundations had the choice of accepting or not to become area council. ▪ 1994: internal reform: a) separation of competence of assessment and funding, the task was to avoid the rise of new networks, break up "subgovernements" and iron triangles. B) problem of inefficiency of the foundations. The governing board decided to fix a minimum amount of funding capacity for the foundations to be authorized to live on. This induced, from 1994 on, the dissolution of 19 foundations, and the creation of 9 new ones, and strengthens the influence of the governing board, but they are still hybrid organisations ▪ 1998: New Reform: only governing board and area councils	▪ 1974: White Paper fail to reform ZWO ▪ 1979: money transfer (fail) ▪ 1982: attempt to reform ZWO through working group (later success but on a consensual basis with reduced ambitions from OCW) ▪ 1988: reform of organisation with deceiving influence on the operational level. ▪ -1994: reform of the organisation, impulsed by the board. ▪ mid-1990: Ritzen (Social-Democrat), intervensionism, a) funding transfer from University to NWO (failed); b) unification KNAW-NWO research institutes (failed) ▪ 1998: reform of organisation (success)
CNRS	▪ own research institutes ▪ indirect University funding through UMR (mixed unity of research)	▪ Organisation: CNRS is governed by a President and a General Director (from the world of science) both appointed by the national cabinet. the General Director is linked to the scientific departments or national institutes, which have each a scientific director in charge of elaborating a strategy for the department, and a scientific council, they attribute funds to laboratories. ▪ 1982: EPST statute: simplification of the accounting budget and increased importance of the planning budget. Budget must serve as policy instrument and therefore have to express choices and strategies (Sevin, 1992: 37); lump-sum treatment of the laboratory resources. Programme funding and individual	▪ 1970's: more programmatic funding (failure) ▪ 1979: integration of CNRS in the Secretariat of University (failure) ▪ 1986: project of the opposition (RPR-UDF) to transfer large parts of research from the CNRS to Universities, abandoned once opposition was on government (minister Devaquet) ▪ 1989: modernisation project (from executive director F. Kourilsky) idea of remodelling the Comité National. First project 32 sections instead of 49 (+ reduction of CNRS

		funding is very rare in the CNRS. ▪ Evaluation by the Comité National: individual evaluations; evaluation of laboratory programs; drawing up reports every four years. Comité National is divided in sections, which are the core of the Comité National. Two third of its member are elected, the last third appointed by the Minister on the proposition of the General Director of CNRS. Its decision are not binding for the general director and the administration council, but, in fact it is rare that its advices are not apllied. Comité National is considered as the "Parlement de la Science". ▪ 2000: creation of an eighth department on the CNRS: Sciences and technologies of information and communication (STIC), which was decided by Allègre. ▪ 2000: reform of CNRS: 1) changing relation between president and General director. President with administration council set the general guidelines and General director manage the Centre, which implies a brightening of the role of the president; 2) expansion of the responsibility of the administration council, it now set the priorities and control the relation with the other organisations, it is also responsible for the new evaluation comitee and the new ethic comitee; 3) strengthening of CNRS independency through the autonomy of the scientific council (the Direction of the Centre is no more represented in it), and moreover, the creation of scientific departments of CNRS is now on under the responsibility of the General director with approval of administration council (before it was let to a ministerial decree). ▪ 2002: Contractualisation with the State: implied a new way of thinking the interaction with political level.	department from 7 to 6).Then, broad consultation led to working proposal with 39 sections (still 6 departments). Reform ended with 40 sections (1991). ▪ 1988-1994: Under Director Kourilsky: attempt to set up CNRS policy through strategic schemes ▪ 1994-1997: as a results of finance crisis, the only project is the balancing of budget. At the end (1997), the situation ameliorates and thirty programmes were launched (180 mio. Frf) , responding to the minister push towards more incentives. ▪ 1997: Minister change and CNRS director also, as a result, programme funding on CNRS turn from a recomandation to a "bad thing" ▪ 1997: authoritative push toward reform from the minister Allègre: setting up of "CNRS-Avenir" in 1998, which has been abandoned. ▪ 2000: new actors, setting up of "Reflexion stratégique", which gave birth to a "projet d'établissement" (2002-2005) serving as a frame for the State-CNRS contract. ▪ 2002: State-CNRS contract
DFG	▪ University research funding ▪ no own institutes	▪ Private Law Association: founding members: Higher Education, research organisations (MPG, FhG, etc.) and scientific academies. ▪ Basic research ▪ Its Autonomy from politics is inscribed on the German Constitution (Grundgesetz) ▪ Financing: 60% Bund; 40% Länder ▪ "self-governed body of academia" (Winnes et Schimanck, 1999:166) ▪ Organisation: - General Assembly composed of the founding members defining the guidelines; - Presidium with a president and a vice-president; - a Senat composed of scientists, which decide the research principles; - a Kuratorium in charge of finance planification; - Commissions, composed of scientists, dedicated to the attribution of funding. ▪ The project that the DFG funds are inititated by the researchers (bottom-up) ▪ mid-1990's: BMBF gives the DFG 5% of the Blaue-Liste, in order that the DFG participate to the funding of extra-university research ▪ 2000: DFG take into account the advices of the Evaluation commission: modification of the organisational structure with the coordination of groups "international collaboration" and " quality insurance" and the setting up of a group on "research perspectives"; creation of the Forschungszentren to satisfy the demand of the evaluation commission about strategic instrument. The specific themes of those Forschungszentren are selected through researchers proposition and not imposed by the DFG.	▪ Begin 1990's:proposition of WR to set up more thematic – instead of disciplinary – research (success: Graduierte Kollege) ▪ 1999: proposition of the evaluation commission: definition of priority areas of research implying new decision-making structures; strengthening of the DFG direction; DFG have to be not only at the service of scientific community but must also shape it; evolution of the evaluation system with the introduction of interdisciplinarity criterias, foreigners experts etc.; introduction of middle term planification.

SNSF	▪ University research funding through program and project funding ▪ No own institutes	▪ Privatte Law foundation ▪ Funding of basic research. Also oriented research from mid-1970's on, through the PNRs. ▪ 1975: introduction of PNR. Reorganisation of the structure of FNRS: augmentation of the members of national council of research (60 max.), four divisions, strengthening of the "Bureau du Conseil national de recherché", which could ratify the funding decision of the divisions. ▪ 1985: non-swiss researchers could be members of the "Conseil National de la recherché". ▪ 1991: first PPRs are in activity ▪ 1994: creation of the GRIPS – following the experts evaluation – pushed by the new general secretary of FNRS (Hertig). Which is an internal reflexion group. ▪ 2001: Division IV is in charge of the « Pôles de recherche » (PNR) ▪ 2002: revision of the statutes with the objectives of simplifying and flexibilising the organisational structure. Making a clearer differentiation between "conseil de fondation" et "conseil national de la recherché": 1) "conseil de fondation" is in charge of the strategy and of the scientific policy of FNRS, it must also represent FNRS interests. As a counterpart, it is no more concerned with scientific functions. It is reduced from 60 to 50 members, from which 20 are appointed by the Federal Council to represent political and economical world; 2) the "Conseil national de la recherche" is the scientific organon of the FNRS. New statutes reinforce its autonomy and scientific responsibility. Members are elected on a scientific basis, so there won't be no more members directly appointed by the Federal Council	▪ 1990's: international experts report incite FNRS to formulate more clearly its objectives and to announce it in political and economical spheres and also in the population. ▪ 1996: GRIPS analysed the programmatic research and made recommendations. PPR and PNR were too similar and must be further differentiated. PNR must have little changes, but PPR have to be deeply reformed. Proposition of GRIPS was to transform PPR in "Sonderforchungsbereiche" ▪ 1997: FNRS report on the "Pôles de recherche"

	Position inside the PFRS	**Relation wiht political level**	**Relation with operationnal level (inside and outside)**
NWO	▪ ZWO : Research council with deep anchoring in the scientific community, identity based on the funding of basic research. Decentralisation. Not innovative : « old boys network ». Linear model (mode 1) ▪ 1988: became NWO, evolution of its view of the linear model. Strengthening of the strategic function as a task. ▪ 1992: NWO discussed what its intermediary position meant for its autonomy: becoming "agent" of OCW will permit to rise the resources for NWO (as institutional "block grants" tended to disappear); and it will also permit to expand the domains of the NWO in the PFRS ▪ end-1990's: turn from a competitive to a cooperative stance. Also, reduction of the "dependence" of the NWO as independent agency. NWO receive the intermediary status it has aspired. New organisa-	▪ 1974: Resistance of NWO and scientific community to the reform (1974 to 1987). Political pressure through austerity. ▪ 1982, new government weakened the reform proposals and create a working group which succeed in managing consensus. ▪ After 1988 relation depends on the minister in place: a) minister Ritzen (SD 1988-1998) caused turbulences, confrontation and hostility by its interventionism; b) minister Hermans (lib) used "New managerialism, better relations. ▪ End-1990's: "controlled delegation" as the relation between OCW and NWO	▪ 1974-1988: Top Level agreed the reforms (at least the idea to reform ZWO), but organisational base refused. Still existence of a distance between management and professional base. Governing board had to deal with both the foundations and the OCW ▪ 1988: After the organisational change, the functioning did not change the first seven years. ▪ University didn't agree with the increase of second money flow. ▪ End-1990's Evolution toward strategic role of NWO. Boudary role imply relative differentiation vis-à-vis the research community as it imply the necessity to choose priority.

	tional spirit and identity of NWO (see strategic plan 2002). NWO is now a corporate actor which plays the typical part of a boundary.		
CNRS	▪ Creation as a "quasi ministry". ▪ Evolution of the position of CNRS when DGRST has been set up, it introduced a competition, but DGRST was too weak to direct CNRS. Moreover, the "conseil des sages" of DGRST entertained good relations with CNRS. ▪ Comité National has a powerfull real position inside the PFRS as it is the evaluating structure that "decide" (with no formal power to do it) the individual nominations and the ability of laboratories to receive or not CNRS label. ▪ The creation of a research ministry in 1982 lowered the position of CNRS inside the PFRS as it introduced competition for the coordination role. But the CNRS kept the central role in French PFRS. ▪ Debate around the position of the CNRS always exists in French PFRS	▪ 1970's: decline of the government interest in research. ▪ End 1970's: government try to integrate CNRS in the decision structures of State Secretary of University. ▪ 1980: changing views about research. ▪ 1982: creation of a ministry implied a dualism with the CNRS. Ministry has formal power over CNRS but the real power is counterbalanced by the power of the scientific community. ▪ 1986: electoral victory of UDF-RPR, idea of dismantling the CNRS ▪ 1997: new governmental cohabitation. conflict between CNRS and ministry (Allègre) ▪ 2000: Normalisation of the relations. Minister has less reform ambition and is more consensual than Allègre.	▪ 1970's: generational change at the head of CNRS, from defender of free research to science managers, will to turn to programmatic research and to reform the Comité National, but no success. ▪ 1989: reform of Comité National: need consultation of the research community and reduction of the first ambitions, conflict between directorate and researchers, solidarity among researchers, consensual outcome. ▪ Begin-1990's: Finance crisis implied that laboratories kept money in reserve and it increased the crisis. ▪ 1998: Plenum of the Comité National (for the firs time), in reaction to the threatening represented by the minister's Allègre will to reform CNRS. Research community unite to face the threat.
DFG	▪ DFG is central in the PFRS as it funds the basic research in University. Universities are, therefore, dependant on the DFG. ▪ Its reluctance to define priorities implies problems of research policy for the political level	▪ 1990's: questions about the quality of basic research lead to an evaluation decided by minister Rütgers. ▪ 1997: evaluation of DFG: the DFG made great effort to define the modality of its own evaluation, which was an evaluation by international committee.	DFG is considered as a part of the scientific community
SNSF	▪ Difficulty of its position in PFRS: sustain research and researchers but FNRS is constraint to take into account the political demands in reason of its budgetary dependence.	▪ 1974: The FNRS must use 10% of its funds to fund research programmes oriented towards solution of societal problems. ▪ 1976: Federal council criticise the autonomy of FNRS but augment the subventions. ▪ 1983: debate on the legislative chambers for the augmentation or reduction of subventions. Partisans of augmentation won. ▪ 1989: Federal Council define new research orientations. FNRS took it into account and sustain those orientations ▪ Begin-1990's: evaluation mandated by OFES to international experts. FNRS is said to be not enough proactive, too influence by the political level. It needs to develop its own strategy regarding research promotion. ▪ Sometimes FNRS must argue with the Parliament concerning the budget. FNRS had more ability to	▪ The milice structure implies (like the DFG) implies that critic is uneasy for the researchers. ▪ Conflictual relation with the EPF council. Beginnig-1990's conflict for the management of Priority Programmes. Each actors obtained a part of the PP. ▪ Conflict with GSR.

		communicate since the arrival of Hertig, as he saw the advanntages of communication for the FNRS. ▪ GRIPS has the objective to represent FNRS in the political debate.	

5 "RESPONSIVENESS" ON THE REGULATORY LEVEL: FUNDING AGENCIES

5.1 Introduction

In the previous chapter, we have discussed how policy-makers or funding agencies have changed the performance structure in public-funded research systems, i.e. the responsiveness of researchers and research organisations with regard to industrial or societal demands. The objective of this chapter is to analyse in what way policy-makers have attempted to make the new policy-design imperative for "productive boundary organisations", i.e. for funding agencies at the intersection of the political and scientific system. Funding agencies are part of the regulatory structure. They are, therefore, an essential part of the policy-regime and, hence, for any reform of the existing mode of operation. Social learning cannot take place without considering the role of these organisations.

Why do funding agencies have such a crucial role for governance in public-funded research systems? Since the end of the 19th century one sees a policy of delegating the task of funding specific topics of political interest or simply of funding scientific research to agencies created for this purpose by scientific or political actors (see in extenso (Braun 1997). The purpose of delegation, instead of organising research funding within the confines of public administration, was above all the consideration that such funding agencies with direct contacts to the scientific community would be better able to "irritate" scientific research than any political command could have done. At the same time, delegation was functional because it meant less work and costs for the political administration itself.

As policy-makers pursued for a long time a rather passive stance in research policy-making, funding agencies became intricately interwoven with the scientific community and scientific interests. The organisation itself of these agencies was such that important decisions on research projects were delegated to the scientific community. The tradition of funding and organising the funding became very often – and above all with regard to the funding agencies in our four countries – managed by scientists and the authority of policy-makers remained weak

in the decision-making of such agencies.

This is true for the German DFG, which was the creation of scientific organisations and not of policy-makers. Its "freedom" from political intervention is guaranteed by the German constitution. In a similar way the Swiss SNSF was a creation by scientists and it took a long time – from 1952 to 1974 – that the SNSF was recognising its boundary function as both an agency of the scientific community and as an instrument of research policy. The Dutch ZWO had – at least legally – a less independent status but regarded itself clearly as a representative organisation of the scientific community. Officially, this was changed in 1988. Only the French CNRS was created in 1939 with the task of representing the scientific community and of developing a national research policy. This did not prevent the CNRS to become after the war a bastion for scientific interests.

In terms of the principal-agent theory and its theoretical enhancements (Braun 1993; Guston 1996; Guston 1998), such a development can be regarded as a "capture by the third party" (see above all Braun 1993). While the primary act of constituting a funding agency can be seen as an act where the "principal", the political institution, delegates the task of funding to an "agent", the funding agencies, further developments prove that the agent becomes to such an extent interwoven with the adressees of funding, scientists, that two principals, science and government, are influencing and controlling the work of the funding agency. This is indeed the definition of a "boundary organisation" according to Guston (1998). However, the first principal, government, is gradually loosing grip and authority, while the authority of the "new principal", science, is growing.

If we try to situate the four funding agencies in question within this framework, one sees other differences in the relationship between the two principals and the agent:

The CNRS for example was seen in the beginning and often afterwards as the principal and agent at the same time. Because of the lack of a genuine political actor in research policy and the clear delegation of research policy tasks in general, there was no authority that could inform and command the CNRS. This changed, first with the creation of the DGRST and, above all in 1982, when a research ministry was established and the tasks of the CNRS were defined in relation to this ministry. Only then can we speak of a principal-agent relationship. However, even then there are – as shown – several periods where the research ministry remained passive and the CNRS could once again assume its double function of a principal and an agent in research policy. It became therefore imperative for policy-makers in France to, first, clearly establish a principal-agent relationship and, second, to make sure that the CNRS respects the task of developing the responsiveness of its organisation and researchers.

The German DFG is the other extreme when it was created, first as the "Notgemeinschaft" in 1919, and then again after the Second World War. Both times, it was an initiative by scientists and after the War the legal form chosen as a "Verein" demonstrated the willingness to keep a distance to the political "financier". One can thus say that the principal of the DFG was not government but the scientific community. The government can rather be understood as the "third party" in this construction with growing influence but clearly remaining the third party and not the principal of the DFG (see below).

The creation of the SNSF in 1952 was likewise the result of an initiative of scientific forces (Academies, universities) (Fleury 2002); (Freiburghaus, Balthasar et al. 1991). The federal

government as the main "financier"agreed to confer the statute of private foundation to the SNSF and to abstain from direct interference and even representation in the beginning. Much quicker than in Germany, the influence of the federal government was, however, strengthened and 1974 represents clearly the turning point, where the SNSF can be regarded as a true boundary organisation with two principals though its rhetorics aim clearly to underline the authority of the scientific community as the main principal of the organisation.

Finally, the Dutch ZWO confirms this pattern: Created by scientists and financed by the state it was mainly conceived as a scientific organisation. This changed in 1974 with the explicit objective to transform ZWO into a responsive organisation. Since 1988 it is officially an organisation with two different points of reference: fostering the responsiveness of research and guaranteeing the scientific quality of the research.

In three of our four cases the initial authority was therefore placed at the scientific level and not at the political level. The CNRS followed a different pattern. In all cases one sees from the 1960s onwards some attempts by the government as the main banker to make itself heard within these funding agencies, though this was often limited to the control of the financial flow of resources. This means that in 1974, the turning point in research policy, a complete reversal in principal-agent relationships had to be performed which meant that the government had to be installed as a principal first and then that one had to find means and instruments to make sure that the funding agencies were changing from "scientific organisations" to "intermediary" and "boundary" organisations without, and this remains important, to loose contact to the scientific community.

Both in France and in Switzerland this needed the establishment of a true political agency for research that could influence the policy-making of funding agencies while Germany had done so (see chapter 3) already in 1962. The Netherlands used the education ministry for this purpose.

We want to know in this chapter how governments endeavoured to force funding agencies into a principal-agent relationship and how they installed responsiveness within these organisations. How did funding agencies adapt to the pressures?

We will see in the next section that, once again, three of the four governments succeeded to establish a new model of responsiveness with regard to funding agencies that is quite similar while the path that led to the introduction – and therefore the learning processes – are remarkably different. The exception is Germany, where the status of the DFG has not changed but where organisational reforms are nevertheless pointing into a similar direction as in the other countries.

5.2 Converging model and divergent paths

Taken together, we believe to have found several components of a new "responsiveness" model that governments have attempted to introduce. These components are:

(1) There is a clear tendency to improve the "strategic capacity to act" of funding agencies. Using the term strategic does not yet imply top-down or bottom-up strategies. The introduction of strategies is value-neutral and not biased. It means that agencies should from now on base their behaviour on goal-means relations, i.e. develop clear objectives, and find efficient

means to realise them. It is more the increase of effectiveness and efficiency of funding activities than the actual guidance of certain contents of the objectives that is at stake here. Strategic capacities need, in addition, coordination between different part of the organisation, something which is particularly difficult in an organisation that is often built on the image of the scientific community. Funding agencies were often using the same disciplinary structure as the scientific community in order to develop their policy. This resulted in a very fragmented and often unlinked structure.

The strategic capacity to act follows in principle new public management ideas. This means that on the one hand, we see – but this depends on countries and governments – a tendency to develop objectives where the government can play a decisive role in developing the overall strategic framework and discuss the more concrete organisational objectives together with the management of the funding agency. At the same time, "operational freedom" is also valid for funding agencies. In order to have more flexibility in implementation and adaptation the government reduces its direct political influence in the more scientific matters of funding agencies. One sees a tendency here to increase the importance of stakeholders and policy-makers within strategic boards of the funding agencies while the boards responsible for the implementation of concrete programmes etc. are becoming more independent (i.e. without political representation). This exemplifies the strategy – operation divide. This tendency can be found in the CNRS, the SNSF and in the big science institutes in Germany, but not in the DFG.

(2) The development of strategic capacities means also – as in the previous case of extra-university research institutions – a strongern internal, central decision-making power. Everywhere there are reform attempts strengthening the powers of the executive within the funding agencies.

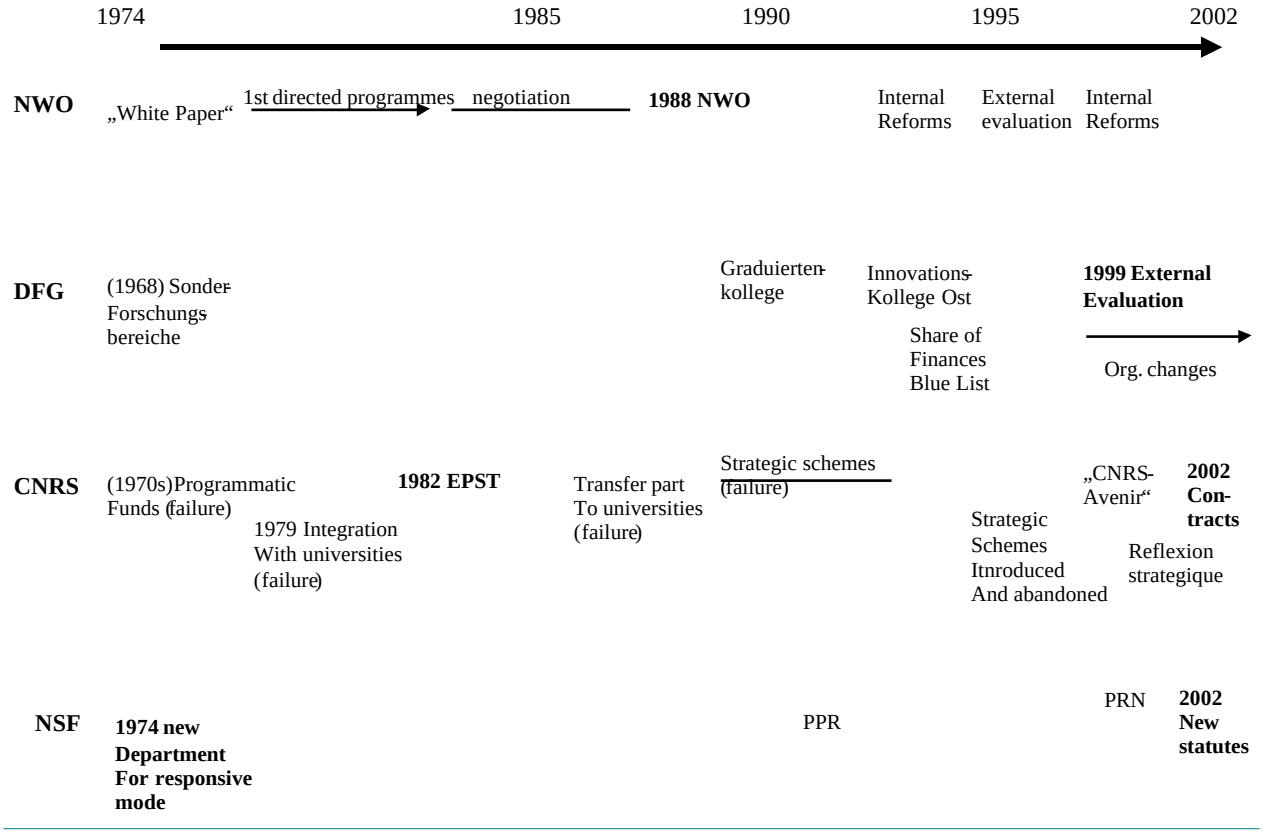
(3) Strategic boards or working groups have emerged everywhere in order to develop ideas which can be presented to policy-makers and in order to develop reflexive capacities for the adaptation of the organisation.

(4) The introduction of a "pro-active" stance is demanded everywhere. While the traditional attitude of funding agencies was very much following the logic of action of the scientific community, i.e. respond to the initiatives of individual researchers and institutionalise the same structure as the scientific community, it now becomes a function of funding agencies to structure and guide the scientific system, to recognise problems in advance, to act and guide the system in less troubled waters. This is a clear regulatory policy which is increasingly demanded. Within NWO this was inscribed within the statutes of 1988, the DFG was confronted with such a demand in 1999, after the evaluation of its function; the SNSF since the beginning of the 1990s and the CNRS since 1988. Funding agencies are considered as strategic actors.

(5) In general, the role of funding agencies is becoming more important. This is an effect of the policy of governments to reduce institutional funding and to promote project and programme funding. Though governments are also using their own agencies, the general tendency is rather to use the funding agencies for distributing the money in a responsive way. At the same time, this also explains that policy-makers want to have more influence within the funding agencies.

(6) Finally, interdisciplinarity is becoming a main demand and funding agencies have to institutionalise programmes fostering interdisciplinarity and new forms of peer review.

These different components are found to a stronger or lesser extent in all four countries which confirms one more time that the new policy-design is gradually be transformed into a new policy-regime which cannot exclude the regulatory structures. The different steps to introduce the new model, the different paths are, however, diverging. See the following overview that summarises main events in the reform of funding agencies since about 1974.[16]



SEQARABICThe overview demonstrates important events concerning the introduction of a more “responsive mode of funding”. This may be changes in the statutes of the funding agency, important evaluations leading to reforms or the introduction of directed funding programmes.

One sees three major organisational reforms before 1990 (1974 in Switzerland; 1982 in France, 1988 in the Netherlands) where the intention was clearly to introduce a stronger responsiveness of the funding agencies in question. The introduction differs considerably. The DFG is not starting any organisational reforms before 1999, when an external evaluation committee advised organisational changes. The somewhat growing influence is only recognisable in the

[16] See also the summary table 5

introduction of some new programmes that are mentioned in the list and the transfer of 5% of the money for the Blue List institutes to the DFG.

Then it needs the "second push" we have already recognised in the case of the extra-university research institutions to install new reforms in all four countries. Since 1998 the convergence process is clearly progressing and this time even the DFG is not spared the need for reforms. In the end all organisations have accepted that they need an organisational reform to improve strategic and responsive action.

There are differences in the path of the countries. This is not only to be seen in the case of the introduction of major reforms before 1990. One can also deduce from this overview that reforms and reform discussions were a permanent feature in the Netherlands and France. France is in addition characterised by frequent failures of reforms and ensuing new reform attempts. The major exception here is the change in the organisational statute in 1982 which was, as explained, the outcome of a nation-wide colloque and the rise of a new socialist government. After that point of time, reforms have been laborious. The previous chapter on the CNRS as an extra-university research institution has already demonstrated the details. The Netherlands by contrast are characterised by a gradual but progressive change. Once the new /organisation was created, the reform process inside the NWO was set in motion though it took quite some time before the "intermediary" position was reached. The latest reforms in 1998 can be seen as the point of time where the reform process as such is concluded.

In comparison to these two countries, the German case demonstrates a stable structure with no organisational reforms before 1999. The DFG has maintained its position as an agent of the scientific community and is only now under pressure to change this attitude. This has not led yet to major reforms concerning the influence of policy-makers within the organisation. Finally, one sees that after the rather quick reform of the SNSF in 1974 new organisational reforms were not needed though in the 1990s it becomes obvious that the functioning of the SNSF is not satisfying and there have been 10 years of discussion and reform attempts before the new statutes were introduced in 2002.

5.3 Learning how to reform funding agencies

What can we say more in particular about the process of change and resistance in each country? Let us start with the two countries of continuous reform attempts but with a different path (gradual transformation in the Netherlands and stop-and-go policies in France).

5.3.1 Netherlands

In the Netherlands, we find three main actors playing the reform game (the education ministry, the management of the ZWO/NWO and the disciplinary communities represented within ZWO/NWO) and several other actors who have an interest in these reforms because they change the actor constellations at hand like the KNAW, universities, or the Ministry of Economic Affairs. The game started with the clear announcement of the government in the White Paper of 1974 (see chapter 3) to transform ZWO into a more responsive organisation. The government would not any longer accept that disciplinary interests represented within "foundations" (with an independent legal status) within ZWO determined the distribution of public

money. Neither the identity of the ZWO nor its organisational construction (fragmented along the lines of disciplinary foundations) gave hope that minor reforms would do to introduce responsiveness on this level. It needed the establishment of a new organisation to create the institutional opportunities for responsiveness. As has been stated several times, this process of reform took 13 years. In the meantime, we see, nevertheless, already first concrete changes in the direction of a more responsive mode in the ZWO by setting up some priority programmes that envisaged fostering more interdisciplinary and applied research.

In order to understand learning capacities it is interesting to notice that the education minister, though he would have had formal powers to do so – ZWO was not a private foundation as in Germany and Switzerland –, did not just decide to change ZWO into a new intermediary body but that he searched for a consensus with the existing management by setting up a working group. This working group consisted of thre representatives from OCW and three from ZWO. The more radical versions of reform were abandoned within this working group and, finally, a consensus was found among these representatives with two essential elements: the construction of "foundations" should make place for "area councils" that were not disciplinary but more encompassing and, above all, directly subject to the policies of the strengthened management. Second, the Foundation for Technical Science (STW), with a focus on applied technological research, should become part of the NWO to manifest the stronger link with clients. The process to transform this compromise into a legal act is revealing as it demonstrates that the scientific base of ZWO did not at all agree to these changes. Lobbying set in to convince delegates in parliament that the foundations should subsist. The result was a compromise – the intention to install area councils but not yet the obligation to abandon the existing councils which resulted in an even more hybrid structure than before – the negative effects of which took 10 years to overcome.

The lobbying of scientists in parliament demonstrates that the newly created NWO was based on a coalition between OCW and elites in the management of ZWO while the scientific base that would have lost powers refused the compromise. The structure of a "professional organisation" with a large degree of institutionalised delegation to the scientific community became a problem here. On the one hand, it was always thought of as a necessary condition for a successful link with the scientific community, on the other hand, it was clear that ZWO was "captured" by disciplinary communities and that the management lacked authority and legal means to overcome the interests of these communities. This, of course, is a problem that all funding agencies deeply anchored within the scientific community had to face. The Netherlands created the base for a fundamental reform by a legal act that was still a compromise but that gave the management all possibilities to refine the organisational structure into the direction of a stronger management position and thus, of a strategic orientation. As we have worked out , we believe that the establishment of a stronger management in combination with a new "constitution" clearly defining the NWO as an "intermediary agency" serving both the scientific community and "clients", fostering both basic and applied research (which is, for example, until today explicitly refused by the DFG in Germany), was a necessary but not sufficient condition to transform the organisation. Hence, there were actors that had an interest in fulfilling the new function but they were still confronted with a strong resistance of disciplinary communities and their institutional strongholds in the foundation. The additional condition was not only permanent pressure by the government but above all two further evaluations, one internal the other external and set up by the government. Especially the last evalua-

tion in 1996 made it clear that the existing hybrid construction cannot be a key for success. Only then – and here certainly "conjunctural" elements helped, i.e. the "second push" – the management had sufficient backing and legitimacy to abolish the foundations and introduce the original construction for NWO in 1998.

The continuity of the reform process was, therefore, guaranteed by an actor, the management, and was helped at several times by pressures from the government. Without a further shift into the direction of "mode 2" setting through in all countries in the mid-1990s, it still remains doubtful, if the final internal reform in 1998 would have been possible.

The achievement of the complete reform does not mean, however, that the organisation is hierarchically directed by the management. The position of a boundary organisation means that mediation activities in both directions – the ministry and the scientific community – remain necessary. This is for example shown in the presentation of the strategic plan which serves as a medium to create a consensus with both sides because of intensive discussions and "voice". Boundary organisations remain hybrid organisations but the organisational structure can be modified in such a way that "immobilism" as an outcome of the mediation procedures become unlikely. With the reforms in 1998 the NWO seems to have reached this stage.

While the scientific community has certainly lost "veto-powers" within the organisation without being set aside, it seems yet unclear in what sense policy-makers have strengthened their influence within NWO by the transformation.

One interesting lesson we have found in the case of the Netherlands is that the government has voluntarily given up its representation within the former administrative board of the ZWO because it had the feeling that such a representation, even with the power of the purse, was no guarantee for influence. The new construction is based on new public management ideas: though the government has no official representation within the organisation it has several "veto-powers" by its right to confirm the budget, to appoint persons for the governing board and by its authority to define strategic guidelines and discuss the strategic plan of the NWO with regard to these guidelines. We characterise this power of OCW by the term "controlled autonomy": there is operational freedom of the NWO but all major strategic and budget decisions are clearly under control of the ministry. This means a frequent process of consultation and negotiation . In fact, it depends a lot on the stance of the responsible minister how intensively the political authority is used. The liberal minister until 2002 pursued a policy of "distance" but this might change with a more active and interventionist minister.

This demonstrates that, without any doubt, policy-makers have been able to transform the funding agency into an "agent" while it was the agent of the scientific community before 1988. This does not mean – and this should be repeated – that the scientific community is without any influence. NWO depends on the input of the scientific community in order to become effective. The "authority", however, is nowadays situated on the political level and the NWO must take great pains to consolidate as a boundary organisation that can communicate with both levels.

The example of the Netherlands shows that a scientific organisation can be transformed into a strategically operating and responsive organisation. We do not intend to conceal the difficulties NWO is still confronting in establishing the promotion of more applied research as a basic activity. Progress has been made though and NWO is actively searching for directed money by

the ministries it can allocate to researchers. According to official documents and in interviews, the new identity of an "intermediary body" is accepted.

The transformation process has not passed without conflicts with other organisations. One should mention here at least the reform project of the former social-democratic minister to transfer money from universities to the NWO in order to have a stronger responsive mode in universities. This transfer failed because of the strong resistance of universities and other bodies. Reform and learning processes take place in interaction with the interests and strategies of other actors.

The manifold activities we find in the Netherlands with regard to NWO are therefore explained by the strong resistance of those actors that are loosing their veto-powers. Even a legal act did not suffice to overcome this resistance. The legal act was, however, most important to create a new "path" for the institution that could not any longer be controlled by disciplinary communities. After that, learning and reforms took place under different conditions and ideas. Only then was it possible to change the institution into the direction of the new model.

5.3.2 France

There is no need to repeat in extenso what has been described in the previous chapter. As the CNRS is both a funding agency (though financing its own or "mixed" researcher groups) and a research organisation, the structure and learning capacities revealed in the previous chapter also hold when it comes to the funding activities. We have stressed though above all the relationship of the research ministry and the CNRS in the previous chapter. In this section we can add information on internal processes within the CNRS concerning the transformation process. The frequent failures of reform are, of course, attributed – as we have stressed already – to the internal organisation and veto-powers within the CNRS.

The transformation into an EPST in 1982 has, as in the case of NWO in 1988, installed the logic of a boundary organisation responsible to two "masters". In addition, we find similar resistance within the organisation as in the NWO. In contrast to the NWO, however, the leadership in the CNRS failed to overcome this resistance. This is certainly in part due to the varying reform pressure on the CNRS, the political stop-and-go we have already described. Another weakness has been the political nomination of leading positions within the CNRS that, in combination with the frequent changes in party colour of the government or new ministers, contributed to a weak position of the management of the CNRS. The reform orientation was, often, short-term oriented and no authority can be established when the lower levels in the organisation know that after 2 or 3 years a new policy might be adopted. Another difference with the NWO is the role of the "Comité National". In some ways, it has a similar position as the former foundations in the NWO. It represents the different disciplines. Its function is, however, even more powerful as its position as the "scientific parliament" gives it sufficient opportunity to intervene in all decisions that concern the reorganisation of the CNRS. In principle, the National Council is an advisory body but in fact, it decides, on the base of own evaluations, on the construction, closing down, and changes concerning research groups. Research plans are presented and discussed within the National Council. Even when the management attempts to circumvent the National Council, there are sufficient means for the Council to oppose these kinds of policies, above all by its power to decide on the recrutement and appointment of researchers within the CNRS. For example, the Council has resisted clearly

the appointment of researchers in thematically defined fields arguing that this would undermine the scientific quality of research. One sees therefore, without going into much detail , there is a fierce struggle between the scientific and responsive mode within the CNRS. Until today, this strong veto-power of the National Council is unbroken and one has still to see if the "contracts" can induce a different stance in this respect.

At the same time, we understand that the success of the reforms in the Netherlands is, without any doubt due to the abolishment of the "foundations" and the strong and coherent power of the education ministry. France failed both to overcome the veto-powers of the National Council – and, in addition, of the strong individual powers of directors of research departments – and to install a strong and coherent political power. The policies since 1982 are permanent attempts to either reduce the role of the National Council or to strengthen the position of the management, without much success. Other tensions are found in the relationship between the president of the CNRS and the general director. Reforms have rather increased this tension than to overcome it . Finally, we find tensions between the scientific and the administrative management within the CNRS.

This points, briefly summarised, make clear that the transformation into a "boundary organisation" serving two masters has been clearly opposed by actors within the CNRS that had, because of the institutional construction, sufficient veto-powers to not implement a more responsive mode. Once again, the new system of contracts is regarded as the breakthrough in this respect because these contracts force all levels in the organisation to make an effort in achieving the objectives fixed in the contract. Given that we find no major institutional reforms within the CNRS, it can be questioned if the system of "checks-and-balances" of the CNRS can be overcome. In simply stipulating that responsiveness must be a second point of reference in the evaluations of the National Council, we have not yet institutionalised a new identity of the organisation. Though this new identity was fixed in in the constitution of 1982, it is not yet acknowledged by most actors within the organisation. Further reforms have to be made.

5.3.3 Germany

The major difference of the German DFG with the previous funding agencies is the legal form: The DFG is a private foundation created by its members and not the state. Since the beginning, these statutes were conceived as a protection against demands from the political side. The state has, therefore, no direct means to prescribe reforms to the DFG. It would need the creation of a new organisation like in the Netherlands to do so but this has never played a role in Germany.

The DFG can therefore be regarded as better protected against reform projects of the government which is part of the story why we see a rather stable structure and only in 1999 some tendencies that the DFG is drifting into the direction. The other part of the story explaining the stable structure is the existence of a research ministry that is supposed to deal with applied and technological research. This division of labour, already valid since the end of the 1960s, has contributed to the lack of political pressure on transforming the DFG into a more responsive organisation.

This does not mean that the research ministry did not endeavour to influence decision-making

within the DFG and that it did not try to install directed funding within the DFG. We have already sketched that one of the negative repercussions of the division of labour was and is the lack of direct access of the research ministry to university research as well as the difficulties to bring basic and applied research together. This is the reason that the research ministry has attempted, time and again, to convince the DFG of the necessity to set up programmes that were focused on certain groups or the combat of certain structural deficits as in the case of the "Sonderforschungsbereiche" aiming to ameliorate interdisciplinary research at universities. The DFG did not always refuse such instrumental action under the condition that it would define how the implementation would take place and that scientific quality would be the main criterion of selecting researchers. If the DFG had to learn something it was how to maintain its autonomy despite of these more directed funding programmes. And the research ministry had to learn that it could not impose its policies on the DFG. The compromise was often, as indicated, a transfer of resources from the research ministry bound to some specified objective and the management of the instrument by the DFG. The representation of the research ministry and of the Länder within the DFG in the so-called "Hauptausschuss" that is supposed to discuss the budget plans of the DFG does not give sufficient influence to guide decisions of the DFG in more detail. The fact that a programm is financed by the research ministry does not lead to a strong position of political actors as the example of the SFBs demonstrates: in the review committee deciding on projects there is only one representative from the federal government and one from the Länder while the majority of committee members are scientists.

This demonstrates very shortly that the DFG has always understood to keep the political "principal" at a distance and treating him as the "third party" with legitimate demands but no rights to interfere into the business of the DFG.

The main tensions between the DFG (and this includes also the MPG) and political actors was this pressure to accept increasingly directed funds while the global institutional funds of the DFG were stagnating. If there was one reason for the DFG to accept the money from the research ministry, it was this stagnation of other resources. The strategy became then, of course, to end the austerity plans of the federal government and to introduce a medium-term growth guaranteed for several years by policy-makers. In fact, this is what happened in the mid-1990s when the federal government and the Länder conceded a 5% growth of resources of 4 years mostly because of the additional task of integrating the research institutes in the East of Germany (Winnes and Schimank 1999). Today, in 2002, another budget cut is intended.

One sees that, nevertheless, the DFG was under no immediate threat of being transformed into a responsive organisation and boundary organisation respectively. The directed funds were disturbing but they did not change the rationale of the organisation and they did not change the principal-agent relationship valid since the Second World War.

Why then do we find a change at the end of the 1990s?

The impetus was the same as in the case of the big science institutes, i.e. a stronger belief of the research ministry and the Länder that more directed fund and more competition were needed in the public-funded research systems of Germany. Regularly evaluations of research and funding institutions should guarantee and ameliorate the scientific quality. Policy-makers decided, after a recommendation by the Science Council, that all research institutions should be subject to an evaluation. This was no problem when it came to the big science institutes or the Blue List Institutes. It was much more a problem to do so with concern to the DFG and the

MPG. Both organisations could have interpreted such a demand as an illegitimate intrusion into their autonomy, something policy-makers wanted to avoid. In addition, the Science Council refused to make such an evaluation for the DFG because of the narrow personal links between these two institutions. As it is, the DFG and MPG did not oppose an evaluation of their organisations as such – the recommendation of the Science Council was difficult to negate – but first, they wanted to be evaluated together and, second, they looked for another organisation that could organise this evaluation. The solution was found with the Volkswagen-Foundation which set up an international expert committee.

Again, the Science Council recommendation and the willingness of policy-makers to have this evaluation, played a decisive role for the reforms of German research and funding institutions. One should underline that the objective of the evaluation was clearly to ameliorate procedures for strategic planning in organisations as well as for the research system as a whole, and to evaluate the allocation of money by the DFG. In addition, it was stipulated that it should be analysed if the DFG had sufficient cooperation with other research actors and with industry (Krull 1999). One sees that for the first time, the degree of responsiveness of the DFG to industry was clearly formulated as well as its overall position within the research system.

The result was, though politely formulated, a bad write-up: The DFG reproduced the disciplinary structures of universities and forecame that researchers in universities looked for funds from other clients and it contributed to a weakness of the overall public-funded research system because of its refusal to develop priorities and strategic capacities. The review committee ended with a number of recommendations that envisaged above all new decision-making structures, a stronger management, a different, more interdisciplinary-oriented peer review system, the introduction of more flexible administrative procedures, and the development of planning capacities .

After this report of internationally reputated scientists, the DFG had small leeway to escape from reforms though it was autonomous in introducing them. These reforms are still going on but there are structures becoming visible already: There are efforts to achieve a stronger internal coordination and, above all, a new group for developing perspectives in research is created. A new instrument, the “Research Centres”, is created that should serve as a strategic instrument in universities though specific topics are formulated in a “bottom-up” way. In fact, this is similar to the NCCR created at about the same time in Switzerland. In a first reaction, the Science Council recommends to develop in addition internal procedures for priority setting of specific topics.

This recommendation of the Science Council reveals all the tensions in the reform process: Though the DFG cannot any longer refuse to also contribute to a more competitive research system and to think more strategically in terms of priorities, it has chosen for an instrument that follows the usual bottom-up procedures and which therefore cannot steer thematically. The Science Council advises to correct this stance. The problem is that the acceptance of this proposition would be in contradiction with the role of the DFG as an agent of the scientific community. It would clearly be a step into the direction of a boundary organisation and the DFG is not yet willing to take this step. In addition, one sees that there have been no internal reforms that would have strengthened the role of policy-makers in the organisation nor the role of other stakeholders. There is therefore a demand for a stronger strategic orientation but the Science Council recognises in a new analysis that capacities to define strategies on the macro

level of the public-funded research system is still lacking. The DFG cannot be instrumentalised to accept certain topics defined for example by the research ministry and it has still to accept a major reform in order to institutionalise thematic priority setting. The solution, the Science Council is presenting, is an overall advisory body of funders where coordination should take place. Implementation would remain autonomous, though.

One notices, without any doubt, that the DFG has largely maintained its position as a scientific agency though a strict "no" to any strategic research has been modified to a "yes-no". Together with the division of labour in the German public-funded research systems this explains that a major coordinating body is needed to put together the different input and interests and try to develop a stronger encompassing sense for strategic research. The lack of a system of contracts makes it difficult to procede otherwise. One wonders, if such a coordinating body can have success. A lot depends on the willingness of participants. As long as implementation remains completely the domain of the DFG and other organisations, it seems unlikely that official strategic plans announced in such a coordination committee will be executed without further difficulties. The system of contract seems to be a necessary step in order to arrive at a stronger responsiveness of the DFG in the future.

5.3.4 Switzerland

Since the introduction of the PNR and the institutionalisation of responsive instruments in a separate department, these seems to have been an equilibrium situation in the interests of policy-makers on the one hand and the scientific community on the other. At least, we do not find another reform attempt since the beginning of the 1990s when an evaluation committee criticised, much in a similar way as in the case of the DFG later on, the passive stance of the SNSF in the structuring of the research system as well as with regard to the representation of scientific interests in the public. The lack of political pressure can in part be explained by the existence of the PNR that seemed to function well, in part by the existence of the Technological Agency that should take care of applied, technological research, and in part by the absence of a stronger political research actor until the beginning of the 1990s (as the creation of the GSR illustrates). In addition, policy-makers were represented in the two main bodies of the SNSF, the foundation council and in the research council and had the right to nominate a number of other representatives in both bodies. In other words, there was the feeling that the SNSF should not become a body responsible also for applied research like the NWO in the Netherlands and policy-makers had enough "voice" within the body – comparable to the CNRS or even stronger – to articulate demands.

The equivalent programme to the German "Research Centres" of the DFG, the NCCR, were, in addition, the creation not of policy-makers, but – as has been shown in chapter 4 – by the SNSF itself. Preoccupied with less funding and a critical evaluation of the PPR, the SNSF started to create its own "strategic group" and to think about future projects, the position of the SNSF etc. The new state secretary for research took up the ideas emanating from this body. This demonstrates that the SNSF is not seeing itself as the agent of the scientific community alone but it recognises its responsibility to the government and society. The "responsive mode" has been introduced in 1974, an early solution for the problem and one which seems to have been largely accepted by the scientific community after its creation though contested before. In 1974, the SNSF has become a boundary organisation. The tensions this in-

duces are becoming obvious when, for example, resources for directed funds are augmenting while resources for undirected funds are stagnating, a situation we find in the 1990s. It is here that internal struggles are taking place within the SNSF to change this situation and to find an equilibrium, which makes that about 20% of the resources of the SNSF are directed funds, while still 80% are undirected. The PNR seem to be widely accepted by the scientific community.

Switzerland presents therefore a rather peaceful picture. Nevertheless, there has been a change in statutes in 2002 that wanted to push the SNSF stronger into the direction of the new model. The main point was not to strengthen the responsiveness but to ameliorate the functioning of the organisation. In the wake of this reform, the influence of government in the Research Council was reduced which corresponds to the idea of a stronger independence of scientific bodies in the organisation. The research council becomes responsible for basic reflections and strategic planning documents. By contrast, the government as well as industry are broadly and even stronger represented in the foundation council. The special committee (Ausschuss des Stiftungsrates) of the foundation council serves as a direct linkage to governmental bodies. Four members of this special committee are nominated by the federal government. While the research council prepares the scientific planning, the foundation council is responsible for the broader strategic planning in terms of research policy. This confirms the status of a boundary organisation and the particularity of the SNSF: policy-makers are participating with an important number of representatives that explicitly have to represent the interests of the federal government within the SNSF, above all concerning the research policy decisions. This is easily understandable as the federal government has no other instrument to implement its own research policy ideas. The SNSF must therefore be the mediating body between political, industrial and scientific interests. Such a strong position of the government is not found in the DFG where the representation does not include strategic planning, nor in the NWO where contracts serve the influence of government or in the CNRS where government is only directly represented within the administrative council in order to discuss budget matters. This does not mean that political actors have more influence in Switzerland than in the other countries. The strong position of the government in France and the Netherlands has been described. It is an open question, if the direct participation in bodies of the funding agencies yields different results than the discussion of contracts that are then implemented by the organisation.

The recent changes in the SNSF have been adopted without major open conflicts. The compromise of a stronger independence in research questions and a stronger position of stakeholders in general research policy questions seem to have been acceptable for both sides.

5.4 Conclusions

If we take the four main characteristics of the new model of responsiveness (see section 2, this chapter), i.e. the strategic capacity to act, centralisation of management, strategic boards and pro-active stance, one clearly sees a difference between the NWO and the DFG. While the NWO has introduced all these characteristics, the DFG is very much at the beginning and has until now only institutionalised a working group for the development of research preferences. Strategic groups of reflection are in the meantime found in all funding agencies. The CNRS is still struggling though with the development of strategic capacities to act and the integration of

a pro-active stance. The intentions and the new contract system are, nevertheless, going into this direction. The SNSF in Switzerland has not centralised decision-making powers but it has reorganised its possibilities to develop research strategies by the new statutes accepted in 2002. We have also seen that there has been a strong convergence process into the direction of the new model at the end of the 1990s, when governments intensified their claims for a concentration of resources as well as for the strategic planning and priority setting in the public-funded research system. The developmental path as well as the outcome has been different, though.

A decisive point for a successful transformation of a funding agencies into a boundary organisation serving two masters, has, without any doubt been the capacity to design a new constitution for the funding agencies as it was the case in France and in the Netherlands. The institutionalisation of the PNR in Switzerland can be regarded as an equivalent mechanism: Such a constitutionalisation has defined a new "path" for organisational behaviour and has redefined the powers of different actors within the organisation. Insofar the constitution was not clear in redefining these powers (this was the case both in the Netherlands and in France), a strong resistance of the "loosers" of the new path could be expected. In fact, this explains the long transformation process in the Netherlands and in France. While the Netherlands have been able, through the strengthening of the centre, permanent political pressure and evaluation procedures, to succeed in this transformation, the ambiguities still existing in the case of the French CNRS still make it dubious if the transformation into a boundary organisation will succeed. In Switzerland the 1974 transformation seems to have installed a rather stable equilibrium that did not induce further reform attempts by policy-makers. The reasons for this have been mentioned: the existence of CTI "responsive instrument", the existence of the Technological Agency, the absence of a stronger political research actor until the beginning of the 1990s, and a strong representation of political stakeholdes in the two main bodies of the SNSF, the foundation council and in the research council. Learning could therefore take place within the confines of the institution.

The "stubbornness" of the DFG in becoming a boundary organisation can also be explained by its constitution that links the DFG to the scientific community, and in addition by the legal status, and the existence of a strong research ministry. Changes in the status quo can only come about by financial pressure, negotiations or, as happened in the 1990s, by the authoritative advice of the Science Council where the DFG itself is strongly represented. We have shown that even after a critical evaluation, the changes into the direction of a "responsive organisation" have been minor. As long as there is no new constitution or at least contracts that redefine the functions of the DFG, it is unlikely that the transformation process will go further than what has been achieved until today.

Despite the differences in accomplishing the transformation, there is a common trend towards strategic thinking in terms of the system. Funding agencies recognise more and more that they fulfil an outstanding function in developing the research potential of the research system and that they have become the nodal points for the organisation of public private partnerships in research. This is a driving force that will transcend the position of all funding agencies.

If we think in terms of learning capacities, we can summarise that government had to learn how to fulfil the role of a principal and funding agencies had to learn how to adapt without loosing their privileged linkage to the scientific community.

In the Netherlands, government learnt how to develop strategic plans and how to bind funding agencies to these plans. The contract mechanism was the instrument. Developments in France demonstrate that there was no continuous learning process by the government. Stop-and-go policies, the abrupt changes in intentions etc. have not been expression of the willingness to learn but to govern without often drawing lessons from previous failure. The institutionalisation of the contract mechanism can, for the first time, contribute to such a learning process because these contracts define objectives for several years therefore binding governemental intervention at least during this period. Nothing promises, however, until now that after termination of the existing contract a stable policy line would be continued. In Germany, government had to learn how to conciliate the interests of the research ministry and the DFG. Financial pressures served to oblige the DFG to accept more directed funding but the role of a principal is not possible for policy-makers given the labour division we find in Germany. In Switzerland, policy-makers had to develop their own reflexive potential and interests as a research actor. Federalism had, as described in chapter 3, constrained the development of federal research policies considerably. Since the beginning of the 1990s a process of emancipation set in that installed a small secretariat with a state secretary who has the capacity to define research priorities and seek a consensus with other research actors. Policy lines have become clearer since then in Swiss research policies. This Group for Science and Research within the federal administration also gives the possibility of presenting a more coherent view within the governing bodies of the SNSF, since 2002 exclusively within the foundation council. The "voice" of the principal has, therefore, become stronger.

At least two of the four funding agencies have learnt to serve two masters, i.e. the Dutch NWO and the Swiss SNSF. They have clearly integrated procedures that present possibilities to both sides to express their interests in a suitable fashion. The stronger interventionist stance of the Dutch government makes it more difficult for the NWO to keep its balance in comparison with the SNSF. The "checks-and-balances" structure of the CNRS has for a long time been an obstacle to become a boundary organisation. It remains to be seen if the contract system will overcome this hindrance. Finally, the DFG has clearly maintained its position as an agent of the scientific community but will be put under pressure in the future to collaborate within a more encompassing effort to organise the public-funded research systems in a strategic way.

If we therefore summarise the actual situation in the four countries in terms of an "equilibrium", one could say that Switzerland and the Netherlands have found a relatively stable institutional solution for future challenges while France and Germany are still experimenting. France still needs a major institutional reform of the CNRS while Germany needs a functioning coordination of its fragmented parts of the research system

6 THE ROLE OF REFLEXIVE INSTITUTIONS IN THE CHANGE OF POLICY-REGIMES

In this chapter we will discuss the place of reflexive institutions in the different national policy regimes and the role of these institutions in the policy-regime change we have described in

the preceding chapters. By *reflexivity* we mean the capacity of systems to "reflect" on their own behaviour, their structures, and problems and the attempt to find solutions to problems. Reflexivity is therefore an integral and important part of learning.

This chapter is structured by the following questions: When and what kind of reflexive institutions countries have set up? What is the degree of "density" of these kind of reflexive institutions? How are they connected to the policy-design and to the regulatory and operational structures? How have public-funded research systems used their reflexive capacities in order to adapt themselves to new challenges and to implement policy design change and ultimately policy-regime change?

6.1 The use of reflexive institutions in countries

First of all, it seems useful to simply describe the components of reflexivity in the different national public-funded research systems. To do that, we will discuss when each country set up reflexive institution and what are their organisational structures and activities.

6.1.1 Switzerland

The *Swiss Science Council* (SSC), established in 1965, was the first reflexive institution that had been set up in Switzerland, some years after the German Science Council (1957), the French CCRST (1958), and about the same time as the Dutch RAWB (1967). This corresponds to the pattern we have described in chapter 3: The small countries were somewhat later in developing their research policy frame than the big countries. The creation corresponds to the beginning of the institutionalisation of a national research and higher education policy. The federal government created the SSC in order to implement the results and recommendations of a national commission that treated the question of universities support. Formally, the activities of the SSC were to support the national government in all questions related to science policy. Members, appointed by the federal government, are coming from different areas: scientific, political, administrative, and economical. Therefore the SSC can be defined as a co-operative and integrative reflexive institution. The council is also a militia organisation even if it has a permanent secretary.[17] The organisation is as follows: a plenary assembly, a main committee and sub-committees, and, as mentioned, a permanent secretary. The different sub-committees show the diversity of the SSC activities: "research policy", "higher education policy", "technological policy and innovation", "science studies and monitoring", "evaluation", "technological assessment", and "foresight". And since 1983, according to the adopted Law on Research, the SSC formulates, every four years, recommendations for the federal government in term of research policy objectives. In more than two decades (1965-90), the SSC has produced an astonishing number of reports and analyses related to the public-funded research system that helped the federal government in its activities of designing the research policy. Due to its militia structure, the SSC often mandates national and international experts to evaluate or do other kind of analyses for the SSC.

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[17] The militia organisation is related to the Swiss liberal political system and can explain why the Swiss political system has a weak state or bureaucratic apparatus. On the advantages and disadvantages of militia organisation see (Germann 1996).

In terms of learning, it is without doubt that the activities of the council played on important role in the "adaptation of priority-setting" and the "operational functioning of research systems" to new challenges. The Council was very influential in the priority-setting of research policy. Its contribution to the operational functioning of the public-funded research system was more indirect.

Despite of these important reflexive activities, the SSC never possessed a high degree of legitimacy. One of the critical remarks was the too close connection to the federal power and more generally to politics due to the presence of politicians and federal civil servants within the SSC. It would lack therefore independence and would have pursued a too consensual course in matters of the public-funded research systems.[18] At the end of the 1980s, the minister in charge of the science policy, F. Cotti, argued on this point that the role of the SSC was not to find a consensus but to produce new ideas.

The situation changed during the 1990s for a couple of reasons. First, by creating the GSR in 1991, the federal government reinforced the strategic capacities of the federal administration. With this new structure, the SSC lost a part of its power in policy-design activities. Second, with the set up of other reflexive institutions (see below), the SSC lost its monopoly of expertise.

Ten years later, in 1998, in the context of a global reorganisation of the federal administration and under the impulse of the new State Secretary, C. Kleiber, the SSC was reformed. The main change was related to the organisational structure. Since this reform, only scientists compose the SSC and the size of the secretary was reduced. Since this reform, the existing subcommittees are organised, with contractual arrangements, in the form of two independent centres: the "Centre of Technology Assessment" and the "Centre of Science and Technology Studies". The latter was the core of former SSC activities. In 2001, this centre was definitively de-connected from the SSC. The rationale of this reorganisation was to strengthen the SSC mission as "spokesman" of the scientific community and to become an independent "think tank". In term of activities, the SSC now had to deal also with technological policy and the new polytechnical universities (HES, "Haute écoles spécialisées"). For all these reasons, the SSC became in 1998 the "*Swiss Science and* Technology *Council* (SSTC). The reform of the SSC was initiated and imposed from the outside (from the state secretary of science and research). The idea of producing large reports on all domains and activities in science policy was abandoned. The Council should rather produce advise and recommendations on a few domains in order to take quick decisions on strategic issues. These reforms have, nevertheless, be put into a more global context and be linked to the general transformation of the public-funded research system. The SSTC is no more the structure where large and deep analyses are realised on the public-funded research system (even if the SSTC produces reports[19]) and could be interpreted as a think tank where reflections on strategic questions are developed.

One can contend that with this reform the public-funded research system had become more conflictual: actors struggle for pre-dominance in the policy-design. The reform of the SSC con-

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[18] See the debate in the annual report of 1988 (SSC 1988).

[19] Four reports were produced by the SSTC : "Promoting academic careers at Swiss Universities" ; "a nine program for the Swiss science and technology" ; "Clinical research in Switzerland" ; "Structural reform of the Swiss higher education system".

tributed to this: Because there are no more politicians or civil servants represented, the SSTC has radicalised its discourse and has become less consensual and more demanding.

During this period of time, but a little bit earlier (in 1994), the SNSF set up an "*Informal Group for Strategic Research*" (GRIPS). The aim of this group that exists until today is to strengthen the presence of the SNSF in the political debate on the public-funded research system and to better defend its interest.[20] Different experts of the Swiss research and higher education policy participate in this group. Various topics are discussed within the GRIPS: programmatic research,[21] gender, evaluation, knowledge transfer, academic career access for women and young researchers, etc.

Few times after the creation of the GRIPS, the State Secretary of science and research set up, in 1997, a think tank called the "*Brain Trust*". The objectives of this organisation were numerous: to discuss and to test informally new ideas and to get information of different national organisations; to diffuse informally new ideas in the different institutions of the public-funded research system; to help the state secretary in the production of reports, etc. The members of the Brain Trust were distinguished personalities in the public-funded research system, representing the different political orientations. The Brain Trust played an important role in different funding topics such as: the creation of the NCCR, "science and society", the promotion of young researchers, the promotion of social science, the financing of research, as well as the foreign relations in science policy.

In a similar vein, the scientific societies re-organised themselves into one council, the *Swiss Scientific Societies Council* (Conseil des académies scientifiques suisses, CASS) in 2000**.** The aim was to have a more active ("intellectual") participation in the national debate on Swiss research and higher education policies. As the SSTC, the CASS presents itself as the "spokesman" of the science.

In sum, we observe that from the beginning of the 1960s to the 1990s the reflexive function in the Swiss public-funded research system was mainly fulfilled by the SSC, except for a few independent reports. As we have seen, this institution didn't only produce advice and recommendations for the federal government but it functioned also, due to its organisation, as a "consensus producer" or as a "broker" (see chapter 2). This double function (consensus building and reflexive knowledge producer) was put into question during the 1990s. After its reorganisation, it became an adviser of the federal government with a clear anchoring in the scientific community. The reflexive knowledge producer function was transferred to an "independent" agency: the Centre of Science and Technology studies (CSTS). In this period of transformation, we see the creation of other reflexive institutions, but this time – and that is new – in organisations that are considered to be on the productive side of the boundary. This is an indication that the necessity to think in reflexive terms is expanding and that there is a blurring of boundaries between reflexive and productive organisations.

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[20] The idea to implement such kind of structure inside the SNSF came from an international committee evaluating the SNSF. In their evaluation, the experts criticised the passivity (too reactive) of the SNSF, especially linked to the political and administrative actors. The GRIPS should increase the independence of the SNSF and to better express its objectives.

[21] As mentioned earlier in chapter 4, the GRIPS had suggested and developed the ideas and concept of the PRN.

This is an important change of the science policy-regime and of the public-funded research system. The system becomes more reflexive but not only due to the activities of the science council but because different actors have developed reflexive structures. The point is that reflections are now produced at different sites with the evident consequence that they are linked to different interest and that they may conflict with each other. The multiplication of reflexive institutions can, therefore, lead to an intensified struggle about the predominance in discourses on the research policy-design.

How did the public-funded research system use the reflexive institutions in order to adapt to new challenges and implement policy design change and ultimately policy-regime change?

If we compare the 1990s with the former period we see that the SSC was an important actor for the institutionalisation of the national research policy until the 1980s, perhaps because it had a monopoly in developing encompassing views and perhaps because it was organised in the form of a cooperative-integrative body. We have seen that the federal government has used the recommendations of the SSC for priority-setting activities. It is more difficult to evaluate the impact of the SSC on the reforms introduced during the 1990s. Quite interesting in this respect is the perception that the SSC has itself of its role. The president of the SSC underlined the important role played by the council in the priority-setting of the government and on two other issues, i.e. the promotion of social sciences during the 1990s and the promotion of young scientists. We have also to mention that the SSC has initiated a lot of international evaluations on different instruments (for example, the evaluation of the "priority programmes") or institutions. These evaluations, done by international experts, were often at the beginning of reforms set up by actors of the Swiss public-funded research system.[22]

For the other changes that occurred during the 1990s, the SSC was just one actor among others and perhaps not even the most important one. Initiatives and recommendations also came, as mentioned, from other reflexive institutions like the GRIPS or the Brain Trust. It is clear that the establishment of a reflexive group inside the SNSF increased the ability of the funding agency but also of the public-funded research system in general to face new challenges. Works and reflections done inside the Brain Trust have been important for the policy stance of federal government.

In the 1990s, therefore, several reflexive institutions contribute to the capacity of the system to act with all conflicts that this involves in terms of competence but also with the advantage of having several points in the system that contribute to a reflexive thinking on strengths and weaknesses of the system.

6.1.2 Germany

As in the Swiss case, the German public-funded research system is characterised by a cooperative and integrative reflexive structure. From the beginning the *German Science* Council (WR; "Wissenschaftsrat") was thought as a "forum" between the Bund, the Länder, and representatives of scientific institutions, in particular the DFG and the MPG. Initiated by the

[22] Of course, the a reflexive institution cannot be the only factor explaining changes in national public-funded research system. The knowledge produced by the SSC often informs, provokes, and stimulates but this in itself is not sufficient. In how far the reflexive studies are "heard", depends a lot on the legitimacy of the institution inside the public-funded research system.

president of the DFG in the 50's, the aim was to exchange information between these actors and to coordinate research policies more systemically on questions related to research financing (Stucke 1993). The set up of the WR received the support of all actors and was the first intermediary structure between the Bund and the Länder and between the State and Science (Stucke 1993: 53; Winnes and Schimank 1999: 29). The WR did not only focus on coordination activities. It is also an organisation that produces knowledge on individual research institutes, disciplines, universities, and on global problems of the research system. Thought as a cooperative and an integrative structure, the WR has the following organisation: A scientific council[23] and an administrative council.[24] The plenary assembly of the WR takes decisions at a two-third majority. This decision structure obliges to find a consensus between members of the two councils. Expertise and knowledge of the WR stem from commissions and working groups, which are composed of members of the two councils and of external experts.

The decision-making structure and the organisation of the WR could be interpreted as a consensus-oriented reflexive institution similar to the SSC in Switzerland. This last characteristic has its advantages and disadvantages, which can be summarised by the following argument stressed by Winnes and Schimank 1999: 139).

> *"Only through such an intermediary body the minimum level of coordination for public-sector research and a productive dialogue between science and state on priorities and problem-solving can be ensured. The strong impact which the recommendations and reports of the Science council had on the structural and thematic development of the research system are a clear indicator for this. On the other hand, the WR shows the disadvantages of the 'the joint-decision-trap' in full force. The need to balance the interest of the Bund, Länder and representatives of universities and non-university research organisations reduce decisions often to the lowest common denominator. (...) Recommendations of the Science council therefore are rather status-quo oriented and unable to deal with fundamental structural problems"*

Therefore, in a paradoxical manner, the WR can be defined as a strong *and* weak actor of the German public-funded research system. Strong, because it has, due to its structure, a high degree of legitimacy with almost all actors of the public-funded research system (Hohn 1990); Winnes and Schimank, 1999: 30) and weak because it is unable, also due to the structure, to change deeply (or radically) the structure of the German public-funded research system. So, the recommendations published by the WR put research actors under pressure even if the statute of the expertise is a recommendation and not a legal decision (Winnes and Schimank, 1999: 30). But the recommendations will not change radically the system and its "référentiel". It is interesting to notice that the outcome of the integrative and consensus-oriented structure seems to be different in Switzerland and Germany: The SSC was criticised because of its proximity to policy-makers while the German Science Council is hampered by a "joint decision trap". In fact we think, as we have stated in chapter 3, that the corporatist organisation of this kind of reflexive structure will have "averaging out" effects both in Switzerland and in Germany. Even if policy-makers may have had an outstanding position in the SSC it is diffi-

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[23] 24 scientists and 8 public personalities compose the Scientific Council. The DFG, the MPG, the „Hochschulrektorenkonferenz" (HRK; Conference of University Presidents) and the HGF propose the scientists. The Bund and the Länder propose 8 reputated persons.

[24] Representatives of the Bund and Länder compose the administrative council (22 members, 11 each)

cult to see how they would have imposed their view in the forum of a consensus-oriented forum. The precise process of decision-making within the Councils is, of course, difficult to know but a status quo tendency and gradual reforms in recommedations seem to be more likely than radical turns.

Next to the WR who is the main and predominant reflexive institution in Germany, the BMBF has set up during the 1990s two other reflexive institutions: the "Council for Research, Technology and Innovation" and the "Council for Innovation". The aim of these institutions is to advise the research ministry in its activities of policy-making and design as for example, the "GRIPS" or the "Brain trust" in the Swiss case. These structures are more policy-design and decision-making driven and do not produce knowledge on the whole public-funded research system. The Council for Research, Technology and Innovation was, by the way, abolished by the new social-democratic and green government in 1998. In a similar vein, a couple of Länder has introduced similar kinds of "think tanks" on research policy.[25]

How did the public-funded research system use the reflexive institutions in order to adapt to new challenges and implement policy design change and ultimately policy-regime change?

Since its creation, the WR has produced many reports. However, the recommendations formulated by the WR were not always taken into account, especially not by the universities. During the 1960s and the 1970s, the WR formulated suggestions to reform the research done in the universities, such as to differentiate the budget allocated to research from the budget allocated to teaching; competitive allocation of financial resources based on evaluation: independent management of planning activities; more flexibility, etc. The universities saw this kind of propositions as a "violation of Humboldtian legacy" (Winnes and Schimank, 1999: 63). Therefore, despite of the initiatives taken by the WR (and also by the research ministry), few changes occurred during the 1960s and 1970s and even the 1980s in the German public-funded research system (Winnes and Schimank, 1999: 73). There were exceptions: It is during this period that the DFG introduced, on the recommendation of the WR, the "Sonderforschungsbereiche" (1968). With the context and the pressure of the 1990s (reunification, international competition, and financial scarcity), the position of the WR became more prominent in the consideration of actors, especially through its evaluation activities. There is no doubt that the evaluations of the WR with regard to the big science institutes and Blue List Institutes have contributed to the process of reform, though not always exactly according to the recommendations of the WR, though these were already compromises between policy-makers and scientists. It seems that the WR has more difficulties to intervene in matters of the organisation of universities and in the domain of competence of the DFG and the MPG. This is easy to explain: big science institutes and Blue List Institutes depend directly on policy-makers while the other three institutions are well protected in their domains of competence. If policy-makers are therefore willing, they can easily use the recommendations for change within their own confines but not so easily within the confines of basic research.

It seems that here international and "neutral" evaluations have an advantage because reviewers are not part of the national system and profit therefore from a relatively high trust in their competent judgment. The reforms of the PPR in Switzerland and of the DFG and MPG were

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[25] For example the land Banden-Württemberg has set up the "Landesforschungsbeirat" and the "Innovationsbeirat" (Winnes and Schimank 1999 : 123).

based on such international evaluations and obliged scientific institutions to accept reforms. This demonstrates that national reflexive institutions have their limits independent of its form as a cooperative-integrative or expert body: The interweaving of these institutions with interest groups in the research system, even if there is a claim of independent analysis, can always give rise to protest and resistance if there are losers in the system because of these recommendations. The expert body might more easily resolve this problem because one could easily integrate international experts or attempt to find outstanding persons that are beyond any partiality.

6.1.3 France

In France, the first reflexive institution that was set up was the CCRST ("Comité consultatif de la recherche scientifique et technique") created in 1958. Its main function was to prepare discussions in government. The name "comité des sages" had been given to it as it was composed exclusively of scientists.

The genesis of this committee is representative for the actor constellation of the French public-funded research system at this time. The first project that intended to organise research at the ministerial level, presented by state minister André Malraux in 1958, proposed the creation of a "Commissariat general à la recherche", which would have been above all other ministries, only directly linked to the prime minister, with its own budget, and a permanent staff. This project was supported by the trade union of scientists but was contested by cabinet's director Pompidou, who argued that no minister would accept to submit his budget to a control of such an institution. In consequence, the ambition of the project was reduced to a mere coordination structure. The "haut commissaire" was replaced by a "Comité consultative" composed of twelve "wise men", who were in charge of counselling the interdepartmental commission "CIRST", presided by the prime minister. The last feature was the creation of a secretariat for the CIRST, namely the DGRST. This project was adopted on the 29th November 1958. However weak the new institutions seemed to be, they began to fulfil a quite important place in the setting up of a modern research policy (Picard 1990).

The CCRST proved to be able to propose concrete measures. Problems arose when it suggested the creation of an "Office des instituts nationaux de recherche", dependent on the prime minister. Those reforms – proposed on April 1959 – were ambitious and challenged the central place of CNRS (dismantling of the Centre and separation of its funding and research functions). This implied strong reaction from both the education ministry and the scientific community. The trade union of scientists reacted vividly and was heard by the cabinet. Nevertheless, it became clear that the creation of the CCRST and the DGRST challenged the former sole competence in research policy-making of the CNRS with future conflicts to come.

There was another reflexive institution in the French public-funded research system before 1981: The "Comité National de la recherche scientifique" within the CNRS. This committee, already mentioned several times, has, among others, also reflexive tasks. From 1959 onwards, it has been in charge of a "rapport de conjoncture" in order to inform political decision-making in matters of research. The first report was, however, not satisfactory given the hope placed in the Comité National. In fact, it never proved able to fulfil this reflexive function. It has there-

fore often been accused of being a conservative institution in the hands of the scientific community. Without taking a normative stance, it is obvious that the Comité National based its analyses exclusively on the criterion of scientific excellence and on disciplinary considerations instead of a more global and encompassing point of view.

The election of Mitterrand as president of the French republic in 1981 set the start for a deep reorganization of French public-funded research system, and implied a differentiation of its structure, introducing reflexivity as one of the central tasks in the public-funded research system.

The preparation of the new research law itself was the outcome of a reflexive effort represented by the organisation of the national "Colloque" on research and technology (see chapter 4). The first institutional change was the transformation of the CCRST into the CSRT ("Conseil supérieur de la recherché et de la technologie"), following the dissolution of DGRST, which was replaced by a research ministry. The CSRT, divided in two colleges, is composed equally of representatives of scientific and technical communities and of research partners (representatives of the world of work, of the productive, social and cultural sectors, and also of the regions). They are chosen by the ministry of research and are mandated for two years.[26] The CSRT is placed under the responsibility of the research minister and chaired by him. Its tasks are to give its opinion on the budget plans, to establish diagnosis and giving propositions on all the issues regarding the national system of research: funding, human resources, industry, regional and international aspects, socio-economic challenges and the institutional organisation. It is responsible for strategic evaluation (Barré 1994). Apart from these reunions, the day-to-day working of the CSRT is assumed by ad hoc working commissions, which are composed by people outside the CSRT. This evolution from CCRST to CSRT marked a will to gain more political influence. Indeed, the CSRT appears to be less connected to the performance level than the former CCRST, notably because of its composition. Moreover, it takes a place in the general movement towards the institutionalisation of science policy that occurred in 1982, and it represents the reflexive component of this movement.

Then, one of the most significant features of the research law of 1982 was the introduction of an independent evaluation. Evaluation is in our view, both an instrument of governance, as it allows a better knowledge of the system for policy makers, and of reflexivity because it is clearly a part of a self-reflection of the public-funded research system. In this case, we want to focus on the second, reflexive role of evaluation. The will of implementing evaluation was demonstrated in the setting up of the CNE (1985) and the CNER (1989), which were the outcomes of the decision to strengthen evaluation in the 1982's and 1985's Law on research. . Other creations were the OPECST (1983) ("Office parlementaire d'évaluation des choix scientifiques et technologiques") and the OST ("Observatoire des sciences et des techniques") created in 1990.

The CNE and the CNER are independent agencies that are linked to the political level. The CNER consists of ten members, nominated for six years by the French president. It is the national institution in charge of evaluating research bodies, research programmes and procedures. It evaluates also the accuracy of the priority chosen by the science policies (strategic ex-post evaluation); the good use and proportion of the funding allocated to programmes.

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[26] Members could make a maximum of two mandates.

Around 1992-1993, a "second push" of reflexivity took place in the French public-funded research system. The evaluations undertaken by the CNE, the CNER and the CSRT led to the same conclusions with regard to the general problems affecting research. We will not describe those evaluations as it is not our focal point here. However, it must be underlined that one of the effects of those evaluations was the setting up of the contract system from 1994 onwards, arriving in the CNRS in 2002. The contract system has a reflexive component as it obliges research institutions – similar to the Netherlands – to elaborate an "establishment project" where it must integrate the guidelines elaborated at the national level, and where it must position itself as part of the public-funded research system in relation to other organisations. This movement towards contracts induced the creation or the reinforcement of reflexive components inside research organisations like CNRS.

The nomination of Allègre as minister in charge of research implied the creation, in 1998, of new reflexive institutions: the CNS ("National science council") and the "Conseil national pour un nouveau développement des sciences humaines et sociales". The task of those councils is to give advice to the research minister concerning the "hard sciences" (CNS) and regarding humanities and social sciences (the latter council). The CNS is supposed to inform the government about major scientific developments, present general priorities and ideas about balancing the research system.[27] Based on these recommendations, the government develop its policies on a rational base, in considering the interests of science and economy.

The CNS is composed of scientists (one third of them from other countries). It diverges from the CSRT as its members are not selected as representatives of institutions or socio-economic groups but as « eminent scientists » and experts. The CNS appears clearly as an instrument of the research ministry.

Next to those two institutions are a number of coordination and concertation institutions which flourished between 1998 and 2000 .

Every EPST has also a scientific council. If we take the example of the CNRS and the reform of its statutes that occurred in October 2000, there is an attempt to give more autonomy to the scientific council as a reflexive institution. Before, this reform, the scientific council was considered as a "ratification organ" for the direction of. In the new configuration, the Administration Council is no more represented inside the Scientific council and the General Director of the CNRS no longer presides the Scientific council. This organisation is conceived to give more room for manoeuvre to the scientific council[28]. Its tasks are: "veiller à la cohérence de la politique scientifique du centre en liaison avec l'ensemble des instances scientifiques consultatives du Comité National de la Recherche Scientifique. Il donne également son avis sur la création ou la suppression de programmes intéressant plusieurs départements, d'instituts nationaux, ou d'unités de recherche et sur les propositions de nomination aux grades de directeur et de maître de recherche pour les personnels qui restent régis par les dispositions du décret du 17 janvier 1980 susvisé. » In addition, the General director of the Centre have to give the scientific council a feedback about the implementations of its recommendations, and the

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[27] Décret n° 98-938 du 20 octobre 1998 portant création du Conseil national de la science.

[28] The members of the scientific council are: eleven members elected by the CNRS workers, 11 members designated by the research ministry on the CNRS proposal (3 from the economic world) and 8 foreign scientists designated by the ministry on proposal from the elected members of the scientific council.

president of the scientific council – elected by its members – has a consultative voice in the Administration council.

There is also a trend toward reflexivity at the operational level that is stimulated by the contractualisation procedures that, from 1994 on, became the frame for the relation between ministry and research bodies. Indeed, the contract implies an effort of reflexivity from the research bodies in order to situate themselves inside the public-funded research system, which one of the conditions of the contract. Reflexivity become therefore a central question of reproduction of the research bodies inside the system, because they have to "prove" their relevance for the public-funded research system in order to fulfil the contract.

In sum, France is characterised by a large number of reflexive institutions, which are not really connected to each other. The large panel reflects the desire of different ministers (at different periods) to reform the public-funded research system.

How did the public-funded research system use the reflexive institutions in order to adapt to new challenges and implement policy design change and ultimately policy-regime change?

Concerning the "oldest" reflexive institution of French public-funded research system, the Comité National, it is unwilling to adapt itself to the new challenges, it remains firmly committed to strictly scientific evaluation criteria, which include disciplinary division of scientific labour.
For the rest of the reflexive institutions, we find something like a paradox when we investigate the influence of reflexive institutions. The following statement of the OECD resumes very well the situation in France

"*La difficulté n'est pas tant définir des priorités, ni même d'obtenir un consensus suffisant sur ces priorités, que d'évaluer les résultats pour mesurer le chemin parcouru et de tirer de cette évaluation des enseignements pour la poursuite de l'action. La France est dotée de suffisamment d'organes de contrôle et d'évaluation pour disposer en principe de toute l'information nécessaire. Force est cependant de reconnaître que la complexité du champ à évaluer et la multiplicité même des opérateurs et des niveaux de l'évaluation rend la chose malaisée*" (OCDE 2001)

Despite, then, of a lot of reflexive potential, France has difficulties to use this potential effectively because of the complexity and fragmentation of its landscape. This appears more clearly if we take the main reflexive institutions: First, the CSRT appears not to be a key player because its means are not proportional to its duties. If we compare the CSRT with the German Science Council, it is far from having the reputation of its German alter ego. It produces advices and recommendations but they do not have the same standing as the analyses of the WR. The other reflexive institution, the CNS, did only come into existence because of a political act. After the departure of the minister, it plays no role in the priority-setting of the system. The CNE and the CNER also lack means and influence, partly because of their advisory role, with the result that their advice is taken into account only when it can be easily implemented (Callon 1995).

Moreover, it seems that the French reflexive institutions are not strong enough to influence by their own strength science policy. The use of ad hoc commissions and "Colloques" becomes

necessary to make the system evolve. The process that led to the implementation of contracts from 1994 onwards is more complex as it has been favoured by a convergence in analysis of all relevant institutions plus the influential Commisssariat Général du Plan in 1992-1993.

The process of reform of the CNRS at the end of the 1990s illustrates this weakness of institutional reflexivity as the reform has been prepared by ad hoc working groups ("CNRS-AVENIR" and the "Réflexion stratégique" du CNRS) and not by the usual reflexive institutions. This process is also representative of another problem that reflexivity has to face in the French PFRS, namely the specificity of the political stream. The first reflexive exercise (CNRS-Avenir) has been set up in order to meet up to the interventionist challenge by minister Allègre. The changing at the head of the ministry and at the head of the CNRS implied that all the recommendatins made within the framework of the CNRS-Avenir were abandoned and a new ad hoc working group "CNRS-Réflexion stratégique" was set up.

We could say that, despite of its weaknesses, the reflexive boundaries of French PFRS have been partly able to implement the new policy design. Concerning the ability to change the overall policy-regime, the French public-funded research systems is actually facing a major challenge as the legal structure of the public-funded research systems is not adapted to contractualisation (Iribarne (d') 1999). The reflexive institutions have not yet proved able to contribute to a convincing solution until now.

6.1.4 Netherlands

Reflexive institutions are well developed in the Dutch public-funded research system. To start with, it must be underlined that the Netherlands have a long tradition of using (quantitative) information. It is perhaps not astonishing that this tradition has been transferred to scientific developments. Not only do we find the creation of an advisory council RAWB in 1967 but also the setting up of a new scientific discipline "wetenschapsdynamica" (the dynamics of science) at universities with a few active researchers at the beginning of the 1980s. They had a considerable influence on the reports and discussions taking place and a number of influential analyses have been undertaken by these researchers ((Dijk, Frankfort et al. 1993: 153). Later, in the mid-1980s, a special funding programme was used to develop more knowledge about evaluation studies. In addition, the Netherlands have developed in an impressive way the use of science and technology indicators (Berwert, Reuter et al. 1999: 57). They serve the function to improve joint actions between enterprises and the state by coordinating research and development. There are further attempts to develop the scientific base for the use of this information in the policy process by founding new disciplines and attracting researchers into these areas.

There are two areas where the reflexivity in the Dutch public-funded research system was developed.

(1) The first step was the institutionalisation of *evaluation*: this already started in the 1970's and continued in the 1980's. The rise of evaluation procedures in the Netherlands follows three reasons: First of all, it was inspired by austerity considerations and the aim to reduce state expenditures. Second, it was stimulated by the cabinet in order to have a more "rational

policy-making". Third, evaluation was part of a project to bring about the strategic turn in the public-funded research system.

We can differentiate four levels of evaluation in the Dutch public-funded research system. First, universities started with evaluation in 1982, with the obligation to submit research projects in order to receive "conditional financing". As a result of the agreements made in 1992 by the Minister of Education and Science and the 13 universities, the Association of Universities in the Netherlands (VSNU) was asked to set up a system for external research evaluation (quality control for university research) as a complement to the internal efforts with regard to quality control (Eiffinger 1997: 32). Since then, the VSNU has set up a national system for external quality assurance in education and research (van der Meulen and Rip 1997: 10). Research programs of the universities are assessed on a four years schedule (van der Meulen and Rip 1997: 10). This system is intended primarily to be used as an instrument for research management by the universities themselves. It seeks to underpin decision-making at the various levels within the universities up to the level of the executive board (Eiffinger 1997: 32).

Secondly, since the 1980's, an increasing number of what Rip and van der Meulen call "free-floating evaluation committees" arises ((Rip and Meulen 1995). These committees produce ad-hoc and decentralized studies about disciplinary and research area developments.

Thirdly, the setting-up of the IOP was the beginning of the development of more regular and systematic evaluation procedures of government-financed funding programs (see also Eiffinger 1997: 27).

Finally, one of the most important developments is the establishment of regular evaluation procedures for research institutes, which have taken place within the "new governance structure". These evaluations are not used to allocate funds or to redistribute funds. Evaluations are there to be sure that research institutes are respecting the general confines of strategic research and what has been negotiated in contracts and statutes of these organisations (Eiffinger 1997: 30). On the same way the research institutions have integrated the evaluation as a normal procedures in the research field, being also aware of its possible negative outcomes. So, the typical model for such evaluations is one of external evaluations usually undertaken by independent peers, is often preceded by internal or self-evaluations (see also (Braun 2001). In this way, evaluations have gradually become an input for discussions of research organisations with the minister of Education, Culture and Science on the implementation of their strategic plans. Evaluation is also a means and increasingly used so to see if newly created institutions hold what they promise. Almost no institution today can be sure to exist forever. At least, there is always the risk of serious reorganisations. NWO had to accept an evaluation after seven years, the AWT has been evaluated after a four-year time-span, and so are other organisations. In principle, research organisations in the Netherlands are now only founded for a limited time-span, before they are controlled and perhaps continued, reformed or dissolved. Evaluations serve to judge on these questions. This, of course, can raise the efficiency of the system according to the criteria developed for the evaluation. In addition, it introduces an "evaluation culture" in the system, where organisations cannot be sure that they will survive.

(2) The second area of reflexivity is *foresight*. Foresight received political attention after the publication of Irvine and Martin study in 1984 (Irvine 1984). Thinking in terms of foresight seemed to be the adequate answer for a small country with a limited potential and the need to concentrate forces. And it fitted into the general administrative tradition of planning and pro-

jection. The social-democratic minister Ritzen, who came into office in 1989, commanded an additional study by the authors. This should become a new foundation for the education ministry OCW to push forward the ability of the government for priority-setting. OCW was known until then for its lack of vision and priorities.

The study led to the creation of the *Consultative Committee for Exploratory Studies* (*Overleg Commissie Verkenningen;* OCV), which had the task to organise a broad process of foresight studies and to give possible solutions for problems. The minister promised to base his policy on the work of this committee and present it to the parliament. The basic structure of the polder-model was respected: First, the ministry delegated priority-setting to an independent, intermediary committee; second, this committee should coordinate all the different foresight activities that were emerging, like evaluation studies, in quite a number of institutions and on several levels. The OCV issued its final report in May 1996 (OECD 1998: 116). The government took over the themes outlined in the final report of the OCV and presented them as priorities in its Science Budget. After its report, OCV was dissolved because it had done its task (1996). A new organization was created that had the task to unite both the advisory function of the former RAWB and of the foresight aggregating task of OCV. This became the *Advisory Commission for Science and Technology* (AWT; "Advieskommissie voor Wetenschap en Technologie").

The OCV "consists of influential figures from scientific and business communities. (…). Exploratory studies present the longer-term opportunities offered by research and define social and private sector demand for research. Using scenario analysis, the OCV develops options for science and technology policy, on the basis of which priorities can be set. It is not up to the OCV to select these options; that is, the responsibility of the government, the various interested parties (…). To increase the chances of implementation, the major research organisations are represented in the OCV. Companies and other social agents are closely involved in the survey to ensure a wide basis of support for its results." The integrative concept is therefore clearly visible in the composition of the OCV. A firm anchoring in the scientific community was respected (Rip and Meulen 1998: 759-61). Members were chosen with an eye on their double functions and disciplinary background. Without a formal representation relation, they were seen as consultative representatives of these organisations, and, as a consequence, were expected to function as an ambassador for the Committee within these organisations and disciplines.

There were two reasons to create the AWT: First, the Government White Paper of 1995 had united the forces of ministries, especially of EZ and OCW, and both institutions wanted a common council that could take into account science and technology policy developments. Both ministries are paying half of the costs for this institution. Second, the RAWB was regarded as an institution with too many affiliations with the different organised interests in the research system. There was a feeling that this hampered innovative propositions of the advisory council. As with the "Wagner Committee" in 1981, the ministries chose therefore a more independent organisation consisting of non-affiliated, independent persons. It was explicitly said that members should not represent organised interests. For its composition: half of the members of the AWT are appointed by OCW, the other half by EZ. The reunions are presided in turn by these ministries.

The tasks were, as indicated in the beginning, defined as: advising government and parliament in all matter of science and technology policy. OCW (but not EZ) can ask the AWT to do foresight studies in science and technology. The AWT is focusing on the knowledge and innovation trajectory. As in the case of OCV, the government obliged itself to integrate the recommendations of the AWT in its policies.

However, a first evaluation in 2001 demonstrated that the body did not meet up to expectations. The reports delivered by the AWT were not of sufficient quality because members of AWT were not used to do the kind of foresight studies required. In the background, another discussion played a role leading to a reformulation of the role of the AWT: There were conflicts with other organisations feeling more capable of doing the foresight studies necessary like, for example, the sector councils (see below). It was criticised that the mix of foresight studies and advisory function was not a good idea and that one should differentiate these two functions. The evaluation recommended in the end to indeed concentrate strategic foresight studies at the level of sector councils and to let the KNAW do all scientific foresight studies. The AWT is still advising the government today, but, first the government is not any longer obliged to follow the advice of the body and the AWT is now dealing with the more general and systemic topics in science and technology while the other organisations are dealing with basic and strategic research.

The *Royal Dutch Academy of Science* (KNAW) is responsible for the organisation of disciplinary and scientific foresight studies. To this end, it has its "disciplinary councils" that can implement such foresight studies. Its specific task is to analyse how one can promote certain developments in disciplines.

The KNAW is a reflexive organisation that is close to the scientific community. Its modes of choosing foresight areas is representative of its anchoring in scientific community as it is often not OCW that is asking for a certain expertise, but the scientists in the KNAW themselves that take the initiative, even if the project must be later approved by the OCW. With the introduction of the global budget, this situation has somewhat changed because the governing board can alone decide what kind of foresight studies it wants to do. The interview partner maintained that the KNAW has quite a high legitimacy and independent status, and that OCW has not too much influence on these decisions.

The last element of reflexivity is represented by the four *sector councils*, which are a Dutch peculiarity. Indeed, while priority setting and the recent foresight exercises can be found in almost all countries, the sector councils,[29] focussing on specific domains like agriculture, health or energy (= sectors), are unique (van der Meulen and Rip 2000: 12).[30] Their composition is manifold comprising researchers, users, administrators, and government officials) (van der Meulen and Rip 1997: 5). Their creation was inspired by, and modelled after, the already existing National Council for Agricultural Research (NRLO), which had already been created in the 1940s. Though the precise function is changing in the course of time, from the organisation

[29] They were given a legal basis under the Law on Sector Councils in 1987 (van der Meulen and Rip 2000: 12). The Dutch name "sectorraden" means sector councils but the official translation (since the middle 1980s) is "Advisory Councils on Research" (van der Meulen 1997). We nevertheless stick to the Dutch term sector councils.

[30] The sector councils were defined in terms of problem domains and relevant research, rather than according to departmental boundaries, which was innovative (van der Meulen and Rip 1997: 5).

of coordination among producers in sectors like agriculture or health and the government to the fostering of innovation today, reflexivity was always thought of as a main task of these organisations. The almost corporatist composition of these bodies lend itself to gather information from producers, clients, and scientists and discuss this information with the government. The sector councils can, in addition, mandate experts to elaborate certain problems and find solutions.

Their statute differs. In principle, they are financed by one or several ministries and they are responsible to these ministries. The ministers have the right to create and dissolve these bodies. Nevertheless, they have a relatively independent status most of the time in terms of operational freedom. A commission, the "*Sector Councils Consultative Committee*" (COS), is defending the interests of all councils. In fact, sector councils try to avoid being treated as a part of a ministry because this would jeopardise their broker function they envisage to fulfil.

In terms of reflexivity, they see themselves as the legitimate organisations within their research area – that is not disciplinary, but sector-bound – to deliver all necessary information for the government and to do the necessary foresight studies in order to let the government decide on future policies. In contrast to the KNAW, sector councils insist on strategic and not on basic research.

Sector councils have to prepare reports every four years on the overall policy and research direction in the sector in question, but their main impact is through a variety of reports published in the meantime, and the interactions and networking that are part of the preparation and dissemination of the reports (van der Meulen and Rip 2000: 14). The sector councils are also involved in processes, which monitor and stimulate research programming by others, like foresight and evaluation (van der Meulen and Rip 2000: 12). They can also initiate evaluations.

How did the public-funded research system use the reflexive institutions in order to adapt to new challenges and implement policy design change and ultimately policy-regime change?

One should evoke one major problem of the "reflexive structure" in the Netherlands: Though the Netherlands have developed a very elaborated and fine-tuned reflexive intelligence structure, a lot depends on how this structure is connected to implementation. The connection between the "reflexive field" and the "funding field" is one of the major keys to success. And it seems that this connection has not always functioned satisfactorily. This is mentioned with regard to the relationship between sector councils and the NWO, which should work closely together. For a long time this has not been the case because foundations and Area Councils were using their own evaluation procedures to base their actions on. Though NWO was supposed to work strategically, there were no institutionalised settings for bringing the recommendations of the sector council over to NWO policies. Only recently we find a positive example which might very well present the key to future success: A former foundation, financed by the health ministry, ZON, responsible for health care, has been united within NWO with the medical area council and became ZONMW. Under its roof, all different activities of health research are united. ZONMW is therefore both basic and applied oriented in its activities. A close connection is set up between RGO, the ministry and ZONMW: RGO is there to advise the ministry on long-term developments by integrating the advice of all kind of different activities. The ministry is integrating this advice in its policy guidelines and ZONMW becomes the executing agency for these guidelines. To overcome misunderstandings and resistance all actors

are participating in the reunions of other actors so that there is a constant flow of information and early consensus-building. Another encouraging development is the working together of KNAW and the RGO in some of the foresight studies. In addition, with the reformulation of the tasks of AWT, the more general foresight studies and analyses are serving as general information in the work of the RGO.

The justification to speak of the poldermodel in the use of "reflexive knowledge" in the Dutch context is justified. The tradition of "controlled delegation" of raising reflexive knowledge to the intermediary level and the bottom-up aggregation procedures demonstrate that priority-setting is a process of interaction in which it is more important to build a consensus on what to do in research policies rather than to find objective measures of foresight measurement.[31] The foundation of the AWT attempted to break with this tradition, but this approach was abandoned after only four years. Today, the network approach seems to be a promising alternative to the existing poldermodel which is more based on the "thematic approach" of a government which is finally responsible to make its choice and impose its choice on all actors in the system. The network approach is "postmodern" in that it delegates authority to networks that are much freer as "agents" than the individual intermediary or operational organisations. The network approach is therefore a new mode of steering which is different from the poldermodel approach. At the moment this is only a confrontation of two different discourses but the "innovation networks" have shown that institutionalisations are already taken place and several studies attempt already to introduce this new discourse in political action.

Up to now, the poldermodel remains the main structural principle. This is why we find the "densely populated intermediary layer" (Rip and Meulen 1998: 758). This "reflexive" layer has developed since the 1970s in a rapid fashion, first to realise austerity measures and to introduce strategic research into the system and later to rationalise political priority-setting. This proliferation of the reflexive system has known frequent changes in a top-down fashion and rapid self-organisation at the operational level. Evaluation has become an element of daily "housekeeping" and foresight studies are needed also to gain legitimacy for policy proposals. The foundation of the OCV was clearly the attempt of a minister to introduce a corporatist and Bernal-like foresight system of priority-setting in research. The foundation of the AWT has abandoned this approach and wanted a more autonomous and neutral expert system. The lack of anchoring in the existing layer has made it impossible to continue into this direction. Instead, a clearer differentiation of functions in reflexivity has been institutionalised guaranteeing to each institution the survival but also making the system more effective. There is a clear labour division in foresight studies and there seems to be more cooperation between these different institutions than before. The traditional lack of coordination between policy formulation and implementation seems to become less important than before so this is a very preliminary impression.

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[31] (Veld, Bruijn et al. 2002) discusses several case studies about the use of knowledge for policy making. In one case study they conclude about the poldermodel: there are many actors and a strong network between political arena and knowledge arena. There is a lot of deliberation and the opinions of others are taken into account. To find a "draagvlak", a common ground, is most important. This is done by deliberation with a lot of actors. No need to impose decisions.

Overall, the Netherlands demonstrate progress in the development of their "reflexive system". There have been periods of trial-and-error and there are still contrasting approaches today. However, the emerging system seems to overcome retrenchment and ancient hostilities and become much more flexible than before.

6.2 Comparison

We can deduce from the description above that reflexive institutions have had an important role in the development of research systems everywhere. It seems that they are a necessary instrument for government to develop ideas on future reforms, propositions for priorities, and, often, for consensus-building in the public-funded research system. These functions can best be fulfilled when reflexive institutions are really boundary institutions, i.e. delicately balancing the different forces. Reflexivity can be a means to solve "puzzling" but one should never forget that knowledge is also a power resource that can be instrumentalised by actors. Any suspicion that the reports of reflexive institutions may be biased in favour of one side or other will reduce the legitimacy of recommendations. We will come back to this point below.

In systematising our findings we can, in the first instance, see differences in the "density" of reflexive institutions public-funded research systems have applied. Density might be pertinent in order to see if a higher density of these kinds of institutions fosters a higher degree of "rationality" in the public-funded research system.

We observe that until the 1990s, the *Swiss* public-funded research system was characterised by a low degree of density in term of reflexive institutions. The SSC was the only reflexive institution. On the other hand, since the 1990s, a couple of new reflexive institutions were set up, such as the GRIPS, the Brain Trust, and the CASS. The Swiss structure of reflexivity has, therefore, been flat but is differentiating and becomes more complex. This effect is exacerbated because of the transformation of the SSC into a scientific advisory council that may become one voice next to others instead of building a consensus around new propositions.

As in the Swiss case, the *German* public-funded research system is characterised until today by a flat structure of reflexive institutions. Set up earlier than the SSC, the WR is, until today, the only reflexive institution in Germany. Moreover, it has not changed its organisational statutes or structures like the SSC in Switzerland has done. However, Germany is following the tendency in the 1990s to increase the complexity of its structure by setting up bodies attached to the BMBF and the cabinet. Their role is, however, reduced and seems to be temporary. Recently, there is the proposition of setting up a forum of all funders in order to develop a common strategy in research policy-making. Even with the introduction of such a forum, Germany's structure would remain flat.

In *France*, the degree of density was low before 1981, as the articulation and "rationalisation" of the public-funded research system was not the central preoccupation of research policy-makers. The reflexive components of the system were either weak, like the CCRST, which suffered from the weakness of its "secretariat", the DGRST, during the 1970s, or "unable" (unwilling) to fulfil their reflexive tasks like the Comité National.

From 1981 onwards, the density increased, because of the political will to integrate the "balkanised" public-funded research system. The "Colloque" has been a profound reflexive exer-

cise that gave birth to the further institutionalisation of reflexivity. In 1989, the density of reflexive institutions has become much higher as the CNE is dedicated to evaluate the universities, the CNER to evaluate research, and the OST is on the way of being set up. If we look at the situation in the year 2000, we notice that more reflexive institutions have been added. The system nowadays is a complex one.

The *Netherlands* clearly have the highest density of reflexive institutions among the four countries. Though being the latest with the creation of a reflexive body, they started in the 1970s to be preoccupied by their capacity to reflect. The development of evaluation capacities and then foresight capacities are consequential steps. In contrast to France, one can say that these capacities are used within the political decision-making process and form a base for decisions. This seems to be much less the case in France. The 1990s are, again as in the other countries, a period of rapid changes in the landscape of reflexive institutions: the establishment of the "co-operative-integrative" OCV, the transformation of the RAWB and the OCV in the independent expert body AWT and the demarcation between the different reflexive institutions in the beginning of the new century.

What can we learn from this?

First, that the creation or transformation of reflexive institutions has been more rapid in the 1990s than in the former periods. There is a tendency in all countries to use reflexive institutions more intensively since the 1990s and, with the notable exception of Germany, also a proliferation of reflexivity to non-specialised bodies within the research system.

One should be aware that in the 1990s the term reflexivity has two connotations: one is the traditional reflexivity "for science policy", an exercise of thought with the objective to overcome problems of and develop perspectives for the research system as a whole. The second one is a reflexivity that individual organisations need to survive in a more complex environment that, in addition, is demanding specialisation and strategic thinking. Reflexivity is here a means of these institutions to develop their view with regard to research development and their (future) positions in the research system in comparison to other systems. Such a reflexivity must not – but can – seek for solutions in terms of the system but only in terms of individual survival. The studies and analysis developed in this context can, however, be used in the general discourse on the future of the system. They then become a mix of general and individual reflexivity, and they can compete with the analyses presented by the specialised science councils. The spill-over of reflexivity to other actors within the system is, therefore, a blessing and a curse: More strategic thinking can help to overcome problems but "opportunistic" advice may favour solutions that will not be in favour of the overall system.

The example of France and the Netherlands demonstrates that proliferation does not onlyy mean that non-specialised actors develop reflexive capacities, but also that specialised institutions proliferate. In the case of France, one wonders if this was the case because of the eager of politicians to have more reflexive capacities or if these institutions were needed as a kind of "symbolic capital" that could be used to further political interests, or if the higher complexity is a result of the already complex operational structure of the research system as such. In either case, more reflexive institutions would not necessarily mean more reflexivity, and certainly not more effective policy-making.

Whether proliferation of science councils or of reflexivity in other institutions, proliferation is subject to another problem that the cases of Switzerland, France, and the Netherlands revealed: this is that more reflexive institutions can only function effectively if their competences are clearly delimited and if they are well connected. As soon as the first point is not the case, conflicts for predominance in reform discourses begin that affect seriously the advice of all organisations. Here, the monopoly of one institution as in Germany can be an advantage. The second point, connectedness, is important to avoid fragmentation, inconsistent advice and lack of information about other areas. The bad example is France in this respect given its competition between political nominated reflexive institutions and the CNRS and the large number of different and fragmented institutions, while the Netherlands seem to have found a way out recently to delimit the competencies of their multitude of reflexive institutions and to find mechanisms to aggregate the advice of these institutions.

The problem of connectedness brings us to another point. It turns out that reflexive institutions that are not able to play the boundary role but that give the impression that they are too closely linked to either the political or the scientific side, have extreme difficulties in making their voice heard at the other side. Examples are the discussion on the SSC in Switzerland at the end of the 1980s and the CNS in France on the one hand and on the Comité National in France and, we would add, though the discussion is not opened yet, the SSTC in Switzerland, on the other hand. The CNS was a political creation despite of the scientists were making up the body. This reduced seriously the legitimacy of the CNS in the scientific community. This does not mean – and this is all the reason for the political creation of reflexive institutions – that these institutions have no influence on the priority-setting and on the policy-design in general. They do as the example of the SSC demonstrates. The problem is implementation. Recommendations that are not supported by the scientific community will have extreme difficulties to be accepted, even after policy-makers have decided to implement them. The other example has the same difficulty: Recommendations of the Comité National, -and this may also hold for the SSTC in Switzerland because of its firm anchoring within the scientific community, even its representative function of scientific views – are not heard by policy-makers. A biased position destroys the credibility of recommendations. Reflexive institutions have therefore an interest in gaining the position of a boundary organisation that can keep both sides at a distance. The SSTC may have a hard time in this respect: Though it is officially recognised by policy-makers, it now represents the view of scientists and does not appear as an "independent" expert body. It is hard to see, how, in this case, it can fulfil a general function of reflexivity.

Connectedness means also a third dimension, next to the coordination of reflexive institutions and the link to either the political and scientific system, i.e. the connection of reflexive institutions with implementation: Normally, reflexive institutions have a more direct link with the "political stream" in order to prepare political decisions while the link to the intermediary agencies on the productive boundary are lacking. That this can have negative consequences has been shown in the case of the Netherlands where implementation was often failing because of the lack of this direct link. This will become an even bigger problem if there is a profound distinction between independent scientific institutions on the one hand and policy-makers on the other hand as is the case in Germany and France. In both countries the divide between the political system and the scientific system is evidently larger than in the small countries making the role for reflexive institutions more difficult. One of the few means to overcome this divide

has been the use of "colloques" in France that can mobilise the country as a whole. Such a "colloque" could be an interesting idea for Germany to overcome its apparent divisions between the scientific and political institutions. Reflexive institutions have an interest in developing good contacts with implementing agencies – already in advance – to be sure that they will be heard. This confirms one more time that a biased position of reflexive institution is detrimental to the reflexivity in the system. While we see new mechanisms in the Netherlands to increase direct relationships between for example sector councils and the NWO, reflexive institutions in Switzerland and Germany use personal relationships to connect reflexive institutions with funding agencies. There are representatives of the DFG in the WR and the SSTC has influence in the SNSF. France has the major problem of having a reflexive institution at the level of the CNRS, the major body of the scientific community, and that relationships with the CNRS and the research ministry are often conflictual. This reduces the influence of "politically initiated reflexive institutions on the CNRS.

The third point we want to raise concerns the organisation of reflexive institutions. We can induce from the examples based on the four countries that there are two models to organise reflexive institutions: the one is the "*cooperative-integrative*" type, the other is the "*independent expert*" type.

Germany and Switzerland, for example, have, at least until 1999, implemented the cooperative-integrative type. They are "*cooperative-integrative*" in that they integrate all major forces in the research system. The German type can even be called *corporatist* as it organises cooperation in the form of formal chambers within the WR while cooperation was organised more informally in the SSC. Since 1999, both systems deviate from one another, as Switzerland is giving up the cooperative-integrative organisation of its reflexive body. Instead, it introduces the independent expert model of the "*scientific advisory body*" that has been the predominant form in France and, most of the time, with the notable exception of the OCV, also in the Netherlands. The Netherlands use, however, sector councils as permanent reflexive institutions that integrate users, producers, scientists, and policy-makers. One distinction one can add is the composition of these independent expert bodies: They can be, and most of the time are, composed of scientists nominated by the government (or the president, the queen). Recently, especially in the Netherlands, stakeholders from industry and other sectors are included.

The rationale of these two models is different:

(1) The cooperative-integrative model not only envisages to give well-found advice, it seeks at the same time to build up a consensus among the main actors in order to be sure that the advice will be heard. In this way, the problem of a failing implementation or a failing decision-making can be reduced. The problems this model encounters is above all the "joint-decision trap": especially in a corporatist construction like in Germany, recommendations are negotiated and often the smallest denominator will be the outcome of these negotiations. Reflexivity is, therefore, the looser in this game, but the system is more stable and develops the capacity – if a consensus has been found – to gradually turn around the system. Radical changes are excluded, except in extraordinary circumstances or profound paradigm changes as we see them in the 1990s: The role of the WR has been more influential because strategic thinking has infiltrated in all organisations. This was the time when more radical – but still not revolutionary – reforms like the one with regard to the big science institutes could be realised. One should be clear, however, that in this model, the creation of consensus is more important than the quality

of the advice. The advantage is the apparent high legitimacy of the advice, if not there is the impression that one side has been more influential in the negotiation process than the other. This is difficult in Germany because of the decision-making formula. It was easier in Switzerland because decision processes were more informal in the SSC.

(2) The independent expert model, by contrast, does not confuse functions, but focuses on advice. The idea is to give a number of independent experts, who are considered competent, the possibility to formulate their point of view. Seldom are these institutions equipped with a real decision-making power. A recent example where this is the case, is Austria. The problems of this model are also evident: all depends on the possibility to build up a high legitimacy among actors on both sides, political and scientific. As such a committee is freer than the co-operative model to formulate more radical advice, it can be the case that recommendations are quite unfavourable for some actors in the system – something which is very rarely the case in the other model – and that recommendations will meet harsh resistance. Implementation may, therefore, be the main problem. There are indications that the reverse case, namely a very strong affiliation with one side, can also be found, not only in the case of the Comité National or the KNAW, but also in the case of institutions set up by the government as the CCRST in France. In this case the credibility of the institution is decreasing.

This problem leads to the recommendation that one should use "*international expert committees*" instead to develop an unbiased view of the situation in a country. We have seen, in fact, that this plays a role. International experts can be chosen for their competence and only for their competence and they are supposed to have no connections and interests linked to the system. Though there are question marks here as, often, international experts have their networks, otherwise they would not know and understand the system, the use of these experts could help to overcome capture of these independent expert institutions. One could imagine that such international experts also participate in national reflexive institutions. This would raise the credibility of these institutions, at least in the case of the "independent expert model". It would less make sense to integrate these experts in a cooperative-integrative model.

Two last remarks should complete our findings:

There are differences in the way reflexive institutions are proceeding to prepare their recommendations (and there are, of course, different instruments to do so, not only by reflexive institutions but also by ad-hoc committees and "colloques"): one way is to delegate the task to a special expert committee that prepares the report that is then discussed within the reflexive institution. The other is a more elaborate procedure, the Netherlands often use, i.e. attempt to integrate most actors in the development of recommendations. The example here is the OCV. This corresponds to the process of "induced aggregation" where consensus-building is of great importance. It is, therefore, not absolutely necessary that the reflexive institutions itself is organised in the form of a cooperative-integrative body. It can use an aggregation process in order to prepare its recommendations. This, however, is rarely done in the context of one report because of the high transaction costs this needs. The Netherlands are, nevertheless, the country that, without any doubt, is the most inclined to use such aggregation procedures. They are also found in Switzerland in the preparation of priority themes and in Germany in the 1990s, when a Delphi study was used to develop priorities. The "colloque" in France is another example. Most of the time, though, such extensive procedures are not used.

Finally, it is important to mention that the use of evaluation and foresight procedures – as an important form of reflexivity – have not been used in an equal fashion in the countries. Again, the Netherlands spring out because of their early efforts to build up a scientific base for evaluation and foresight and because of their efforts to integrate such procedures in the priority-setting and strategy-building of the country. It seems to us that the integration of evaluation, in particular, as a routine process of all research institutions in the system is a very important point to raise the overall reflexivity of the system. The Netherlands are the best example for this and France has started in 1994 to go into the same direction. The use of new public management methods, i.e. contracts, has been most important for the integration of evaluation and, hence, strategic thinking in the public-funded research system. This demonstrates that reflexivity needs also a research base that is prepared to react: The introduction of evaluation raises in general the capacities of research institutions to act, it contributes to the general discussion on problems of the system and it makes it easier to implement priorities and reforms once decided on the political level. Strategic thinking of research institutions, which is very much influenced by regular evaluation, is a conditio sine qua non for the effective use of reflexivity.

We think that the Netherlands are, in this respect, far ahead of the other three countries, that France is following neatly, but has considerable difficulties to rebuilt its structures to make them conducive to such an effort, that Switzerland has started at the level of universities to introduce more strategic thinking, while Germany has started at the level of the big science institutes with first experiments in this direction. The message is clear here: if these three countries will not be able to introduce strategic management as a routine process in their research institutions (and this means at the operational, intermediary, and political level), even perfect solutions and recommendations developed in the reflexive process will have difficulties to be implemented. In addition, it lacks an important input for reflexivity in the system.

7 ADDIN SUMMARY

7.1 Summary about objectives and finding

One of the first findings in our project was that research policies in all OECD-countries were and still are subject to a profound *paradigmatic change* in research policies. The period we investigated was therefore, clearly, not "normal policy change" but a more profound change in policy ideas and the "policy core" (cf. Sabatier). The focus of our attention became therefore not to describe country differences in the different modes of policy-learning, as for example developed by Peter Hall (Hall 1993), but to show how countries have learnt to cope with this paradigmatic change, how they adapted or resisted the implications of the new "ideas" into their policy-design and ultimately how they learnt to reform existing policy-regimes. Learning meant, therefore, the capacities of countries to develop new and innovative ways of reform, of creating a consensus on reform and of using their "reflexive capacities" in implementing reforms. More in particular, we concentrated on one main point of reference in the new paradigm, i.e. social and economic "responsiveness" of public-funded research systems and how it

was institutionalised in the causal beliefs of research policy institutions and implemented within regulatory and operational structures of the public-funded research systems.

While paradigmatic changes in the way how to organise research for purposes of innovation and societal problems are widely discussed in the literature of the sociology of science, we could show in our research that there is a confluence of paradigmatic changes at two levels: at the level of the "référentiel sectoriel", i.e. the way how to organise public-funded research in order to improve its effectiveness and efficiency given a change in the causal beliefs on the functioning of science and technological innovation, and at the level of the "référentiel global", i.e. the way how the state organises its relationship with society. Recent changes and the kind of learning processes can only be understood if one discerns both paradigmatic changes that are interlinked in their consequences but not in their origins.

If one looks in more detail into these changes in ideas on research policy-making, one can further disentangle the working of "ideas": "Responsiveness" as a policy aim started in the 1970s as the outflow of a social-democratic "conjoncture" (cf. Poulantzas) and economic crisis. It was the social-democratic notion of responsiveness, i.e. the introduction of social responsibility and sustainability, which encouraged the institutionalisation of research policies at that moment. Only at the end of the 1970s do we see the more fundamental paradigm shift in technological innovation ("new growth theory"), followed by "mode-2" thinking and "strategic research" in the 1980s and 1990s with concomitant shifts in the use of instruments. Finally, the "référentiel global" changes in most countries in the 1990s. This is the moment of the "second push", when all countries were changing their institutions into the direction of "strategic" and "programmatic" action.

A major finding of our study is that while we expected large variation between countries in coping with the "ideational change", we found a large convergence, though the points of introducing changes and the process of change differed. We could demonstrate that on the three levels of investigation in our study – the use of instruments for technological innovation, the reform of research institutes at the operational level, and the change of "regulatory" institutions like funding agencies – the contents concerning what to do were very similar. On the base of empirical knowledge we developed "ideal models" on each level that were in the end found (with modifications) in each country. Once again, there were large differences between countries *when* reforms had been introduced but the contents of the change were found at least in nucleo in each country.

As our research design had been based on divergence (of learning), we were not prepared to tackle the question *how causal beliefs have spread to such an astonishing amount and rapidity among our countries*? The answer to this question would have needed a similar research design as Peter Hall has used it for explaining "social learning" in economic policy. From our interviews and the literature we have, nevertheless, drawn some preliminary lessons concerning this question. It seemed to us that research policy is a policy field, which, for a long time, has not been highly contested and lacks therefore the polarisation in the party system that could make a rapid diffusion of ideas difficult. In the absence of political polarisation, the administrative logic of higher effectiveness by means of "lesson-drawing" (Rose 1993) can become prevalent. The prevalence of this logic in the research policy field explains perhaps also the relative density and intensity of international administrative networks, another favourable

factor for the diffusion of knowledge. The role of supranational organisations like the one of the OECD cannot be underestimated in matters of research. This has been proven for the development of research policies in the 1960s. Given the various reports published by the OECD in our period, as well as the indications we have for example on the link between OECD recommendations and policy change in Switzerland. We presume that the OECD has remained a nodal point in the diffusion process. The role of "reference countries" does play a role in most policy fields but in particular in research policies. One can discern different periods where different countries have in sequential order played a role for imitation of countries. Most recently, Japan and the USA belong to the group of reference countries. Japan made the blueprint for most technological innovation instruments in the 1980s, transferred to the UK and from there to most of the other European countries. "Mode-2" strategies, the "triple helix" etc. are modes of organising science that are above all and foremost developed in the USA and diffused from there to the other countries. The diffusion of the "référentiel global" is quite another story, which does not concern us here but which is studied in various contributions (Ferlie, Pettigrew et al. 1996; Bogumil 1997; Braun and Merrien 1999; Kettl 2000). It would need, however, another study – and this will be our next project (see the summary of "Die Transformation von Forschungssystemen: Konvergenz und Divergenz in der Forschungspolitik von OECD-Ländern" attached to the report) to confirm the importance of each dimension and the precise processes of diffusion of policy knowledge.

Instead of analysing how exactly new policy ideas are diffused, we endeavoured to look into the process how the new paradigms have set through, how they have changed the policy-design and the policy-regime that is linked to this design. There is a clear sequential order in this process: First, causal beliefs change with implications for the use of future policy instruments and, later, structures and institutions on the operational level and the boundary are attacked in order to bring the structure in accordance with the policy-design. We endeavoured to describe this process of change and reforms that were the outcomes of new causal beliefs rather than to explain the process of acceptance of new causal beliefs, as we originally intended, at least for Switzerland. In this way we were able to demonstrate how this change happened in each country, reveal the learning processes behind these processes, and understand differences in a more rapid or a more slow spreading of ideas. We consider it as a contribution to existing knowledge to have shown that the paradigm change is a deeply *political process*, something often underestimated in studies of the sociology of science which are focussing on the operational level of research. Our study demonstrates the political dimension in the transformation from "mode-1" to "mode-2" research.

Before we present our results more in particular we would like to come back to one point we mentioned in the introduction of our report and which figured prominently in the outset of our study: we intended to show the importance of "*puzzling*" in policy-making but without forgetting "*power*" as the central category in political science. We think we have stuck to this intention: It clearly emerged, as our previous remark on convergence has shown, that "ideas matter". Their force, the causal beliefs behind the ideas, can be at the source of profound political change. Ideas can gain such a momentum that no actor can stay outside their orbit. Even the DFG had to made concessions at the very last with regard to the notion of "strategic science" and "responsiveness" and even the CNRS had to agree to a contract system in 2002. Ideas have, however, material force, i.e. they often determine who are the losers and winners of the political process emerging from these ideas. Our analysis, turning to the implementation

of instruments and the reforms of institutions, has revealed the role of "power", of veto-points, of domain struggle of actors and the results for learning. Actor constellations explain to a large extent the learning capacities of countries. This is why we invested considerable time to describe these constellations.

Another introductory remark concerns what we have called "*reflexivity*" and "*reflexive institutions*". Self-reflexive capacities of research systems have until now very seldom been the object of research, and they have not been our object of study at the outset of the study. Evidence has shown that they are important for learning capacities. We refer in the first instance to organisations like science councils and advisory committees but also to a more general knowledge produced by evaluation and foresight. According to us, reflexive institutions and reflexive mechanisms form an important part of the learning capacities of the system because they can instruct and "rationalise" action. This is why we have dedicated a chapter in the comparative report as well as case studies in each country to the role of reflexivity in countries. Our findings demonstrate the proliferation of reflexivity in most countries and the important role reflexive institutions can play in policy regime change. At the same time, they are embedded in actor constellations and therefore in domain struggle of actors. In this sense, "puzzling" and "power" is again, but this time within one organisation, the subject of our study, revealing by the way the inseparable unity of both sides of policy-making. As in the case of convergence, we know, however, that our findings are preliminary and that further investigation is needed. This would be the second follow-up project we have not yet developed: analyse in more detail the internal functioning of reflexive institutions in different countries and their connection with the level of decision-making and implementation.

The role of *boundary organisations* has, in particular drawn our attention. We have found evidence on several levels (implementation of instruments; reflexive institutions; funding agencies) that institutions that are built to link different functionally differentiated systems without bowing to either system have a special positive importance for learning processes (see (Braun 2003). We believe that the functioning of these boundary organisations is still not sufficiently known and further research would be needed to improve our knowledge in this respect.

We think that we have found a number of interesting conclusions concerning systemic learning capacities in research systems. More in particular we could induce from our empirical observations which kinds of structures are conducive in the knowledge generation, accumulation, and diffusion. The model that emerges is based on decentralised and inclusive organisation, boundary and reflexive organisations, flat structures, a low degree of competitiveness, and endogenous learning.

In the next sections we would like to summarise our main finding. The following section 7.2.1.1 highlights some of the main points of the chapters on policy-design (chapter 3), instruments (chapter 4.1), research institutes (chapter 4.2), funding agencies (chapter 5) and reflexive institutions (chapter 6). Section 7.2.1.2 treats the two variables we have used as a framework for choosing our case studies, the federal-unitary structure, and the size of the country, which is synonym to the kind of political culture we find in countries. The "embeddedness" of countries within such structures might be an intervening explanatory variable in order to explain variations in learning capacities. Section 7.2.1.3 treats the governance ca-

pacities of governments in the four countries and in the final section 7.2.1.4 we will present some general hypotheses on the learning capacities of research systems that might be used in further studies for confirmation.

7.2 Results

7.2.1 Changing the policy-design and the policy-regime

The change of the policy-design in the 1970s

We started our analysis with the 1970s because it turned out that this moment was decisive for a first fundamental change in the policy-design of research policy and we wanted to know how this change came about. In addition, one can see that the change in policy-design generated already a first change in institutional structures of the public-funded research system. In the Netherlands and Switzerland it was the impetus to set up a research policy at all.

It turned out that this change was not yet the paradigm change, which developed later on in the 1980s and 1990s, but a change inspired by political ideas about the role of state intervention (active, interventionist, planning) and the role of science had to play in society (problem-solving; contribute to sustainability of resources and nature). The public-funded research system was subject to these ideas launched by social-democratic parties that were in most governments at that moment. The pressure behind these political ideas was not only an aspiration for social-democratic hegemony but also the economic crisis and the disquieting report of the Club of Rome warning against the consequences of the "scientific-industrial-political" growth complex for nature.

Two remarks can be made here:

One, it becomes visible, and this is confirmed later on in the case of the neo-liberal turn at the end of the 1970s, that "party-control" and "conjoncture" matter in order to change the policy design of the "référentiel sectoriel". Neoliberal governments have easily grasped at the message of the "new growth theory" and the political consequences in terms of political action (facilitation and not intervention) and initiated new research policy instruments and a different stance of government in policy-making. The general ideas of the "référentiel global" change by party-control and "conjoncture". In due consequence they become part of the design of policy-makers in the different public policy areas and the "référentiel sectoriel" has to be adapted.

Second, it is shown that in this way "responsiveness" becomes a main objective in the research policies of countries but it is not yet the responsiveness defended later on in the context of economic interests and technological innovation. Nevertheless, the social-democratic policies started to change the public-funded research systems into the direction of more responsiveness, which made it easier later on to continue the reforms in the context of "systems of innovation". One should stress that the change in the 1980s would perhaps not have been possible without the first reforms in the 1970s though they are not directly linked. The important point is that the policy-design and also some of the regulatory and operational structures

start to change and that responsiveness becomes for the first time a "point of reference" in the policy-design.

The more detailed country reports demonstrate that "institutional legacy" mattered within this transformation process: Germany had advantages because of conducive structures for responsiveness already developed; France shut down its conducive structures at that moment and had to wait until 1982 before it could change its policy-design; the small countries had to reform more fundamentally their structures that did not correspond to the demands of the new policy-design. While the Netherlands declared a "big bang" change they, in fact had some difficulties to reform their structures but started seriously so in the 1980s. Interesting is the case of Switzerland, which was in fact quick to react and which found a solution that, for a long time, installed an equilibrium in relationships of research and between conflicting demands of responsiveness and autonomy of science. We contend that the cooperative-integrative structures Switzerland had built within its science council and its main funding agency contributed considerably to this formulation of a consensus. The solution – to confer to the semi-autonomous funding agency the task of managing oriented research – was such a balance because it prevented a stronger centralisation of funding at the level of the federal government which was favourable for both the member states and scientific representatives; the participation of the federal government within the funding agency guaranteed "voice" and influence, and the funding agency could maintain its monopoly position in the domain of funding though it had to accept more influence by policy-makers. This equilibrium and the avoidance of a more complex regulatory structure (by, for example, using other funding agencies or a research ministry) had lasting positive effects in terms of learning and did not change much even after the federal government set up a special unit for research policy. The institutional solution found in 1974 was path-structuring until today. It was advantageous in terms of learning because domain conflicts could most of the time (not always as the struggle concerning the "priority programmes" in the beginning of the 1990s demonstrates) been avoided and the cooperative-integrative institutions created the necessary links for consensus-building.

Instruments and responsiveness

There are two points we want to raise concerning the chapter on instruments and responsiveness.

The first one concerns a learning device that seemed to be particular promising and that we found above all in the Dutch case of implementing the innovative-oriented programmes in the beginning of the 1980s. The responsible ministry delegated the execution of the programme, decisions on the concrete financing of projects and daily management to an independent commission where the ministry was represented but could not dominate. The position of this committee Rip and Nederhof labelled as a "fixer" (Rip 1986) and in our terminology, we would use the term "boundary organisation" for this committee. The transfer of the right to decide and act gave this commission a considerable independence in dealing with the affairs of funding and the scientific and industrial side was well integrated or connected to the commission. This gave the commission an unique position as a "go-between" (see also (Nooteboom 1999) between science, politics, and industry. The preparedness of policy-makers to grant such a considerable independence made it at the same time possible to develop learning proc-

esses within the commission that resulted in frequent adaptations of its functioning.

There is no need to elaborate the functioning of this institution in detail here. We believe, nevertheless, that such a position as a boundary organisation is particularly conducive to social learning as it is inclusive and integrating and because it attempts to balance the different rationales of systems (Braun 2003).

The second point is the difference we found between the small and consociational countries and the big countries in their mode of learning concerning the innovation of policy instruments. We contend that both the Netherlands and Switzerland – despite of differences - have a more inclusive and decentralised way of organising learning processes than Germany and France. There are striking similarities in this respect between the two small countries. The inclusion of all major actors, bottom-up aggregation processes, "fixers", and often a rather remote stance of government32 make learning an encompassing communication process. The effect is indeed "systemic learning" as inclusion fosters also the diffusion of learning and results. We have labelled this type of learning "deliberative learning".

Germany's position can be characterized as "in between": There are inclusive elements in Germany, which even take a corporatist character but this concerns industry and not the integration of basic research institutions. The dualist character of the German system – with a strong research ministry and a strong scientific community, represented by the DFG and the MPG – makes learning processes exclusive and, in part, competitive. Germany uses no "fixers". The project agencies of the research ministry cannot be regarded as such.

The same holds for France where we find a similar and even more conflictive structure because of unclear domain competences between the research ministry and the CNRS. Learning processes seem to be even more exclusive than in Germany where the Wissenschaftsrat dampens somewhat the effect of the dualist structure. In France, intermediary organisations are lacking. This makes it that there is no balancing of forces in the French system. Instead, we see a shifting of balances to one side or the other which prevents systemic learning. "Competitive learning" seems to be the right term for learning processes in France.

Extra-university research institutions and responsiveness

There is also considerable convergence in the new model of how to organise research structures in a more responsive way but terms and points of time differ. The general tendency is to change research institutes which for a long time have functioned according to the "anarchic" university model into "strategic" actors in the research system. A shift from global, institutional funds to programmatic and competitive funding as well as evaluation as an integral part of the functioning of organisations are the components of reforms.

Again, we found differences between small and big countries. This time, however, neither the structure nor the policy of the small countries was similar. A first interesting observation in

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[32] This does not mean that government would always remain outside. In Switzerland, the federal government has several veto-positions it can use but it remains a rather weak actor. In the Netherlands, especially the education ministry can be quite interventionist. We will come back to this below.

terms of learning is the case of Switzerland: When the research law was adopted in 1983, the federal government could have used its authority to create extra-university research institutions on a more extensive scale than before. It did not do so. Several reasons might have played a role: the (bad) experiences from other countries, the considerable long-term costs this would have meant and the long predominance of universities in the system. Path-dependency won and led to the introduction of a rather flat and flexible structure of financing extra-university research institutions. This avoided the problem of the other three countries in the 1990s how to reform their extra-university research institutions. At the same time, Switzerland could not in the same way profit from the assets of such institutions in terms of stock of knowledge and specialisation in applied research or in different research topics. In this way, the Swiss maintained their flat operational structure, but since the 1990s they are reforming their universities quite according to the model the other countries are using for their institutional reforms.

The Netherlands has a similar complex extra-university research structure as Germany and France. We found that, nevertheless, they were able to start profound reforms already in the 1980s, while Germany waited until the end of the 1990s, and France initiated a big bang in 1982 but had considerable difficulties in implementing the new policy lines. Only now, France is starting like Germany to make business and introduce more fundamental changes. At the same time, it seems like the Netherlands have already achieved their objectives and that their system is coming the nearest to the "responsive model" of institutions.

Without going into detail, we consider that a number of factors explain the success of the Netherlands: the harsh austerity policy; a central government, which introduced a "controlled autonomy" for the institutions in the public-funded research system; the "voice" for a large number of actors; the existence of economic models that were congruent with the later models of new public management, a long tradition of "functional" or "corporatist" autonomy in different sectors of society, which offered an "isomorphous" and conducive structure to the reforms; finally the frequent use of evaluations and advisory committees. It took, nevertheless, a considerable amount of time before these reforms were concluded. This demonstrates how difficult it is to change institutions, which have a considerable potential of resistance.

France and Germany had even more difficulties. Several reform attempts failed, among others because the extra-university research institutions in both countries were particularly large and important. Radical reforms would have meant considerable "sunk costs" for the government. This protected these institutions for a long time until a "second push" in the 1990s brought a radical turn in both countries. In France, the turn can be attributed to the confluence of several critical analyses from quite different institutions concerning the functioning of the research system. This initiated a new reflection process that ended in the introduction of the contract system in the CNRS and, already before, for other research institutions.

Germany needed several impulses in order to arrive at a more fundamental reform of its big science institutes and, gradually, also of other institutions. Learning based on the creation of new big science institutes after reunification, a considerable budget stress and, most remarkably, the rise of a thinking based on "systems of innovation" in political circles and boundary institutions. These different influences resulted in the demand from policy-makers to have all institutions evaluated in their functioning within the system. The most visible result is the introduction of programme funds for the big science institutes and the reduction of institutional global funds to a maximum of 20% of resources. The rationale is, of course, to integrate

strategic thinking within these organisations.

We have, therefore, a quite varied picture: Switzerland, which had learnt how to avoid rigidities in the public-funded research system; the Netherlands which, gradually but steadily, reformed its public-funded research system completely and both France and Germany that have only started with serious reforms developing a stronger responsiveness of research institutions in the system. The impression of the somewhat quicker sailing boats represented by the small countries and the big tankers France and Germany seems to be confirmed.

Funding agencies and responsiveness

Though funding agencies are part of the boundary and therefore of the regulatory structures, the main features of the reform we presented above for the extra-university research institutions – with the exception of Switzerland – is also valid in the case of funding agencies. For France, this is evident as the CNRS represents both a research and a funding organisation.

We see, again, a general shift in the kind of model that is applied with regard to the funding agencies: This time it is a shift from institutions that are deeply anchored in the scientific community to institutions that serve as boundary organisations, i.e. that integrate the twofold rationale of responsiveness and scientific quality while maintaining their independence.

It seems to us that, once again, the small countries have better solved this transformation process. The Swiss developed early, as shown, a balanced model of a funding agency, where the relevant actors of the research system were represented. Policy-makers felt evidently that they were well represented within the Swiss National Science Foundation and scientists had their protected domains in the departments of fundamental research. When the balance seemed to have been toppled in favour of policy-makers, reforms attempted to rebuilt the delicate balance. Today, there is a clear division of labour between the research council managed by scientists and the foundation council where policy-makers and stakeholders are well represented and decide on the more strategic question of the organisation. The funding agency has for a long time clearly functioned as an arena where the interests of actors were such balanced that major conflict were absorbed. The major changes, the introduction of new programme funds, passed without major conflicts. In addition, the SNSF was prepared to evaluate its own functioning two times in the 1990s, which gave sufficient opportunity to adapt the organisational structure.

The story of the Dutch NWO is longer and much more complicated. We can repeat what we already stated in the case of Dutch extra-university research institutions: there were a number of factors – in part unique in the case of the Netherlands – that contributed to the gradual transformation of research and funding institutions. In the case of the NWO, additional factors were the important role of the management, the case of a permanent political pressure, the change of the constitution in 1988, and – as in Switzerland – frequent evaluations. Today, NWO is defining itself as an intermediary agency serving two masters, the political and the scientific, being eager to build bridges in this sense. Basic and applied research belong to the fundamental tasks of this organisation.

The French government was - after the change of the “constitution” of the CNRS in 1982 –

frequently attempting to reform the internal organisation of the CNRS but failed to do so until 2002. We attributed this failure to the more conflictive stance of the CNRS vis-à-vis the research ministry and above all, to the "*political discontinuity of power*". Learning processes need stability and a long time. Lessons are built on experiences that are built on lessons etc. France failed to make sure that lessons were constantly drawn from former experiences and lessons. It "re-invented" the wheel too often. Nevertheless, one sees that nowadays, France is trying to re-build the CNRS in terms of a boundary organisation but must still prove that it will be capable to do so.

A very different case is Germany. One can surely state that Germany is the only case where the main funding agency, the DFG, has not been transformed into a boundary organisation. This is the result of the dualist structure. In contrast to France, which has a similar dualist structure, the DFG is, however, well protected in its freedom by the constitution and has never accepted a fundamental reform of its own statutes. It has remained the "agent" of the scientific community while the CNRS was, since the beginning in 1939, a boundary organisation, even when it developed into an organisation representing above all the scientific community. There have been some minor reform attempts recently that have led to the introduction of a strategic group within the organisation and the set up of a new funding instrument but this does not change the unwillingness of the DFG to become a boundary organisation.

Germany is, according to us, the country with the most serious problems in introducing "strategic science" into the public-funded research system. It lacks a boundary organisation but is built on a dualist and often conflictive structure (the research ministry and the DFG). The dualist structure forecomes an encompassing coordination process like we find it in Switzerland and the Netherlands; it has not introduced yet a contract system that could be used for the introduction of strategic thinking in research institutions and, hence, the dispersion of strategic science is still lacking. The DFG might be right in defending the basic research area as a domain of the scientific community, a boundary position would, however, help to connect different parts of the system and raise the overall learning capacity of the system. The capacity of one organisation to link basic and applied funding is, without any doubt, today an advantage when the time between invention and application becomes ever shorter. We think that the Dutch NWO has gone the farthest in this sense, as are, by the way, the British Research Councils. The Swiss have strengthened in the meantime their technological agency, which creates new coordination problems. The CNRS in France must still find its role in applied research and is encircled by a large number of more applied-oriented extra-university research institutions.

Reflexive Institutions

The creation of reflexive institutions took place in the early days of research policy-making, i.e. at the end of the 1950s and during the 1960s. Most of the time this meant the establishment of a scientific council. The next period of reform and institutionalisation have been the 1990s, which can thus be seen as the most active period of institutional reforms in all four countries, though Germany failed to change its reflexive structures in this period. It is characterised by different activities: an intensified use of existing science councils, a creation of new scientific councils and a proliferation of reflexivity to other institutions of the public-funded

research system. We made the distinction, though, between "reflexivity for science policy" and "reflexivity for survival". The proliferation of reflexivity meant above all that more institutions are developing a "strategic sense" and "strategic activities" to maintain their positions within the research system. This has positive and negative corollaries: As a positive effect can be seen that the diffusion of reflexivity contributes to a higher level of reflexivity of the system while the negative effect, the individual rationale behind this reflexivity, fosters "opportunistic behaviour" which is detrimental to a rational development of the public-funded research system.

We contend, in addition, that a strong proliferation of reflexive institutions increases the danger of conflicting and contradictory advice and of malevolent competition because these institutions become entangled in a struggle for domain competence. A clear demarcation of competencies, intelligent links between the different institutions, and an organised aggregation process of reflexive studies are needed to forestall this negative effect.

We discerned two general models in countries: the "cooperative-integrative model", which integrates stakeholders in the organisation and formulates recommendations on the base of informal or formal compromise; the "independent expert model", which looks for well-known scientific (or other) experts who are directly advising the government.

We considered that both models have their advantages and disadvantages: The first model links consensus-building and advice which makes it easier to implement the recommendations afterwards but, often, recommendations are the "lowest denominator" of different interests and not the "rational solution" at hand, which reduces the legitimacy of these recommendations as well as their effectiveness. The second model has the advantage of a stronger independence of experts from external influence and a high legitimacy of their recommendations. Recommendations can be more radical as they are not required to take into account the different interests in the public-funded research systems. The disadvantages are, first, that radical recommendations, which almost always mean winners and losers, risk to remain in the drawers of the reflexive institution and, second, that these institutions are, nevertheless, drawn in the direction of scientific or political interests.

We believe that the best solution to organise the reflexive process are reflexive institutions which are best situated when they keep their distance to both sides, science and government and are considered independent in their judgment. The creation of international expert bodies, increasingly used in countries, seems to go into the right direction and one can imagine to integrate such international experts also in national independent expert committees.

This does not yet solve the problem of connecting such independent bodies with the scientific community and government. Here, different models can be imagined. It seems favourable to have a broad bottom-up aggregation process that could be organised by this independent expert body and that could be the base of the recommendations. Bottom-up means, of course, also propositions and interests of the government.

No reflexive action can, however, have positive effects when the research and regulatory structure is not conducive to strategic thinking. Only if the different institutions in the system are used to think in terms of their strategic position in the system and to think in terms of welfare effects for the system, can we expect to have a successful spread of "rational ideas" within the system. The introduction of regular evaluations of institutions and programmes linked to the

development of strategic plans seems to us a conditio sine qua non for successful reflexivity.

7.2.2 Does centralisation of power and consociationalism matter?

At the outset of our research, we contended that the concentration or dispersion of powers among political units (i.e. federal or unitary states) and the size of the country mattered as intervening variables in the explanation of variations in learning capacities. The size of the country meant differences in the political culture prevalent in countries: Small countries usually have dense networks of elites and a habit of consensus-building (consociationalism) while big countries are more prone to centrifugal and conflictive forces. What can we say about these two variables at the end of our study?

Federalism matters

Without any doubt the difference between federal and unitary states matters in learning but one has to specify the relationship. Federalism structures above all institution-building in the public-funded research systems. This was in particular visible in Switzerland. The extremely flat structure, the weak political actors and the strong and cooperative-integrative funding agency must be explained by the conflicts between cantons and the federal government and the predominance of decentralised federalism in this country (see in general (Braun 2003). Federalism has contributed, but was not the only factor, to the "diffused powers" in the public-funded research systems that are at the base of the "deliberative learning" type in Switzerland.

In Germany, federalism is working in a different way because of a stronger "harmonisation" culture (see also: (Braun 2001). This is most obvious when we compare the role of political actors: Germany has established a quite strong research ministry, which is a central actor in the public-funded research system while Switzerland has lacked such a strong actor. In the management of public-funded research structures, however, the working of federal structures is comparable: The "power-sharing" in the "Bund-Länder-Kommission" and the "Wissenschaftsrat" between the Länder and the federal government is well known. Several analyses demonstrate that the federal relations allow to science the position of a "tertius gaudens" (Hohn 1990; Stucke 1993; Braun 1997). More concrete examples in our study were the difficulties of the research ministry to reform the big science institutes in the 1970s because, among other factors, of a distributive coalition between the Länder and their big science institute; the lack of direct access of the research ministry to universities and therefore the necessity to cooperate with the DFG to develop programmed research. The result is clearly, as in Switzerland, a weaker position of federal government. Federalism is, therefore, a constraint for the institutionalisation and for the reform of institutions. In Germany this becomes even more obvious in the case of the beginning fundamental reforms in the 1990s: This time the big science institutes were the first victims of reform because in this case the federal government has the predominant position in comparison to the Länder which is not the case with regard to the other public-funded research institutions. The stronger reform drive in the 1990s overcame the power of distributive coalitions.

Having an unitary state does not yet mean unlimited freedom for the central government to do what it likes and to impose learning processes on the system. The government and their ministries have, of course, a stronger position than in federal countries but this position is often limited by other features. In the case of France, we have demonstrated, that political influence suffered from "shifting centres of power" that are – a structural homology – comparable to the shifting power centres in the case of "semi-presidentialism". France suffers from path dependency: The creation of the CNRS as a corporatist institution with delegated political powers has weakened the political influence ever since and contributes to the contestation of powers from both sides today. France is therefore also suffering from "divided government" though not caused by the territorial structure. The research ministry has considerable powers that are nevertheless most of the time counterbalanced by the CNRS. There is a strong centrifugal tendency in the country contributing to the "competitive learning" in the country. The "divided government" explains the considerable slack in learning in France.

In the Netherlands, the other unitary country, we find a strong concentration of powers in the education ministry that is only limited by the division of labour with the Ministry of Economic Affairs introduced in the beginning of the 1980s, and the traditional "functional corporatism", i.e. the habit of delegating powers to semi-public bodies, that acts as a self-restraint of the ministry. The Ministry of Economic Affairs has never used its powers in a hierarchical way. As it had to develop competencies and knowledge and because it had a long tradition of cooperation with industry, the stance of the Ministry was at a "distance" to actors, which explains the role of the programme committee as a "fixer". The education ministry had a strong interventionist culture but often lacked vision to use it in a more offensive way. We think, nevertheless, that the central position of the education ministry and its continuing and coherent role in fulfilling the role as a political actor in research policy, has very much contributed to the continuing reform élan of the Netherlands. The negative corollary of a strong ministry is that persons are becoming important. One can demonstrate both for Germany and the Netherlands that different ministers can have a considerable influence on the policy style of the ministry (more interventionist, more liberal). Persons become more important in concentrated powersystems.

Culture matters

We found differences between small and big countries as expected. While the big countries were more divisive and conflictive in the organisation of their public-funded research system, the small countries established institutions for consensus-building. The "art of coalition-building" belongs to the strong requirements in the "diffused power system" of Switzerland and in the "polder-model" of the Netherlands. Switzerland has institutionalised consensus-building both in the science council (until 1999) and in the SNSF. Both institutions have been main arena's for developing research policies. As in the Netherlands, one finds, however, a general effort of actors to avoid the veto of other actors by early integration in the policy formulation. This is facilitated by the "double functions" of research policy elites in different organisations. The Netherlands have developed elaborate bottom-up procedures in their complex "mediation system".

As all public-funded research systems have multiple actors with veto-positions, we consider

the consensus culture as an advantage for social learning. It makes it easier to find a consensus on reform projects. This is, however, no guarantee for immediate implementation as the example of the Netherlands has demonstrated. Despite an elaborate bottom-up procedure, there was a considerable resistance by research actors in the system before, finally, the great transformation could take place.

If the big countries need a consensus they need either corporatist bodies like the Wissenschaftsrat in Germany, with the danger of "joint decision traps", or they must mobilise a national consensus in the form of "colloques" as in France. Outside these institutions or forums learning is subject to conflictive attitudes or indifference of actors. Even when big countries have constructed a corporatist body for consensus-building, it is not comparable to the more encompassing attempts of small countries to create a consensus among actors.

7.2.3 Governance capacities

In this last section we would like to summarise the governance qualities of each country and its implication for learning capacities. The following table we developed in the context of our study gives an overview:

Tab. 1: Actor Constellations and Policy-Innovation Capacity

	Actor Constellations	*Policy-Innovation Capacity*
Switzerland	A large number of actors in problem and policy stream; no clear centre; no real veto-players; diffused powers; parliament important in political stream; Inclusion; Art of coalition-building; the system learns not just one institution	Innovation can be quick if there is a general basic consensus; good chances for implementation; this is independent of "paradigmatic" and "normal" policy-making

France	In-built schism in the system between political agencies and intermediary organisations responsible for regulation and research; no division of labour between political and scientific funding; high fragmentation of institutions; lack of continuity of political agencies; polarisation if there is a strong research ministry; lack of centre if there is no strong research ministry > delegation; Research ministry is a veto-player, so is the CNRS; "thrust and riposte" instead of long-term cooperation; experiments possible because of delegation and fragmentation; research ministry predominant in problem stream; no regular participants in policy stream, ad-hoc inclusion; cabinet decides in political stream	Policy-Innovation can be quick; but implementation may fail;
Germany	Labour division between political and scientific funding; multiple veto-players; Research ministry predominant in all streams, learning within one organisation; "corporatist" inclusion in policy stream of beneficiaries; "voice" for scientific organisations; Strong pressures from outside needed to change organisational routines	Profound innovation takes quite long as they meet organisational resistance; pressure from outside important; "normal policy-making" by contrast easy and quick
Netherlands	"Divided government" > two ministries with important potential in research; ministries play important role in all streams; "experts" – but also given other examples of policy innovation all other actors ("bottom-up aggregation") – integrated in problem stream; policy stream includes most actors; ministries and parliament decide in political stream; ministries are veto-players, other actors have veto-potential if they build up coalitions; no thrust and riposte but compromise-building or hierarchical decision by ministry;	Innovation takes some time because of expertise and compromise-building process. This even holds for normal policy-making.

Switzerland can be characterised as a "diffused power system" where a central and predominating political actor is lacking. There are no real-veto players and a low potential for exclusion. Such a system creates the need for a search for consensus, even independent of the already existing consociational culture. Solution-finding is a rather informal process where major confrontations between actors are avoided. An important condition for success is the use of "double functions" and close networks. Revolutionary steps ahead are seldom possible in such a system but it is not excluded that radical reforms are taken. In such a system, new ideas can come from anywhere but they must fall on fertile grounds. If a paradigm change has sufficiently been diffused among actors and been accepted as such, then a quick reaction and policy turn is feasible in such a system. If this is not the case, it needs a long time to build up the consensus among actors.

France has a dualist structure with shifting power centres and a varying interest of the government and the public administration in research policy-making. The "discontinuity of political interest" seemed to us a major disadvantage of the system. This discontinuity is also found in the leading positions within the CNRS. The Netherlands demonstrated, by contrast, that only a stable and continuous exercise of political power can institutionalise a permanent learning and reform process. It is astonishing that under these circumstances France has, nevertheless, started in the mid-1990s a more fundamental reform process by introducing the contract system though one may doubt if this system will function as it should given the incom-

patibility of existing structures with the new public management system. The turn was explained above all by the confluence of several reflexive analyses and a general sense of crisis in the public-funded research systems at this time.

The dualist structure is the main problem of France as it is in Germany: the divide between political funding and scientific funding of research provokes either unilateral and uncoordinated action or needs large transaction costs (and often failures) to install a consensus on joint action. The conflicts about domain competence between the CNRS and the research ministry aggravate the situation and make it very difficult to find such a consensus. Germany has even bigger problems in building up joint action between the scientific and political funding organisations as the scientific organisations are not yet formally boundary organisation as the EPST in France. Only voluntary participation or financial pressure can be used to convince the DFG to participate in oriented research. The dualist structure provokes in France the pattern of "thrust and riposte" or of a decentralised and uncoordinated behaviour in research policy-making. Both ways are not conducive to institutional innovation and the introduction of more responsiveness in the system. Systematic inclusion strategies are lacking in France. The high degree of polarisation makes learning competitive and erratic.

Germany is subject to similar problems. It is confronted with very strong veto-positions of actors at the operational and boundary level while it has, at the same time, the strongest research ministry of the four countries. Federalism curbs, however, this power and strengthens the veto-power of scientific institutions. In such a situation, the research ministry can learn within its own confines and reform its structures and instruments, though we found also considerable problems in this capacity to reform its own structures. The point here is to demonstrate that learning is confined to separated areas, to scientific institutions or to the research ministry. The Wissenschaftsrat cannot until now be used as a more powerful and uniting strategic actor given its corporatist features that induce joint decision traps. Other institutions to make all actors of the system cooperate are lacking. Any encompassing reform of the system remains tricky and difficult. The division of powers becomes therefore a major problem for Germany now basic and technological research are growing together. The conflict will be sharpened in the near future.

Finally, the Netherlands, are, according to our study the country that has learnt the best to reorganise its features. The combination of continuous political power, an elaborate and complex reflexive system that now is connecting well the different institutions and which is, at last, avoiding overlap of competencies; the polder-model which expresses the traditional consociational political culture; the tradition of "functional corporatism", the diffusion of evaluation and foresight; the development of reflexive resources at the level of universities; and the diffusion of strategic science throughout the public-funded research system are components of successful learning.

7.2.4 What can we learn about learning capacities?

It was our intention to use the comparison of research systems as empirical grounds for a more general reflection on "systemic learning". Since the beginning it was obvious to us learning capacities of, let us say, political institutions alone would not suffice to introduce change

or innovate research systems. It needs learning at all levels of the public-funded research system – i.e. on the political level, the boundary, and the operational level – to be successful in this sense. Our notions of "software" and "hardware" comprised in a way this systemic dimension: the change of the "software", i.e. norms, scripts, and causal beliefs (the policy-design), takes place at the political level, while the change of the "policy-regime" needs also a diffusion of the software to regulatory and operational structures. The change of a policy-regime is, therefore, a systemic event.

If we think in these terms learning capacities of systems become a function of knowledge generation, knowledge accumulation, and knowledge diffusion. We would like to summarise briefly our findings in these terms.

Knowledge generation

The first point that makes a difference for learning capacities is the question to what extent research systems learn in an endogenous or exogenous way. Endogenous learning means, as we stipulated in the first chapter, reflexive capacities of systems to organise learning on the base of internal structures and procedures. The best example is the proliferation of evaluation procedures or foresight studies. One can also think of reflexive institutions that are specialised in knowledge generation and communicating them to decision-makers on the regulatory level. Systems that are able to use a number of such reflexive institutions and which have institutionalised evaluation and foresight throughout the system will have a far-reaching capacity to learn endogenously. Systems that do not possess such institutions depend on exogenous learning. That means concretely that it needs an impetus outside the system like an economic crisis, a change in party-control, particular events like the reunification in Germany, or simply pressure from industry to embark on a road of change. We have seen that such exogenous events have been at the beginning of reforms in all countries but that countries are, since the 1990s, building on their reflexive capacities to strengthen endogenous learning. This would be a major step ahead in terms of learning capacities. Exogenous events remain erratic and contingent.

The second point concerns the way knowledge generation is organised within the system. There are two possibilities: a bottom-up or a top-down organisation (and, of course, we find in-between ways of organising). It is our contention – and we follow neatly von Hayek in this respect – that a decentralised and inclusive system with diffused powers has better learning capacities than a system where knowledge generation is monopolised by one or a few central organisations. It is important that innovation can come from all parts of the system – as we described it for Switzerland – and that this knowledge is aggregated – like it happens in the Netherlands. Reflexivity must be an activity of all parts of the system, while specialised reflexive institutions are there to aggregate this knowledge and not the other way around.

A low level of conflict seems to be pertinent for a decentralised and inclusive knowledge generation. In case of overlapping domains of competence or conflictive domains of competence, knowledge generation becomes subject to "opportunistic" behaviour and competition. Competition might be well for the purposes of a market, it is not for systemic learning capacities.

Finally, we think that boundary organisations as mediators between different systemic levels

can have an important function in knowledge generation. They usually have the antennae and sensors developed for listening to the "field" and they also possess direct access to the centres of political power. They can, therefore, fulfil a function of early warning and information in the system in knowledge generation.

Knowledge accumulation

Knowledge generation is important but it would be in vain if generated knowledge becomes forgotten and must be generated time and again. This is what we called "re-inventing the wheel" in the French case. Two structures seem important to us to avoid such a fruitless repetition of knowledge generation.

The first one is the continuity of political power and leading positions in regulatory institutions. The frequent shift in party-control and personalities at the top of a research ministry as well as the frequently changing directors and presidents in the CNRS have been detrimental to learning because new interests negated old reports. It is clear that one cannot avoid that reflexive action is embedded in an environment where power is a major driving force. It is better though to have a constant and coherent power that allows accumulating knowledge than to have permanently changing interests. A policy of the "calm hand" is conducive to learning in this sense.

Reflexive institutions are, without any doubt, the second necessary structure a system needs to accumulate knowledge. To fulfil this function, it needs, however, a standing secretariat or persons with a long-term commitment that can build on existing knowledge already produced within the organisation. An advisory body the composition of which changes at each occasion or that is dissolved after one report cannot guarantee such continuity. On the other hand, it is clear that only such specialised institutions can and will have an interest in accumulating knowledge. They must be the watchmen in the system paying attention that the system does not forget, mostly because of political considerations but also because of complexity. We need specialised institutions in order to meet up to the growing flood of knowledge that is generated.

Knowledge diffusion

There a large number of structures needed for a high degree of learning capacities.

Public-funded research systems are differentiated. It is therefore of utmost importance to develop functioning connections between the different parts of the system. Again, the degree of conflict and competition between the entities plays a role. A "divide" within the system as we find it in the big countries Germany and France is detrimental to the fine-tuning of communication. Small countries evidently have an advantage because of more frequent contacts, a smaller number of actors, and in general a stronger urge to play a co-operative game. The personal contacts might, however, not suffice. An intelligent management of connecting the different parts of the system is indispensable.

The difficulties to do so are in part dependent on the degree of system differentiation. The more complex a system, the more difficult it becomes to clearly delimit functions and to connect the parts. Complexity is not necessarily a function of the size of a country as the Netherlands have shown. Here the institutional dynamics of research seem to play a role and political structures like federalism can have a positive role in preventing a strong differentiation like we have found in Switzerland. We believe that a flat structure has advantages because of the lower degree of complexity. Knowledge diffusion becomes easier in this way.

Boundary activities are once again a necessary part: This time it concerns not the generation but the diffusion of knowledge. Boundary organisations with their links to both sides and their ability of handling "boundary objects" can be a transmitter of knowledge in the system.

Finally, we are convinced – given our findings – that the proliferation of "strategic think" throughout the system and in particular on the operational level is necessary for a rapid diffusion of knowledge. Organisations must be prepared to "hear" and have developed the necessary utilities to "listen" in order to integrate new knowledge into their organisational strategies and, finally, into their organisational routines.

8 ANNOTATIONS

A

ACI : Actions concertées incitatives
ANVAR: Agence nationale pour la valorisation de la recherche
ATP: Actions thématiques programmées

B

BLK: Bund-Länder Kommission
Blue List : Blaue Liste Institut
BMBF: Bundesministerium für Bildung Wissenschaft Forschung und Technologie
BMFT: Bundesministerium für Forschung und technologie

C

CCRST : Comité Consultatif de la Recherche Scientifique et technique
CEA : Commissariat à l'Energie Atomique
CNRS: Centre National de laRecherche Scientifique
CNS: Conseil National de la Science
COMES: Commissariat à l'énérgie solaire
Comité National: Comité National de la recherche scientifique
CRUS: Conférence des Recteurs des Universités Suisses - Rectors Conference of the swiss Universities
CTI : Commission pour la Technologie et l'Innovation - Commission for technology and innovation
CUS: Conférence Universitaire Suisse - Swiss University Conference

D

DFG: Deutsche Forschungsgemeinschaft 22
DGRST: Délégation générale à la recherche scientifique et technique

E

EPST: Etablissements publics à caractère scientifique et technologique
EZ: Ekonomische Zaken - Ministry of Economic Affairs

F

FhG: Fraunhofer Institutes

G

GFE: GrossForschung Einrichtungen - Big Science Institutes
GSR: Groupement de la Science et de la Recherche
Grands Organismes: French extra-univerity research institutions

H

HGF: Hermann-von-Helmholtz Gemeinschaft Deutscher Großforschungseinrichtungen

I

IOP: Innovatiegerichte Onderzoeksprogrammes - innovation-orientated research programmes

K

L

LTI : large technological projects

M

MPG: Max-Plannck Gesellschaft

N

NWO: Nederlandse Organisatie voor Wettenschappelijk Onderzoek - Netherlands organisation for scientific research
NCCR: National Center of Competence in Research

O

OCW: Ministerie van Onderwijs, Cultuur en Wttenschappen - Ministry of education, cultur and science
OFES: Office fédéral de l'éducation et de la science - Federal office for education and science
OFFT: Office Fédéral de la Formation Professionnelle et de la Technologie - Federal Office for professional education and technology
ONERA: Office NAtional d'études et de recherche aéronautique

P

PNR: Programmes nationaux de recherche - Narional research programmes
PPR: Programmes Prioritaires de Recherche - Priority Programmes
PRN: see NCCR
Project agencies" ("Projektträger")

R

RAWB: Raad van Advies voor wetenschapsbeleid - Advisory council for science policy

S

SFB: Sonderforschungsbereiche - Special research domains
SME: Small and Medium Entreprises
SSC: Swiss Science Council
SNSF: Swiss National Science Foundation

T

TNO: Nederlandse Organisatie voor toegepast-naturweteschappelijk onderzoek - Nederlands Organisation for applied scientific research

V

Verbundforschung
VLSI: Very Large Scale Integration

W

WRR : Wetenschappelijke Raad voor Regeringsbeleid - Scientific council for public policy

Z

ZBO: Zelfstandige bestuursorganen - Autonomous administrative units
ZWO: Organisatie voor zuier Wetenschappeljijk Onderzoek - Organisation fro pure scientific research

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10 ANNEXE: FOLLOW-UP PROJECT

Skizze Dietmar Braun

Die Transformation von Forschungssystemen: Konvergenz und Divergenz in der Forschungspolitik von OECD-Ländern

Die Forschungspolitik[33] der OECD-Länder steht seit den 90er Jahren vor weitreichenden Herausforderungen, was die Organisation der Forschung, den Modus politisch bindender Entscheidungen und die Einbettung des Forschungssystems in die Gesellschaft betrifft. Kein Land kann sich diesen Herausforderungen entziehen.

Zu nennen sind hier in aller Kürze:

(1) „Ent-Grenzung“

Der Aspekt der Ent-Grenzung zeigt sich in vielen Hinsichten: die Globalisierung und europäische Integration hinterfragt zunehmend den Stellenwert einer eigenen nationalen Politik; viele Ziele der Forschungspolitik – insbesondere die Finanzierung teurer Forschungsprojekte und Forschungsinfrastruktur – scheinen nur noch in Kooperation zwischen Staaten möglich zu sein; Forschung vollzieht sich mehr und mehr über die Grenzen hinweg; die Mobilität der Forscher nimmt zu; die Bedeutung des benchmarking und von „best practices“ wächst angesichts grenzüberschreitender Kontakte und Informationen; Politikentscheidungen werden vernetzter und interdependenter, unter anderem durch internationale und supranationale Organisationen.

(2) Austerität

Seit den 80er Jahren ist die Forschung, insbesondere an den Universitäten mit einer Politik der Austerität konfrontiert, die zu einer Verknappung von finanziellen Mitteln und hohen Anforderungen an Effizienz geführt hat. Hierdurch bedingt sind Diskussionen über Umstrukturierungen und ein neues Management in der Organisation der Forschung.

(3) Veränderungen im „Regieren“ von Forschungssystemen (Governance)

Neue Orientierungen und Paradigmen bilden sich in der Forschungspolitik heraus:

- Das Prinzip „value for money“ avanciert zu einem dominanten Bezugspunkt politischer Forschungsfinanzierung und damit des Forschungshandelns. Dieses Prinzip hat es immer schon gegeben, es durchdringt aber jetzt praktisch jeden Sektor des Forschungssystems. Damit findet ein Wechsel von Selbstreferenz zu Fremdreferenz im Forschungshandeln statt.

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[33] Darunter sollen hier Entscheidungen auf der politischen Ebene sowie Entscheidungen auf der intermediären Ebene von Forschungsförderorganisationen über Prioritäten, Ziele, Finanzierung und Organisation der Forschung verstanden werden (siehe zu der Unterscheidung von politisch – intermediär und schließlich “operational” (OECD 1991)

- Gleichzeitig vollzieht sich in vielen Ländern ein Wechsel in der Staatsintervention. In der Art der Steuerung haben sich die Forschungssysteme immer schon stark unterschieden. Heute aber scheint eine alle Länder umfassende Neuorientierung in der Staatsintervention zu bestehen, die durch mehr Zurückhaltung, stärkere ex post Kontrolle von Forschungsleistungen, die professionellere Entwicklung von politisch definierten mittel- und langfristigen Forschungszielen und durch einen Anreiz zur „Selbstorganisation" in der Forschung charakterisiert ist. Die Beziehungen zwischen Staat und Wissenschaft sollen dabei auf eine neue, vertraglich definierte Basis gestellt werden

(3) Veränderungen in der Forschungstätigkeit

Mit der wachsenden Bedeutung von Querschnittstechnologien und der zunehmenden Akzeptanz der die Bedeutung von technologischen Innovationen unterstreichenden „new growth theory" (Romer 1994), entsteht die Notwendigkeit, die häufig unterschiedlich institutionalisierte Grundlagenforschung, angewandte Forschung und technologische Entwicklung direkt aneinander zu schalten. Die Schaffung von Interaktionsräumen zwischen den Forschungsphasen (siehe auch Stokes 1997), wird zur Priorität in der Forschungsförderung. Gleichzeitig beginnt ein Hinterfragen der bisherigen Politik zu den „Eigentumsrechten" in der staatlich finanzierten Forschung.

Diesen latenten und manifesten Veränderungen in Orientierung und Organisation von Forschungspolitik und Forschung vermag sich kaum ein System zu entziehen. Die *Aufgabe* besteht darin zu ergründen, wie die nationale Anpassung an diese Herausforderungen über forschungspolitische Entscheidungen verläuft, ob wir auf dem Weg zu einem „integrierten", globalisierten Forschungssystem sind und welche Folgen dies für die Produktivität von Forschungssystemen hat.

Der Schwerpunkt dieses Themenbereiches ist nicht – obwohl dies dargestellt werden muss –, einfach die nationalen forschungspolitischen Entscheidungen nebeneinander zu legen und zu systematisieren. Gerade das Thema der „Ent-Grenzung" weist noch einmal eindrucksvoll darauf hin, dass die nationalen forschungspolitischen Entscheidungen nicht isoliert vollzogen werden, sondern möglicherweise in zunehmender Weise aufeinander Bezug nehmen, imitiert werden, auf inter- oder supranationaler Ebene entschieden werden usw. Gleichzeitig gibt es eine Reihe von Studien in der vergleichenden Politikforschung, die darauf hinweisen, dass auf diese Weise zwar die Konvergenz der nationalen politischen Entscheidungen zunehmen kann, gleichzeitig aber genügende Gründe bestehen anzunehmen, dass Divergenz weiterhin die nationalen Forschungssysteme charakterisieren wird (siehe zum Beispiel Dyson 2000; Jordan, Wurzel et al. 2000; Kohler-Koch 1999). Wiederum andere Studien betonen die Möglichkeit von parallel ablaufenden Konvergenz- und Divergenzprozessen.

Seit langem ist bekannt, dass die Forschungspolitik in vielen Ländern von außen beeinflusst wird. Es gab immer „Vorzeigeländer" (wie Deutschland in der Hochschulpolitik zu Ende des 19. Jahrhunderts; die USA nach dem 2. Weltkrieg; Japan in der Technologiepolitik ab den 70er Jahren), die als „Modelle" dienten. Außerdem kann man nachweisen, dass gewisse „Diskurse", „implizite Theorien" (Hofmann 1993) und Paradigmen in der Forschungspolitik in allen Ländern in ähnlicher Weise Einfluss auf die Forschungssysteme und ihre Steuerung gehabt haben. Dies wird auch dadurch belegt, dass ähnliche Steuerungsinstrumente und Institutionalisierungsformen in der Forschung in den meisten Ländern in etwa gleichen

Perioden eingeführt wurden. Trotzdem ist nach wie vor genügend Varianz geblieben, die durch die nationalen Bedingungen beim Aufbau eines Forschungssystems erklärt werden müssen. Gerade hierüber gibt es aber nach wie vor nichts Systematisches. Eine Rolle spielen könnte zum Beispiel die Größe eines Landes, sein politisches Regime, die Höhe des Bruttosozialprodukts, der Stellenwert der Bildungspolitik, die (politische) Kultur und andere Faktoren. Und selbstverständlich spielen die jeweils spezifischen Akteurskonstellationen, historische Ereignisse, die für die Wahl eines bestimmten Pfades verantwortlich sind usw. in jedem Land eine Rolle. Kurzum: Konvergenz und Divergenz haben sicherlich in der Forschungspolitik und der Organisation der Forschung immer dicht nebeneinander gelegen. Wir wissen aber immer noch nicht, welche Faktoren für das eine oder andere eine Rolle spielen, wie vor allem Konvergenz möglich ist und zustande kommt. Gerade dies wird heute zunehmend aktuell, weil mit der Ent-Grenzung der Politik möglicherweise Divergenzen, nationale Sonderentwicklungen und die Bedeutung der Pfadabhängigkeit obsolet werden und sich Konvergenz zunehmend durchsetzen kann. „As we move into increasingly global waters we are confronted with increasing complexity and thus nationally specific factors will no longer sufficiently explain many of these developments. How national systems interact with the rest of the world is becoming increasingly important" (Lundvall und Tomlinson 2000: 10).

Bei der Erörterung dieser Forschungsthematik soll also herausgearbeitet werden, inwiefern die Anpassungsprozesse in den Ländern im Austausch einerseits mit anderen Ländern und Erfahrungen vonstatten gehen, „Lernen", „feedback"-Prozesse, „best practices", „lesson-drawing", „internationale Regime und Organisationen" oder schlicht Vorzeigemodelle in der Forschungspolitik eine Rolle spielen oder/und inwiefern andererseits Pfadabhängigkeit, unterschiedliche Regierungs- und Interventionsstile, unterschiedliche Kulturen und Akteurskonstellationen in der Forschungspolitik nach wie vor ihre Bedeutung bei der Erklärung von Anpassung von Forschungssystemen haben. Von besonderem Interesse ist auch zu verstehen, inwiefern forschungspolitische Entscheidungen heute über mehrere politische Ebenen verlaufen und eben nicht nur im nationalen Kontext.

Die Transformation von Forschungssystemen aufgrund forschungspolitischer Entscheidungen – und nur um diesen Aspekt soll es hier gehen, also nicht etwa um die lokale Anpassung von Forschungsorganisationen oder Forscherinnen – muss also als ein dialektischer Schritt von Konvergenz und Divergenz verstanden werden und es kommt darauf an herauszufinden, wieviel Divergenz und wieviel Konvergenz wir unter welchen Umständen in der zukünftigen Forschungspolitik erwarten können. Erst dann kann festgestellt werden, ob wir tatsächlich auf dem Weg zu einem über Globalisierung, Ent-Grenzung und Europäisierung entfachten integrierten, forschungspolitischem System sind.

Bedeutung der Fragestellung

Die Ent-Grenzung (insbesondere die Rolle der Europäischen Union in Europa) wird enorme Konsequenzen auf die nationale Forschungspolitik haben. Es ist deswegen von Bedeutung zu erfahren, mit welchen Konflikten die Transformation vonstatten geht und inwiefern wir künftig mit einer „globalisierten Forschungspolitik" und homogenen Forschungssystemen rechnen können oder inwiefern wir weiterhin auf die nationale Forschungspolitik zählen können und Vielfalt die Forschungssysteme charakterisieren wird. Was ist der zu erwartende Spielraum nationaler Forschungspolitik? Inwiefern wird die Produktivität der Forschungssysteme durch Konvergenz und Divergenz beeinflusst?

Wir lernen bei der Analyse, was möglicherweise „best practices“ in der Anpassung sind. Dabei geht es nicht darum, in ein „naives benchmarking“ bei der Empfehlung von „best practices“ zu verfallen (Lundvall und Tomlinson 2000: 6), sondern gerade vom Systembegriff auszugehen und jedes Land als Konfiguration mit typischen Eigenschaften zu verstehen. Die relevanten Variablen dieser Konfigurationen gilt es zu enthüllen, um zu verstehen, wie sich optimale Anpassung über Konvergenz oder Divergenz vollzieht.

Um Konvergenz und Divergenz festzustellen, bedarf es erst einmal einer systematischen Erhebung der Forschungspolitik und der historischen Entwicklungspfade in den verschiedenen Ländern. Dies ist bis heute nie systematisch geleistet worden, obwohl die OECD sporadisch einige vergleichende Analysen anbietet (OECD 1972, 1973, 1974, 1991, 2001). Dabei müssen erst noch die relevanten erklärenden Variablen entwickelt und getestet werden, die die bisherigen forschungspolitischen Wege und Leistungen erklären. Hiermit kann also eine eklatante Lücke in unserem Wissen über die Forschungspolitik geschlossen werden.

Die Mehrebenenpolitik ist angesichts der Bedeutung der Europäischen Union eine der dominanten Themen in der heutigen europäischen Politikwissenschaft. Zu erfahren, wie Nationalstaaten ihre forschungspolitischen Entscheidungen angesichts der zunehmenden Bedeutung supranationaler und internationaler Organisationen organisieren, ob sie dies mit Rücksicht auf die anderen Ebenen tun oder nicht und welche systematischen Unterschiede hierbei zwischen den Staaten bestehen, erscheint von großem Interesse.

1.1 Theorien

Als theoretische Zugänge eignen sich hier vor allem neo-institutionalistische Theorien zur Pfadabhängigkeit (Pierson 2000; Mahoney 2000); Theorien, die sich mit dem Lernen von politischen Systemen beschäftigen (Olsen und Peters 1996; Bennett und Howlett 1992; Kingdon 1984; die Literatur zur „begrenzten Rationalität“ (March und Olsen 1989); Ansätze, die „Ideen“ und „Paradigmen“ in der Politik behandeln (Hall 1993; Braun und Busch 1999); Theorien zur Konvergenz und Divergenz von Strukturentwicklungen wie z.B. der Ansatz zu „lesson-drawing“ (Rose 1993; Conzelmann 1998) und Policy Transfers (als Übersicht Dolowitz und Marsh 1996), aber auch die ökonomischen Ansätze, die zumeist im Zusammenhang mit Studien zu nationalen Innovationssystemen verwendet werden (Lundvall und Tomlinson 2000; Fagerberg 1995; (Venables, 1999)

Mögliche Schwerpunkte dieser Forschungsthematik:

1. Systematisierung von Polity, Politics und Policies der OECD-Forschungssysteme

2. Die historischen Entwicklungslinien der OECD-Forschungssysteme (Institutionen; Regierungsstile; Rolle von Ideen und Paradigmen)

3. Ermittlung von Erklärungsfaktoren zur Herausbildung unterschiedlicher Gruppen von Forschungssystemen (wie große/kleine Länder; Vorreiter/Nachzügler; Bruttosozialprodukt; Regierungsstile; Verhältnis Staat – Gesellschaft; Kultur; Spezialisierung in Industrie, Forschung usw.)

4. Verlauf und Erklärung von Diffusionsprozessen von forschungspolitischem Wissen

5. Nationale Verarbeitungsprozesse von Herausforderungen und die Rolle von Wissen und Lernen hierbei

7. Die Rolle von internationalen Organisationen wie der OECD und der Europäischen Union als Integrationsmotor als Erklärungsfaktor für die Konvergenz von Forschungspolitik und die Organisierung der nationalen Forschungspolitik unter dem Gesichtspunkt der Mehrebenenpolitik

9. Erklärungsmuster für Konvergenz und Divergenz

1.2 Vorhandene Forschungserkenntnisse und Defizite

Bis auf die OECD finden sich wenige vergleichende Publikationen zur Forschungspolitik der OECD-Länder. Die OECD hat immer wieder sporadisch versucht, die nationalen Forschungssysteme nebeneinander zu stellen oder aber bestimmte Aspekte der Forschungssysteme und der Forschungspolitik zu erörtern. Immer geht es dabei aber um praktisches Wissen zur Verbesserung der bestehenden Forschungspolitik und weniger um systematisches Grundlagenwissen in bezug auf die Forschungspolitik. Es gibt zwar, vor allem über die USA, eine ganze Reihe von Einzelfallstudien, sie werden aber – bis auf die OECD-Studien – selten systematisch nebeneinander gelegt. Themen wie die Schaffung von forschungspolitischen Institutionen, die Entscheidung über Forschungsausgaben, die Rolle von Förderorganisationen und die Prioritätenbildung oder Reformen lieben weitgehend brach. Es besteht bisher noch kein systematischer Vergleich, der dazu dient, historische Entwicklungsmuster zu erkennen, vergleichende Daten zu erheben und zu nutzen und für alle OECD-Länder einmal Hypothesen i.b.a. die Erklärung von Unterschieden in der Forschungspolitik zu entwickeln Es fehlt an Wissen z.B. über den Einfluss von politischen Regimen, föderalen und unitarischen Ländern, großen und kleinen Ländern, politischen Kulturen usw. In den wenigen politikwissenschaftlichen Studien etwa des Science Policy Research Unit an der University of Sussex werden vor allem Finanzierungsströme und institutionelle Strukturen diskutiert, während der Bereich der Entscheidungsprozesse, vor allem auch innerhalb des politischen Systems, vernachlässigt wird.

Über Konvergenz und Divergenz wird dagegen häufiger im Zusammenhang mit Innovationssystemen nachgedacht (als neuere Übersicht (Larédo und Mustar 2001). Die Forschung über nationale Innovationssysteme beschäftigt sich ja mit der Einbettung von Technologiepolitik in die sozialen, politischen und kulturellen Strukturen und versucht somit in ähnlicher Weise zu ermitteln, wie sich nationale Systeme in bezug auf Innovationsleistungen anpassen können. Hier ist zum Teil Material zusammengetragen worden, das zumindest bei der Systematisierung nationaler Forschungssysteme helfen kann. Es kann aber nicht genügen, da es in einem anderen Diskussionszusammenhang entwickelt wurde und zum Teil stark von ökonomischen Theorien beeinflusst ist. Außerdem hat die Forschung über Innovationssysteme kaum die Forschungspolitik selbst analysiert. Sie denkt eher auf der Ebene von Strukturen und Institutionen.

Genutzt werden können auch Erkenntnisse, die im Zusammenhang mit einem Forschungsschwerpunkt der DFG „Regieren in der Europäischen Union“ erzielt wurden, wobei allgemein auf die Problematik von Mehrebenenpolitik, Divergenz und Konvergenz von Staatstätigkeit eingegangen wurde (siehe Kohler-Koch und Eising 1999).

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