Abstract

This article studies professional careers between research and positions of responsibility in the governance of science. The process by which researchers are recruited in science policy organizations is studied as well as the conditioning social mechanisms which intervene in the subsequent development of their careers. 65 professional life stories of researchers that have held management, policy making and political positions in the Spanish R&D system between 1975 and 2007 have been employed.

The study identifies organizational, cognitive and institutional social mechanisms that affect the researchers’ careers depending on the scientific specialties of origin, the positions held and the length of time out of research. The conclusions highlight the implications of hybrid careers for both human resource management and organizational learning in science policy.

Keywords: science policy, research careers, social mechanisms
1. Introduction

In the governance of science the management teams play a critical role. Organizations that specialize in controlling and funding R&D activities, as well as research centers and universities, are constantly looking for people with technical ability and professional recognition to be decision makers. These people can frequently be found in the scientific domain. Therefore, it is common to find researchers in important positions in the governance of science and it is also common for scientists to fill political positions related to R&D.

This leads to a unique career between science and science policy which has not been systematically studied despite the important implications this has. On the one hand, it poses a human resource problem for scientific organizations and for R&D policy in general. The governance of science system, together with the reward distribution procedures in the scientific community, create situations which may have unforeseen consequences. The participation of researchers in science policy is often required in the scientific world and, occasionally, it is a logical consequence of a successful scientific career. Nevertheless, too much involvement in science policy can be a risk for research careers, especially in systems which do not have organizational arrangements to manage this kind of situations. On the other hand, the study of this professional group provides a strategic research site for the political sociology of science because of both the forces which lead certain types of researchers into positions of responsibility and the consequences for the governance of science.

The purpose of this article is to observe the hybrid careers between science and science policy in order to provide an analytical framework for research into this area. The strategy of the study is to identify the social mechanisms that intervene in the making of these careers by observing the interrelationship between the contexts of the two worlds and the circumstances of the different individuals. To that end, we have used the life story methodology with a wide group of researchers that have filled positions of responsibility in the Spanish R&D system between 1975 and 2007.

The article is divided into eight sections. After this introduction section 2 describes the background of the issue. Section 3 explains the research strategy and the methodological design. Following that we describe the profile of the people that begin hybrid careers. Sections 5 to 7 analyze the organizational, cognitive and institutional mechanisms that affect professional development in this field. Finally, section 8 details the different professional paths that emerge from hybrid careers.
2. Scientists and the governance of science

In the scientific world positions of responsibility, even at the highest political levels, are held by researchers which have experience and recognition in their respective fields. This also usually happens in those professions which have a certified body of knowledge backed by formal credentials, such as law, medicine or the different fields of engineering. In the organizations that employ these professionals there are stratification mechanisms which lead people recognized as experts in their profession to occupy positions of power and authority (Abbott, 2005a). Nevertheless, in places such as universities and research centers, as well as in all of the public policies that affect them, this phenomenon is especially noticeable. In the power structure of science there is a kind of self-government by scientists. This is due to a mix of technical reasons related to organizational management efficiency and also to institutional reasons related with the rules and regulations which prevail in research.

First, the R&D world is made up of a complex of specialties and disciplines where a particular social organization exists. Scientists act simultaneously in several contexts: they are socialized and receive credentials in a discipline, acquire competency and recognition in a specialty and are employed by a specific organization. The authority relationship at work is not carried out directly between the researchers and the organizations that employ them, but through intermediation by colleagues who are considered capable of judging their peers. This results in an exchange whereby researchers make contributions to knowledge through the communication channels of science, and in return receive professional recognition which is then used by individuals and organizations as currency when work and compensation are allotted (Hagstrom, 1982). Also, the relationships that scientific organizations maintain with their environment have special characteristics since specific funding and evaluation agencies judge the quality of the results they produce and provide resources in accordance (Braun, 1998).

This is, therefore, a complex social subsystem which must be understood in order to hold positions of responsibility. The specialist decision-making process is not usually standardized in a set of protocols, which makes it very difficult to describe, learn or teach the task requirements needed for these positions. The knowledge required is therefore of a tacit nature. In order to properly operate in this field, a high-level understanding of the practices and rituals of science is needed, as well as knowledge of the professional networks and information sources. Understanding and assimilating the resource distribution methods and the channels to gain access to them is also needed. There is very little chance to teach this knowledge to people who come from other institutional domains. That is why most of the time the people who have this set of capabilities are those that have worked as professional researchers in some scientific specialty.
Second, apart from the technical reasons, there are factors which have to do with the rules and regulations predominant in the profession that also cause scientists to fill these positions of responsibility. These rules have to do with a certain legitimacy required to gain access to the governance of science. This works on several levels. The politicians who have the prerogative to make appointments prefer renowned scientists in the key positions. Authority seems more effective if people in positions of responsibility are considered legitimated by other researchers and are well known by the public (Dickson, 1984). At the scientific community level, those that have positioned themselves in the professional network to have more chances of being appointed are also the scientists that have achieved greater visibility and formal recognition. This visibility allows them to emerge as charismatic figures that are more easily accepted to make judgments and decisions about other colleagues. When it comes to exercising authority, the elements that make up the scientists' charisma are created through the recognition of their scientific achievements in the form of distinctions, citations in publications, project funding and intellectual patronage of young researchers that leads to the creation of a school (Zuckerman and Merton, 1971).

This special social system governed by scientists with professional experience and recognition creates a distinctive professional career path: one followed by researchers that occupy positions of responsibility in the different decision-making bodies related to science. It is a professional career which even fits the classic structural definition of a career path. Namely: "A career is a succession of related jobs, arranged in a hierarchy of prestige, through which persons move in an ordered (more-or-less predictable) sequence". (Wilenski, 1961). However, it is a career that is not developed in linear terms, but consists of an intersection between research and science policy where the decision making is subject to conditions from both worlds. This affects the personal and professional cycle of some researchers and takes them through positions governed by different institutional logics.

This puts forward a research problem which is interesting from several different points of view. Careers in science policy have an impact at the micro level since they affect the future of the scientists that follow them. At the scientific organization level it poses a management problem which must be dealt with when electing the governing bodies. Additionally, it has implications for the governance of science since the access of the scientific elite to positions of responsibility may transfer concepts to the decision-making process and create organizational arrangements that affect the conditions under which scientific research is carried out.

Nevertheless, the intersection between science and policy has not been sufficiently studied from the point of view of professional careers. There have been relevant contributions regarding the participation of scientists in policy making (Jasanoff, 1990), as well as a long tradition of studies on scientific careers (Zuckerman and Merton, 1973; Chubin and Connolly, 1982). However, systematic research, with a certain theoretical basis to produce an integrated analytical
framework for career paths in public policy, is practically non-existent. A presentation by Susan Cozzens to the AAAS (2001) where she gives a brief description of the characteristics of the “policy professionals” can be used to bridge the gap between the different approaches of science policy and sociology of careers. Cozzens differentiates between two kinds of careers. On the one hand the “amateurs” are those researchers that, having received recognition in their specialty, become leaders in their respective centers and scientific societies. They make “committee careers” as usually participate in evaluation panels, consulting groups or advisory committees for the funding agencies or science policy strategy bodies. In some cases they take on positions of responsibility in these funding or advisory agencies. They are considered amateurs because their professional universe is not in policy-making but in a discipline. Normally they are part of the elite authorities that govern the disciplines or the organizations that contain them. Although they are frequently in touch with decision-making, this is a consequence of their research careers and, sometimes, the culmination of a successful career. However, they do not stop being scientists: they are professionals that systematically provide information for policy decisions. On the other hand, there are policy professionals whose work, although usually accompanied by a doctorate in science, is not usually defined by their competency in the production of scientific knowledge. These are professionals that develop their careers in the public administration of R&D and in the specialized organizations that regulate, finance or control it. They therefore have essentially different competencies compared to those needed in a specialty, such as analysis techniques, information gathering and processing, writing skills, as well as a “big picture” view of the trends in a scientific field or area of activity.

It is difficult to create a sharply focused profile to distinguish the two careers. They exist in a gray area between science and politics and are characterized by being in boundary organizations (Guston, 2000) where the rules of admission are not clearly laid out. Occasionally a group of recognized professionals can be found that do have specific training and certification which feed into these careers. However, this is only the case in some very developed countries in scientific terms such as the United States.1 In countries with smaller R&D systems, and especially in those with emerging systems, the number of policy professionals is very small. Most of the people that enter this area are researchers, normally because it is not possible to find professional managers from fields other than scientific specialties.

Now then, the third career positioned between the amateurs and the decision-making professionals has some specific characteristics which differentiate it from the others. The first are researchers who normally do not stop working in a lab or academic center. The second have a professional background and develop their activity in a domain other than science, and therefore are not considered part of the so-called scientific community. The career that surfaces between science and politics has features from both worlds and can be qualified by using the

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1 Mainly connected with associations like the American Association for the Advancement of Science (AAAS) and with some universities through their master programs on science and public policy.
A hybrid career is a professional path which implies holding positions that have different characteristics, each with its own different evaluation and reward distribution methods (Baylin, 1989).

In the research world these kinds of careers have always existed due to the diverse roles required in a lab (Kranakis, 1992). The most common is the one between research and management in industrial R&D. An early organizational response to this situation is the so-called “dual ladder” (Gunz, 1980), which soon was discovered to have limitations due to the difficulty in connecting the goals of the organizations and the aspirations of highly qualified workers (Allen and Katz, 1986). Research into this problem has shown the diversity of careers which stems from the different combinations of work content and organizational strategies, and has highlighted the conflicts which arise between opposing professional values and practices. Furthermore, the changes that have taken place at universities and public research centers since the 1980s have also led to studies on hybrid careers between management and research (Turpin and Deville, 1995), or between the universities and industrial corporations (Owen-Smith and Powell, 2001), resulting in useful evidence for building a profile for hybrid careers.

The career between science and science policy is another variant which has several characteristics in common with the previous ones, as well as its own variety of peculiarities derived from the world of public policy. First, there are some common patterns which drive people from the science domain into others. This is because they belong to the same “organizational field” (Powell, 2005), in this case the public sector of R&D, that has a structure of interrelationships between the implementing, funding and regulatory organizations, which is based on the common practices of the scientific communities and where specialties are the elemental core of the production and verification of knowledge. While in other organizational fields technical competence can be separated from management competence, and some times positions of responsibility can be held by public policy professionals (Hesketh, et.al, 1992), in the sciences there is a kind of “social fence” which excludes the non-higher-level experts from gaining access to governing positions.

Second, scientists are socialized and build their cognitive careers based on the social practices of specialties structured in hierarchical positions based on reputation (Whitley, 2002). This causes what the human resource literature calls “career anchors” (Schein, 1977). Anchors are the collection of initial motivations and the knowledge obtained from work experience in a field of activity. In the case of science policy, the anchors are in the scientific specialty where the experience is acquired. The problem with hybrid careers between science and science policy is that no clear anchors exist in the specialties which have an immediate correspondence in the

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2 For example, Baylin identified in industrial labs the “managerial”, “technical”, “project-to-project” and “technology transfer” paths (Baylin, 1986).
other world. People that transfer to another domain must adapt their intellectual baggage to a new environment and frequently must do so by improvising.

The third characteristic of hybrid careers is that positions in the policy domain require a degree of dedication that is incompatible with other activities, especially with those of the previous anchor. Those that have been outside of their research field for some time have difficulty staying in touch with the specialty. Moreover, the evaluation and reward systems in the new domain follow a different set of rules and therefore the achievements obtained in one world are not usually interchangeable in the other.

This combination usually produces results, generally unforeseen, that affect both the researcher’s life and the management of the scientific organizations and pose several questions: What motivation and circumstances push scientists to fill these positions? How does public policy affect personal biographies? What kind of professional careers arise from these situations? What mechanisms intervene in the restructuring and diversification of hybrid careers? The following section will establish the basis for observing this problem.

3. Methodology

In the literature on professional careers a distinction is usually made between those approaches that focus on variables and those that focus on actors (Hermanowicz, 2008). The first group tries to generate empirical regularities using statistical analysis, normally over large populations, while the second is more interested in the interpretations people make about the social processes they live in. The research strategy used here share some common ground with the second type due to the use of qualitative research techniques, although the two options are not considered mutually exclusive. In this work we study a social process through individuals that move through a series of events over time (Abbott, 2005b), which allows us to identify theoretically informed factors that are useful when observing causal relationships between variables.

The aim of the observation procedure used in this work is to build an analytical framework that defines the distinctive traits of the professional careers between science and science policy as well as to show the main processes by which those careers are built. To that end, we use the notion of social mechanism. The social mechanism approach tries to extract explanations from social change and variation. How the existing structure in a specific situation influences individual actions is usually considered initially, while studying at the same time how these actions subsequently generate new structures. Within the wide range of explanations based on social mechanisms (Swedberg and Hedstrom, 1998), our approximation corresponds to what Stinchcombe (1991) called “situational mechanisms” which favor the transition from macro to micro level. That is, the observation focuses on how the individual actors are exposed to
specific social situations and how these macro situations shape beliefs, opportunities and the courses of actions these people follow.  

In order to achieve this, it is useful to understand these careers as connections between personal situations and social structures in the world of science (Nystrom and Arthur, 1989). Positions bond individuals to organizations and to the institutional rules which predominate in the social structures they are in. This, at the same time, is a channel of social influences that affects work and, therefore, the production of knowledge that the people are able to perform (Glaser, 2001). When studying careers it is necessary to observe the dynamics that unfold as people transfer through different phases of their lives. A useful methodology for identifying these mechanisms is the life story. This allows us to connect the individual scientist's lives to the macro-structures that shape the conditions under which they develop their careers (Clausen, 1998).

Specifically, we use here the professional life story of scientists with hybrid careers between the research world and the science policy world. The subjects under study are researchers that have held administrative posts, policy making positions, or have had appointments of political responsibility. The selection criterion used was people who have held these kinds of positions full-time. This is the fact that distinguishes them from the traditional scientific careers which are compatible with doing research work. Scientists that handle normal management tasks in their specialty and at the same time do research without being forced to abandon scientific activities are therefore excluded.

The selection was performed in the context of the Spanish R&D system. The positions were held in time periods corresponding to three stages in the development of Spanish science between 1975 and 2007. Researchers were selected according to factors which may influence the development of hybrid careers and, therefore, add elements of differentiation that are relevant for comparative analysis (Ragin, 1987). The main criteria used to classify the

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3 A mechanism is a set of systematic propositions which provides a plausible explanation of how several elements are linked. Our intentions in the use of this approach are essentially explanatory. Although the cases we observe are placed in a specific social context, the inner working of the elements that act on them attempt to be general. This is what gives them explanatory value as opposed to ad hoc explanations tailored to the observations of specific cases (Swedberg and Hedstrom, 1998. chap.1).

4 The three stages used to make the case selection were the following:
- Stage 1 (1975-1986): Beginning of the institutional construction of the R&D system. This corresponds to the political transition towards democracy, when official practices applied toward the evaluation methods and funding on universities and public research centers were first established.
- Stage 2 (1986-1999): Development of the regulatory and organizational foundations of the R&D system. This stage coincides with the approval of the Science Law of 1986 and the enactment of the current structure for R&D policy, as well as with the creation and consolidation of the funding and evaluation agencies.
- Stage 3 (2000-2007): Diversification and expansion of the R&D system. The system grows thanks to economic development together with the diversification of the intervention policies and procedures in R&D over the previous institutional foundation.

For a detailed analysis of recent Spanish science policy history see Sebastián and Muñoz (2006). For the transformation of the Spanish R&D system see Muñoz (2004). For the evolution of the funding agencies and the incentive and reward system see Fernández-Esquinas (2006).
professional life stories have been the degree of responsibility of the position held, the length of
time on science policy positions, and the scientific specialty of origin. The specific combination
of these factors is considered to be the basis for the operation of the social mechanisms that
shape careers between science and science policy.

a) Degree of responsibility in science policy. To establish a typology on degrees of
responsibility it is useful to return to the old distinction between first, second and third level
entities, that refer to a functional division of bodies in the R&D domain that respectively have
planning, decision-making and implementing tasks. Based on this classification the subjects
were assigned to three kinds of positions:

-Administration and management positions within a scientific (or implementing) organization,
normally a university or a public research center. Most of these are university chancellors and
vice chancellors, presidents of the CSIC (Spanish Council for Scientific Research) and directors
of public research centers. Positions in large scientific infrastructures and international scientific
organizations are also included.

-Policy making positions in bodies that oversee implementing organizations. They are located
normally in funding, evaluation and planning agencies at both the national and regional levels.
One difference with respect to the previous group is that these positions often have a stronger
political component because the appointments come directly from the Government.

-Political positions related to R&D. These are positions that are part of the State structure of
authority. This includes Director-Generals, Under Secretaries and Ministers. This also includes
political positions in international bodies related to R&D.

Apart from having different responsibilities these positions are at different distances from
research. Namely, most of the people in administration and management positions do so in the
same organization they work for, while policy making and political positions require mobility.
They are in institutional domains that are far removed from scientific activity as far as the kinds
of decisions, the level of professional relations and the visibility achieved. Privileges and
salaries associated with these positions are also different. We expect that access to diverse
levels of responsibility will affect differently the subsequent opportunities.

b) Time in science policy positions. The amount of time a person holds any of the above
positions will be relevant for their scientific careers. These are full-time jobs that require a great
deal of dedication and make it difficult to be in contact with the initial specialty. We expect that

5 This functional distinction was common in international organizations during the 1960s and 1970s,
especially in UNESCO (UNESCO Archives, 1963). It used to be employed as a template for implementing
science policy organizational arrangements in developing countries. This template was especially
important in Spain during the political transition to democracy. The idea of the three levels was one of the
pillars for the construction of modern science policies in the late 1970s and early 1980s, as opposed to
ideas from OECD usually implemented in the 1960s. (Serratosa, 2008; Muñoz and Sebastian, 2008).
During the selection process we have used the organizational charts of the most important first, second
and third level organizations in the Spanish R&D system and have classified each one in the time stages
between 1975 and 2007. The selection was performed with the collaboration of a group of experienced
experts that have identified the professional profiles of the people in the organizational charts.
different amounts of time in full-time positions will have a different affect on professional careers. Therefore, the selection of the interviewees included people who remained in their positions for different lengths of time. Although the periods are not rigidly established we have classified them into groups of short experiences (4 years or less) and long experiences (more than 4 years).\(^6\)

c) Scientific specialty of origin. The researcher’s specialty has implications in the hybrid careers due to the differences in time cycles and resources needed in the different fields of science. With the number of cases employed in this study it is difficult to do a comprehensive classification of specialties. Nevertheless, common elements do exist among specialties with regard to organizational methods of work and the resources needed to work in a specialty. The most relevant gap is between those specialties that require costly and sophisticated equipment and large teams which are often called “collectivized sciences” (Ziman, 1991), as opposed to those other specialties where it is possible to work individually. It is not possible to draw a parallel between research fields and distinctive ways of producing knowledge. Nevertheless, the collectivized fields usually correspond with those that have a greater cognitive consensus, as well as with specialties where new discoveries are made at a greater pace. In this case we have selected people that come from scientific specialties with different degrees of work collectivization and with different degrees of cognitive consensus. Both aspects are usually related to the time cycles in the discoveries that are made. Additionally, to achieve a greater degree of variability we have also taken into account the point in time where the hybrid career began. We believe that the stage in the professional path may influence the subsequent development. As a result, the professional life stories include people from different grades of seniority in accordance with the life cycles in the specialty of origin.

The observation procedure followed for the life stories combines analysis of documentation with personal interviews. We requested a curriculum vitae (CV) from the people selected when asking for their collaboration. For each case a preparatory study was made which included the examination of documents related to the positions held, the reference stages as well as biographical information by way of specialized documents in science policy and gray literature produced by the subjects themselves. The life stories were produced by way of a semi-structured interview organized chronologically according to the most important positions found in the CV. Additionally, a number of common questions about the professional careers were asked at the beginning and end of the interview.

65 professional life histories were completed in total (see Table 1). Among the professionals interviewed we have included a wide range of disciplines and specialties such as social

\(^6\) A period of four years is the most common duration for positions in this domain of the Spanish R&D system. They coincide with the different political terms and correspond to the appointments to positions. The periods between university elections where the governing boards are elected are also every four years.
sciences, humanities, life sciences, experimental sciences and engineering. The interviews were recorded, lasted approximately 3 hours on average and were subsequently transcribed and edited. The analysis uses the complete set of information acquired to identify patterns in the professional careers and social mechanisms, in addition to observing the belief base and the strategies adopted regarding the professional careers.

Table 1. Distribution of the professional life stories

<table>
<thead>
<tr>
<th>Type of position*</th>
<th>Specialty of origin (collectivization)</th>
<th>Development stage of the Spanish R&amp;D system**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>High</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>2</td>
</tr>
<tr>
<td>Policy making</td>
<td>High</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1</td>
</tr>
<tr>
<td>Politics</td>
<td>High</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Low</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>19</td>
</tr>
</tbody>
</table>

*The type of position refers to the highest level of responsibility held.

** The stages refer to the period in which the hybrid careers began, independent of whether they subsequently continued in other stage.

4. Brief profile of the hybrid careers

The profile of people in hybrid careers consist of a mixture of personal motivations and co-optation from the political establishment which act as push and pull factors over some individuals. At the time they filled a science policy position all had tenured appointments in universities and public research organizations. Practically all were experienced researchers, had achieved sufficient visibility and were recognized as competent professionals as measured by the current development standards of the national R&D system, although they were in different stages of their scientific career. However, the high level positions which are sensitive due to their prominence or degree of visibility (for example, the president of the CSIC) are held by researchers with an extensive career and a high level of recognition in their specialty. Normally this includes having international standing and work experience in other countries with highly developed R&D systems.

Furthermore, the professional profile corresponds to people with experience in managing R&D related resources, such as leading projects, research groups or departments, which implies people management skills and the ability to acquire funding. All of the interviewees had actively participated in evaluation and advisory committees in their respective specialties, which
suggests that before having a hybrid career they had what was previously called a “committee career”. This kind of experience is an addition to their scientific CV and at the same time acts as a social relationship mechanism which facilitates contact with people with decision-making capacity when it comes to getting a professional promotion. This series of factors results in a specific profile. They mostly belong to areas of collectivized science where these kinds of experiences are more frequent, especially in the experimental sciences. These are people who begin to take on responsibilities at a mature age (normally older than 45) since the above mentioned characteristics are obtained during the intermediate stage of the scientific profession life cycle. 

With respect to the motivational factors, the decisions to participate in the political arena respond as much to the professional recognition as well as to the comparative advantages which come with science policy experiences. The ways these positions are presented in the CVs and interpreted by the interviewees themselves show that they are considered an added element of scientific prestige. Furthermore, having a position of responsibility benefits the scientific career. This professional recognition has comparative advantages since it increases the chances of getting resources. A position of this kind gives access to strategic knowledge because it provides a wider view of a specialty or a scientific organization, apart from tacit knowledge about the mechanisms for securing resources and access to larger professional networks.

Still, the competitive advantages do have their limits. In the following sections we identify the mechanisms in play when professionals remain in decision-making positions. The emphasis is placed on the unforeseen consequences produced by the governance of science.

5. Organizational mechanisms

When a researcher is removed from scientific practice in a specialty and a workplace, organizational resources for research can be lost. In competitive funding systems this means not requesting and managing projects. As the time goes by the projects end and the accumulated resources needed to continue research begin to fall. The researchers also lose contact with the teams they were in. When a person in a hybrid career is leading a research team, not exerting that leadership for too long means risking the loss of the human resources in the group. This happens, for example, with the post-doctorate researchers whose salary depends on funding for projects. This also happens to the PhD students because it is not

7 Additionally, this is a male-dominated area since the selection base is comprised mostly of men (in the 65 life stories only 5 are women) Although this fact was not studied in detail during the research, it seems that hybrid careers suffer from a lack of upward mobility to positions of responsibility for women, and can be considered a special case of the glass-ceiling effect in scientific careers (Xie and Shauman, 2003).

8 The narrative of the professional career path in sciences coincides considerably with the typical stages established by Dalton et. al (1977), where he identified the career stages as “Apprentice”, “Colleague”, “Mentor” and “Sponsor”. The Sponsor stage is where management for the organization takes place. In the R&D domain, after receiving professional recognition as a researcher and manager, sponsorship is considered a natural extension to a CV of a highly recognized researcher.
possible any longer to act as supervisor under normal conditions. In addition, while away a researcher may stop leading a team with complementary professional interests and capabilities that works in a coordinated fashion, and which is normally the result of a considerable investment in effort and trial periods for personnel that may last years.

Independent of whether the researcher is in a leadership position or not, without funding and human resources it is difficult to work and consequently difficult to make contributions to knowledge. This happens in all specialties since dedication is needed to be up to date with the latest advances and to make relevant contributions. Nonetheless, it is especially important in those collectivized disciplines that require equipment and larger teams. Hybrid careers imply a loss of organizational resources and a time limit beyond which it is not possible to turn back. The limit is normally related to what point of life the researcher is at and to the prerequisites needed in a specific research field in order to produce acceptable advances.

The following comment from a chemistry researcher illustrates the mechanism:

In order to create a research team, including thesis, projects and equipment, you need more than 10 years once you have the capacity to act independently. When you lose the team it takes another 10 years minimum to put it back together again. If when you try to put the team back together you are of advanced age, it means that even if you are successful you will be close to retirement. In any case, you will be at an age when it is difficult to maintain the same demanding workload.

6. Cognitive mechanisms

One mechanism that is especially important in the development of hybrid careers has to do with elements that affect the capacity to maintain the knowledge needed to carry out the research work in a specialty. When a full time decision-making position is held, there is a risk of losing cognitive resources. This happens especially in those disciplines with a high cognitive consensus, where the high concentration of personnel and resources on similar research problems worldwide means that discoveries and methodologies advance constantly. In these specialties there are critical moments, especially when a revolutionary discovery leads to a paradigm change. When close contact with the specialty is lost the risks of becoming cognitively outdated are high. ⁹

Another change in the cognitive scheme occurs when there are developments in scientific instrumentation. In some specialties the use of technology interacts constantly with the dynamics of discoveries, so that developments in equipment cause substantial changes in

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⁹ This also happens in specialties in the humanities with different organizational requirements. For example, a researcher, who at the beginning of his career was active in the philosophy of science and also in logic, stated that after years in science policy he could stay abreast of knowledge in the first field, but not in the second.
scientific advancement and, in some cases, a change of paradigm (Joerges and Shinn, 2001). This is common in the collectivized specialties of rapid development, but can also happen in social sciences or the humanities. For example, the application of computer processing and storage technology in the field of linguistics, calculation and modelization tools in economics, or the use of modern dating and cartographic techniques in archaeology, are all elements of technological advance that produce significant changes in these specialties.

For both knowledge and instrumentation, if these advances occur when researchers are in a different environment from their workplace, it is much more difficult to assimilate and the risk of becoming cognitively outdated increases. In some cases contact with the base knowledge which is the prime material of the specialty is lost, while in other cases it is the ability to ask relevant questions consistent with the “state of the art” in a research problem. In both cases the researchers finds themselves in a structure of opportunities that forces them to take another path.

The following case of a biology researcher, who spent many years in the management of a public research center, reveals the mechanism:

During my time in the position xxx I tried to take documentation home that would help me stay up to date. To that end I searched for or asked collaborators for articles about the state of the matter or about advances in our field and I would read them on the weekends. However, at a certain point I stopped understanding the articles that I read. Suddenly, a new language for referring to the new discoveries and the new types of analysis had appeared, and it was different from what I was used to.

7. Institutional mechanisms

There is a third mechanism which is intimately related to the other two that deals with the set of attributes that are considered suitable for recognition as a researcher. In the scientific careers the organizational resources are related to the cognitive resources, and the connection between the two is frequently conditioned by institutional factors, especially by legitimacy.

After several years of not working in the scientific specialty the CV begins to lack information that is considered vital, such as publications, patents, project management, responsibility over research teams or scholarship supervision. These items give legitimacy to the researchers and grant them access to resources and responsibilities. The evaluations of funding proposals usually look at the production over a period of time immediately prior to the time of the evaluation. The results achieved by the resources managed, normally the outputs of the projects, is what is under review. These outputs are what give credibility to get funding, or to be promoted to a position of higher responsibility which means access to more economic resources. When a decision-making position is held, it means not producing the results which
are part of the reward system of a specialty. And if, at the same time, material, human and
cognitive resources have been lost, the process becomes irreversible. The lack of legitimacy
becomes a barrier and blocks access to organizational resources as it simultaneously deepens
the lack of cognitive resources. Without this kind of previous achievements participation in the
competitive system is not possible unless specific support channels for these situations are available.

The following example from a physicist illustrates the concept of scientific legitimacy related to
funding procedures.

The science evaluation system is relentless and sometimes blind. It does not matter who you
were or the important things that you have done. Unless there is a pre-existing mechanism that
takes into account work in other domains, your proposals will be judged on the same basis as the rest. During the evaluation of a project they say things like: “You have not had a major publication
in the last three years”, or “you have not shown you can handle the human resources needed to
manage a new project”. Under these conditions, and after spending several years without running
a project, the system throws you out.

How long can you be in a hybrid career if you want to return to scientific pursuits? The answer is
not uniform for all careers and all specialties. The risks of passing the point of no return are
lower in fields where the work is organized on a more individual level and in the specialties with
low cognitive consensus, especially those where multiple paradigms and traditions coexist over
long periods of time. The organizational and cognitive mechanisms have a more subtle impact
here, although that is not necessarily the case with the institutional mechanisms relating to the
scientific CV.

The risks are more acute in the collectivized disciplines with rapid development in addition to
those affected by technological revolutions. The answer in these cases depends on the
combination of the different types of resources that the researcher has accumulated at the time
of the change. In the careers of scientists in these specialties there is a rising curve in the
accumulation of resources and professional prestige which levels off once they reach a certain
point (Mallon, et al, 2005). They must be trained researchers and have overcome the
professional progress curve in order to return after an extended period away from normal work.
In these cases, accumulation of prestige, social capital, economic resources and a consolidated
team are sufficient to continue and guarantee a place to return to.

If the change to a hybrid career happens when scientists are still on the upward curve instead of
the level part, the risks of not being able to return become more serious. If they are not well
consolidated researchers, the time they can be away is very limited. For people in highly
internationalized experimental sciences the limit is usually around four years. The most critical
issue in the specialties with high cognitive consensus is publications, especially at the
intermediate point of the career. In these cases, a long period without publications can affect the standardized indicators used for assessment. For example, Figure 1 shows the records from the ISI Web of Science of a chemistry professor in the intermediate stage of his professional career (44), who has held for three years the position of vice chancellor of research in a large university. It can be seen that during those years the publications drop drastically and only recover one year later. According to this researcher, beyond that timeframe it is believed that there is no possibility of recovering the lost visibility needed to maintain a sustainable line of research.

Figure 1. Chemistry professor in an administration position from 2001 to 2003. (Published items and citations included in the ISI Web of Science)

In any case, we must consider how far removed the position is. The higher the responsibility the farther away it is from the activity of normal research. The people in intermediate positions near their specialty are able to maintain contact with the scientific activity. This occurs, for example, when they run research centers in similar or related specialties or when they are in a committee or funding agency specialized in a scientific field. This is a strategy used by scientists with consolidated careers who does not want to stay out of research; they adjust the positions they accept according to how close they allow them to be to their research centers and their workgroups.

A researcher with an extended experience in managing biology centers explains the strategy for avoiding disconnection:

I have never accepted responsibilities that do not allow me to go to the laboratory at least two or three days a week. If you accept other responsibilities you are sacrificing your scientific career. We must thank those that have accepted higher positions because they are essential for the development of the system, but in that case, after a while you must be aware that you are in another world.
8. The diversification of hybrid career paths

Several mechanisms working together create a series of paths that are the result of a restructuring of the researchers’ professional careers. Below we describe the four paths identified:

Path 1: Professional Management of R&D. Made up of researchers that turn their professional careers to management and policy making. People from disciplines with a high cognitive consensus, that have begun their hybrid career at an intermediate stage of their research career, and that have spent a long time away from their original activity, can be expected in this path. These circumstances create an opportunity structure which makes return difficult. Those that do return to their research centers find themselves in the position of having to begin at practically the same level as new researchers. Nevertheless, in the management domain they have the tools and accumulated knowledge to continue an upward career, although it may be less structured and have lesser recognition than a research career.

Path 2: Social science researchers on R&D topics. This is made up of researchers that direct their research activities toward the social sciences in areas related to science and technology. Hybrid careers place some people in a good position to link their tacit knowledge from research and science policy with the codified knowledge of the social sciences. We expect to find here researchers that have an aptitude for change, mostly from humanities or social science disciplines, due to the knowledge base they have which is useful for this reorientation.

In this path we usually do not find scientists that have had short experiences in administration or policy making, or scientists that have held high level positions since in these cases they redirect their careers to other places. The natural scientists that end up in this group are those that have a special sensibility for the R&D world since a significant effort must be made to adapt to the terminology and the methods of the social sciences.

Path 3: Moving out of the organizational field of public science. Comprised of researchers that reorient their careers into another field different from science in the public sector, mainly in the political sphere or in the business world. We expect to find scientists in this path who have held high-level positions. This gives them access to more networks and more visibility which makes moving to other domains easier, in high-level positions as well. When they have access to this kind of contacts, the range of alternatives other than returning to the laboratory increases. In addition, this path does not mean a loss of resources or status.

Path 4: Return to research activities. We expect there will be people that have been in a hybrid career for a short period of time and have held low level positions. These situations allow the people to return to their research activities under normal conditions. Moreover, the structure of
opportunities created does not offer any special chance to reorient a career in another fashion. Holding a position of this kind is just one more step in the career path of a researcher and does not have to be a negative professional experience as long as there is no loss of resources or legitimacy.

It is much more difficult for this path to happen to people that have had to manage several disciplines over long periods of time or to researchers that have held high level policy positions. The work agenda changes drastically in both cases. Nevertheless, in this path we must distinguish between scientists with more consolidated careers and less consolidated ones. Scientists that have initiated a hybrid career with accumulated resources in their specialty and do not restructure their career in another sense usually return to the laboratory as more highly consolidated leaders. A hybrid career is an additional resource for their professional progress. The management experience is something that is even valued in a high level researcher. When they return to the specialty, these researchers usually do so at a more advanced stage of their professional career: they do not in reality return to the lab work, but manage research teams, laboratories or specialized centers.

On the contrary, scientists that begin with few accumulated resources, and therefore at a greater risk of losing them if they are away from research for long periods of time, return under precarious conditions. At this point other kinds of careers that are normally hidden, but have implications for life in the laboratory, come to the surface. This involves scientists that must restructure their activity within the academic world to fill positions related to management of the discipline (as editors, project managers or department managers) or teaching activities. In this last group of cases we find the most important problems of professional satisfaction and also the greatest difficulty in human resource management for the organizations they work for.

9. Conclusions

The ruling governance of the sciences occasionally have consequences for the careers of the researchers, for the organizations they work for, and for the development of science policy. Social mechanisms exist that place recognized scientists in positions of governance and also influence the career paths of researchers that pursue hybrid careers, creating conditions which, at times, force them to restructure their professional trajectory. In this study several organizational, cognitive and institutional mechanisms have been identified that operate from different aspects of the social structure of the sciences. Although here they are presented independently, the examination of the life stories reveals that they operate jointly and, therefore, the three aspects are intimately related.

Factors related to the researcher’s situation in the science policy world as well as professional background intervene in the activation of these mechanisms. Two relevant factors in the first
group are the degree of responsibility held in the governance of science and the length of time
the positions have been held. These two factors act differently depending on the scientific
specialty of origin and the point the researchers are at in their professional career when they
begin the hybrid career. The farther away they get from their scientific specialty, and the longer
they are away, the greater the possibility of losing the cognitive and organizational resources
and the legitimacy required to continue connected to research. In the same way, if the
researcher has a less consolidated position, there will be a higher risk of losing those resources.
Researchers in this kind of situations are more frequently obliged to change their career path.
This happens especially in those researchers which come from collectivized specialties with a
greater cognitive consensus exists. Besides requiring a high level of material and human
resources these specialties renew at a faster pace the knowledge and specialized equipment
that are the basis on which new discoveries are made.

From the combination of elements mentioned a series of paths emerge that diversify the hybrid
careers. Moving to one of them does not only depend on the conditioning factors mentioned
previously, but also on the opportunities that arise when participating in science policy as well
as the strategies and motivations that the researchers employ in the configuration of their
professional careers. Some of the paths we have identified become a management problem
with different aspects. First, the research centers lose highly experienced researchers. This
does not always mean that efficient managers are gained in exchange since the two
competencies do not necessarily go together. Second, it is difficult to integrate people which
come from hybrid careers into the usual positions available in the research world. There are
also integration problems for those researchers that are not able to resume their scientific
careers but are forced to return to active research due to the lack of other alternatives. Third, it
is difficult to take advantage of the tacit knowledge created in management and decision
making. Sometime tacit knowledge is literally lost when the people that have it leave their
positions, since researchers do not usually write about science policy or transform their
experience into documented management protocols. This can hinder organizational learning in
the development of science policy because the new management teams do not have the
possibility of using the experience of their predecessors. This happens especially in those R&D
systems that are being set up or are growing and therefore have not incorporated formal
organizational arrangements into the governance of science.

In the field of science policy the solutions for solving this contradiction have different
implications. One criterion is to use seniority when recruiting researchers as it reduces the risk
to their careers. This is a common solution for professional development in those specialties
where productivity is related to certain age groups. Nonetheless, this criterion can conflict with
other values in effect in the governance of science, especially the value of participation. Using
seniority as a management tool means reinforcing the already existing stratification in the
science community by which only people of a certain age are eligible. This not only excludes
younger candidates, but also women due to the glass ceiling effect. A second solution is to split off the management career, to separate it from the research career when the right conditions are met. Professionalizing some specialized activities resolves numerous problems when setting the workload of the researchers that participate in the governance of science in addition to improving decision making. However it also has its limitations with regard to the ability to find sufficient policy professionals.

These two possibilities are always present in the domain of science policy. In addition, we defend the need to use organizational strategies that take into account the specificities of hybrid careers when recruiting and evaluating the researchers that take this path. On the one hand, evaluation criteria and incentives should be established which make it easier for researchers to return to their original activity with the added value of management experience. On the other hand, mechanisms should be created that ease access to specialized positions in the governance of science, especially advisory positions, for those researchers who need to reorient their careers by making it possible to retrieve tacit knowledge and facilitate organizational learning in science policy.

10. Bibliography
