Science, Clients, and the State

A study of Scientific Knowledge Production and Use

ISBN 90-365-1996-9

Cover design: Communication Department, University of Twente, the Netherlands
Printed by UNITISK, Czech Republic
Published by CHEPS/UT, P.O. Box 217, 7500 AE Enschede, NL, secr@cheps.utwente.nl

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A STUDY OF SCIENTIFIC KNOWLEDGE PRODUCTION AND USE

PROEFSCHRIFT

ter verkrijging van
de graad van doctor aan de Universiteit Twente,
op gezag van de rector magnificus,
prof.dr. F.A. van Vught,
volgens besluit van het College van Promoties
in het openbaar te verdedigen
op donderdag 4 december 2003 om 13.15 uur

door

Åse Gornitzka

geboren op 23 november 1962

te Tokyo

Dit proefschrift is goedgekeurd door de promotor:

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Preface

The two subjects addressed in this study, problem choice and the use of research, are highly relevant in the world of public administration as well as in the academic research arena. They have been conceptualized and investigated by many scholars. This study attempts to add to the rich body of knowledge in the field in question, social studies of science, by focusing especially on the possible effects of the organisational context on the selection of research problems and the bureaucratic utilization of research.

The study was made possible through a doctoral fellowship from the research training programme "Research on Research" at the Norwegian Institute for Studies in Research and Higher Education (NIFU), funded by the Research Council of Norway.

In many ways the study shows how crowded research processes are: they are filled with actors that are involved for shorter or longer periods, with colleagues who stay and colleagues who leave, and with people that have an interest in and pay attention to research in varying degrees. That is also the case with my research work in this area that has found its, so far final, expression in this thesis.

My work has gone with me to several geographical and intellectual locations. From its Norwegian home base at NIFU, Oslo, my work has travelled to the U.S.A. to Michigan State University, East Lansing, and Stanford University and SCANCOR, Palo Alto, and to the University of Twente and CHEPS, Enschede, the Netherlands.

While I am grateful to all current and former colleagues who left their mark at different stages of the research process, I am especially indebted to: Karl Erik Brofoss, who provided valuable and much appreciated guidance during the first phase of the study, my NIFU colleagues, especially Werner Christie Mathisen and my long-term partners in crime Liv Langfeldt, Ingvild Marheim Larsen and Bjørn Stensaker, the CHEPS team, especially Harry de Boer, Peter Geurts and Carlo Salerno, Lawrence Busch and James G. March, for the scientific inspiration provided during many seminars at Michigan State and Stanford, and Jon Elster for his comments on a paper of mine that has been turned into a chapter in this book. Thanks to Bjørn Magne Olsen and Monique Snippers for invaluable technical and practical assistance.

I am especially thankful to the many people in state agencies and in the research units in Norwegian agricultural and fishery sectors who took the time to fill out questionnaires or to be interviewed for this project. Without their contribution this research could not have been conducted.

Finally, I thank my supervisor Guy Neave who guided me through the last steps.

I dedicate this thesis to my three beautiful distractions and sources of inspiration, Mari, Sebastian, and Mads, to the Mormor-institution whose pillars are made of love, care, and kindness, and to Peter who did my life and my work a world of good.

Åse Gornitzka
Oslo, November 2003

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1 Science, clients, and the state: an introduction

1.1 Research questions

Norway is a country of which the economy is closely linked to natural resources. While the current image consists of a country floating economically on oil, traditionally Norway has been more identified with farmers and fishermen. On the one hand these images are, of course, simplifications, and do not do justice to the sophisticated and varied economic basis of the country. On the other hand, it cannot be denied that in Norway these primary economic sectors have been and are politically and economically important areas in which public and private actors and interests come together in many ways. As in the other countries in north-western Europe also Norway has a strong and active state. This state is, amongst other things, responsible for the governance of the primary sectors and for setting up and maintaining the appropriate institutional arrangements and "steering capacity" needed for this governance function (Peters 2001: 1). In taking care of this governance task state agencies are driven by many political considerations. However, in addition to these political considerations state governance is also related to if not, at least to some extent, based on scientific information.

In this study we will focus on the relationship between the state and science in the framework of the two primary sectors in Norway, i.e. agriculture and fisheries. This study deals with two aspects of this relationship, i.e. how are research problems with respect to the two sectors chosen, and what factors influence the use of scientific information by governmental actors.

Thematically this study belongs to a tradition in the social sciences within which science-society relationships are investigated in a broad sense. The research questions for this study have been narrowed down considerably, both in terms of what aspects of science-society relations are being dealt with and concerning the scope of the study. The study focuses on parts of the Norwegian Research and Development (R&D) system with a particular history and particular traditions. Norwegian fishery and agricultural research cannot be said to have been undertaken in an ivory tower. Researchers and research structures in both sectors are to a large extent intertwined with the society that surrounds them. The organisational history of Norwegian fishery and agricultural research is the story of science funded and organised on the basis of utilitarian arguments, utility for

farmers and fishermen, food production and industry, and not in the last place, utility for the public policy with respect to these sectors.

The first part of this study focuses on problem choice, i.e. how do researchers select their research problems. Here the central questions are:

> *What role do potential users of fishery and agricultural research play in the selection of research problems?*
>
> *To what extent is the potential application of the research results defined as important in the problem choice process?*

This implies that *user orientation in problem choice* is being investigated, i.e. to what extent do actors outside the research system have access to the problem choice process and to what extent do considerations of the use and application of science enter the definition of relevant problems and criteria of choice at the research-performing level.

The second part of the study discusses how scientific knowledge is disseminated and used outside the scientific community. Here the focus is on state agencies as users of scientific knowledge. The main question in this part is:

> *How do organisational arrangements affect dissemination and use of scientific information in government agencies in the agricultural and fisheries sectors in Norway?*

This implies that organisational factors that influence *the utilisation of research* by government agencies are being investigated. A central concern in this is not only to look for those aspects of an organisation that influence or regulate the use versus non-use of scientific information, but also to investigate different types of science utilisation.

In this chapter first a brief historical account of the two sectors in question is presented as a general background and as an introduction both to the research questions and the particular sectors that this study is focused upon. Second, the research design will be presented. Third, the research questions will be positioned in the discipline of political science. Fourth, four state models are introduced in order to briefly discuss various alternatives with respect to how public research can be organised, managed and funded by the state. Finally, an overview of the study as a whole is provided.

1.2 Agriculture versus fishery as public policy, economic, and research sectors

The two public sectors upon which this study focuses exemplify how science and research have been crucial first for developing areas of the national economy, and second historically as a vehicle for the modernisation of the traditional parts of the Norwegian society (cf. Jacobsen 1978 [1964], Schwach 2000a). The total agricultural area amounts to 3 percent of the total area of the country. In addition there are forests that amount to approximately 25 percent. In 1990 there were 85,000 holdings exceeding 2 hectare per unit. By international standards these holding are small. Five percent of the working population consist of farmers, and holdings are generally family businesses. About two percent earn their living as fishermen. Thus in terms of labour market share both sectors have become marginal for the national economy, if we only look at the primary "producers".

However, there are big differences between the fishery and the agricultural sector, in terms of their economic, political and cultural/societal role in the contemporary Norwegian society and in the development of the polity. With respect to the cultural role, the traditional and national imagery in the nation-building that took place from the mid-19th to the beginning of the 20th century is connected to the farmer and not the fisherman. The national identity was primarily linked to the farmer and the farm, and the independent farmer became the national icon that was used to evoke the national spirit as an affront to Danish rule and cultural hegemony (Østerud 1978; Wicken 2000: 65). Politically, the farmer and the farmers' movement played a much more important role than the fishery sector, and left a lasting imprint also for the modern political landscape in the shape of a political party that sprung directly out of the agrarian movement. The fishery sector has traditionally been less organised and less politically significant, and the fisheries never got the same place in Norwegian history as the agricultural sector, nor given the heroic status in the nation-building process (Wicken 2000: 66).

The difference is also clear in terms of national policy. Even before the Second World War, Parliament defined farmers' income as a domain of public concern and included it in the political agenda. In 1975 a clear commitment to a specific income objective was passed unanimously in Parliament: "Farmer's income should equal the income of the average industrial worker." This goal was said to be achieved in 1982. In agriculture the level of subsidies has during the post-war era grown to surpass the level of subsidies in both Sweden and Great Britain. There was a high level of protection of the domestic agricultural sector through import bans on foreign agricultural products, and only an insignificant part of domestically produced agricultural products was exported.

The fishery sector on the other hand has always operated under conditions of international market competition, with very little of the import protection and trade regulations that are central to the policies of the post-war period with respect to the agricultural sector. Despite the political "invisibility" of the fishery sector, the export of fishery products has become a considerable economic factor for the national economy. Economically, the fisheries industry is the backbone of coastal Norway. In the year 2000, Norway exported fish and fish products worth more than NOK 32 billion to more than 150 countries. Over half of the export value stems from capture fisheries. Most of those fish stocks are shared with other countries and require international cooperation in their management. (Hoel 2000: 1). The public policy challenge in the area of fisheries has also been framed differently. In the realm of fisheries regulations, the key challenge is to set the catch quotas at levels corresponding with the precautionary approach and sustainable yield, avoiding depletion of fish stocks. A basic precondition for realizing this is that the science required is established and delivers reliable results that can form the basis for advice. In enforcing fishery regulations, the major obstacle is to improve compliance with the regulations adopted. The major challenge in fishery science is related to improving current methods of estimating the abundance of fish stocks and getting a better grasp on the influence of climate change on living marine resources (Hoel 2000).

Consequently, one could argue that apart from being defined as economic sectors focused on primary production activities, the two areas have few common features. Yet, as we shall see, using the comparison of these two sectors as a starting-point opens up interesting lines of investigation, partly *because* of their dissimilar histories. This can, for example, be illustrated by pointing to the differences in the way in which the research structures in the two sectors were institutionalised. In the agricultural sector the Agricultural University of Norway was set up in 1859 as a purely educational institution. Research was introduced as a primary function only in the reorganisation of 1897. The history of the establishment of the Agricultural University can be read as splitting off from the University of Oslo[1]. The University of Oslo had disassociated itself from the type of education that was linked to the fields of practice, not only in agriculture, but also with respect to technical and mechanical education in general. Even though the University of Oslo was chartered to incorporate such studies in its activities,

[1] The University of Oslo was at that time named after the Danish King Frederick. It was not until 1939 that it changed its name to the University of Oslo (Universitas Osloensis).

the university abandoned this type of education, both in principle and practice, as part of its academic mission (Valen-Sendstad 1959: 35-40). Establishing a separate chair for agricultural studies at the University of Oslo had been discussed on several occasions in Parliament in the 1830s, but the university prevailed in its resistance. This paved the way for the establishment and institutionalisation of a separate agricultural higher education and R&D infrastructure that eventually became of central importance to the entire agricultural sector. The mission of the Agricultural University of Norway was explicitly linked to farmers and public administrations in the agricultural sector both in terms of the content of the education given and later in the research and experiments performed. It is clear that this core institution had a mission "of its own"; an institutional identity that was less linked to academia, and more to the sector it was to serve. It had many of the organisational structures of a research university, with the notion of academic freedom, yet "with a purpose" and specific social service mission. During more than hundred years, not only did the agricultural sector have research and higher education institutions and extension agencies with a clear mission of promoting agricultural science, but the sector was furnished with a distinct agricultural profession of "civil agronomists" with a dedication to the same values. In some respects this profession established itself as patron of the agricultural sector. It has for decades been predominantly present in all of the public agencies in agriculture, from the Ministry down to the extension agencies at the local level. For instance, 47 percent of the bureaucrats in the Ministry in 2000 had a sector specific higher education background (in Norwegian: *sivil agronom*) (Christensen *et al.* 2000). It may be regarded as a "glue" that holds the various elements of the agricultural sector together.

Fishery science and especially the Institute of Marine Research have long traditions dating back to the mid 19th century. Yet in the fishery sector an institutionalisation of a client-oriented profession and a set of institutions at the service of the sector similar to the ones found in the agricultural sector was not attempted until the 1970s, i.e. over a hundred years later than in agriculture. During the 1970s a Research Council for Fishery Science, a College for Fishery Science, and an extension service for the fishery sector were established, though at a much smaller scale than within agriculture.

Desectoralization and de-institutionalisation

Just as fishery science institutions were about to be built up and to accumulate a stronger sectoral tradition, we see in both sectors trends of a de-institionalisation of a particular client – science – education relationship. The colleges for vocational training are integrated with the rest of the education system; the Veterinary College and the Agricultural University of Norway were in 1997 transferred from the

Ministry of Agriculture to the then Ministry of Science, Education and Church Affairs. This seems to be part of a general trend, as can be illustrated by the fact that in 1993 all five research councils, including both the fishery research and agricultural research council, merged to form one all encompassing research council under the auspices of the then Ministry of Science, Education and Church Affairs. In the science and educational system the sectoral specific traits that used to be so prevalent especially in agriculture, are in some respects fading. One can discern both trends resulting in a move away from formal and direct sectoral affiliation. On a symbolic and formal level there are also tendencies towards desectorilization. One example is the tendency to change names and labels, e.g. from the Norwegian Agronomist's Association to a more sector neutral name (Nature Managers' Association). This trend can be seen also in the kinds of themes included in research programmes, as well as the shifts in terms used in these programmes, e.g. from agricultural to rural, from agricultural production to food and nutrition, and from agricultural production to nature conservation or management. This might reflect a flight from concepts associated with traditional agriculture. In the eyes of the general public this may seem as a merit of necessity, since the legitimacy of traditional agriculture is being questioned. For example, at the beginning of the 1990s for the first time in Norwegian modern political history it became politically feasible to attack the level of agricultural subsidies and highlight the consumer interests as not always compatible with traditional structures of food production.

Sectoral research in transition

The arguments for public support of agricultural and fishery research are manifold. The goal complexity reflects compounds of objects stated for the national agricultural and fishery policy. In fishery research there is a main split between *resource management* research (research as the basis for decisions concerning quotas and a fishery policy for sustainable yield), versus research on technological and natural science for *economic development*, both in the traditional fisheries and aquaculture. During the 1980s the latter has been given stronger emphasis in policy statements and in organisational arrangements, most notably through the launching of aquaculture as a national target area in research. Traditionally agriculture has been viewed as the most research intensive *qua economic production* of the two primary sectors, but especially with the rise of aquaculture the Norwegian fishery production has become more research based.

As a consequence of the declining economical role of agriculture, the research agenda, at least at the research policy level, has changed. With problems of overproduction and pollution from modern agriculture, and a dwindling public support for a high cost agricultural sector, the arguments for state support of agricultural

research have shifted from the contribution of research to increased productivity, to arguments linked to nature conservation, environmental and ecological research, and research as problem solver for the societal and economical problems in the rural areas in general. Examples of the latter include research for rural tourism and stopping the drain of women from rural areas, and research on culture landscapes. At the research policy level Norwegian agricultural research was linked to new actors and new problem areas throughout the 1980s and 1990s. In the fishery sector the R&D system has also gained new audiences and new participants in decision-making, but here mostly due to the introduction of aquaculture in the 1970s. The latter represents a significant change in the concept of the fisheries and the role of science in the sector. Aquaculture makes the fishery sector in many ways more similar to the agriculture sector, amongst other things, since it does not represent so much the issue of reaping natural resources as cultivating them, with the societal, technological and economic changes that entail (Christensen 2000: 132-133)

Organising sectoral R&D

In agriculture and fishery sectors research is organised according to the so-called sector principle (cf. Brofoss and Wiig 2000: 91-94). Also as far as the science policy for the sector is concerned, the Ministry is the pivot of the political administrative system in both sectors. The Ministry of Agriculture and the Ministry of Fishery have the responsibility for organising, funding and working out an overall science policy in their sectors. According to the research policy doctrine a sector responsibility concerns not only the Ministry's own needs for research; it entails the responsibility for research and knowledge production for the *entire* sector, thus including research for clients outside the domain of public administration in the fisheries and in agriculture[2].

The Ministries are formally the centres of most of the R&D activities in these sectors, given the fact that agricultural and fishery research are public activities both in terms of funding and in terms of the status of most of the research institutions in these sectors. Both Ministries rely mainly on a combination of supporting research through their own government research institutes, channelling funds through the research council (with emphasis on funding of research programmes and target areas), and through commissioned research or governmental R&D projects.

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[2] The sector principle was importantly modified in the mid 1980s by introducing a stronger role for the research council and channeling Ministerial funding of the long term, basic funding of especially the institute sector and research programmes.

Particularly within agriculture, the sector principle of organising research was fully applied in the 1980s and 1990s. Every major subunit in the Ministry had its own research institute in the corresponding field, e.g. the Agricultural Ministry's veterinary department had the responsibility for the Norwegian School of Veterinary Sciences and the National Institute of Veterinary Research; the department of agricultural policy and economics had its own Institute for Agricultural Economic Research; the forestry department had its Institute of Forest Research. By and large, the sector principle in research was highly institutionalised. The agricultural sector had the strongest traditions for institutionalising the state – research relationship, with an agricultural university established in the middle of the 19th century and most of the other research institutes set up at the beginning of the 20th century. With one major exception (the Institute of Marine Research, 1912), the fishery sector is somewhat newer in terms of institutions. The research council was established in 1972, and most of the sectoral institutions for research and higher education were established during the last 20 years. Yet, the history of the Institute of Marine Research amply demonstrates the tight links between public administration and policy, and the corresponding scientific enterprise in this sector already at the turn of the 19th century (cf. Schwach 2000a, 2000b).

These are truly organisational structures for applied research, with strong formal links between research institutions, research councils and the public administrative apparatus. Nevertheless, the way the R&D system is organised and operates reflects the different, and to some extent, competing functions research has in these sectors.

1.3 Research design

The research strategy for this study encompasses a quantitative as well as a qualitative part. For the purpose of this study we conducted a mail survey among agricultural and fishery scientists in the Norwegian research system. The mail survey was aimed at gathering data at the level of research projects, especially with respect to problem choices, scientists' contacts with users, as well as the organizational arrangements surrounding research projects.

The qualitative part consisted of in-depth interviews that were conducted with middle and lower level bureaucrats in selected units in the government agencies. These units include three departments in the Ministry of Agriculture, two sections in the Ministry of Fisheries and the Directorate of Fisheries, two of the government agencies for the fisheries located regionally, and parts of the

Norwegian Agricultural Advisory service. In addition, interviews in one section in an agency that is not formally part of the sectoral bureaucracy were conducted, the Directorate for Nature Management. The interviews were conducted to gather information about the contacts between bureaucrats and researchers, and the use of and need for scientific information in government agencies. The analytical framework for the study has been designed in such a way that it serves the overall purpose of the study, that is to clarify how properties of organisational context influence problem choice, the search for, exposure to, and use of scientific information in organisational decision-making. This is reflected in our survey sample, and the selection of interviewees.

Note that this is not a study on the use of sectoral research in policy-making *per se*. Instead this is a study on how science and research are used in the actions of bureaucrats. This is a study about what government agencies do, i.e. the whole range of activities, which includes in addition to strict policy-making and policy-implementation work, also activities such as writing internal papers, preparing politicians' speeches, communicating with colleagues from the same Ministry and from other Ministries and agencies, etc. This does not imply that we want to suggest that studying the use of research in policy-making and policy-decisions is either irrelevant or empirically impossible (see, for example, Rich and Oh 2000; Hanney *et al.* 2003). Rather we wanted to include both the process of problem choice and utilisation of scientific knowledge and information by bureaucrats in our study, implying that we did not want to limit ourselves beforehand to "only" examining the question of utilisation in strict policy-related decision-making processes within government agencies. In that sense the "everyday life" of bureaucrats within the two sectors has guided the development of our study design.

More detailed information on both parts of the study can be found in appendices I and II.

1.4 Science as an object of study in political science

Political science as a distinct discipline is defined not so much by a common theoretical and methodological approach as by the *object* of study: political institutions and political processes (March and Olsen 1994: 2). How then can a science-society study be considered part of political science? There are two main reasons why the research questions of this study fall within the realm of political science. First, the object of study is broadly speaking "science policy" or *policy for*

science. Science has since the end of World War II been a policy sector marked by state involvement. National governments have become the main mentors of science. This is a common trait to all countries that are involved in scientific activities, regardless of political and economic regimes (Solingen 1994). How science policy is organised and implemented varies considerably across nations and over time. Nonetheless, public funding of scientific activities remains an important feature of research systems. In Norway, for example, about 50 percent of the gross domestic expenditure on R&D is invested by the government. Thus scientific activity relies heavily on public money and government budgets. Consequently, decisions made in the political system are crucial to the research system, as it is dependent on the shape and direction of a national *policy for science*. This in itself could be seen as a rudimentary argument for studying science policy and how it affects science and knowledge production from a political science perspective. However, mainstream political scientists have not been moved to any large extent to undertake such studies. In the present context, investigations of effects of science policy correspond to the first part of this study.

Another aspect of this study pertains to how science affects policies and politics: what is generally labelled *science in policy* (Jasanoff *et al* 1995). This has been more frequently an object for political science investigation - largely in terms of studying the role of scientific advisors (Gilpin 1962; Snow 1961; Solingen 1994; Jasanoff 1990). Hence, the second part of this study turns the focus from the scientific community to the political-administrative apparatus and investigates the role of scientific information in public administrative action and decision-making, in short the knowledge basis for public policies and government activities and actions. This part can be seen as belonging to the political science tradition of studying public bureaucracies, public administration and policy.

The role of scientific information as a knowledge basis for government activity should be considered as an important area of study since we can assume that knowledge is essential to social problem solving. However, as an explanation to failure or success in problem solving this topic is studied less than social conflicts, government organisation, and so on (Lindblom 1990: 45-55). Research and science are of interest not only in their own right, but also because the patterns of interaction between science and government are framed by the research policies of the government. At least we can assume that there is a relationship between a *policy for science* and *science in policy*. In that sense the links between the two main research issues are explored within the framework of this study.

Finally, it is not taken as a point of departure that the science-state relationship is in essence bilateral. Instead it is assumed that it involves a "third party" – at least

this is the case in the fields of science this study focuses upon, hence the title of this study. In agriculture there is a visible and acknowledged group of clients at whom agricultural policy is directed and this group overlaps with the group of clients that are considered to be the users of science, in addition to the users that are within the government policy-making system itself. Traditionally, the definition of clients of fishery *policy* and fishery *science* has been less visible and less overlapping, compared to the situation in the agricultural sector. Nevertheless, this study takes as a starting-point the triangle consisting of science, society and the state, where "society" is represented by those societal groups that are considered to be the clients of both public policy and of the research in a given sector. We will retrieve these broad categories in the analysis of both knowledge production and knowledge utilisation.

Before discussing the research questions introduced above in more detail, first these questions will be positioned in a general framework for understanding arguments and structures in the relationship between science, clients and the state. In addition, we will outline the role given to and the structures that surround science in the agriculture and fishery science. Below it will be discussed how a research system and the science-state relationship in practice are modelled upon different overall models for the relationship between knowledge production and the state system. By using four models that depict the relationship between science and the state, we intend to define in overall terms the different roles of science that are reflected in the relationship between the sectoral research system and the state in the two selected sectors in the particular context of post-war Norway.

1.5 Agricultural and fishery sciences in a heterogeneous state

Science and the state

In modern democracies there is a mutual dependency between science and the state. The scientific community is largely dependent on government funding. In addition, the state is responsible for establishing and securing institutions within which a large part of the scientific activities are performed. In "return" the state relies on science and technology to secure its core cultural, political, economic, and strategic viability (see, for example, Solingen 1994). Science is thus a considerable political resource. It offers a knowledge base for policy-making, it is put forward as a vehicle for economic growth, and in many countries it is a stronghold in maintaining and developing military capabilities. Furthermore academic research and science provide the foundations for training and education of political and

bureaucratic leaders of the civic society, as it is the basis for higher education in general. In specific areas of politics and policy, the role of science is looked upon as essential, most notably in the military and defence sector, in industrial policy, and in public health care (Hanney *et al.* 2003), and as will be amply pointed out, also in agriculture and fisheries. In addition to these arguments for the national support of science as the basis for rational technical political action, the "alliance" between science and government has aimed at the "enlightened democracy" (Ezrahi 1990: 2). The rationale for science is based not only on the need for political and material growth, but also on upholding and developing cultural and social values.

Four models have been introduced by Olsen (1988) to depict the development of the modern welfare state in a Scandinavian setting. The starting-point is the assumption that majority rule in the Scandinavian democracies is balanced by different values and principles for state governance. These principles and values are illustrated through these models that provide different answers to questions such as: What are the responsibilities of the state? What are the roles of the public/citizens? What kinds of organisational forms are appropriate? They point to differences in two underlying sets of rules determining state versus society relations within a policy subsystem, each model epitomising the nature of state encroachment on different aspects of society. Olsen (1988) suggests that the four models can be retrieved in Western democracies in different blends. In addition, their relative prominence may shift over time, and from one societal sector to another. The result being a heterogeneous state consisting of different organs and sectors not necessarily applying the same approach to government steering and control. Changes in this approach may occur without necessarily doing away with the remnants and institutional arrangements of former approaches. The models embody different democratic ideals and views of the role of the state, the public and government agencies. The models also provide different types of answers to the question why and under what conditions governments want to give agencies more autonomy. In contrast to models applied in higher education research the issue of whether or not institutional autonomy and self-regulation are part of a steering approach is not made into the defining characteristic of the models (Gornitzka and Maassen 2000). Rather all models can operate with agency autonomy, only the justification for it and underlying ideas of such autonomy are different (Olsen 1988: 237). The four models are: the sovereign state; the institutional state; the corporate-pluralist state, and the classical liberal state. Below the main characteristics of each of the models are summarised.

"State models" in the present context refer to different approaches to the national government's control and steering of research and higher education institutions

(Gornitzka and Maassen 2000) as well as to the institutional context of policy processes. The way in which research in the Norwegian agricultural and fishery sectors has been organised, managed, and funded reflects a complex web of different interests, values, and decision-making principles. The purpose of this section is to use the four models for focusing on the different roles of agricultural and fishery sciences, and different interests and principles of decision-making connected to research in these two sectors that coexist in contemporary Norway. These models give different answers to the underlying questions in this study, i.e. who are the clients of science, and what organisational forms and structures of governance are appropriate between these clients, the state, and the research system. Some basic characteristics of each model, and the principles, values, and types of organisational forms that are in general associated with them, will be discussed briefly, before the role of research is discussed and the question whether traces of any one of these models can be found in Norwegian agricultural and fishery science towards the end of the 20th century.

Agricultural and fishery science in an institutional state model

In an institutional model certain public institutions have a special responsibility to protect certain values and traditions against the whims of shifting political regimes, the shifts in coalitions, and short-term interests of lobby and interest groups. In the field of research and higher education this model is probably best exemplified through reference to the relationship between the state and the old elitist universities, where there was a shared understanding as well as unwritten conventions of state non-interference between state civil service and universities.

Within this model the state represents a political and moral order. The state is a collection of long lasting operating procedures reflecting values and principles that are shared. The role of the public is basically that of citizens with rights and duties. The role of the state is to safeguard common values, interest and traditions, and to secure autonomous institutional spheres. The role of the public organisations and agencies is not as a neutral instrument, but as carriers of missions, values and identities. Their autonomy is based upon a shared norm of non-interference and an appeal to higher and more stable values than numerical democracy, majority decisions, ministerial responsibility or interest group bargaining. Changing such institutions is not done overnight by new political leaders or by a winning coalition of interest groups. It takes time.

Typical public organisations associated with the institutional state are the independent court or the *ombudsman*, and the traditional university with its independence from political, economical and other interests in pursuit of the values and interests embodied by the traditions of academia. This includes the

notion that the scientific mission should not be influenced by changes in political or economic power.

Does this kind of model have anything to do with the scientific institutions in agriculture and fishery? Do these institutions and the scientists working for them have a role as carriers of a mission, and of values of which they are the guardians? First, a major part of agricultural and fishery research is conducted in a university setting: the Norwegian Agricultural University and the College for Fishery Science. Whether researchers are working in a university setting compared to a government research institute setting, we assume, affects the actions and choices that are made at the research performing level. This organisational dichotomy is assumed to have implications for governance relations *vis-à-vis* the Ministry and management of research *within* the research institutions. This distinction is important in much of the analysis in this study and it is discussed in detail in chapters three, four and five.

A look into the arguments for public support of research and the prevailing organisational arrangements reveals how sectoral research institutions are seen as carriers of cultures, missions, values, and identities independently of the current political administrative or societal demands for research and scientific knowledge. The Ministries have, for instance, institutionalized mechanisms that protect the research institutions from too strong an influence from the political-administrative hierarchical governance structures, and overall the research institutes have been given considerable autonomy in many areas.

Additionally, there is a strong *tradition* of non-interference in the state-research relationship. Research institutions in these sectors are also carriers of values of a search for truth that limits the hierarchical governance and user influence on these institutions. This ambiguity will be analysed as part of chapter seven in this study.

Agricultural and fishery science in a sovereign, rationally-bounded state model

This model is closely associated with the interventionist state or model of state control, in which research is seen as an instrument for reaching economic or social goals. That role is best upheld by tight control over research institutions and a strong emphasis on them being accountable to political authorities.

The role of the state in this model is to govern society, according to the preferences, plans and visions of the good society held by the elected political leadership. The public appears as voters every fourth year and the rest of the time they have their role as subordinates. The dominating organisational forms are the

neutral agencies as an instrument in the hands of the elected political leadership. The role of research in this model is as a policy instrument along with others. This is clearly reflected in the way that the non-university part of agricultural and fishery research is organised. The description given above of organisational arrangements in agricultural and fishery research leaves no doubt that research is organised to be a link in a hierarchical chain going from the politically elected leadership via the state bureaucracy in these sectors down to research performance level. In other words, a research structure with its raison d'être in the capacity to be an instrument in an overall sectoral policy in a sovereign state. The classical example is the government research institute doing applied research as well as administrative tasks for the corresponding department in the sectoral Ministry.

As we shall see in this study the instrumental role mentioned above is a significant aspect of the role of research in these two sectors, a function that has become increasingly important during the 1990s. Especially the Ministry of Agriculture used its governmental research institutes more actively in its own policy formulation and implementation activities. The hierarchical governance of these institutions became stronger, and the political administrative apparatus perceived itself as the main "client" of science. For traditional fishery science this has been the case all along. The Ministry and the Directorate of Fishery have been the main clients of the sectoral research, often leading to conflicts with fishermen, for example, when the annual decisions on the quotas of North Sea cod are made on the basis of research results.

Agricultural and fishery research in a corporate-pluralist, bargaining state model

This model challenges the view that the state is a unitary actor with monopoly over power and control in society. Rather it assumes that there are several competing and legitimate centres of authority and control. The delegation of authority to a network of boards and committees brings together interest groups acting on the basis of their own interest. The state is not only negotiating and bargaining with different interest groups in society, it is itself a conglomerate of different interests. Changes in public organisations come about as a result of changes in a constellation of interests, resources and alliances. The presence of the corporate bargaining state is highly visible in the agricultural and the fishery sector. Not only in the annual negotiation preceding the fishery and agricultural agreements, but the corporate traits are also present in policy formulation and implementation.

Clients in an institutional state are regarded as being part of a patron-client relationship, with a tradition of commitment between science and agriculture and to some extent also fishery. In a sovereign state model the clients of science are

seen are state agencies with the possibility of hierarchical control. In a corporate-bargaining state on the other hand clients are interest groups that bargain over pieces of the research pie. To some extent agricultural and fishery sciences is seen as a good that interest groups bargain over. The organisation of agricultural and fishery research has a strong element of user influence in terms of a system of interest representation. This reflects the belief that the research system will take into account different aspects of potential applicability when different groups are given access to decision-making bodies. In this respect the R&D system has clear traces of the *corporate-bargaining* state, so dominant in post-war social democratic Norway. All through the post-war period the organisation of the R&D system in agriculture has to some extent reflected the heterogeneity of different interests. However, during the late 1980s and early 1990s the definitions of relevant interests for this research sector have changed alongside the shift in goals for agricultural research and the search for a new legitimisation basis for this kind of research.

For the Agricultural Research Council, the period 1981 to 1991 marked the era of the introduction of non-sectoral representation at the expense of the number of representatives from the agricultural political administrative apparatus and the farmers' associations. In 1981 the advisory boards' only representatives from outside the agricultural sector were two members appointed by the Ministry of Finance and the Ministry of Environment (Gornitzka and Schwach 1990). In 1991 the non-sectoral representatives formed the majority among the members appointed among users. Still, representatives from the agricultural scientific community constituted the largest group represented in these bodies. In these governing bodies the changes in arguments for continued funding of agricultural research were matched with the introduction of representatives from the new interest groups.

Likewise, the surge of research programmes in the 1980s in both these sectors not only served to emphasise the utilitarian arguments for the public funding of research. Its organisational form, with boards and committees as governing bodies, has also strengthened the role of interest representation in the research system. This was visible in the committee structure of the new merged research council.

Agricultural and fishery research in a supermarket state model

Here the role of the state is minimal. In its crude form it assumes that practically all state actions and activities by public bodies will be less efficient, effective or just, than the activities of private individuals relating through the market (Miller and Edwards 1995). The role of research institutions is to deliver services. The criteria for assessing research institutions are efficiency, economy flexibility and survival. The role of the state is that of the bookkeeper for the great necessities, amongst

other things, to make sure that market mechanisms with respect to research activities and higher education run smoothly. There is no dominant arena of policy-making, as a result of an extreme decentralisation. Decisions are individualised, except for the state as "night-watchman". Social participation takes place through market action. The domain of government interference consists of strengthening the self-regulating capacity of research institutes. The dominant organisational form is similar to the corporation embedded in a competitive market. The autonomy of research institutes depends on their ability to survive. Change of research depends on the rate of stability or change in the environment. Whereas the supermarket model has elements in common with the corporate-pluralist model, especially when it comes to the stakeholders involved in the playing field, there is (at least) one crucial difference. In the corporate-pluralist model, stakeholders have their stake because their role is legitimised *a priori* and often institutionalised, for example, in the case where confessional groupings play a role, whereas the stakeholders in the market model "earn" their position because of the resources they have available. Until the mid 1990s this model had less relevance for most of the core research done in the two sectors since it was largely a publicly funded activity done within state owned institutions. In the R&D-sector in general there were from the early 1990s on signs of the mergence of a stronger market orientation, such as changes in the formal status of research organisations from state owned to independent research institutions, stronger emphasis on a diversified funding structure, increase in external funding of university research and increase in the ministries' use of competitive bids for research projects.

Conclusion

Institutional discretion, ministerial governance, and interest group influence within the research system for agricultural and fisheries exist in a state of tensile balance. A mixture of different interests and principles of decision-making can be observed in the research system as a whole and a certain blend at the level where research is performed. This is certainly not a balance that is fixed in time and space. One of the most interesting aspects of agricultural and fishery science is how the blend of interest and decision principles changes according to what part of the research system one is looking at and how this balance changes over time. As far as can be seen, the 1980s brought developments in two directions. The first step incorporated a trend towards a "de-institutionalisation" of the traditional science-clients relationship in agriculture and to some extent in fishery, a development in which university/college research is starting to move away from its traditional clients and is formally becoming more like the non-sectoral colleges and universities. Note, however, that this is a very slow movement and perhaps somewhat of a silent revolution. On the other hand we have seen trends in which

the government research institutes are becoming more integrated in the political administrative hierarchy - the state has become more important as a client of science and research institutes are more used as instruments in a changing sectoral policy arena.

The main features of the four models are summarised in Table 1.1.

Table 1.1 The main features of the application of four state models (Olsen 1988) in agricultural and fishery research in Norway

	Institutional state model	Sovereign, rationality-bounded state model	Corporate-pluralist state	Classical liberal ("supermarket") state
The role of research	Uphold traditions, academic freedom, and a responsibility towards the history of research institutions, store and transmit knowledge, secure future independent pursuit/transfer of knowledge, act as a carrier of culture, uphold and protect its special institutional sphere	Implement whatever political objectives are on the research policy agenda	Reflects the constellation of interests voiced by different organised interest groups in the sector, such as unions, professional associations, industry or regional authorities	Deliver services
Criteria of assessing research	Effects on the structure of meanings and norms	Political effectiveness of institutions	Usefulness for various interest groups	Efficiency, economic flexibility and survival
Dominant organisational form	Similar to an "independent court" embedded in a moral order	Similar to an agency embedded in a government hierarchy	Similar to a network of mutually dependent countries	Similar to the corporation embedded in a competitive market
Change of research	Through historical processes; evolutionary rather than as a result of "reform". According to logic of academia	follows changes in the political leadership via elections or changes in political coalitions	Depends on changes in power, interests and alliances	Depends on the rate of stability or change in the environment.

Research can thus serve heterogeneous and changing functions and roles, and this sets the background for the research questions that are addressed in this study. The empirical part of this study does not cover the history of agricultural and fishery sectors, but it is set in the specific context of these two sectors in the first half of the 1990s. As we have indicated above, this was a period where the balance between different functions of research and ways of organising research and the relationship between the state and the research system were changing or on the brink of change.

1.6 Overview

The first part of this study is focused on the production of knowledge, i.e. the work that goes on *within* research organisations at the research performing level. One way of approaching the science-client relation in this area is to examine how, if at all, external influences are part of an important aspect of any research process: the selection of research topics. How do researchers select problem areas and specific problems to work on? The latter phenomenon will be referred to as *problem choice*.

Why this focus on problem choice? Problem choice is of interest in the study of science in the first place because it is important in defining the areas to which scientists give attention, thereby determining collectively the future arenas of scientific investigation and possibly the scientific forefront. In addition, problem choice is also of relevance because the choices made entail specific social formations, such as the establishment of "invisible colleges" and specialities in science (Zuckerman 1978: 66). In connection with the overarching question in this study, problem choice is singled out for investigation because it is assumed to be an important factor in determining the relation between specific research communities and their potential user groups, i.e. actors that potentially will use the outcomes of their research.

In this study the two core questions with respect to problem choice are: Who are involved in the process of problem choice? And: What are the relevant criteria for making choices as regards research topics? In addressing these questions the main focus will be on the role of potential users of the findings of science. These clients can be involved in problem choice in two ways, i.e. either as a direct participant in choice processes, or through the fact that participants stress those criteria of choice that reflect the wishes and needs of different client groups. In the latter case the users of the findings of science may have "spokespersons" who see to it that such wishes and needs are part of the choice criteria. On the basis of these two

aspects this study aims to uncover degrees of user-orientation in problem-choice.

The reasons for user-orientations to vary may be idiosyncratic, haphazard, or accidental. Besides, it might not even be possible to pinpoint all the underlying causes with the available data, even though these data will be used to examine a number of factors that could provide some explanations concerning the aforementioned variations. In addition, also other issues related to problem choice will be discussed that are at least as important for understanding it as the degree of user-orientation, for example, the factors that can be argued to regulate and affect the access of participants to and the inclusion of specific wishes, needs, and concerns in problem choice.

Since this study is in general aimed not only at exploring specific aspects of problem choice, but also making an effort to explain them, it is necessary at this point to outline a theoretical point of departure upon which such an explanation can be based. Problem choices are not made in a vacuum; neither have studies of such choices been undertaken in isolation. A long, but heterogeneous line of science studies constitutes the necessary backdrop of this study. In chapter two the theoretical and empirical work done in the field of science studies is discussed in order to single out the elements that are part of the theoretical approach to the study of problem choice in this particular context. In chapter three we continue this discussion by focusing on the underlying assumptions and expectations with respect to user-orientation in problem choice. In this chapter the hypotheses for this study are introduced. In chapter four the main findings are presented of the empirical study on problem choice in the sectoral research structures in Norwegian fisheries and agriculture. In this chapter an overview of actors and criteria of choice is given, as well as the level of variation in problem choice according to some of the main explanatory factors discussed in chapter three. The overall model and the testing of the hypotheses with respect to what explains variation in problem choice are presented.

In the second part of the study we turn to the issue of knowledge utilisation, i.e. how research is being used by actors outside the research organisations. Here the focus is on the utilisation of research by one important group of clients, namely public agencies in agriculture and fisheries. We realise that drawing a line between producers and users of scientific knowledge can be regarded as a controversial distinction. Users can to some extent be regarded as being part of the knowledge production process, and utilisation can be seen as an integral part of knowledge production itself. Further maintaining a distinction between the two types of actors or processes has been contested in science studies. However, both on theoretical grounds and for analytical purposes we regard it as important to make such a

distinction in this study. In this part of the study the following assumptions are made. First, utilisation can be studied separately from knowledge production. Second, it is assumed that scientists have a distinct role in relation to public policy-makers, and third that the organisations the scientists and public policy-makers belong to have separate missions and characteristics.

In chapter six the analytical framework for the study on the use of scientific knowledge is presented. This theoretical approach draws first on the specialised framework for analysis that has been developed in "utilisation studies" and second on general theories of organisational decision-making. Chapter seven contains a presentation and analysis of the main characteristics of the interaction between science and politics. In addition the flows of information between research units and government agencies in the public administration of the two sectors are examined in this chapter. In chapter eight the ways in which scientific information is used by governmental agencies in the two sectors are analysed. The analysis is mainly organised around the concepts of research utilisation discussed in chapter six. Finally in chapter nine the main findings of the study are summarised, and a reflection is given on some of the biases of the research design of the study.

2 Theoretical backdrop for the analysis of problem choice

2.1 Introduction

An overview article of studies of problem choice of scientists published in 1978 distinguished three elements that frame choices and used them for categorising the factors that influence the opportunities and constraints in problem choice. The three elements were 1) attention structures embedded in theoretical commitments, accepted scientific laws and the prevailing concepts and labels; 2) social processes internal to science; 3) extra-scientific influences such as the economic and military needs (Zuckerman 1978). Based on this grouping this study can be regarded as highlighting the third group of factors, i.e. the influence of "society" on problem choice. A major concern will be to examine how, what some would call, the "extra-scientific" influences concur with what has been labelled the cognitive and social aspects internal to science. However, the development of science studies in the 1980s and 1990s has challenged the whole notion of categorising the forces and mechanisms that are at work in science in this way. The purpose of the following sections is to establish a framework for analysing the research issue in question, by bringing together the insights from traditional sociology of science and the more recent theoretical trends into a neo-institutional approach to the study of science.

2.2 Social norms and scientific action

Merton and the scientific ethos

Usually cited as the founding father of the sociology of science, Robert Merton introduced the idea that scientific activity is governed by a set of social norms embodied in the scientific ethos:

> *The ethos of science is that affectively toned complex of values and norms which is held to be binding to the man of science (Merton 1968:605).*

The norms are imperatives for scientists to act in specific ways, no matter what the instrumental future oriented motivation dictates. If we see action guided by norms as non-outcome oriented action where norms of action are "shared by other people and partly sustained by their approval and disapproval" (Elster 1989b: 99), then we can view Merton's contribution indeed as a theory of science driven by social norms. Merton claims not only that there are sanctions applied to any breach

of norms, but also that these norms are internalised:

> *These imperatives, transmitted by precept and example and reinforced by sanctions are in varying degrees internalized by the scientists, thus fashioning his scientific conscience or, if one prefers the latter-day phrase, his superego. Although the ethos of science has not been codified, it can be inferred from the moral consensus of scientists as expressed in use and wont, in countless writings on the scientific spirit and in moral indignation directed toward contravention of the ethos. (Merton 1968: 605-606)*

As such, Merton points to the two pillars of an explanation of human action in terms of social norms. First, people act according to norms that are upheld both by a system of sanctions and rewards at the social level. Second, there are personal, internal accompanying emotions that sustain norms. Accordingly, we cannot see the ethos of science without considering the social system of science. Scientific activity cannot be understood without relating it to a "community of scientists", i.e. the set of norms is embedded in the social structure that surrounds science. The social norms that Merton pointed to do not exist independently of social systems.

What are these norms that apply particularly to the scientific community? First the norm of *universalism*: the acceptance or rejection of claims entering the list of science is not to depend on the personal or social attributes of their protagonists (Merton 1968: 607). Second *communism* refers to the norm of common ownership of goods. The substantive findings of science are a product of social collaboration and are assigned to the scientific community. The scientist is obligated to share his findings with the rest of the scientific community. Furthermore, norms of *disinterestedness* and *organised scepticism* imply that the actions of scientists should contribute to the interests of science and truth seeking, and not to specific interests of groups and individuals. In addition, researchers are under the obligation to publicly criticize the work of other scientists. This is not to say that scientists operate under norms of altruism:

> *... rather [it is] a distinctive pattern of institutional control of a wide range of motives which characterizes the behavior of scientists. For once the institution enjoins disinterested activity, it is to the interest of scientists to conform on pain of sanctions and in so far as the norm has been internalized, on pain of psychological conflict." (Merton 1968: 607).*

Merton introduced this ethos as a set of norms that is valid for "science in general". These norms are also a *description* of a set of norms that is operating within the scientific community. His claim is that the scientific ethos is not just a set of ideals to which scientists pay lip-service. As a consequence, this represents a fairly strong claim about the scope of his theory. For supporting this contention

Merton used mostly biographies of famous scientists. He underlined the importance of the reactions within the scientific community to instances where action was contrary to the norms of science. The indignation by one's peers that is associated with breaking norms is an important indication that social norms are operating within a social group. "Social norms have a grip on the mind that is due to the strong emotions they can trigger (Elster 1989b: 100).

Counter norms in science

Later works have questioned both the centrality of the set of norms Merton pointed to for explaining scientific activity, and the existence of a common scientific ethos (Gaston 1978; Hansen 1988). The consequent empirical testing of Merton's theory did not lead to conclusive evidence (Mulkay 1977; Zuckerman 1988). Others have stayed within his theoretical framework, yet claimed that the evidence indicates the existence of a complex set of norms that operates alongside and sometimes contrary to the set initially conceptualised by Merton. Their claim is that the ethos of science Merton pointed to, is far too general to be of any help to students of scientific behaviour - it is more a lofty ideal that has little to offer as an explanation of why scientists do what they do.

Mitroff's study of Apollo moon scientists may serve as an example of a study that re-evaluates Merton's original contention without discarding it (Mitroff 1974). Merton's image of the norm-guided scientist conducting disinterested and emotionally neutral research is to a large extent corrected by Mitroff's study. The latter puts forward a set of counter-norms comprising norms of particularism, secrecy, interestedness and organised dogmatism.

The scientists studied by Mitroff are generally characterised by a strong emotional attachment to their scientific investigation. As such, they are the opposite of the disinterested non-personal scientists that a Mertonian ideal would predict.

> *X is so committed to the idea that the moon is Q that you could literally take the moon apart piece by piece, ship it back to Earth reassemble it in X's backyard and shove the whole thing ..and X would still continue to believe that the moon is Q. X's belief in Q is unshakeable. He refuses to listen to reason or evidence (Mitroff 1974: 586).*

They claim their results to be their own private property; they are expected to promote the interests of their "invisible college" and fend off attacks on their paradigm. The identification of a specific set of counter norms is probably not the most interesting aspect of Mitroff's study. Rather it points to the possibility of a complex set of norms that works parallel to the Mertonian ethos: norms that are prominent in one situation are subordinate to counter-norms in other situations. However, the breaking of norms does not mean that they do not exist or are

unimportant. Scientists work under conditions of normative ambivalence (Mitroff 1974:593-594). This is a highly plausible conclusion. If we grant that social norms are conductive to human action, we would indeed expect that different and possibly conflicting sets of social norms coexist and that references and adherence to such norms are situationally contingent (Elster 1989b).

However, another interpretation of the evidence that Mitroff presents is that the behaviour he uses to identify a set of counter-norms, is not an instance of norm-guided action, but rather a description of patterns of action that arise when scientists behave like rational, calculating individuals. In such a perspective, deviant behaviour, i.e. deviant according to Merton's scientific ethos, occurs where social norms lose their grip as a guideline for scientific behaviour. This issue will be addressed later in this chapter. Mitroff's point is nevertheless well taken. There may not be a one unitary set of dominant scientific norms that can serve as a valid and comprehensive explanation of scientific action. Possibly a more fertile approach is to look for norms that are specific to scientific sub-groups and that might be put forward as important determinants of action on a more specific level than "the scientific community" as one entity.

Critique of social norms as explanation of scientific action

From the point of view discussed in the previous sections, scientific action and belief are to be understood in terms of "technical-rational" considerations imputed to scientists and upheld by the social system that surrounds scientific investigation. In most treatments of the origins of social studies of science the Mertonian approach is connected to the functionalistic school in sociology (Barnes and Edge 1982: 2; Mulkay 1991: 62; Restivo 1995). The conformity to norms is maintained by an effective system of control, and these norms are functional for science – reliable scientific knowledge will be produced only in so far as these and no other norms actually guide scientists' actions. Douglas (1986: 31-43) argues, extending Elster's (1983) analysis of functional explanations in the social sciences, that the problematic aspect of most functionalist explanation of human and social behaviour lies not in its functionalism, but in the lack of completing the logical requirements of a functional explanation of human action[3]. Discussions of

[3] If we apply Merton's functional approach to the study of science in terms of Elster's five requirements to a functional explanation (Elster 1983:57), it may look like the following. (1) Good science is an effect of adherence to a scientific ethos. (2) Good science is beneficial for the scientific community and the society at large (3) Good science is unintended by actors adhering to the ethos of science. (4) Good science, or at least the causal relation between norm adherence and good science, is unrecognized by scientists. (5) Good science maintains the ethos of science by a causal feedback

functionalist explanations are more salient in questioning the emergence and maintenance of a scientific ethos, than as a factor in explaining action. With respect to the latter case it should be questioned whether a set of norms exists and to what extent it motivates action, instead of discussing how and why a scientific ethos came to be. As Hansen (1988: 34) indicates, a problematic aspect of Merton's way of invoking social norms as explanation of scientific action is that his level of abstraction and unit of analysis, "the scientific community", is too all encompassing and general to make it a useful point of departure for studying scientific activities in specific cultural, organisational and historical settings and for understanding mechanisms in operation in particular instances. However, there is no immediate need to toss aside the idea of understanding scientific activities as instances of norm-guided behaviour all together.

A mainstream of critique originating from the social studies of sciences itself does not follow this line of questioning. Rather, it basically trails the paths usually associated with a critique of social norms as explanation of human action in general. As suggested by Elster (1989c), such objections generally centre around two arguments. First, social norms are not real, i.e. they have no independent motivating power. Consequently, social norms can never motivate action, but rather they represent ex-post rationalisation of human action. According to this argument reference to social norms serves some ulterior purpose. Second, norms are not "autonomous". They can be understood as an instrument used to achieve some end, what Elster calls optimizing mechanisms in disguise (Elster 1989c: 130).

Of the two arguments against explaining human action in terms of social norms the former argument figures prominently in the critique of Merton's theory of the scientific ethos. Students of scientific activities claim that Mertonian norms represent an idealisation of the scientific method. Referring to a scientific ethos is rhetoric to uphold the status of science in society (Mulkay 1979). The norms of science are nothing more than rationalised self-interests to make sure that the "dogs can go on with their doggy life". Mulkay (1991:69) states in his discussion of the social norms of science that:

> *In science, then, we have a complex moral language which appears to focus upon certain recurrent themes or issues; for instance, the procedures of communication, the place of rationality, the importance of impartiality and commitment, and so on. But no particular solutions to the problems raised by these issues are firmly institutionalized. Instead, the standardized verbal formulations to be found in the scientific community provide a repertoire which can be used flexibly to categorize professional actions differently in various social contexts and, presumably, in accordance with varying social interests. It seems to me*

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loop passing through scientists. Clearly, condition number four does not fit with a Mertonian functional explanation of science.

> *misleading to refer to this diffuse repertoire of verbal formulations as the normative structure of science or to maintain that it contributes in any obvious way to the advance of scientific knowledge. (Mulkay 1991:69)*

His general conclusion is that those issues that were previously regarded as components of the dominant normative structure of science are better conceived as vocabularies of justification. They are used to evaluate, justify, and describe the professional actions of scientists, but they are not institutionalised within the scientific community in such a way that general conformity is maintained. However, it can be argued that this argument is flawed in the sense that it self-defeating:

> *If some people successfully exploit norms for self-interested purposes, it can only be because norms take precedence over self-interest. Moreover, even those who appeal to the norm usually believe in it, or else the appeal might not have much power. The power of norms derives from the emotional tonality that gives them a grip on the mind. (Elster 1989c: 128)*

Elster's argument is just as valid when we discuss the role of social norms in science. Admittedly, social norms can be used manipulatively in this context as well - norms are frequently employed in tactics and strategies, as a way of insulating scientific activities from external pressures and keeping up the status of scientific knowledge and its producers. However, the tactical potential of norms lies in the fact that they are significant for human action other than their manipulatory value. If they are merely glossy coating of self-interested behaviour, then for the "hoax" to continue, the "manipulators", i.e. the group of scientists and others with self-serving interests in upholding the rhetoric, would have to keep a set of gullible true "believers" duped over time. That does not stand out as a very convincing argument.

One approach in the social studies of science dismisses the role of social norms of science as autonomous. Instead it attempts to demonstrate how "social factors", such as gender, class, and economic power, entered the scientific process and influenced the content of scientific investigation - scientific knowledge production thus becoming "fuelled" by social interests (Restivo 1995). This is usually labelled "the strong programme". Instead of viewing science and knowledge as determined by norms for scientific behaviour one refers to the influence of interests of societal groups on knowledge production. These studies replace one version of a "deterministic" view of scientific behaviour with another. Science should not be interpreted as behaviour determined by a scientific ethos, but rather as behaviour determined by the relationship between science and social collectivities and the interests of such collectivities. The notion of science as individual instrumental action, however, enters science studies when quasi-economic models are

introduced.

2.3 Scientists as rational actors in a market: quasi-economic models of science

In his description of the social system of science, Merton uses a quasi-economic model that both anticipates and resembles later models introduced as frameworks for understanding scientific activities. Merton's own analysis centres on competition and awards systems in science (Merton 1973). The empirical investigations of Cole and Cole (1973) follow the Mertonian tradition in studying the effects of elite structures in science. Other influential scholars have also used economic metaphors to analyse science. Hagstrom (1965), for instance, while drawing an analysis of pre-market economies, uses a market or barter-like model to analyse scientific activity as operating under a norm of "gift-giving". Bourdieu (1975) on the other hand, does not interpret science as being similar to primitive economies invoking norms of reciprocity. Instead he sees the scientific field as the locus of competitive struggle and he explains the activities of scientists as the result of the strategies they use in their quest for maximising "symbolic capital".

A major critique of the Mertonian tradition, whether it focuses on norms or facets of scientific competition, is that it reduces the sociology of science to the sociology of scientists and the social structure that surrounds them, basically leaving out content and cognition as subjects of research in science studies. The models of Hagstrom and Bourdieu do not escape this criticism: they fail to incorporate the content of science into their models (Latour and Woolgar 1986: 205). The later quasi-economic models set out to redress that aspect. They include fact-building and the cognitive aspects of knowledge production into the economic model in which the scientists are construed as rational individuals operating on a scientific market.

A major contribution in this respect is offered by Latour and Woolgar's study of laboratory scientists at the Salk institute. In their book, first published in 1979, they put forward an economic model of scientific behaviour. In the *Zeitgeist* of the late 1970s and 1980s the book is called "Laboratory life - the social construction of scientific facts". The authors contend that the actions of scientists, as well as their choice of problems to investigate, method, theory, colleagues, decisions about publishing, can be understood as a quest for credibility:

> *The notion of credibility makes possible the conversion between money, data, prestige, credentials, problem areas, argument, paper, and so on.... [O]ur argument is that each facet is but one part of an endless cycle of investment and conversion. If, for example, we portray scientists as motivated by a search for reward, only a small minority of the observed activity*

> *can be explained. If instead we suppose that scientists are engaged in a quest for credibility, we are better able to make sense both of their different interests and of the process by which one kind of credit is transformed into another. (Latour and Woolgar 1986:200-201)*

Scientists are like investors in a market. They invest their scholarly credibility in those tasks that are expected to maximise their utility, i.e. more credibility. As Callon (1995:38) points out there is a resemblance between this model of scientific action and a Marxist model of capitalist economy, in that it is not recognition or credibility in itself that is the end. Rather it is the possibility of obtaining more of it: "Reproduction for the sake of reproduction is the mark of pure scientific capitalism" (Knorr-Cetina 1982:105). Research results are published as articles in scientific journals thereby creating a supply of information. At the same time, there are other researchers with a demand for information that can increase the speed and ease of their own work, in other words, information that can increase the return of their own investment in their research activity.

Those with information to offer that is in demand by other scientists are rewarded with increased credibility, and this "capital" can be converted into "goods" such as research funds, equipment, or assistants. In turn this enables the researchers to write and possibly publish even more articles, and if these are saleable to research colleagues, the cycle is complete.

To claim that scientists read each others articles out of deference to the norm of organised scepticism or gift-giving in science is completely contrary to what Latour and Woolgar observed in the laboratory they studied. Consequently, these authors portray scientists as market strategists acting rationally in order to survive on the credibility market. The way they do it is essentially a question of producing/constructing fact statements that are credible and therefore in demand by other scientists. They are, however, reluctant themselves to give their model the label "rational". It can nevertheless be argued that this is the implicit assumption of the model. It seems to be the name of the game to rationally calculate the expected utility of alternative courses of action. The authors claim that they do not wish to:

> *.. propose a model of behaviour in which individuals make calculations in order to maximize their profits. This would be Benthamian economics. The question of the calculation of resources, of maximisation, and of the presence of the individual are so constantly moving that we cannot take them as our point of departure (Latour and Woolgar 1986: 232).*

For their model to work, however, there must be an underlying assumption of rational instrumental behaviour. Not to infer such an assumption, it seems, would leave a serious void in their line of reasoning as long as they depict the scientists as: "...strategists, choosing the most opportune moment, engaging in potentially

fruitful collaborations, evaluating and grasping opportunities, and rushing to credited information" (Latour and Woolgar 1986: 213). As Knorr-Cetina (1982) suggests, when using quasi-economic models, as Latour and Woolgar do, one does not get around making assumptions of individual actions and what motivates them. In this case, not to assume instrumental behaviour would turn them into models in which scientists are individuals who somehow make subconscious choices and investments in their careers. This does not imply that all scientists share a common set of preferences with credibility ranked first, but in order to take part successfully in a cycle of credibility one has to act according to preferences for credibility acquiring and conversion. Whether this is an end in itself or a means to achieve other interests is irrelevant to the model.

2.4 Scientists as political actors: an actor-network theory

Latour developed his earlier work further, and in "Science in Action" he goes from market to Machiavelli considering scientists and engineers as splitting images of Machiavelli's Prince (Latour 1983; Latour 1987). In line with the interpretations of Callon (1986) and Callon, Law and Rip (1986), Latour regards the scientific process as consisting of a series of decisions about alliances. Scientists ask themselves questions such as: With whom can I collaborate in the building of an empire of scientific facts, and whom should I write off? How can I make my allies faithful? The point of scientific activity is to dominate and control. The scientist sets out to enrol others so that they participate in the construction of his or her facts, and to control their behaviour in order to make their actions predictable. This is what both Callon and Latour call the translation process: the identity of the actors and the possibility of interaction as well as the room to manoeuvre are negotiated and delimited.

The difference between Latour's scientists and Machiavelli is that Machiavelli did not think of cutting down the barriers between humans and things when looking for allies. Latour calls scientists and engineers those subtle enough to include in the same repertoire of ploys, human and non-human resources, thus increasing their margin of resources. There is no distinction between science and society; there is no distinction between human and non-human actors. Actually, he ends up crossing out the social part of social studies of science: it is simply studies of science. This constitutes a critique of the "strong programme". When society as described by sociologists confronts nature, society is always considered to have the last word, Latour claims. His approach sees the negotiations that go on to construct facts as comprising both nature and social actors. What is left of the scientific enterprise are actors and stronger or weaker associations between them -

an association is weak when it breaks and strong when it holds.

The analysis in "Science in Action" not only takes the analysis from "market" to politics, it also opens up for a range of actors that is involved in "science". Since there are no distinctions between science and society there is no reason to distinguish between within-science actors and extra-scientific actors that are involved in networks of science. In that respect Latour broadens the scope of the analysis compared to the primarily *within* science analysis of "Laboratory Life". In crossing the boundaries of the laboratory or study chamber Latour does not only broaden the scope of analysis, he also discards the very notion of "science" as a separate entity from "society" and vice versa. He argues that to maintain such distinction is "sociologics" and obscures the political character of fact-building, the latter referring to the everyday professional practice of scientists. In this respect he is in line with Callon, Law and Rip (1986) who promote a:

> *.. method that does not distinguish on a priori ground between "science" (which is purportedly about "truth") and "politics" (which supposedly concerns "power"). It is our argument that a proper understanding of social and scientific change requires the abandonment of this dichotomy. (Callon et al. 1986: 4)*

But there is more to their and Latour's position than a methodological prescription for following actors around in their attempt to transform society as they seek to produce scientific knowledge.

> *In particular, it is vital not to be diverted by the myth that says that there is a gap between science and politics and that the two are, or should be, separate. Our argument [...] is that science is politics by other means and accordingly, that the study of science takes us straight into politics.... The idea that there is a special scientific method, a realm where truth prospers in the absence of power, is a myth. Indeed, it is particularly important to follow actors closely when they enter strategic loci, for it is often in the interest of the forces at work to conceal the way in which they act. (Callon et al. 1986: 4)*

Actor-network theory is thus a long way from the notion of scientific community that a Mertonian theory depicts. It does not accept the notion of a special social structure surrounding scientists, such as the social structures that comprise a normative structure within the Mertonian view. This implies that the existence of social norms as explanations for scientific action and choices is rejected, as well as the notion that we should look for explanations of scientific behaviour in people's *preferences*. People's interests are too volatile and negotiated to be explanatory factors. In common with the quasi-economic model of Latour and Woolgar, the underlying premise of Latour's political model of scientific action consists of the scientists as interest-driven actors. Latour uses the term "goals" instead of the terms preferences or interests, in order to distance himself from an interest driven

model[4] (Shapin 1988). However, in my opinion his arguments at this point are not convincing enough to not interpret his theory as being based on viewing action as instrumental.

2.5 Science and society - what is inside and outside?

Although a majority of students of science today would reject an ivory tower view of science, many of the studies undertaken are marked by what Knorr-Cetina and Mulkay (1983: 8) label "methodological internalism". There is a preference for the microscopic and detailed study of scientific practice, such as done in ethno-methodological studies of laboratories or in discourse analysis. As opposed to a Mertonian tradition there is no parallel "explanatory internalism" that attempts to explain science by endogenous factors. Rather there is little emphasis on explanation at all in this type of work. This is not to say that the society - science distinction has not been a subject of interest in science studies, since "boundary issues" have been of enduring interest in the field and often surfaced in the "internalism versus externalism" debate (Shapin 1992).

Boundary issues

There are profound variations in the way "external" is conceptualised as well as in the degree to which "external" factors are considered important and relevant to scientific knowledge production. In Gieryn's (1995) review of literature from science studies on boundary issues, two groups are distinguished: the constructivists versus the essentialists. The latter are argued to do boundary work, i.e. their studies attempt to define the characteristics of science as opposed to other activities. It will be obvious that Merton is to be placed among the essentialists - in so far as the institutionalised ethos of science is put forward as a criterion for demarcating science from non-science. Constructivists on the other hand examine

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[4] Instead Latour forwards the idea that interests cannot be imputed to social groups, and in doing so he distances himself from "a strong programme" position in science studies. On the other hand, in the way he describes the political process of fact-building according to his actor-network theory, an essential part is how scientist creates and define the interests of others, i.e. their potential allies, making them see that it is in their interest to want what the scientists want. Such a description fits well with a Machiavellian outlook on science, but it does rather depict the scientist as some sort of "unmoved mover", whose interests are constant whereas the interests of others are amenable to the scientist's manipulations.

boundary work being done by others as actors draw the demarking lines of science: "The task of demarcating science is reassigned from analysts to people in society and sociological work focuses on episodes of boundary work" (Gieryn 1995:405). In that sense science is defined as the negotiated space filled by those who win the battle of enrolment.

Neither position is very helpful as a starting point for studying user and scientist interaction in problem choice. In the study of the impact of science on society and vice versa, it is of some importance to keep the two entities at least conceptually apart. Consequently the approach concerning boundary issues referred to Gieryn as constructivistic, is not applicable in a study such as this one. Instead it will be assumed that "science" and "society" are "social facts" and as such possible to study without having to partake in the creation of explicit boundaries. As Shapin indicates, Latour's rejection of "modernist" dichotomies, such as "science versus society" and "human versus non-human", represents some sort of analytical Puritanism that distances itself from locutions and concepts that are important in everyday life and culturally consequential:

> *In the world in which we now live scientists and other social actors use "science", "society", and the boundaries between them to co-ordinate their activities and to distribute value. In that precise sense, "science" , "society", and the boundary-discourse occasionally used in actors' practice, have got as much ontological right, and as much right to be used as analysts' "categories" as "stronger and weaker heterogeneous associations". (Shapin 1992: 358-359)*

On the other hand, the entities that are to be included as analytical concepts would have to be more specific than the essentialists' "scientific community" and "society".

Transepistemic arenas of research

Knorr-Cetina (1982) offers an insightful critique of the use of such broad categories in the study of scientific activities. She seriously questions whether such all-encompassing categories as "scientific communities" are proper units of analysis. In addition she wonders whether such communities represent the salient framework within which scientific work is conducted. Her critique is especially based on the fact that focusing on "scientific communities" obfuscates the role of non-scientific actors in knowledge production:

> *For if specialty communities were the locus of the social and the cognitive organisation of scientific work we could consider the observable relationship between scientists and non-specialists as irrelevant to the production of knowledge. (Knorr-Cetina 1982:103)*

On the basis of her own studies of laboratory work in biology, she argues for the importance of studying the contextual organisation of knowledge that includes "non-specialists" as an essential part of knowledge production. Knorr-Cetina asserts that what she terms "transepistemic connections of research" are built into scientific enquiry. Such connections and arenas are:

> *...relationships which in principle go beyond the boundaries of a scientific community. These symbolic relations are not primarily determined by characteristics held in common by its members as in the case of a logical class. The social integration which emerges from this picture is based not upon what is shared, but what is transmitted between agents. (Knorr-Cetina 1983: 132-133)*

Knorr-Cetina thus opens the analysis of scientific investigation to include external agents without discarding distinctions between science and other activities. She goes on to promote a view of knowledge production as socially negotiated and in that sense socially constructed. It is possible to interpret these as qualities that are generic to science.

The new mode of knowledge production

Gibbons *et al.* (1994) also consider knowledge production as something that involves external actors. However, their framework is very different from Knorr-Cetina's. They suggest that the characteristics of a new mode of knowledge production can be regarded as being opposed to a traditional mode, and not as a generic quality of scientific enquiry. According to Gibbons *et al.*, (1994) in the traditional mode, science is generated within a disciplinary, primarily cognitive context - a context that is defined in relation to the cognitive and social norms that govern basic research and academic science, implying that knowledge production is carried out in the absence of a specific practical goal. Like Knorr-Cetina, they claim that in the new mode knowledge is being produced under continuous negotiation in a context of application. In this context research problems are being continuously negotiated, while the diffusion of results is an integral part of the production process, i.e. far from the description of the "diffusionist" or "linear" model of the role of science and technology in society. Social accountability is permeating the whole knowledge production process. There are new participants in the definition of what is worthwhile doing and these participants affect the structure of research itself. The core of this mode of knowledge production is formed by hybrid communities in science. They contribute scientific and technical knowledge to society, while at the same time social norms and expectations held by different institutions and communities are brought home to research communities. The relationship is reciprocal:

> *Science does not stand outside of society dispensing its gifts of knowledge and wisdom; neither is it an autonomous enclave that is now being crushed under the weight of narrowly commercial or political interests. (Gibbons et al. 1994: 22)*

In their view the new mode is a different form of knowledge production than what is conventionally called "applied science":

> *When knowledge is actually produced in the context of application, it is not applied science, because discovery and application cannot be separated, the relevant science being produced in the very course of providing solutions to problems defined in the context of application. (Gibbons et al. 1994: 33-34).*

Gibbons *et al.* provide a descriptive contribution to the study of science and society rather than a framework for explaining both change in a specific mode of knowledge production over time as well as why we would find one mode of knowledge production in a particular context and the other in another. They do, however, provide a worthwhile analysis of how external actors are integrated in the type of knowledge production known as science. Furthermore their analysis gives weight to the set of norms said to be emerging as part of this mode of transdisciplinary knowledge production (Gibbons *et al.* 1994: 9) and to a set of organisational and institutional characteristics of this mode of knowledge production.

2.6 Institutional framework for the study of science-society relations in problem choice

Lessons from science studies

This brief presentation of some of the contributions to the social studies of science reveals that traditions of thought in this field are related to differences and controversies in the social sciences in general. One can distinguish basically two types of theories of scientific activity. First the Mertonian tradition that looks for norms belonging to the system of science as a determining variable. Second there are the models that see scientific action as instrumental either as a quest for "credibility capital", or as a pursuit of control over actors in a network. Even though (some of) the latter contributors would probably mind the way they have been labelled here, the distinction corresponds to the one between human action as rational choice where behaviour is guided by concern for the outcome, versus instances where behaviour is guided by the adherence to social norms of action and consequently cannot be classified as instrumental future-oriented action (Elster 1989a).

The second point to note is the difference in actor view that these approaches display. The market model and the political model depict scientists as atomistic and basically ignore the traits of science as a social system that would affect the functioning of market-like mechanisms and the political strategies that are open to scientists. On the other hand the Mertonian approach tends to overlook the actors in their focus on the system of science and in their purely epistemological account of scientific action and judgements. Naturally this corresponds well with a basic tension in the social sciences: a social deterministic perspective on human action, where behaviour is given by the social structure that surrounds it, versus a voluntaristic approach stressing the individual as an independent agent. This distinction can also be associated with the differences between sociology and economics: "economics is all about how people make choices; sociology is all about how they don't have any choices to make" (Dusenberry quoted in Scott 1992:44).

However, conceptualizations developed in economics, political science and sociology over the last 20 years are argued to have brought a merging of the two perspectives closer. Human action is neither deterministic nor totally atomistic. People act and make choices within an *institutional* setting that affect their behaviour in specific ways (Moe 1984; Bates 1988; Elster 1989a; North 1990; Powell and DiMaggio 1991; Scott 1995). The institutions that surround human action and decisions matter, as seems to be the general agreement reached through the rapprochement of the various disciplines within social science: "Integrating individual choices with the constraints institutions impose on choice sets is a major step toward unifying social science research" (North 1990:5). What is meant by "institutions", and what aspects are focused upon, however, remains disparate, while also "institutional analysis" takes on different meanings for different authors.

This theoretical development is not discernible in science studies. Rather there seems to be a lack of a framework that does what neo-institutionalism has done in other areas of social science, namely delineate ways in which institutions at the macro-, meso- and micro level affect and structure human action, and in their turn area affected by human action. One could argue that there are elements from the social studies of science that can be fitted into a neo-institutional framework. The quasi-economic models could be interpreted as a description of the institutional rules that structure scientific competition. Merton's approach does in fact emphasise the institutionalised norms of scientific action, but as has been pointed out, the emphasis is on an institution of science that is at a very high level of abstraction and on an institution that is basically insulated from outside influences. As Callon (1995) indicates, Merton's view does imply that the crossing of

boundaries of the institution of science will result in a breakdown of scientific norms, rules of the game, and incentive- and resource structures in science. Hence, in science studies one has seemingly ended up with either relying on "scientific communities" as the framework of knowledge production, a concept that is basically inapplicable for most analytical purposes, or on interest-driven atomistic actors, thereby giving little attention and significance to larger social structures. Whitley points out:

> *The denial of the universality of homogeneous, totalistic and coherent scientific communities dominating the lives of and thoughts of scientists, ... , need not imply the rejection of any sort of social structure beyond small groups and "transepistemic arenas of research" having some impact upon scientists' actions and judgements. The realizations that some biomedical scientists organize their work in different ways from some physical scientists in the latter half of the twentieth century should surely have prompted consideration of why this is the case, what are its implications for knowledge production and organization, and how can we analyse such variations, rather than generalizing this particular point to all scientific fields and knowledge manufacturing processes. (Whitley 1984: 5)*

Whitley goes on to promote studying modern sciences as particular kinds of work organisations that construct knowledge in different ways in different settings. His own analysis rests on a comparison between "scientific fields" and how they are organised not as a consequence of some intrinsic difference in the subject matter of sciences, but as: ...."historically contingent variations which alter with the changing circumstances and contexts" (Whitley 1984: 6). Although this study is not so focused on the differences between "scientific fields", Whitley's point applies to the framework used in this study to examine problem choice. Furthermore, there seems to be a neglect of an explicit analysis of the fact that modern science is an organised activity and that it is more or less systematically linked to different institutions and organisations in society at large. In addition, the institutional and organisational embeddedness of science is not the same across time and space. In that sense we could expect to see variations between what scientists do and how they relate to different sets of external actors.

What would a neo-institutional perspective on scientific action entail? An institutional approach to the study of science might facilitate the merger between insights from an actor-oriented theory of science and a structural approach. During the last twenty five years in the social studies of science the latter has not been *comme il devrait l'être*. This is illustrated by a prominent scholar in contemporary social studies of science, Michel Callon:

> *The belief in the existence of norms and their regulating role is one of the fundamental characteristics of Mertonian and Post-Mertonian sociology which is itself linked to a more general functionalist and culturalist analysis of institutions (Merton 1973). But this belief*

is explicitly or implicitly shared by a large number of epistemologists and or philosophers of sciences. The postulate that a scientific method exists, no matter how it is characterized, leads necessarily to the idea of social or technical norms and consequently to a sociology which the sociologists no longer believe in. […] The more one insists on the existence of a scientific method, the more the sociology used is simple and out of date. (Callon 1986: 225)

However, as discussed above, a major brand of sociology and related fields of social science has not abandoned the idea of norms and rules as decisive for human action. Rather it remains a central idea and as such has been developed further in sociological institutionalism (DiMaggio and Powell 1991; Scott 1995). Without looking blindly at Merton's[5] original formulation of the ethos of science as a guiding light, the institutional approach enables us to incorporate the idea of the existence of rules that are part of the institutions within which scientific knowledge production takes place, rules that guide the way scientists act, and the choices they make and actions they take without black-boxing the scientific activities. It will provide us with an alternative to seeing scientific action as the exchanges and negotiations undertaken by atomistic actors. The latter would rather be the type of economics or political science that these disciplines, to paraphrase Callon, "no longer believe in".

What then would an institutional approach to science studies have to offer? It provides first of all a vocabulary that makes it possible to maintain a distinction between different social institutions, such as science, politics and public administration, on the basis of the assumption that the rules of such institutions make them distinct from each other, e.g. the rules of the scientific "game" are different from those found in political institutions. This latter point is essential if there is to be any point in studying the relationship between science and clients, as is the purpose in this study. Furthermore, if there is such an entity as an institution of science its defining characteristics would not be a set of shared intentions, i.e. people sharing the same preferences, but its rules.

However, while making distinctions between different types of institutions, a neo-institutional perspective, as outlined, for example, by Scott (1995), has the potential

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[5] One may find the trajectory of the Mertonian approach to science studies somewhat puzzling, for whereas Merton's work on bureaucracies is mentioned as one of the forerunners of the neo-institutionalist approach, at least in sociology, his work in the sociology of science is not part of the neo-institutionalist heritage (Scott 1995), nor can the analysis of Mertonians be said to be part of the latter theoretical landscape. In fact new institutionalism is fairly absent in current social studies of science.

of facilitating a way of conceptualising "boundary issues" in science. This potential can be realised by seeing scientific knowledge production as taking place in a mesh of different institutions and organisations, and how what counts as science is performed within such a setting. The interlocking of several of these institutions and organisational settings shapes the actions and choices made in particular instances. A main merit of the neo-institutional perspective in organisation studies is precisely that of opening up the study of organisations and as a consequence no longer seeing them as closed or shielded from outside influences and connections.

Furthermore, an institutional perspective on science will allow us to regard science as path-dependent, an institution that is not necessarily the product of historic efficiency but rather the outcome of particular trajectories embedded in history, traditions and events. While this study is not concerned with explaining why scientific or other institutions relevant to scientific knowledge production exist, this latter point serves to distinguish an institutional perspective on science from a universalistic concept of science, as something disconnected from historical, political or social contexts. In addition, an institutional perspective does not assume that human actions are predestined according to institutional characteristics of action. Instead they are interpreted as being structured and in that sense to a certain extent predictable, even though:

> *Individuals and collectivities interpret what rules and identities exist, which ones are relevant, what different rules and identities demand in specific situations or spheres of behavior. (March and Olsen 1994: 10).*

What remains is to define what is meant by an "institution", point out which institutions and organisations are relevant to scientific knowledge production, and single out which aspects of an institutional approach to the study of science will be focused upon in this analysis of problem choice in the context of this empirical study and the basic assumptions upon which this analysis rest.

The three pillars of institutions and scientific knowledge production

Scott puts forward the following general definition of institution:

> *Institutions consist of cognitive, normative and regulative structures and activities that provide stability and meaning to social behavior. Institutions are transported by various carriers - cultures, structures, and routines - and they operate at multiple levels of jurisdiction. (Scott 1995: 33)*

Institutions are thus seen as made up of three pillars: regulative, normative, and cognitive aspects of social institutions. Authors within the institutional perspective attach varying weight to each of these pillars, both in terms of analytical focus and

the significance of each of them as constitutive parts of institutions. A common aspect seems to be the focus on institutions as providers of *rules* for human action. However, there are various views with respect to the type of rules through which institutions are coupled to social action.

Some focus on the *formal regulatory* content of rules: "...an institution can be defined as a rule-enforcing mechanism. The rules that govern the behaviour of a well-defined group of persons, by means of external, formal sanctions" (Elster 1989a: 147). Others concentrate on the rules that are both formally explicit as well as posing *informal* constraints on behaviour such as conventions and codes of behaviour (North 1990). A common characteristic is that those who study the regulatory aspects of institutions are concerned with how institutions structure the utilitarian pursuit of personal interests by way of coercion, and a system of sanctions and rewards. That is, the regulative pillar of institutions is associated with viewing action as instrumentally guided. In terms of the study of scientific knowledge production, this perspective is focusing on the structure of scientific competition, for example, as seen in much of the quasi-economic models discussed earlier. If we broaden the scope of analysis, we can include the wider governance structures that regulate scientific knowledge production, in particular the varying ways in which scientific organisations are linked to governments, state agencies or other organisations and agents through regulatory means of compliance.

Normative aspects of institutions focus on values and norms, and how institutions provide normative expectations of what actors are supposed to do and not do. Some norms are general and apply to collectivities as a whole, whereas others apply only to specific positions or actors (Scott 1994: 63). Both signal what others expect of us and what we expect of ourselves. Here, institutions manifest themselves through different roles, i.e. the specialized values and norms for particular individuals or special social positions. Norm guided action is marked by a different logic, a logic of appropriateness of action rather than by the future-oriented logic of instrumental action. This distinction is described by March and Olsen (1989: 23) as anticipatory versus obligatory action. Institutions provide roles and people act according to their conception of the normative expectations that occupying a particular role entails. Such expectations both constrict and empower action. In March and Olsen's institutional approach the first two pillars are retrieved in their conception of "rules":

> *Institutions have a repertoire of procedures, and they use rules to select among them. Rules may be imposed and enforced by direct coercion and political or organizational authority, or they may be a part of a code of appropriate behavior that is learned and internalized through socialization or education (March and Olsen 1989: 21-22).*

This makes it possible to draw a parallel between those theorists emphasising the normative pillar of institutions and Merton's descriptions of how the ethos of science works, in other words, it allows us to rephrase Merton's positions in March and Olsen's language (1989: 23). The logic of scientific action within a normative institution of science would bring a scientist round to asking: What kind of situation am I in and what is the appropriate action for a scientist like me in a situation like this? If the "appropriate action" should have been determined by an ethos of the institution of science, it would probably not have been much help for people in the role of scientists if specific courses of action in most stages of the knowledge production process would have been regulated. However, the underlying logic would be the same. Usually such a logic of action is associated with bureaucratic behaviour and legalistic reasoning and subsumation (March and Olsen 1989), i.e. activities usually considered antithetical to "creative" activities such as scientific discovery and production of knowledge.

Highlighting the cognitive aspects of institutions directs attention to rules that constitute the nature of reality and the cognitive frames within which meaning is given. Rather than seeing action as influenced by the roles actors play, this kind of institutional analysis considers institutions to be linked to human action by the identities that institutions provide to individuals. Identities can be defined as conceptions of who we are and what makes sense for us in a given situation (Scott 1995: 44-45). Compliance to institutions is in that case less a result of normative pressures and expectations or coercion, than of action as "taken for granted". It is not a question of internalisation of dos and don'ts, but an internalisation of typification, of categories and symbolic systems that determine the ways in which we see the world and how we act in it. Such an institutional perspective looks into how institutions embody cognitive frames that exercise control apart from and in the absence of normative or regulative constraints: "Not norms and values but taken-for-granted scripts, rules and classifications are the stuff of which institutions are made" (DiMaggio and Powell 1991a: 15).

In terms of scientific knowledge production, one could argue that producing categories and typifications is exactly what science does. Rather than seeing science itself as influenced by cognitive aspects of social institutions, it contributes to symbolic systems of other social institutions (see, for example, chapter 6 on the role of science and its typifications in governmental policy-making). However, this type of production in itself does not take place in a cognitive vacuum - but rather within the frame of existing cognitive structures, whether one labels them "paradigms" (Kuhn 1962), "disciplines", "scientific fields" (Whitley 1984), or "transepistemic arenas" (Knorr-Cetina 1982) (Douglas 1986). Science consists in

this perspective of representational rules that help to create a shared understanding of realities that are taken for granted. Scott's interpretation of such rules seems highly applicable as a way of describing scientific institutions:

> *Any institutional complex incorporates a collection of knowledge claims; these include not only empirically based observations about specific phenomena, as well as claims or beliefs that have little or no empirical support, but also more fundamental assumptions about how such claims are constructed and validated: what Friedland and Alford (1991) term institutional logics. These logics establish the framework within which the claims are situated and provide the rules by which the claims are validated and challenged. (Scott 1994: 60)*

It is important to stress that looking at science from a cognitive perspective on institutions does not return us to a position where cognitive factors are separated from social ones. A main point for these institutionalists is rather the social construction of reality, and that taken-for-grantedness in science, as in other spheres of life, would be very much part of as well as a result of such constructions (Berger and Luckman 1966). In that sense the constructivist position in science studies is potentially compatible with the latter stock of institutional analysis. The link between cultural approaches to the study of science, as found in much of the so-called laboratory studies, and the "cognitive pillar" in the new institutionalism is thus feasible to make, although this connection has not been developed yet (Knorr-Cetina 1995).

What logic would an institutional approach to the study of science perceive as the basic logic of social action? Taking an institutional approach would not necessarily imply the rejection of viewing action as rational. Rather, a major body of the neo-institutional analysis would advocate a recognition of such action as dependent upon the subjective and social interpretations and perceptions of preferences, alternatives, consequences of choice, and the other elements that are part of rational instrumental action. Rational action can thus be seen as occurring within a broader framework of rules, roles and identities (March and Olsen 1994; Scott 1995). In that respect there is no basic contradiction between rationality and institutionalism - the former functions within the latter. But an institutional concept of human action includes, and in so doing transcends, the rational models in a fundamental way by insisting on institutionalised identities that create individuals (March and Olsen 1994: 8). In addition to regarding rationality as embedded in an institutional context, an institutional perspective thus adds a second element as part of a logic of human action - a logic that interprets action on the basis of what is appropriate in a given situation according to the identity of the actor:

Actions are expressions of what is exemplary, natural, or acceptable behavior according to the (internalized) purposes, codes of rights and duties, practices, methods, and techniques of the constituent group and of the self. (March and Olsen 1994: 8)

2.7 Conclusion: science as organised activity

Institutions operate and are studied at multiple levels - from world systems to subunits within organisations. Much of the new insights in the neo-institutional literature as part of the field of organisational studies deals precisely with institutional processes at the macro level that affect sets of organisations and individual organisations (Powell and DiMaggio 1991b; Scott and Meyer 1994). Furthermore, institutions exist in the form of formal organisations, even though institutions need not be embodied in organisations. Rather institutions can be "carried" by cultures and regimes that cross organisational boundaries or exist outside of formal organisational arrangements (Scott 1994). However, as is demonstrated by at least 80 years of organisation studies, formal organisations are important structures within which social action and interaction occur. Organisations, like institutions in general, vary in the degree to which they exercise cognitive, normative, and regulative control over actions. Several ways of coupling organisations to action have been identified. First, by command and force: the division of formal authority through the establishment of formal hierarchies, i.e. an organisation provides a set of rules for action to which non-compliance entails the possibility of sanctions. Second, organisations deploy models that regulate human actions by providing people with a blueprint or scripts for action without accompanying sanctions or particular rewards. Further subdivision within this field might result in various sub-fields of organisations, such as organisations for applied science versus universities. At a more specific level there are different normative and regulatory rules, as well as informal rules that apply. At the organisational level we can expect to find blends of different rules and enforcement mechanisms that vary according to differences in organisational structure. Subsequently, these can be expected to lead to differences in actions and choices of scientists.

There is little in the science studies literature that is helpful in identifying varying organisational forms in research organisations. However, especially the literature that deals with the organisational aspects of higher education (for example, Clark 1983; Birnbaum 1990) and to some extent the general organisational literature (e.g. Mintzberg 1983; Cohen and March 1986; Hall 1991) are more relevant in identifying different organisational forms and analysing the consequences and function of such formal organisational arrangements. Referring to this body of literature some inferences can be made about the blend of what have been

identified as institutional processes and control mechanisms related to the structural characteristics of research organisations.

First, there is general agreement that research organisations are characterised less by formal regulatory processes than organisations within government bureaucracy or private corporate enterprises. We could attribute that to the nature of the "technology" of scientific production, if we make a materialist's interpretation of an organisation's structural characteristics. Organisational analysts have frequently pointed to the connection between the type of technology and the type of organisational structure (Mintzberg 1983; Scott 1987a: 214, 236). The "technology" of research can be seen both as complex and uncertain. The complexity is related to the fact that research as a work process involves a host of different elements that are taken care of by the individual scientist or research unit, either sequentially or simultaneously. Uncertainty revolves around the nature of "discovering" new aspects of natural or social life. These aspects of research as a type of activity signal a resistance to the possibility to plan and design the process of research as a routine activity. As such this is reflected in the formal structures of research organisations.

Alternatively, instead of emphasising the natural link between technology and structure, one could argue more in line with institutional arguments as regards these features of research organisations. The argument would then be that the history of science and research and how such social activities are understood in modern societies have resulted in spheres of organisations where such control mechanisms are perceived as illegitimate, unfeasible or undesirable. Since that discussion is hardly an issue here, it suffices to say that in general one would expect that at an organisational level research organisations will display a relative absence of coercion. Instead such organisations will rely on other institutional processes.

The population of research organisations primarily rests on normative and cognitive pillars for structuring actions of organisational members. However, there are also variations within this population of organisations. Usually research organisations are considered to belong to either a home for fundamental research, for example, a university organisation, or applied research, such as government laboratories or research institutes. Further they can be part of industrial laboratories, or units for R&D. A general assumption in this respect is that the amount of coercive control that organisations exert over individual actions increases as one goes from the former to the latter, while also the scope of cognitive and normative structuration of action increases. However, as made clear by Gibbons *et al.* (1994), in knowledge production these traditional organisational forms have been accompanied, or are in the process of being replaced, by new

modes (see above, section 2.5). Such distinctions between different types of research organisations will be discussed in more detail below as an important part of the analysis of the organisational context of problem choice.

Taking a step up from the organisational level, the concept of organisational fields has been developed within institutional approaches to organisational studies as a mid-level element that links organisations and wider societal arenas (Scott 1996: 166). This concept refers to "communities of organisations that participate in the same meaning systems, are defined by similar symbolic processes and are subject to common regulatory processes" (Scott 1994: 71). DiMaggio and Powell (1991b: 64) call it "a recognised area of institutional life". As Rip (1988) makes clear, the role of such intermediary systems, mediating between societal structures and individual organisations, has only rarely been the subject of theoretically based analyses within the field of science studies. Usually this level has been reserved for science policy studies, an area widely recognized as under-theorised (Rip 1988; Elzinga and Jamison 1995; Guston 1996). In the study of scientific knowledge production the relevant "organisational field" would include formal organisations, such as research councils, universities, government laboratories, institutionalised peer review, and also what one in Mertonian lingo would call "external agents", e.g. government agencies and industrial organisations. As DiMaggio and Powell (1991b: 65) point out, an organisational field does not exist a priori, but has to be determined on the basis of empirical investigation. Identifying and examining the impact of different parts of the organisational field as the contextual elements of problem choice will make up an important part of the analysis to be presented below.

3 Scientists, clients and user-orientation in problem choice: assumptions and expectations

3.1 Introduction

In this chapter some elements of science as shaped by disciplinary and professional institutions in which scientists operate will be discussed, as well as specific aspects at the organisational level: the differences that exist within the organisational field of scientific organisations. These aspects are subsequently discussed in the light of the research questions addressed in this study. Within the framework of this study, the focus will be on the actors in science and the choices they make within an institutional setting. With respect to this institutional setting, the focus will be on the "institutions" of academic science and disciplines, and on the formal organisations in which science is conducted.

The presentation in the previous chapter of the theoretical underpinnings of both science studies and the neo-institutional perspective in organisation studies has outlined trajectories of research far above what can be followed up within the limits of this study. The preceding chapter serves nonetheless as the backdrop from which the underlying assumptions and the factors that will be the objects of investigation in the scope of this empirical study are subtracted. Using an institutional perspective on organisations this study is aimed at investigating the extent to which a set of institutional and organisational factors are at work. It is expected that these factors will constitute the social context of choice situations. The assumptions and potential explanatory factors in this are grouped as follows:

1 The difference between autonomous and heteronomous organisations in terms of internal governance and degree of hierarchical control over research.
2 The organisational arrangements between research and users of research: the role of government agencies, research councils and research programmes, and organised links between external actors and research.
3 Institutions in science: the institution of academic science; cross-disciplinary variations.
4 The role of research funding in problem choice.

The first three sets of factors relate to institutional arrangements within which research takes place and to the way in which we can expect these arrangements to affect problem choice. They are ordered in terms of varying levels from which the potential explanatory factors are drawn - the first at an organisational level, the second and third set refer to institutional links between knowledge production and different types of organisations in the field of agricultural and fishery science. All these can be fitted into an institutional perspective on the organisation of research, emphasising different types of structural links between knowledge production and other relevant institutions and organisations. The last factor to be addressed is of a somewhat different nature and draws attention to research funding in its own right as the possible determinant of problem choice. Whether this can also be said to represent an institutional factor in problem choice will be discussed later.

The reader is reminded here that the main question examined in this part of the study is the one concerning user-orientation in problem choice. This implies we investigate why some of the projects that respondents have reported on in this study include users as participants in problem choice and others not. In addition, this part of the study is focused on the reasons why some projects are reported as taking into account to a stronger degree than others the problem solving potential and user relevance when selecting research problems. In other words: What influences the pattern of decision premises and decision participants in such choices?

3.2 The organised surroundings of problem choice - organisation level factors

A central concern of this study is to investigate the effects of organisational arrangements on that part of scientific activity that can be labelled problem choice. The basic assumption is that the actions of an individual within an organisation can be traced back to the organisational position he or she has. That goes for instances where the organisational participant acts on behalf of the organisation. The formal organisation has the ability to shape and systematise the decisional reality that surrounds the individual organisational participant (Simon 1968; March and Simon 1993 [1958]). This happens when the organisational structure influences what are considered to be relevant and acceptable solutions and problems for the decision-maker, as well as which persons are looked upon as relevant participants in decision-making processes (March and Olsen 1976). To the extent that organisational structures are stable, they will provide the organisational participants with a relatively systematic selection of what is considered relevant information to look for, and to take into consideration (Egeberg 1989: 20). These structures affect

the channels of communication through which information is disseminated. Consequently, the different organisational participants will "see" different worlds according to where they are positioned in the organisation (March and Olsen 1976: 59). This type of reasoning leads us to the question how organisational structures affect scientists when they choose the problems to do research on and it drives us to look for the impact of organisational contexts on user-orientation in problem choice processes.

However, focusing on organisational structures does not imply that solely the hierarchical and legalistic aspects of organisations are in the spotlight. Formal organisations also consist of resources, values, traditions and scripts that are perpetuated and carried by organisational structures.

Behavioural assumptions

What behavioural assumption of scientific action must be made when we concentrate on formal organisational structures as determining factor? We could make assumptions of bounded rationality, norm-guided action or taken for granted behaviour in scientific organisations. If we see organisational participants as rationally bounded people, acting on the basis of limited information about possible courses of action and the consequences associated with them, than the position in an organisational structure is a major variable in the selection of information (Egeberg 1989: 20). At the same time, an assumption of bounded rationality does not exclude action on the basis of what is appropriate. Organisations are normative systems that not only provide the rationally bounded individual with incentives and constraints for action, but also with norms and routines for appropriate behaviour as was discussed in chapter 2 of this study. A basic expectation is thus that formal organisations provide a foundation for regular patterns of action that trace back to the way that activity is organised. Each of the behavioural assumptions can be interpreted as a mechanism by which organisational surroundings are linked to action. However, discriminating between them cannot be done on the basis of the empirical material available in this project. So with the data at hand, the mechanisms that are assumed to couple organisations to action will remain untested. What can be investigated is the nature of the connection between different organisational contexts of problem choice and variations in both the decision premises and the participants being part of such choices.

Two types of research organisations

Professional organisations, research organisations included, can be divided into two basic categories, i.e. autonomous and heteronomous organisations (Scott

1987a)[6]. In the framework of this study these two categories will be interpreted as follows. In autonomous professional organisations, the professionals, - in our context the scientists - are responsible for defining and implementing the goals of the organisational activities and for defining and maintaining the standards by which work is evaluated. In such organisations we find a binary system in which there is a schism between what are considered to be administrative tasks and professional tasks. The former are the responsibility of the administrative hierarchy, while the work of the professionals is "out of reach" for administrators. Accordingly, there is a dual governance structure[7] consisting of an administrative hierarchy, and a collegial and decentralised system (Bensimon *et al.* 1989; Birnbaum 1990). The professional is responsible for his own work and is in general the object of collegial control and evaluation. An example of a research organisation that corresponds to an autonomous professional organisation is a university oriented toward basic research (Clark 1983; Clark 1989). Clark's argument refers to differences between various types of higher education institution. He argues that the institutional differences can be traced back to the status of universities within a distinctive population of universities and colleges. Top ranking universities exhibit strong levels of faculty authority, while dropping institutional rank is associated with increased reliance on formal organisational command structures of the institution, or an increased importance of the regulative aspects of organisations. In this study it is not assumed that differences in organisational structure are based on the differences in organisational prestige, rather we assume that inter-organisational differences in, for example, governance structures are based on organisational types found within the higher education sector versus those found in the research institute sector. We can extend these arguments to the differences between research organisations being part of the population of research universities, and those being governmental research institutes. The latter are regarded in this study as heteronomous organisations.

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6 The description of autonomous versus heteronomous organizations draws on Scott 1987: chapter 9, especially 236-239.

7 As pointed to in several studies - this dualism may be overstated, and the overlap between administrative and professional academic responsibilities might be of utmost importance for understanding the decision-making structures of universities. In the context of this study, it is argued that first of all, even though this structural characteristic is not applicable to university organisations in general, dualism of governance is a basic attribute of Norwegian universities, certainly in comparison with the governance structure of most research institutes. Second, as far as the significance of dualism is concerned, research activities of universities are least connected to universities as bureaucracies and decision-making concerning knowledge production is an area where the dualism of university governance becomes most apparent.

In heteronomous organisations the task uncertainty and complexity are handled by delegation of responsibilities to the professionals. In that respect they resemble autonomous organisations. But in heteronomous organisations the professionals work within a formal hierarchy, and there is less discretion and autonomy delegated to the individual professional than in autonomous organisations. In heteronomous organisations professionals have leadership positions that combine professional and administrative responsibilities. As opposed to Clark's argument (Clark 1983, 1989) this is unrelated to the status of the organisation, rather it is based on the stable organisational traits found in the organisation's governance structure. Furthermore it can be argued that differences between autonomous research organisations, such as universities, and heteronomous organisations, such as government research institutes, are related to the way in which research organisations are linked to external agents, such as government agencies in the Norwegian case. Variations in research organisations' relations to the state are also an indicator of differences in terms of the internal organisation of work. This issue will be discussed in more detail in section 3.3.

This dichotomy of professional organisations[8] points to a basic distinction of value in the study of the organisational effects on problem choice. We can assume that problem choice is considered to be a professional arena of activity and decision-making. In a heteronomous professional organisation people in hierarchical positions are expected to be relevant decision makers, while the definition of relevant and acceptable problems is assumed to be influenced by common organisational goals. A typical situation for problem choice is an organisation's budgetary or planning process. In heteronomous organisations problem choice is in general much more dependent on common formal decision-making structures than problem choice in autonomous professional organisations. In autonomous organisations we expect such decisions to be less connected to formal organisational decision-making procedures, and more to collegial structures. As a consequence it can be assumed that administrative factors are more prevalent in problem choice in heteronomous organisations than in autonomous organisations. Administrative leadership positions will play a more central role in the former types of organisations than in the latter, because they are assumed to combine professional with administrative leadership responsibilities ("unity of leadership"). In addition, we expect that leaders in heteronomous research organisations have a

[8] The underlying dimension to this dichotomy has to do with how governance is structured in professional bureaucracies such as those organisations producing scientific knowledge, and how bureaucracy is coupled to collegial forms of organisation. Important elements from other models of university and research organisations such as political and garbage can models are not fitted into the distinction between autonomous and heteronomous professional organisations.

special responsibility towards external agents and organisations, and that they play a mediating role between "insiders" and "outsiders".

However, the central focus is not on the internal processes of research organisation. It follows from the focus on user-orientation in problem choice that this study is primarily aimed at examining the external influences on the organisation of research. Indirectly the internal organisation of work and decision-making is important to the extent that internal participants can stand as mediators or guards in relation to external orientation in problem choice. In heteronomous organisations the hierarchical position would determine "external" responsibilities of organisational members as well as their access to decisions about problem choice. In this respect, we expect that the position of an individual researcher in the internal hierarchy of a heteronomous research organisation will influence, first, the control that the researcher has over problem choice, and second, the contact he or she has with external agents.

In autonomous organisations the organisational structure allows less leeway for direct coercive control over the professional's activities, thus external relations and the interpretation of external expectations is decentralised. This does not mean, however, that such organisations are without regulating mechanisms. The collegial control or power relations within such organisations might be as strong as the hierarchical (Fivelsdal 1985: 12; March and Simon 1993 [1958]: 126-129), but it may well be less tightly connected to the individual organisation as such.

Focusing on the formal organisation of research within research units would render the following general proposition: formal organisational arrangements influence problem choice in research and the access to external participants as well as considerations of use and potential applicability. User-orientation is part of the organisation's goal in the research institutes included in this study and these organisations have a governance structure that couples the problem choice decisions to the needs of the research organisation. Whereas governance structures in autonomous organisations are not coupled to such choices in situations where collegial or individual discretion is high.

Hypothesis 1:

Problem choice in autonomous research organisations will be less oriented towards users and application than problem choice in heteronomous research organisations.

This implies that we expect that the degree to which problem choice is user-oriented will be significantly weaker in universities than in the government research institutes. However, there are few indications as regards the intensity of such a

difference.

A related argument is that of the effect of individual positions within research organisations - the role of formal hierarchies within research organisations. We would expect clear differences to exist between the two types of research organisations with respect to the extent of the participation of people in administrative and leadership positions in problem choice and the extent to which the research organisation's research priorities enter as criteria of choice[9]. Whether and how that in turn is related to user-orientation in problem choice is less immediately obvious. This will be more a point to be explored than a specific assumption that will be tested.

In addition we need to conceptualise the relationship between science as an institution and science as the organisational home of researchers. Clark has described how the structure of disciplines interacts with organisational (he uses the term "institutional") structures, to make up "the master matrix" of universities (Clark 1984). "The institutional differentiation interacts with the disciplinary differentiation in a self-amplifying fashion that steadily widens and deepens the matrix of differences" (Clark 1989: 7). Clark's basic argument it that there exists a matrix between discipline and organisation, and that there is a cultural overlap brought about by organisational as well as disciplinary chains or links. There is a varying degree to which disciplinary cultures and organisational cultures converge. In leading research universities Clark (1989: 6) has noted a high degree of convergence.

An assumption that we can arrive at from this perspective is that the organisational context of research is a major contributor to whether or not we find a match between academic values and norms and organisational values and norms of conduct. Clark suggests that this variation is attributable to organisational status, i.e. the "rank" of the organisation within a higher education system, whereas this study looks into the same variation, but according to type of knowledge producing organisation, i.e. universities as opposed to research institutes. One could contend that organisations involved in applied research must mediate an inevitable conflict between professional norms as found in science as an institution and organisational needs (Sutton 1984), i.e. as an opposition derived from the nature of "pure science" and "applied science" and the organisational context associated with the two. This perspective presupposes that in government research institutes organisational needs incorporate user-orientation and that this imposes a situation

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[9] This is defined in the questionnaire as: "follow up the organisation's research plans" and "Do research with relevance for any other of the organisation's tasks.

of normative conflict to the extent that researchers also relate to the normative and regulative structures of academic science. This normative ambivalence is different from the one proposed by Mitroff (cf. chapter 2, section 2.2), since this ambivalence is not caused by norms and counter-norms within academic science, but by norms of academic science pulling in one direction whereas the organisational norms and needs pull in the opposite direction. Some would deduce from this that the central problem of organised research is to mediate the conflict between scientists' independence and the organisation's need to manage their research. Further that within a university setting there are no particular organisational claims made on the researchers' problem choices. The latter are not supposed to be free floating, but guided by the structures of the institution of academic science[10] (cf. section 3.4). With respect to research in the government research institutes Sutton concludes from his study of a government sponsored laboratory that within such an organisational and professional setting, scientists work outside of the normative limits of classic academic science. He attributes this to the way government is involved in setting and supporting applied research priorities, and argues that this produces autonomy from academic norms, and the development of a separate normative structure:

> *Problem selection at L.L.L. [Lawrence Livermore Laboratory] differs from that of a university in one significant aspect: it is dictated more by programmatic needs than by professional priorities. It differs from industrial research, on the other hand, in that research operations are not subordinated to any other functional unit, [....], within the organization.* (Sutton 1984:214)

Were this finding to be valid in the context of this study, we would expect to find a similar difference in problem choice among the choices made in a university versus those made in a government research institute. The obvious test would be to investigate the degree to which academic criteria are more salient for university

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[10] In his analysis of science as a vocation within a setting of organisations in higher education, Hackett (1990) argues convincingly that there is a link between research and the organisational setting within which it is conducted. As such the organisational changes brought about by resource dependency or in conceptions of what is legitimate behaviour in and of research organisations, affect what researchers do and the choices they make. He argues that there has been a change in research universities from embodying traditional-collegial values to rational-administrative values. The point is well-taken, and if this is valid for institutions of research and higher education within the context of this study it would mean that academic culture would be more compatible with the formal arrangement of government research institutes than previously outlined. However, such changes in academic culture are not possible to incorporate in this study, but it serves to make us aware that the possible opposition between the institution of academic science and the organisational needs of government research institutes may be overstated.

researchers than for researchers in government research institutes. That in itself is not the primary focus of this study. Nonetheless, this aspect is clearly of interest because we can expect it to be related to user-orientation in problem choice. On this basis we might expect to find differences in the role of academic criteria of problem choice according to the institutional setting that researchers operate in. In that sense we could expect to find interaction effects between discipline and organisation as a factor in problem choice.

3.3 The organisational field of scientific knowledge production

A research organisation does not exist in a vacuum. From the focus chosen in this study and the institutional perspective on organisations, it follows that the way in which the external relations of an organisation are structured is an important factor in problem choice processes. As Rip (1988: 69) has noted we can in general discern three basic patterns of change in organisational fields of knowledge production. These patterns of institutional change clearly have relevance for Norwegian national research policy processes in sectoral research and for how the relevant organisational field is structured. The first pattern or development occurred in the nineteenth century when professional careers of researchers were coupled to the state and state patronage of research. The second wave took place in the early post-war period with the establishment of intermediary institutions that linked the state and knowledge production by way of research councils. This happened in the Norwegian agricultural sector in 1948, whereas such an institution was established in the fishery sector as late as 1972 (Skoie 1984). The 1980s brought about the third wave of restructuring of the organisational field of knowledge production with the introduction of research and development programmes, i.e. organisational structures explicitly oriented towards directing missions to or coordinate research. In the Norwegian context research programmes, although often initiated at governmental level, were hooked up to and based in the already existing intermediary institution of the research councils (Ståhle 1993). In fact it became one of the important ways in which the research councils did their business. The latter development did in fact represent a strengthening of the regulative basis of individual research projects, in the sense that research activities became the object of formal coordination and governance by being connected to a (formal) research programme.

Some of the factors investigated as potentially relevant for understanding user orientation in problem choice have a parallel in the three waves of institutional change. First, the role of the state in problem choice is examined, under the heading of vertical influence on problem choice. Next horizontal influence on

problem choice is discussed, such as the role of research councils and its programmes and other organisational arrangements that directly couple research to external actors. These factors are equivalent to prominent research policy tools that are in turn based on the notion that the way research is formally organised affects scientific knowledge production.

Vertical organisation: The state as shaper of the organisational field and as user of research

As noted, for example, by most neo-institutionalists the state cannot be considered as "just another actor". In most organisational fields the state does exercise authority over other organisations, and in that respect it represents a special kind of institutional agent (Scott 1995: 93-97). The role of the state in structuring and shaping institutions in the field of scientific knowledge production can hardly be overstated, while at the same time state agencies are themselves also directly influencing knowledge production. In the context of this study the relation between knowledge production and government authorities is a central dimension.

The role of the state in knowledge production has been pivotal in the agricultural sector and important in the fisheries, though less unequivocal. The state clearly is a major shaper of institutions with respect to scientific knowledge production in both sectors, although in this respect the histories of the fields of fisheries and agriculture are not completely parallel (see chapter 1 and section 3.4). In effect, this implies a two-sided role of the state in scientific knowledge production as found in the sector principle that is parallel to the two roles of the state as institutional agent. This principle has been underlying ministerial involvement in research and development since the 1970s (Kallerud 1997). It implies that ministerial involvement should ensure production of research, both basic and applied or long term and short term, for the entire sector for which a Ministry is responsible. In that respect sectoral Ministries have a significant role in shaping the overall conditions and structures within which knowledge is produced. Furthermore, the sector principle in the organisation of research implies that scientific knowledge is produced as an instrument in the formulation and implementation of sectoral policies, i.e. the informational needs of the Ministry itself are a parameter in scientific knowledge production. State agencies are thus primary clients or users of science in their own right, generally referred to as the role of "science in policy". This model of the organisation of research and development is in contrast with the centralised model where the responsibility for research appropriations and organisation is in the hands of a central Ministry for Science (OECD 1971, Ståhle 1993).

The way in which research in the fields of agriculture and fisheries is organised in

Norway is based on a sector model. Securing knowledge production according to the needs of the Ministry and its subordinate government agencies, and for the sector in general, is the responsibility of the sectoral Ministry. The sector principle has been particularly prevalent in the agricultural sector (cf. chapter 1). At the time our survey was carried out, nine out of ten of the agricultural research organisations were owned by the Ministry. In this sector the state relation with research organisations is regulated through formal rules embodied in the specific types of state ownership of research institutes, universities and other institutions of education and research. If formal structures matter, we can expect that the varying formal arrangements will represent a source of systematic selection of what are considered to be relevant and important research problems. Of the research organisations included in this study, only one, the College of Fishery Science, was not explicitly linked to the corresponding sectoral Ministry at the time of the study.

In the agricultural sector the sector principle has even been applied within the ministerial structure, with each government research institute connected directly to the corresponding department in the Ministry of Agriculture. Consequently these institutes are coupled directly as an informational partner to a specific sub-sector within the ministerial policy area. In this sense these institutes are clearly part of a hierarchical order, implying that the sectoral Ministry has stronger involvement in problem choice, both as participant and in terms of decision premises, than in the other research organisations in this study. As a result we can expect that university research in the fields of agricultural[11] and fishery science will be less oriented towards the specific government needs for research or attentive to the research priorities of the Ministry. These institutions are governed under the university act, which ensures much more institutional autonomy than provided to government research institutes.

Furthermore, we can expect that compared to research in government research institutes, university research in these two sectors is not only less concerned with meeting the needs of the hierarchical superior agency or Ministry, but will also be less focused on fulfilling the informational needs of other users in the sector (cf. the other aspect of the sector principle)

Hypothesis 2:

Research organisations that are directly owned by a sectoral Ministry will be more user-oriented in problem choice than research organisations that are governed under the University act.

As far as the units included in this study are concerned, this hypothesis predicts the same pattern of results as hypothesis 1. As discussed above, the distinction between autonomous and heteronomous organisations is linked in this context to the type of governance relation between research institutions and the state. While autonomous research organisations are expected to display greater autonomy for the individual researchers they employ, as well as greater organisational autonomy from the government, heteronomous organisations operate under stronger vertical ties since they are much more explicitly a part of a governmental chain of command in each sector.

Within the group of research organisations covered by this study, the state relations vary according to type of government funding these organisations get at the organisational level. If we treat autonomy from the state as a continuum and not as a dichotomy, we can investigate possible differences between each group of autonomous versus heteronomous organisations.

First, we can expect a difference between a university that is formally linked to a sectoral Ministry (Agricultural University of Norway) as opposed to a university linked to a Ministry of Education and Science (Norwegian College of Fishery Science, University of Tromsø).

Hypothesis 2a:

Research done at universities that are formally under the auspices of a sectoral Ministry will be more user-oriented in problem choice than research done at universities that are linked to an Education and Science Ministry.

In the group of heteronomous organisations we can make an inter-organisational distinction with respect to the degree of autonomy from the government. The type of government appropriation can be seen as an indicator of the formal arrangement that regulates state influence on organisational activities, the basic variable being the degree of budget specificity (Sutton 1984). We would expect problem selection to be affected by the degree to which governmental funding is open, i.e. the degree to which it comes in the form of lump sum allocations[12]. Within the group of government research organisations included in this study there is considerable variation in the extent to which budgetary allocations from the

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11 Although the Agricultural University was until 1997 formally under the jurisdiction of the Ministry of Agriculture

12 However, it could be argued that this is more likely a direct effect of funding that operates at the level of each research project, rather than an organisational variable at an aggregate level. This argument is dealt with in section 3.4.

government are earmarked or not. This is measured in terms of the relative proportion of lump sum appropriations of the total budget at the organisational level.

Hypothesis 2b:

Research organisations with a large proportion of earmarked items in their budgets at the organisational level will be more user-oriented in problem choice than research organisations with a low proportion of earmarked items.

Horizontal organisation: research programmes and organised user governance

Obviously there are important links between organisations and their environments, research units and their clients, other than the hierarchical legalistic ones we have been focusing on so far. There are horizontal arrangements that might be just as important with respect to "external" influence on problem choice. We might think of research councils as inter-organisational matrices that connect different types of actors to each other. Such a matrix might be an important factor in coupling a research organisation to its environments and regulate the relationship between the two. The primary modus operandi of Norwegian research councils in the 1980s and 1990s has been research programmes. If there is a connection between user-orientation in problem choice and links with research programmes, we will assume that this a not mediated by formal rules. Rather, we can assume that specific mechanisms are connected to sanctions and rewards offered by research funding or by effects coupled to cognition, in the sense that research programmes contribute to structuring the attention of relevant research communities to specific research problems and by defining specific types of users as relevant to problem choice. In the sectoral research councils for agriculture and fisheries, the different user-groups were represented in the council and to some extent also within collegiate bodies connected to each of the research programmes. In that respect we would expect that problem choice will be more oriented towards users when they are connected to research programmes. A second type of horizontal organisational means of coupling users and problem choice of scientists is by way of organised user governance, that is to say that projects have an especially set up advisory or governing board.

Hypothesis 3a:

The problem choices with respect to research projects that are connected to user groups by way of research programmes will display a higher degree of user-orientation than the problem choices made with respect to research projects that are not connected to such programmes.

Hypothesis 3b:

The problem choices with respect to research projects with organised user governance are more user-orientated than problem choices made with respect to research projects without such formal governance arrangements.

3.4 The institution of science and academic disciplines

Apart from the formal organisation as a constraint and basis for action, the actions of organisational members are influenced by the cognitive and normative identification people have towards the groups outside the formal organisation they belong to and work in (Egeberg 1984:34). In organisational analysis there is a tradition to study the effects of such identification in relation to the organisational members' distribution on age, gender and education (Pfeffer 1982:277). In the following the two potential sources of "external" identification in the case of scientific organisations and the professionals that work in them will be looked at more closely. Higher education has a well-documented effect on how people act in formal organisations (Lægreid and Olsen 1978; Egeberg 1989). Educational training represents a way of systematising, conceptualising and filtering a complex reality (March and Simon 1958:152-153), and such effects continue to operate within the formal structure of an organisation. In terms of institutional factors in organisational life, there is little doubt that undergoing higher education is a major source of structuring not only what people know, but also how they think and what their values are, i.e. it couples people to common cognitive and normative structures. According to Weber the effects of higher education are at the very basis for recruitment to bureaucracies and for their rational functioning (Weber 1971). But how can education be related to what scientists do and how they act?

Stemming from the common root of higher education we can identify factors relevant to the study of research activities. First, we can revert to the notion of an "institution of science". One thing practising researchers undoubtedly have in common is their extensive scientific training at universities. However, whether there is such a phenomenon as a common set of normative, cognitive and regulative structures connected to what one might call the profession of science is less unequivocal, and even if this is the case - how do such structures affect problem choice? Second, there is the possibility that within an "institution of science" we might find differences in problem choice behaviour according to characteristics associated with cross-disciplinary variations. Of particular interest in this study are a number of assumed differences between academic disciplines and professions.

The effects of academic training on research are first of all plausible if we assume that education has something to do with socialisation, i.e. the process by which new members of a group, organisation or society internalise norms and values of the entity they are becoming members of. However, socialisation does not only deal with values through which patterns of behaviour are copied and the potential members are made familiar with professional skills, cognitive frames and norms and values. An extensive academic training does not only represent an introduction to the normative and cognitive structures of specific disciplines, but also to the way that the "academic collegium" is supposed to act and think. Exams and grades may well not only signal the knowledge attained and skills acquired from education, but also represent an indication of how well students have understood and internalised the norms and values of a scientific discipline and "the institution of academic science". If this is the case we will in the very basis for recruitment of new researchers find that the most socialised of students go on to pursue a career in research (Tvede 1990). Furthermore, the recruitment period is filled with socialising measures, such as courses in theory of science and scientific method, and in a number of disciplines there is a close mentor-student relationship that facilitates socialisation (Teigen and Tvede 1993).

An institution of academic science and problem choice

Thinking along Mertonian lines, the norms and traditions of academic science are expected to affect the problem choices of researchers. Assuming that there is an institution of science presupposes that there are values and norms that are common to men and women in research. The institution of science is usually linked to beliefs and values of academic science often referred to as the academic profession (Braxton and Hargens 1996; Teichler 1996) or the academic culture in universities (cf. Hackett 1990; Maassen 1996, for a discussion of the concept of academic culture). Aside from values and norms of academic science, an institution of academic science would comprise less intangible aspects as found in the relatively conspicuous structures of rewards and sanctions of scientific competition, e.g. as we see it in the system of scientific publishing, peer review and scientific awards.

Both academic culture and institution of science are concepts pertaining to many different aspects of academic and scientific life, such as the relationship between research and instruction, etc. The points of interest here, however, are much more limited. First, to what extent are problem choices in sectoral research affected by what we might label the decision premises of academic science? This is fairly well documented in prior studies of problem choice. Accepted theoretical concepts, terminologies and established scientific laws are an important part of the assumption structure that focus the attention on some problems while diverting it

from others (Zuckerman 1978: 79). Embedded in academic fields of learning are definitions of which problems are salient and solvable to the extent that they merit investigation. Degree of consensus as to what are considered important issues is found to vary across disciplinary boundaries (Braxton and Hargens 1996). Nevertheless we can assume that academic criteria of choice are common to academic science as opposed to "external" criteria of choice. Second, how does an institution of science relate to user-orientation in problem choice? When scientists show a strong degree of consideration for academic choice premises, does that preclude considerations of relevance and future use of research?

The following aspects of an "institution of science" are expected to be of relevance in a study of problem choice. The aspect of scientific training outlined above would imply an inertial effect on problem choice. Scientists choose research they are trained to do and for which they have the required skills to perform. Furthermore, they choose those problems that are defined as salient and researchable by the paradigms and theories they have become committed to. Consequently the best predictor of the outcome of future problem choice is the outcome of the preceding choices. So a major expectation is that problem choice is characterised by sheer persistence (Ziman 1987). This has, amongst other things, been demonstrated by the study of the scientific careers of astronomers (Gieryn 1978), a field in which over 90 percent of the scientists worked on the same problems as they did ten years ago. Such persistence is partly a result of the effects already discussed, such as socialisation, cognitive filters and skills. It is also a consequence of decision-making and career economics, i.e. prior choices and "investments" in research problems become "sunk costs" for the rest of a scientist's career or the research activities of research organisations. Migrating from one area to another may involve heavy costs, especially if it entails a change of methods and the procurement of new scientific equipment. Accumulated skills, resources, networks and reputation in one problem area make it less costly to produce results and publications, compared to a situation in which a scientist would switch to a new area.

There is, however, some evidence of a basic tension between tradition and innovation in problem choice - between change and continuity (Gieryn 1978). This is a tension that we retrieve in structures of sanctions and rewards, especially related to scientific competition and publication that surround institutionalised science in both its regulative and normative aspects (Meadows 1974; Mulkay 1977). Changing from one problem area to another involves risk - chances of failure are greater in a new field and changing requires investments in unfamiliar knowledge, concepts, skills, etc. (Hagstrom 1965; Gieryn 1978). However, the gains from migrating to new areas of research may be considerably higher if it involves doing

research on "hot topics". This is linked to the reward system in science as found in the system of scientific publishing - the potential gains from doing front line, original research increases the prospects for publishing in the most prestigious journals. The calculation of the balance between costs and gains from risk taking is, however, far from unaffected by changes in how scientific competition is structured. As Hackett (1990) points to, when resources for science become scarce this affects the scientist's own tolerance for risks and the tolerance of funding institutions in science, with higher risk aversion in funding agencies based on peer review.

Why scientists remain within one set of problems or "migrate" to other problem areas is not the question we set out to investigate. The pertinent point is that scientific training, and sanctions and rewards in science can be expected to push problem choice in two, possibly opposite, directions. First, making the choice a natural continuance of former research. Or second, pushing research in the direction of areas where the potential rewards from successful scientific contributions are higher. This will have consequences for what we expect to see in terms of choice criteria and patterns of participation in problem choice, as well as how criteria of choice rooted in an institution of academic research are linked to user-orientation. We might expect academic premises for making problem choice running athwart user-oriented criteria, i.e. academic premises can be viewed as conflicting, creating choice ambiguities and situations of cross pressure in problem choice. A prerequisite for user-orientation in problem choice would then be that academic choice criteria are not prevalent in affecting problem choice. Furthermore, as pointed to in section 3.2, the organisational surroundings of research are expected to influence the degree to which academic criteria of choice have leeway, i.e. the degree to which they are undisturbed by possible conflicting demands from the research organisation.

Hypothesis 4:

The more weight put on academic criteria of choice the less user-oriented the choice of research problems will be.

Cross-disciplinary variation

In addition to analysing the effects of science as a common community, another aspect worth paying some attention to is the possible effects of differences between scientific subfields as regards the norms, values and rules of research activities. We have seen already how scientific collegiate criteria of evaluation and control are essential in research organisations. We know something of how the "institution of science" works - but is it also possible to see differences between

scientific disciplines that are relevant for that part of the scientific system focused on in this study? A series of empirical studies and efforts for developing a theoretical framework have been undertaken, most of this literature focusing on "internal" aspects of fields of learning (cf. Braxton and Hargens 1996). Nevertheless, some scholars have indicated that there are disciplinary differences in so far as some disciplines have incorporated "external" values to a greater extent than others as an integrated internal part. Also some scholars claim that there are disciplinary variances in *tolerance* for such outside influences, e.g., Kuhn's theory of the development of scientific paradigms (Kuhn 1962) and the "finalization theory" (Böhme et al. 1976). A more recent contribution to the analysis of disciplinary differences is Becher's[13] taxonomy of academic disciplines (1989). He posits that differences between disciplines as regards their cognitive orientation are associated with differences in their social organisation, including their extrovert orientation and their vulnerability towards external influence, although the latter aspects are less well documented empirically in his study than the internal organisational characteristics of disciplines.

> *The implication of this analysis is that even when aggregated at a broad general level, different epistemological categories can be seen to be associated with distinctive sets of relationships between the academic communities concerned and the wider contexts in which they subsist. No part of the world of learning is immune from interaction with its environment, but the form that interaction entails will clearly reflect the nature of the knowledge domains in question. (Becher 1989: 148)*

The point of relevance to this study is simply that variations in degrees of user-orientation might not be so much a question of how research is organised, as proposed earlier, but rather that different disciplines have different cultures and normative structures as far as user-orientation in problem choice is concerned. These differences will unfold irrespectively of the organisational context[14]. Apart

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[13] Becher's perspective differs from the analysis of both Knorr-Cetina (1982) and Gibbons et al. (1994) (cf. Section 2.5). He focuses on the relationship between type of knowledge production (or "academic territory") and social organisation ("academic tribes"). Knorr-Cetina sees transepistemic arenas as part of all scientific knowledge production irrespective of the cognitive styles of different academic disciplines, and Gibbons et al. claim that inside-outside relationships have changed as a result of historic developments at the moment when scientific knowledge production transfers from the old to the new mode.

[14] Note that "organisation" here refers to the contextual variables described in the earlier section, and not to the type of social organisation referred to by Becher. Furthermore, Becher's argument would ultimately lead us to assume that the influence of differences in academic inquiry as found in the various disciplines cannot be found outside of university research, or that one type of scientific inquiry is necessarily

from pointing to disciplinary variations, Becher's taxonomy is not very helpful in specifying what kind of relationship we can expect between various disciplines and the degree of user-orientation in problem choice, since much of the research areas in this study are formed by different subdisciplines of biology, whereas Becher's taxonomy enters "biology" as one entity.

The empirical study by Busch and Lacy (1983) demonstrates that disciplinary differences within agricultural science have a major impact on the way problems are chosen and defined. Nevertheless, the relative weight given to different criteria of choice does not lead us to expect a clear pattern of differences in user-orientation according to academic discipline, with the exception of basic sciences. Agricultural scientists in the basic sciences give significantly less weight to user-oriented criteria of choice and greater weight to academic choice criteria (Busch and Lacy 1983: 110-113). Apart from an expected difference between the basic sciences and other disciplines in agricultural and fishery science, the propositions regarding the cross-disciplinary variations in this study are open-ended and exploratory[15]. However, based on studies of sectoral differences in the Norwegian context we are able to develop a more specific hypothesis concerning the relationship between disciplinary differences and user-orientation with respect to differences between agricultural and fishery science.

These differences are closely connected to the important links between science and professions. By profession is meant an academically educated occupational group, i.e. there is a trajectory pointing from a specific university degree to particular occupational positions in working life outside of academia. A profession can be an important part of how a scientific discipline is linked to its environment. The profession becomes the link between "practice" and science (Eckhoff 1967; Stankiewicz 1979). Whereas the academic disciplines give, through their transmission of knowledge, not only factual premises for making decisions but also normative premises, professions furnish their parent disciplines with tangible proof of the applicability and usefulness of the particular kinds of knowledge that these

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linked to one type of social organisation. If this was the case it would not be possible to use organisation as an independent control variable, and study the possible effects of disciplinary differences. His study is an effort in classification and identification of key distinctions in disciplines in terms of their research norms and practices, rather than a theory of why there such distinctions exist. Becher's taxonomy is not developed into a theory that specifies the causal mechanisms and causal direction that couple cognitive styles to social organisation. He describes *associations* and *interactions* between intellectual "territories" and "tribes", however, he seems to give primacy to the former.

15 Cf. Appemdix I for how "discipline" was operationalised in this study

disciplines produce.

In a Norwegian context, the development of a separate agricultural science and profession ("civil agronomist"), and their coupling to separate public institutions for the management of agricultural sectors, has been regarded as an essential characteristic of this sector. It implies an early institutionalisation of a sectoral academic discipline and a profession with a strong "clientelistic" approach to a well defined set of clients, i.e. farmers and their organisations (Jacobsen 1965). The point in this connection is that one could assume that the long term, strongly institutionalised relation between discipline(s), profession and clients in this sector has made an impact on the criteria of choice of research problems in the agricultural sciences. It can be argued that we can expect user-orientation in problem choice to be stronger in the agricultural sciences than in the fishery sciences, given the fact that the latter lacks the strong traditions of coupling science, clients, professions and the state in the same way as can be seen in the agricultural sector. The fishery sector does not have the "sector profession" that creates a common educational background of science, primary production and public administration,[16] as is the case in the agricultural sector. The College of Fishery Science at the University of Tromsø, established in 1972, was a deliberate attempt to establish an education based on the principles of the agricultural ideal. This can be seen as an attempt to build a client oriented profession with the same defence mechanisms, defending the front-line producers or the primary link in the chain of production in the capture fisheries. In the early days of the College of Fishery Science, work experience from the fisheries was put forward as an entrance requirement to the study. However, the story of The College of Fishery Science seems to indicate that it was unsuccessful in forging the same links between science, clients and the state administrative apparatus as in the agricultural sector (Hallenstvedt 1998). We can assume that as a consequence of the nature of the links between scientific organisations and other organisations in the environment, the research units in agricultural science will be open to the definitions and problems of client groups - and these clients groups are closely related to the

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16 However, according to Schwach (2000a) a profession developed in the Fishery sector was the professional oceanic scientists. This field of science has an emphasis on fieldwork and the practical side of capture fisheries, amongst other things, as practiced in the annual oceanic expeditions. In that sense Norwegian oceanic science differs substantially from the oceanic /fishery science as found in the USA which is laboratory based research. Yet, a core difference between this profession and the agricultural profession is that it was linked to the public management and the "modernisation programme of Norwegian fisheries". This profession was largely disconnected from the primary producers in the capture fisheries. There was not a common educational basis shared between clients, science and the state.

scientific discipline through the profession. The basic differences in the traditions and structure of knowledge production and transfer in these two sectors would then lead us to assume that the field of agricultural science has developed a particular "ethos of agricultural science" that is explicitly oriented toward the practical use of science, incorporating users as participants in research, and thus espousing seemingly contradictory choice criteria. This as opposed to fishery scientists who we in general can assume to be trained and socialised into a more traditional set of academic values (cf. Schwach 2000a: 272). This proposition thus rests on the assumption that a stable, institutionalised and reciprocal relationship between science, professions and clients influences the premises for decisions made in research as well as the values of scientific disciplines. Where there is a strong link between a scientific discipline and a client oriented profession the link renders problem choice more user-oriented than in disciplines where such links are looser or non-existent. We would thus posit that there is a basic difference between agricultural and fishery science embedded in the histories, traditions and structures of the two underlying sectors.

Hypothesis 5:
The degree of user-orientation in problem choice varies according to disciplinary differences, irrespective of the organisational context in which such choices are made.

Hypothesis 5a:
Problem choice of agricultural scientists is more user-oriented than problem choice of fishery scientists.

Hypothesis 5b:
Researchers from the basic sciences, both within fishery science and agricultural science, are less user-oriented than colleagues from other disciplines.

3.5 Funding and problem choice

So far the focus has been on control systems and on cognitive and normative identifications within or across organisations. Organisations also represent streams of resources. It can be argued that organisations are linked to their environments through dependence on continued resource allocation. All organisations must engage in some kind of exchange of resources with their environments (Pfeffer and Salancik 1978). In the world of research organisations resource dependence is potentially a key concept by which we can understand how clients gain access to problem choice. If we interpret the research organisation as an organisation that exchanges information for resources, then the content of that information is of

vital importance for the potential "buyers" of that information since it will determine how willing they are to sponsor the research organisation, its research projects or programmes. From such a perspective, the survival of the organisation is dependent upon satisfying the expectations and wishes of its environment (Scott 1987:127). One should note that trading in science is not normally a case of buying ready-made products, given the characteristics of science as a public good. What a buyer of science products is doing is more related to buying the attention of scientists on a particular topic or problem, than to buying solutions or products (Von Hippel 1987; Kreiner and Schultz 1993).

If we so far see organisations as monolithic units where leadership has a primary responsibility for dealing with the organisation's external relations, then we would from a resource dependence perspective expect to see the organisational leadership engaged in buffering the core of the organisation against external pressures. In addition the organisational leaders can be expected to be involved in developing and implementing strategies that will minimise the organisation's uncertainty and dependence on the environment. The consequences for problem choice are that the direction in and degree of user-orientation is determined by a) whether different client groups can contribute to the organisation's need to acquire resources, and b) whether such client groups represent a source of resources that the organisation is dependent upon for survival. Thompson's *Organisations in Action* (1967) includes one of the first formulations of similar arguments in its contingency approach to organisations (Scott 1993: 63). Latour's *Science in Action* contains some of the same arguments in relation to the scientific activity that goes on at the "core" of a research organisation, when he describes how science goes from "inside and out":

> *Technoscience has an inside because it has an outside. The bigger, harder, purer the science on the inside the further outside other scientists have to go. The science that is seemingly cut from society is so because there are some scientists busy recruiting allies, resources, interesting people and convincing people. [.....]The ability to work in a laboratory with dedicated colleagues depends on how successful other scientists are at collecting resources. This success in turn depends on how many are already convinced by scientists that the detour through the laboratory is necessary for furthering their own goals (Latour 1987: 156-157).*

Although Latour does not relate his arguments to the significance of the organisational setting that surrounds laboratory work, the parallel is clear. In his translation model (cf. chapter 2) researchers are but the tip of the iceberg, implying that there are many more needed to work on the "outside" in order to make an "inside" possible. The former are people involved in "non-scientific" activities such as negotiation, management, regulation, inspection and sale. Latour claims that "in the construction of technoscience we have to include all the elements that

have been recruited or are doing the recruiting" (1987: 164). Clearly, the latter are part of what Thompson (1967) would call "core protectors" that deal with external resource dependencies research organisations are faced with.

On the other hand, if we look back to the quasi-economic model approach to the study of science, the adjustment to resources may also occur at the level of the individual scientists. We have already seen that this is likely in research organisations that we characterised as autonomous professional organisations, where formal leadership and formal structure have less possibilities to influence the work of the individual professional. An actor-oriented view of science as proposed by Callon, Latour and their colleagues, is compatible with this latter version. The difference is that resource dependency is managed at another level.

The point of singling out resource dependency as an independent factor in problem choice is that one might expect that adapting the topic of research, either at the organisational or the individual level, will occur no matter what the institutional and organisational setting is, or the cognitive or normative identification of the individual researcher. Consequently, the streams of resources that flow to research will render their own patterns of participation and definitions in problem choice - researchers will "look" where the money is, and "go" where funding guides them. Although a simple proposition, this might nonetheless represent an important correction to the theoretical emphasis presented thus far. It suggests obviously that the role of economic resources is not unimportant in an organisational perspective on knowledge production - it is on the contrary a vital element of what constitutes an organisation. Both resource dependence theory and institutional theory analyse organisations as open systems, linked and depending upon other organisations in their environment. Their focus is usually considered as differing. While resource dependence theory looks at exchanges of tangible goods, such as monetary resource flows, the institutional perspective analyses regulative, normative and cognitive relations between organisations and their environments. The distinction between the two perspectives on organisations is based on a differentiation made by the "early" neo-institutional analysis of organisations, i.e. a distinction between technical/material versus institutional environments (Meyer and Rowan 1977; Meyer and Scott 1983). Later contributions question the extent to which the resource dependency and neo-institutional perspectives are contradictory, and see them as complementary explanations to organisational action and structure (e.g. Tolbert 1985; Oliver 1991; Scott 1995, Maassen and Gornitzka 1999).

For the purpose of this study it is fruitful to maintain a distinction between financial resource flows and the other structural variables introduced so far, and to

examine how funding is directly affecting an organisation's activities. This relationship is analysed at a project level, and not at an organisational level. As pointed to in section 3.2, the nature of the overall funding pattern is interpreted as a general organisational characteristic. Focusing on funding at a project level and expecting this to influence user-orientation is more in line with the atomistic view of action as outlined in chapter two. On the basis of this view funding is treated as an independent variable in its own right and not as part of what constitutes organisational characteristics. One would then expect the streams of resources that flow to research render their own patterns of participation and definitions of important criteria of choice in the research process, and that at a project level problem choice is only user-oriented to the extent that clients are furnishing research funds, irrespective of the organisational surroundings of research. However, this presupposes that researchers somehow are moved to (re)directing their attention to users of research if there is an economic incentive to do so, thereby implicitly suggesting that researchers would otherwise give weight to academic choice criteria. In many respects this implies a view of knowledge production in which scientists are opportunistic actors who pursue academic careers, and who will err from an academically "credibility circle" only when the funding from external sources would infer giving weight to users' needs.

Hypothesis 6:

User-orientation in problem choice is dependent upon the type of funding research projects get - projects that are funded by clients will be significantly more user-oriented than projects with no such funding.

4 Participants and criteria of choice in problem selection

4.1 Introduction

In this chapter the major findings are presented of the empirical study on problem choice in fishery and agricultural science. To start with, an overview of actors and criteria of choice is presented, as well as the level of variation in problem choice according to some of the main explanatory factors introduced in chapter 3. The overall model and the testing of the hypotheses with respect to what explains variation in problem choice, follow in chapter 5. In other words, this chapter provides a description of *what* is important in problem choice of agricultural and fishery researchers, whereas the next chapter focuses on *why* there are differences with respect to who participates and what is given weight in problem selection.

The data on problem choice in this study represent a *reconstruction* of what happened when a certain research project was launched. Moreover, problem choice is not necessarily a decision made at a given moment with one or a limited set of actors deciding what research problem is to become the subject of a research project, nor is it always a rational choice where actors are confronted with a set of alternative research problems and choose the alternative that will maximize their expected utility. One assumption in this is that the selection of research problems normally will be more like decision-making processes in other types of organizations: a process where actors come and go, and a process involving a mixture of definitions of relevant problems and criteria of choice (March and Olsen 1976; Egeberg 1984). Especially with the data at hand it seems futile to try to pinpoint *the* moment of choice and the mechanisms that influenced the outcome of that choice at that particular moment in time. However, 85 percent of our respondents cited their research project according to title and year of commencement. This should indicate that most of the researchers in this survey envision their own research activities in terms of well defined 'projects' with an end point and a starting point, i.e. their research activities are not conceived as a continuous and ongoing endeavour with no boundaries in time and space.

4.2 Participants in problem choice

The locus of this section is the people involved in making decisions about what

themes, problems or areas are to become objects of research. Why is it interesting to know about the social and participatory aspects of a problem choice situation? Considering this as an important part of a research process, presupposes that actors matter: that it makes a difference who is involved in making decisions. We can assume that actors bring with them different kinds of expectations, frames of reference and points of view, and that this will affect the content and outcome of choice. Consequently, this section looks at the types of actors who enter the 'arena' of decision-making as one way of measuring how aspects of relevance and use are part of the selection of research problems.

In our survey the researchers were asked to report to what extent different groups of actors had been involved in the initial stages of the research project they were part of at that moment. The questions on participation were designed to make the respondents answer as specific as possible in terms of reporting about their own research activities. "Involvement in problem choice" was defined as taking the initiative with respect to or contributing with ideas about the content of their research project.

Thus the data show that a variety of different actors is involved in the selection of research problems, but the degree of involvement varies greatly according to different types of actors. Table 4.1 gives an overview of the relative involvement in problem choice of different groups of actors at a project level.

Table 4.1 Actors involved in selection of research problems of a project - degree of involvement. Percentage and mean score. N=264

	Degree of involvement				
	Strong	Middle	Some	None	Mean
Type of actor					Score[1]
Individual researcher	56	18	3	23	2.07
Colleagues at research dept./institute	32	26	8	32	1.60
Colleagues at other dep. at university/College*	5	22	10	63	0.67
Sectoral scientists outside own research unit	12	16	11	61	0.78
Scientists outside the sectoral research system	6	12	6	76	0.48
Leaders of research unit	15	14	11	60	0.84
Sectoral research council	8	9	9	75	0.49
Sectoral Ministry/directorate	5	9	6	80	0.39
Other potential users	9	12	5	74	0.56

* Question asked only to respondents from the Agricultural University of Norway and the Norwegian College of Fishery Science N=119

[1]"not involved" = 0 to "strongly involved" = 3

The researcher and his colleagues

The researcher himself and his colleagues in close organisational proximity are the central actors involved in problem choice at this level. The number one participant in terms of involvement in the selection of research problems is the performing researcher himself – in 56 percent of the cases the researchers performing the actual research were strongly involved in defining what the project was about. This corresponds well with the underlying assumption concerning research organisations as professional organisations where researchers have strong influence over their own organisational tasks. According to the findings presented in Table 4.1, the research organisations in this study seem to give researchers considerable influence over choices pertinent to their own research.

However, there may be a certain unwillingness to admit being marginal in problem choice for a person occupying a research position and therefore the report on own involvement might be overrated. If this indeed was the case one could argue that the fact that 23 percent reported no personal involvement at all, is surprising. Moreover, the variations we find in the researchers' own involvement seem

intuitively sensible. Going through the returned questionnaires, it was in this respect striking that the research projects where the performing researcher was not involved in the research initiation stage of the project were either projects where a doctoral student was recruited to work on an already defined project or cases where a researcher has taken over the responsibility for a project from colleagues who have left the research institute.

Department heads or others in formal departmental leadership positions are clearly much less relevant as participant in problem choice than leaders of research units in government research institutes. According to the expectations outlined in chapter three - we would expect the participation in problem choice to vary according to organisational context (see section 3.2), in the sense that participation is structured by hierarchy in heteronomous organisations as opposed to the situation in autonomous research organisations. This is documented in Table 4.2. Here we that leaders of research units are significantly more involved in problem choice than department heads at universities (mean score 1.17 versus 0.43).

Table 4.2 Degree of involvement in problem choice according to type of research organisation. Sub group mean. ("not involved"=0 to "strongly involved"=3). N=264.

	Institute	University
Individual researcher	2.03	2.13
Colleagues at research dept./institute	1.74*	1.43*
Colleagues at other departments within own university+	-	0.67
Sectoral scientists outside own research unit	0.86	0.68
Scientists outside the sectoral research system	0.40	0.57
Leaders of research unit/department heads	1.17*	0.43*
Sectoral research council	0.42	0.56
Sectoral Ministry/directorate	0.48	0.29
Other potential users	0.70*	0.40*

+Question asked only to university researchers. N=119

* Significant sub group mean differences. Level of significance ≤0.05. T-tests.

For the respondents from the Agricultural University and the College of Fishery Science we are able to compare the degree of participation from department colleagues versus research colleagues at other departments at the same research institution. On average, problem choice at the two universities included in this study involve sectoral researchers outside the university to the same extent as colleagues at the neighbouring departments. We can thus assume that university departments are organisational units where researchers are as closely related to colleagues operating within the corresponding scientific disciplines or

sub-disciplines *outside* the university as to fellow faculty from other fields of science *within* the same university. The disciplines and sub-disciplines represented in a department allow participants that are formally external to the organisation, but scientifically internal, to "penetrate" the larger organisational framework of the university (Clark 1983; 1984).

On the other hand there is little evidence to support the claim that researchers at universities are *more* closely attached to disciplinary colleagues outside their own university than to fellow faculty from other departments, such as suggested in Clark's master matrix model where scholarly activities are kept within the boundaries defined by the discipline rather than by the organisational boundaries of a university. Rather, according to Table 4.1, the degree of involvement in problem choice drops considerably in as far as any type of extra organisational actor is concerned.

The boundaries dividing research organisations according to their sectoral affinity seem even less penetrable in terms of direct personal involvement in problem choice: in only 6 percent of the projects, non-sectoral researchers were reported to be strongly involved, whereas 76 percent of our valid cases show no involvement from this group of scientists.

Overall, problem choice in agriculture and fishery research is arguably not a strikingly lonely process, involving one solitary researcher. Colleagues at the university department or research institute are strongly involved in the generation of ideas and initiatives in the research process. It is a process where researchers both in the organisational and disciplinary surroundings contribute to the definition of relevant research problems.

Participation of users

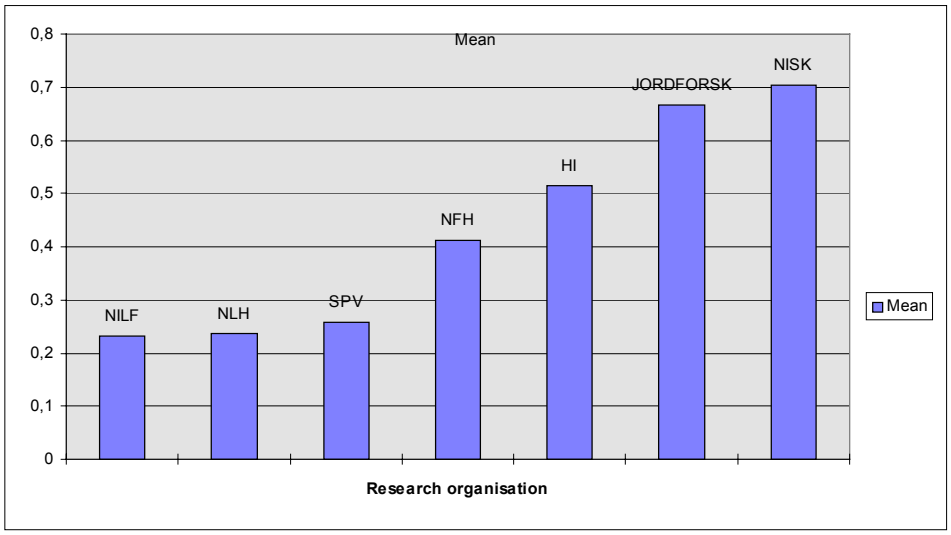
Users of fishery and agricultural research are reported to be among the actual participants in problem choice (26 percent of our cases, cf. Table 4.1), but this group of actors is far less involved in generating ideas for relevant research problems than the researcher himself and his immediate colleagues. Compared to the results from Busch and Lacy's study of American agricultural scientists, the Norwegian fishery and agricultural scientists seem much less prone to involve users and clients directly in the selection of research problems. In the American study "clients or users emerge as the most frequently mentioned group that significantly influences the scientist's choice of research problem or topic" (Busch and Lacy 1983: 92).

Considering this study's special focus on the public administration of agriculture

and the fisheries as users of science we included the sectoral Ministries/Directorate as a separate category. The Ministry of Fisheries and the Ministry of Agriculture are central as formal actors in these sectoral R&D systems. As discussed in chapter 3, based on the sector principle in ministerial research policy, we would expect to find a relatively high degree of involvement in problem choice from a sectoral Ministry, even at a project level, in order for the Ministry to make sure its informational needs are met. In this study, the central role of Ministries as initiators of research is not retrieved at the research performing level; here the sectoral Ministries are fairly absent as direct participants in problem choice processes. They are involved in about 20 percent of our cases. Note that this concerns project level participation. The involvement at organisational level processes is probably higher, as will be discussed in chapter seven, since the traditions and practices of Ministries is to set overall priorities and try to influence through broader themes and not to get directly involved in individual projects to the same extent.

Contrary to what was expected there are no significant differences between university versus government institute setting in terms of degree of involvement from ministerial actors (cf. Table 4.2). We can on the other hand observe considerable variation between the seven research organisations included in this study (see Figure 4.1). The variation in terms of sectoral Ministry's involvement does not seem to follow the university versus public research institute distinction, nor sectoral affiliation. The research organisation with the lowest average mean score on this variable (Institute for Agricultural Economics) is a government own applied research institute with formal ties directly to the Ministry of Agriculture, so is the institute with the highest score (Institute for Forestry Research).

Figure 4.1 Participation from sectoral government agencies in problem choice, Mean scores according to research institution



NILF=Norwegian Agricultural Economics Research Institute, NLH=Agricultural University of Norway, SPV=Norwegian Plant Protection Institute, NFH=Norwegian College of Fishery Science, HI=Institute of Marine Research, JORDFORSK=Norwegian Centre for Soil and Environmental Research, NISK=Norwegian Forest Research Institute.

Participation of sectoral research councils

The Fishery Research Council and the Agricultural Research Council are also fairly peripheral as participants in problem choice. These units are, however, slightly more involved than their corresponding Ministries. The sectoral research councils are relatively strongly involved as funding agencies and as organisers of research programmes of which individual projects in the two sectors are part. Of the projects, 60 percent has some financial support from the sectoral research council (i.e. the Agricultural Research Council and the Fishery Research council) and 36 percent is part of one of these research council's research programmes. Nonetheless, as indicated, a central position in funding and programme organisation does not seem to guarantee direct access to the research process when research problems are selected. This might also be directly related to the type of selection procedure that research councils use - implying that the research councils do not directly instigate and define research problems, rather they choose from a pool of already developed research proposals on the basis of applications they receive.

Participants in agricultural versus fishery research

The patterns of participation in problem choice are very similar across the disciplinary areas of agricultural versus fishery research. The pattern revealed in Table 4.1 does not change much when we look at the two fields of research separately. To test the association between field of research and patterns of participation in problem choice, we conducted a t-test to probe possible significant sub-groups mean differences. There are no significant differences between the two types of research fields when it comes to the participation level of the various groups of users identified in this respect with one exception. In fishery research the researchers themselves are more strongly involved in the choice of problems than their agricultural counterparts. However, despite this difference, there is so far no reason to believe that fishery scientists at the Marine Research institute and the College of Fishery Science are either less or more *user-oriented* in problem choice than agricultural scientists in this study. Note that this is only a valid conclusion with respect to the participatory aspect of problem choice.

In view of these results, we could conclude that the research projects reported on in this study have a pattern of participation in problem choice that is less "user-oriented" than one might have expected. On the other hand, we may view direct participation as strong kind of involvement. Our respondents were able to pinpoint the type of groups outside their research organisation that are involved. One might argue that this represents a fairly strong openness to actors outside the researchers' immediate work environment. Compared to Busch and Lacy's (1983) study of agricultural science in the USA, we phrased our question in such a way that we could tap the direct participation of different groups. The US study asked for importance of user influence in choosing research problems *in general*. That includes the indirect influence of users and not necessarily highlights participation. We have to wait with our conclusions about the degree of "user-orientation" until we have looked at other aspects of problem choice later on in this chapter, and in the analyses in chapter 5. A preliminary conclusion is that actors from outside the "scientific community", such as private or public users or actors representing Ministries and research councils are fairly marginal as direct participants in problem choice, but so are scientists from research institutions other than the one the involved researcher is part of.

4.3 Clusters of participants

To what extent can we trace clusters of participants? Are some participants more likely to be accompanied by a specific group than others? To probe these questions we conducted a simple correlation test with respect to participation from different actors. Here the participation variables have been dichotomised into "involved"

versus "not involved" categories. We are interested in the relationship between involvement of users and participation from different types of researchers.

Table 4.3 Significant correlations between involvement from different actors in problem choice (0="not involved"; 1="involved"). Pearson's r. N=264

	1	2	3	4	5	6	7
1 Colleagues within department/institute							
2 Colleagues at other univ. department+	.29**						
3 Sectoral researchers	.18**	.27**					
4 Non sectoral researchers	-	.21*	.13*				
5 Leaders of research unit		.25**	.19*	.14*			
6 Sectoral research council	.22**	.23*	.24**	.14*	.21**	-	
7 Sectoral Ministry/Direc.	.12*	-	.19**	.16*	.30**	.34**	
8 Other potential users	-	-	-	-	-	-	.22**

\+ Question asked only to respondents from the Agricultural University of Norway and the Norwegian College of Fishery Science N=119

*p≤ .05; **p≤ .01; ***p≤ .001

Even though most of the correlations are not particularly strong, the main finding of interest to us is that there is no evidence that user participation is antithetical to involvement from the different categories of researchers - none of the variables are significantly negatively correlated. Furthermore user participation and involvement of the sectoral Ministry are significantly correlated with each other. However, the participation of sectoral Ministries is somewhat different compared to participation of other user groups, in the sense that Ministry participation is positively correlated with participation from both other researchers and the research council. This might indicate that the Ministries are different from "regular" user groups in that they fit in with both researchers and other users as problem choice participants. It could represent the empirical illustration of the sector principle in research policy as described in chapter3, where a sectoral Ministry is not like "any other client".

Later in this chapter we present the result of a factor analysis of the same variables that point to some other nuances in the data on problem choice participation.

4.4 Who are the users?

As a way of understanding which actors the researchers defined as users of their research we asked those who reported involvement from user groups to specify who these participants were.

Table 4.4 displays the types of participants involved in problem choices that were not part of any of the other categories specified in the questionnaire, i.e. the table gives an overview of the participants cited under the categories "users" or "others". Not all respondents who reported that users have been part of the problem selection process actually specified the set of actors involved, so the information in table 5.4 does not give us the total picture of the users involved. Sectoral Ministries (and for fishery science the Directorate of Fisheries) were listed as a separate category in the questionnaire and consequently such actors are not among those listed in
Table 4.4.

Table 4.4 Participants involved in problem choice within the categories "users" or "others". Frequency distribution.

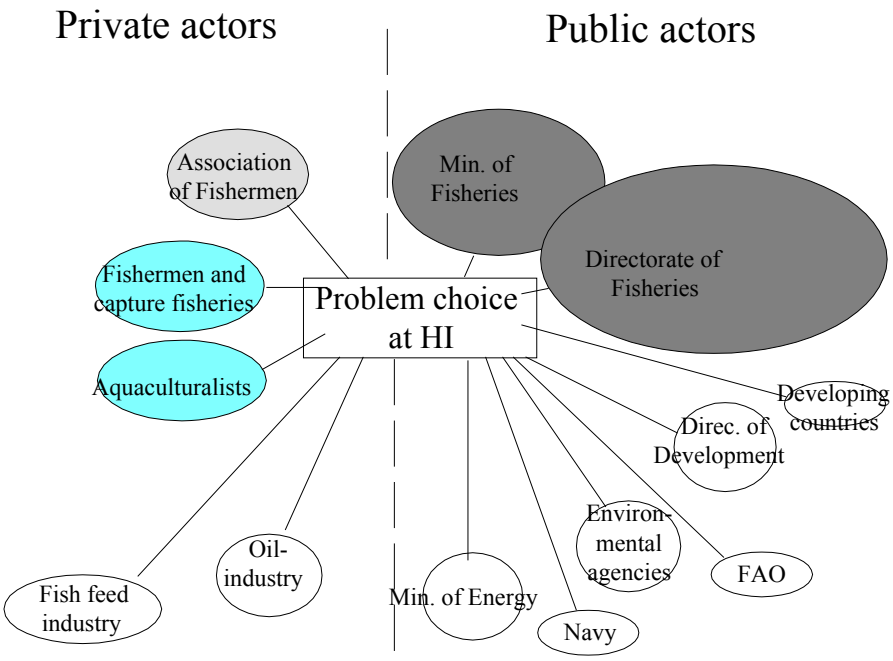
	Research sector		
Type of participant	Fishery	Agriculture	total
Professional organisations or organised interest groups	32	17	23
Public administrative units in primary sector other than Ministry/Directorate	3	23	15
Environmental public agencies or public administration outside the primary sector	27	19	22
Industry or private enterprise	29	13	20
Other	9	29	20
(N)	(34)	(48)	(82)

Judging from Table 4.4 the lack of differences between fishery and agricultural science discussed earlier, is to some extent a matter of a superficial similarity. Fishery scientists included in this study have another set of users involved in problem choice than their colleagues within agricultural science. In fishery science the user groups, besides the Ministry or Directorate of Fisheries, most frequently cited are professional/organised interest groups and industry/private enterprises. Apart from the Ministry of Agriculture, other public administrative units within agriculture are the most frequently mentioned among the participants in problem choice within agricultural science. This could indicate that fishery science is more oriented towards the private sector than agricultural science.

Unlike fishery scientists, agricultural scientists frequently refer to students and research administrative units (other than the Agricultural Research Council) as being involved in choice of research problems. Neither can be understood as clients of research in the interpretation used in this study.

In figure 4.2, participation in problem choice among "user groups" for one of the research institutions is visualised. This illustrates the variety with respect to user groups that are involved in problem choice - a variation that is under-reported when these groups are put together in one user category.

Figure 4.2 Actors involved in problem choice – Institute of Marine Research (HI)



4.5 Who benefits from research?

Less than ten percent of the researchers included in our study indicate that their current research project does not involve applied research; 62 percent say that applied science constitute 50 percent or more of their current project. An overwhelming majority (87 percent) of the researchers in this study perceive their current research project as potentially useful to actors outside the research system. The remaining group see their current research either as primarily of interest to the research community or the general public and not any particular identifiable user. A reasonable assumption is that most people would like to spend their time doing something they perceive as useful, and so also researchers will tend to view their

own research as beneficial to someone. This question was designed to tap the specific groups or actors that the researchers saw as those who would benefit from the results of their current research project. The perceptions of researchers might not correspond perfectly with the actual usefulness of research projects. However, the data point to some interesting aspects of the different groups for which fishery and agricultural scientists feel their research is beneficial.

Some of the researchers answered the question by pointing to fairly broad categories. We were, however, able to construct categories on the basis of their answers. The frequency distributions are presented in Table 4.5.

As we can see from Table 4.5, according to the perceptions of the researchers the sectoral industry in general and sectoral public administrative agencies in particular are the two predominant categories of actors who are expected to benefit from the results of their current research project. 26 percent of the fishery scientists mention the fisheries in general and a rather high proportion perceives actors involved in aquaculture as potential users of their research.

Table 4.5 Groups perceived as potential beneficiaries of research. N=264. Percentage.

	Fishery science	Agricultural science	Total
Part of primary sector as beneficiaries?			
- no	51	62	58
- agriculture	-	25	16
- forestry	-	12	8
- capture fisheries	26	-	10
- aquaculture	24	-	9
Public agencies as beneficiaries?			
- no	48	51	50
- sectoral public agencies	28	22	24
- environmental agencies	5	6	5
- both environmental and sectoral agencies	10	11	11
- agencies in other sectors	7	4	5
- "public agencies" (unspecified)	3	6	5
Business and industrial enterprises?			
Yes	19	6	12
Organised interest groups as beneficiaries?			
- yes	9	10	10
(N)	(102)	(162)	(264)

Agricultural scientists are less inclined to mention "their" sector under this question. Public agencies receive a high score, and here again the sectoral agencies are most frequently mentioned, irrespective of research sector. Organised interest groups within agriculture or fisheries are relatively marginal as perceived beneficiaries of research.

It is interesting to note the difference between fishery science and agricultural science as far as business and industrial enterprises are concerned. Fishery researchers report more often that such groups will benefit from their research. In addition to the traditional industry connected to the fisheries, such as food processing and input industries, fishery scientists consider oil companies in particular to benefit from their research, especially in as far as oceanography is concerned. This might illustrate that relevance of research is shifting, in the sense that one type of research organisation is not permanently connected to a particular set of user groups. With the rise of gas and oil exploration in the North Sea, the Institute of Marine Research has experienced a change in their set of clients for their oceanographic research, in the sense that they now include oil-companies next to their traditional client groups such as the capture fisheries and merchant fleet (Schwach 2000a).

4.6 Criteria of problem choice

So far we have looked into participatory aspects of problem choice. However, a choice process also involves an interpretation of what are interesting, important, acceptable and good topics to do research on. In this section the factors that are defined as relevant to the process of selecting research problems in fishery and agricultural science will be discussed. These factors are referred to as criteria of choice.

User-oriented criteria of choice

We have seen in the preceding sections that most of the respondents in this study report that they are doing applied science. Furthermore, they are able to identify particular groups as potential users of their research. However, this is not equivalent to bringing in application and use potential as a *criterion of choice*. Therefore the question is of relevance whether the concern for application of research results and users' needs is seen as important in the process of selecting research problems.

The respondents in our survey were asked to rate how important a set of different factors had been for the instigation of their current research project in order to get an insight into what are regarded to be important criteria of problem choice. The ratings of some of the criteria that we can label as user-oriented criteria of choice are presented in Table 4.6. The figures in this table give a slightly different picture of the science – user relationship than the one we have seen with respect to the *participatory* aspects of project selection.

Table 4.6 Weight given to user-oriented criteria of problem choice. Frequency distribution. Percentage and mean score ("unimportant"=0 to "very important"=3). N=264.

	Degree of importance				
	Very important	Important	Somewhat important	Un-important	Mean score
Users' expressed need for research	36	26	17	21	1.77
Solve specific problems in own sector	45	24	10	21	1.94
Solve specific problems in other sectors	8	14	18	61	0.68
Contribute to general knowledge in own sector	28	34	16	23	1.67
Knowledge needed for public administration of own sector	28	23	19	30	1.49

These results give an overall impression of user-oriented factors as a very important set of choice criteria. "Solving problems in own sector" is rated as a very important consideration in selecting research topics by 45 percent of the respondents. Likewise, 36 percent of the respondents reported that to follow up users' expressed need for research on a particular research problem was a very important factor for the launching of their current research project. Only 21 percent of the respondents viewed this factor as unimportant.

Before we go any further, it should be noted that rating the importance of different factors in problem choice does not necessarily reflect the personal "user-orientation" of the individual researchers who filled out the questionnaire. The questions in this part of the questionnaire were designed to get an insight into the researchers' conception of the actual emphasis set on these factors when choosing the subject of scientific investigation. The researchers' own ideal conception of what is important to consider in problem choice might be different.

Nonetheless, judging from these figures one might assume that researchers in agricultural and fishery science see their own research as part of a *problem solving* effort for the sector to which they are organisationally and financially closely linked. To a large extent these researchers see themselves as doing science with regard to the applicability of their research, and contributing to building up the knowledge base for the sector in general.
Furthermore, they seem to be attentive to the users' expressed need for research to a much stronger degree than the data on user participation indicate. This may signify that participation of users in problem choice processes is not a necessary condition for application of research to be considered important. There seem to be

other ways in which "user-orientation" plays a role in these processes instead of through the direct participation from users.

Not surprisingly, the relevance to users outside the agricultural or fishery science is not important in problem choice. One could argue that any other result would be "sensational". This aspect, however, was included as one way of investigating whether a "desectorisation" of research has occurred in this part of the research system (cf. chapter 1) connecting agricultural and fishery research to new clients outside the traditional sectoral boundaries. Such a change is not reflected in these data. However, as illustrated earlier, analysing when new clients of sectoral research might in fact be incorporated and thought of as part of the sector and in that way, investigating "desectorisation", must rely on another type of data than those available in the present study.

Academic orientation

The user-oriented criteria "solving problems in agriculture and fishery" and "satisfying users' need for knowledge", are emphasized in problem choice. Yet, at the same time factors more oriented towards the academic content and the academic practices with respect to research are just as prevalent in this part of the Norwegian research system. Other studies of researchers in the so-called applied sectors of the research system seem to indicate that some research institutes have developed a "hybrid-community" or "problem-solving community" which reduces the potential or alleged crosscutting conflict between academic criteria of choice and criteria of relevance. In these settings considerations of a research project's problem-solving potential merge with considerations of scientific quality and interest (Mathisen 1989). As we can see from Table 4.7 this seems to be the case for the research projects reported on in our study. "Continue prior research", "Develop new methods", and "Follow up important scientific discussion in my research field" are the criteria that are frequently cited as having been very important in the choice of the current research projects of our respondents. These criteria obtain relatively high mean scores. However, solving problems for users is still the single most important overall factor for the selection of research problems, having the highest mean score and being most frequently cited as very important for problem choice (see also Table 4.10).

Table 4.7 Weight given to academic criteria of problem choice. Frequency distribution. Percentage and mean score ("unimportant"=0 to "very important"=3). N=264.

	Degree of importance				
	Very Important	Important	Somewhat important	Un-important	Mean score
Continue prior research	39	25	11	26	1.72
Develop new theories	22	29	20	28	1.42
Develop new methods	33	28	19	20	1.69
Follow up an important scientific discussion	29	31	18	21	1.64
Publication probability in scientific journals	20	31	18	21	1.51
Be able to work with competent colleagues	11	27	29	33	1.11
Approval of colleagues	19	30	16	35	1.30

In chapter two, a distinction was made between the inertial effect of an institution of science versus the incentive for change and risk taking stemming from scientific competition. It might be argued that giving weight to the possibility of continuing prior research represents "traditional" forces in science, whereas publication probability stands for an incentive for moving to new areas of more publishable research. Doing research that represents a continuation of prior research activities is rated on average as more important than doing research that will have a high publication probability. Consequently it might be argued that this part of the research system is more influenced by prior choices of researchers than by the pursuit of future gains from publication in scientific journals.

However, to equate publication probability with innovative and risk-taking forces in science is probably contestable. Certainly we would expect that the degree to which research must be innovative and front-line to be publishable is dependent upon both the publication practices within different disciplines of relevance and within scientific journals in the fields in question. The ratio of the number of articles submitted for publication and the number of articles accepted for publication can be excepted to affect the need for research to be original and novel to be published. Publication policy might also differ from journal to journal in terms of how the balance between conservatism versus innovation is tilted. Since this study does not contain data on which types of journals the respondents aim at for publication of their research, this argument can not be pursued any further here.

We see that the criteria "colleagues' recognition of a particular research topic", and "the prospect of working with competent colleagues on a particular topic", seem to be the least important of the academically oriented criteria of choice. Around one third of our respondents did not consider these to be important factors in the

selection of their current research projects. As suggested by former findings, prior choices in research must consequently be interpreted as the most important factor determining problem choice among academic choice criteria. The prospect of producing research results that can be published in scientific journals ("publication probability") seems, however, on average to be as important as the prospect of developing new scientific theories. Also within this type of sectoral research, "publication probability" represents an influential factor as an embodiment of the scientific reward system, where reputation follows publication.

Administrative factors in problem choice

Among the criteria of problem choice we listed in our questionnaire were some that are linked to the administrative aspects of doing research. We asked our respondents to rate the importance of getting *funding* for research or access to *scientific equipment*. Both equipment and funding are in most instances conditions for doing research. How important are such factors when researchers choose their research problem?

Table 4.8 Weight given to administrative criteria of problem choice. Frequency distribution. Percentage and mean score ("unimportant"=0 to "very important"=3). N=264.

	Degree of importance				
	Very important	Important	Somewhat important	Un-Important	Mean score
Funding	16	23	11	34	1.20
Access to scientific equipment	1	12	31	55	0.58
Organisation's research priorities	21	34	19	26	1.45
Relevance for other tasks in organisation	17	33	20	29	1.36

In general administrative criteria seem to have played a somewhat lesser role in the choice processes, compared to the other criteria of choice included in this study. Access to research funds is considered definitely more important than access to scientific equipment. In a majority of cases, consideration of the access to scientific equipment does not enter as choice criteria when research topics are selected.

The two most important administrative criteria of choice are connected to the *needs and priorities of the research organisation,* i.e. the organisation's research priorities and choosing research problems that are relevant for other tasks within the organisation. Less than 30 percent of our respondents regard these factors as unimportant; the majority of the rest reports such factors to be somewhat important or important. The influence of the research organisation's priorities is

judged on average as more important than doing research that is relevant for other organisational tasks. This finding further underlines the importance of viewing contemporary agricultural and fishery science as a joint organised activity - and not as an endeavour undertaken by atomistic individuals detached from the organisation that surrounds them.

Research policy and problem choice

Administrative criteria of choice connected to institutions outside the research organisation on average do not appear to be particularly important. These one might call *research policy* related criteria of choice (see Table 4.9). To follow up the research priorities of the Ministry of their sector seems to be more central in problem choice than adjusting to research programmes. Almost 40 percent of our respondents reported the latter to be unimportant. That makes this factor one of the three least heeded of all the factors that our respondents were asked to rate.

The importance of adjusting to research programmes is rated fairly similarl compared to the importance of access to research funds (see table 5.9). In fact, these two variables are significantly, but not strongly, correlated (Pearson's r =.15, cf.Table 4.12). There is a tendency for those who stress the importance of access to funding also to emphasise the need to adjust to research programmes. Clearly, research programmes are a major source of funds for fishery and agricultural researchers, so when research programmes influence the choice of research problem the access to research funds might be an underlying factor, and in some cases, vice versa.

Table 4.9 Weight given to research policy criteria of problem choice. Frequency distribution. Percentage and mean score ("unimportant"=0 to very "important"=3). N=264.

	Degree of importance				
	Very important	Important	Somewhat important	Un-Important	Mean score
Adjust to research programmes	13	22	26	39	1.06
Follow up research priorities of sectoral Ministry/directorate	20	25	20	36	1.28

Criteria of choice in universities versus public research institutes

The difference between a university versus a public research institute setting when it comes to problem choice relates primarily to two sets of choice criteria. First,

significant differences in mean scores of the two sub-groups are found with respect to the weight given to the needs or priorities of the research organisation. The average score given to the latter set of criteria demonstrates the biggest difference between problem choices in public research institutes and university research. As proposed earlier (cf. 5.2), access of actors to problem choice is much more structured by organisational hierarchies within public research institutes, compared to the situation in university departments. Problem choice in public research institutes is among the decisions that are coordinated with the collective activities of the organisation. That does not entail that university researchers choose their research topics disconnected to any kind of social structure, however, the link between the formal research organisation and such choices is much more elusive in universities.

Second, there are differences in weight given to user-oriented choice criteria, and this supports the proposition outlined in chapter three (hypothesis 2). Furthermore, contrary to what we found with respect to ministerial participation (cf. section 4.2) there is a significant difference between institute and university research with respect to the weight given to the ministerial research priorities. The overall pattern thus supports the idea that university research is less explicitly part of a government chain of command in knowledge production for the sector than research in public research institutes (cf. chapter three).

On the other hand there are no significant differences in the extent to which academic criteria are deemed as important in choice processes. So a preliminary conclusion would be to argue that in institute research, academic criteria of choice operate side by side with user-oriented criteria of choice, and that a basic difference between the two is that in problem choice in government research institutes greater weight is given to a larger set of choice criteria than within universities. The difference between problem choice in the university units and the research institutes that are part of this study is *not* that the latter are less academically oriented than university units, but that they are significantly more adjusted to both client's need and ministerial and organisational research priorities.

Table 4.10 Weight given to criteria of choice according to type of research organisation. Sub-group mean ("unimportant"=0 to "very important"=3). N=264.

Criteria of choice	Institute	University
Satisfy users' expressed need for research	1.96*	1.53*
Solve specific problems in own sector	2.12*	1.71*
Solve specific problems in other sectors	0.68	0.67
Contribute to general knowledge in own sector	1.80*	1.50*
Knowledge needed for public administration of own sector	1.60*	1.30*
Continue prior research	1.60	1.83
Develop new theories	1.43	1.40
Develop new methods	1.94	1.40
Publication probability in scientific journals	1.56	1.45
Follow up important scientific discussion	1.70	1.50
Be able to work with competent colleagues	1.12	1.10
Recognition of colleagues	1.34	1.21
Funding	1.25	1.14
Access to scientific equipment	0.65	0.50
Organisation's research priorities	1.69*	1.16*
Relevance for other tasks in organisation	1.64*	1.01*
Adjust to research programmes	1.12	1.00
Follow up research priorities of sectoral Ministry or Directorate	1.48*	1.06*

*= Significant sub-group mean differences. Level of significance = .05. T-tests.

Choice criteria in agriculture versus fishery science

We wanted to take a closer look at the choice criteria that are ranked among the most important for the fishery versus the agricultural researchers. Table 4.11 displays the subgroup mean ranking for each of the criteria of choice, in agricultural versus fishery research respectively. The similarities between the disciplines in rating of important criteria of choice are more striking than the differences. However, fishery scientists tend to give higher ranking to most of the criteria they were asked to grade. Consequently, one way of comparing the subgroup means is to compare the top five lists of criteria within each subgroup.

"Solving problems in own sector" is on average ranked as the most important factor in the two fields of research. Likewise, "satisfying users' expressed need for

research" is among the top three criteria, and "developing new methods" is among the top five in both groups. However, the "continuing prior research" factor has the second highest score among fishery scientist, whereas the agricultural scientists do not include this among their top five of most important criteria.

Five criteria of problem choice are ranked significantly different by the researchers from the agricultural research institutions compared to the fishery researchers included in this study. The fishery researchers place significantly more importance in "contributing to knowledge needed in public administration of their sector" than their colleagues in agricultural research. This is interesting and contrary to the expectations proposed in chapter three, where the general relationship between public agencies and research was expected to be closer in agricultural than in fishery science. Fishery scientists are significantly more concerned with two of the academic criteria of choice ("develop new theories" and "continue prior research"). Why agricultural scientists are less concerned with choosing research topics that are of relevance to other tasks in the organisation does not lend itself to any apparent sensible interpretation.

As a preliminary conclusion we can say that the fishery researchers present themselves just as user-oriented as their research colleagues in the agricultural sector. However, contrary to expectations outlined in chapter three, the fishery scientists are more involved with research projects that are oriented toward public agencies' need for knowledge than their agricultural counterparts. That is also not in accord with the researchers' report of who they view as beneficiaries of research, where it looks as though fishery scientists are more oriented towards private actors as potential users (cf. section 4.5).

Table 4.11 Weight given to criteria of choice in agricultural versus fishery science. Sub-group mean ("unimportant"=0 to "very important"=3). N=264.

	Agricultural science	Fishery science
Satisfy users' expressed need for research	1.74	1.81
Solve specific problems in own sector	1.86	2.06
Solve specific problems in other sectors	0.78*	0.52*
Contribute to general knowledge in own sector	1.70	1.64
Knowledge needed for public administration of sector	1.33*	1.74*
Continue prior research	1.53*	2.03*
Develop new theories	1.30*	1.61*
Develop new methods	1.67	1.73
Publication probability in scientific journals	1.46	1.60
Follow up important scientific discussion	1.62	1.68
Be able to work with competent colleagues	1.08	1.17
Recognition of colleagues	1.23	1.40
Funding	1.13	1.31
Access to scientific equipment	0.51	0.70
Organisation's research priorities	1.48	1.41
Relevance for other tasks in organisation	1.24*	1.54*
Adjust to research programmes	1.05	1.09
Follow up research priorities of sectoral Ministry/directorate	1.36	1.13

*= Significant sub-group mean differences. Level of significance ≤ .05. T-test.

4.7 Dimensions in problem choice

Conflicting criteria at project level?

As we have seen there are many criteria of choice operating within the process of selecting a topic for a research project. We wanted to check whether some of these criteria seemed to be incompatible with each other. It has traditionally been the argument that criteria of inherent scientific relevance versus criteria that emphasize the applicability of research in "society" are mutually discordant.
For this purpose a simple correlation analysis was conducted between the different criteria of choice variables with two categories: the factors that are *strongly* emphasized in selecting research problems versus those not strongly emphasised (

Table 4.12). Indeed, putting strong emphasis on satisfying users' need for research is negatively associated with strongly emphasizing the publication probability in scientific journals, and "solving sectoral problems" is negatively associated with strong emphasis on developing new scientific theories. In this respect there is some evidence to support the hypothesis launched in chapter 3 that the more weight put on academic criteria of choice the less user-oriented the choice of research problems will be. However, this is valid only for two of the academic criteria of choice and two of the user-oriented criteria which the respondents were asked to rate. Apart from the two already mentioned, there are no negative correlations in the correlation matrix. There are, in other words, no overall patterns that indicate that stressing the importance of developing new scientific theory, and related factors, is *incompatible* with taking some consideration of the potential applicability of future research results. If this were the case, the bottom left corner of Table 4.12 would have contained significant negative correlations. However, what we observe is basically an absence of significant correlations between academic and user-oriented choice criteria. In most instances both academic criteria and relevancy are considered in such choices without these choice criteria being mutually exclusive.

List of criteria in numerical order

1. Satisfy users' expressed need for research
2. Solve specific problems in own sector
3. Solve specific problems in other sectors
4. Contribute to general knowledge in own sector
5. Knowledge needed for public adm. of own sector
6. Funding
7. Access to scientific equipment
8. Organisation's research priorities
9. Relevance for other tasks in organisation
10. Adjust to research programmes
11. Research priorities of sectoral Ministry/directorate
12. Continue prior research
13. Develop new theories
14. Develop new methods
15. Publication probability in scientific journal

16. Follow up important scientific discussion
17. Be able to work with competent colleagues
18. Recognition of colleagues

Table 4.12 Correlations between criteria of choice. Pearson's r. Only significant correlations are included. ("not very important"=0, "very important"=1). Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2	.34**																
3	.14*																
4		.16**															
5	.32**	.35**		.29**													
6																	
7																	
8					.17**	.13*											
9					.21*'			.20**									
10						.15*		.13*	.19**								
11	.30**	.18**	.18**	14*	.24**	.13*		.20**		.19**							
12																	
13		-.12**										.27**					
14	.22**	.23**						.15*					.14*				
15	-.17**																
16												.17**	.32**		.18**		
17							.20**	.14*	.19	.21**		.30**			.26**	.23**	
18							.22*	.17**							.21**		.19**

*p≤ .05 **p≤ .01

There are, nevertheless, certain patterns regarding what kinds of criteria are mentioned together. In order to investigate this further a factor analysis was carried out that allows us to check which dimensions in criteria of choice belong together empirically. The results of this analysis are presented in Table 4.13.

Table 4.13 Dimensions in criteria of choice. Factor analysis. Principal components analysis. Rotated factor matrix.Varimax rotation method

	Factor 1	Factor 2	Factor 3	Factor 4
Develop new theories	**.740**	.110	.086	.071
Continue prior research	.732	-.151	-.078	.332
Follow up important scientific discussion	.667	.257	.204	-.095
Publication probability in scientific journal	.570	.443	-.084	.075
Be able to work with competent colleagues	.541	.402	.094	.165
Solve specific problems in other sectors	.506	.189	.195	-.369
Recognition of colleagues	.033	**.729**	-.046	-.063
Organisation's research priorities	.145	.637	.156	.310
Relevance for other tasks in organisation	.234	.566	.176	.177
Access to scientific equipment	.166	.495	.188	.446
Develop new methods	.338	.474	.227	-.077
Adjust to research programmes	.186	.474	.187	.366
Knowledge needed for public administration	.185	-.136	**.724**	.194
Solve specific problems in own sector	-.021	.055	.720	.072
Satisfy users' expressed need for research	-.014	.175	.644	-.091
Contribute to general knowledge in own sector	.095	.111	.625	.119
Follow up research priorities of sectoral Ministry/directorate	.097	.360	.554	.066
Funding	.076	.205	.157	**.756**

The factor analysis has provided some interesting results. The analysis indicates that there are four dimensions to be singled out in the data on criteria of choice, of which two are of particular interest here. First, factor 1 in Table 4.13 can clearly be interpreted as a dimension for academic orientation in problem choice. The variable that "carries" this dimension is the giving weight to developing new theories as a criterion of problem choice (highest factor loading for factor 1). The factor includes all the variables that have already been defined as part of academic

criteria of choice, with two exceptions. One of the variables ("develop new methods") that is defined as part of a set of academically oriented criteria is not part of the cluster of variables that appear as the academic dimension in Table 4.13. It can be argued that this is due to the fact that the respondents have interpreted "method" not as scientific method in particular, but that they refer to method in the practical field of agriculture and the fisheries. As such it should not be included as an academic choice criterion. Furthermore "recognition of colleagues" is principally part of another dimension (factor 2) that seems to relate to contextual issues, consisting both of administrative and research policy variables. However, this factor carries less of an immediate interpretation.

The results of the factor analysis inspire a revision of the content of what constitutes a user-oriented dimension in problem choice. "Solving problems in other sectors" is a criteria that acts "out of class", in the sense that it clearly does not belong among the user-oriented criteria. Consequently the user-orientated dimension should be looked upon as oriented to users and application of research within the primary sectors. Second, "following up research priorities of sectoral Ministry/Directorate" must be considered as part of the set of variables that make up such a dimension, i.e. factor 3 in Table 4.13, which makes sense. Consequently, the factor analysis has served to clarify the "content" of user-oriented criteria of choice as it appears in these data. The user-oriented factor thus consists of criteria that are directly aimed at sector-specific users and the public administration of the sector. The two factors with the highest factor loading are "contribute to knowledge needed for public administration of own sector" and "solving specific problems in the sector".

Factor 4 consists of two variables ("funding" and "access to scientific equipment"), where funding is the overall variable that determines this factor. Choosing research problems according to whether there is funding available is a variable that does not have a high factor loading on any of the other three factors identified in the analysis.

Returning to the issue of conflict in problem choice, we can see that the factor analysis corroborates the notion that an academic orientation and user-orientation in problem choice are not mutually exclusive. Both factor 1 and 3 are distinct, but unipolar dimensions - even though there are negative loadings from two of the academically oriented variables on factor 3 and vice versa. These loadings are nevertheless far too weak for us to consider factor 1 and 3 as bipolar dimensions.

Conflict at organisational level

The evidence reported above reflects the emphasis that was put on different criteria of choice when *particular* research projects were launched. Each respondent was asked to report from the choice processes surrounding his/her current project.

In addition we asked the respondents to rate the level of conflict between different actors concerning what should be the object of research at the respondents' own research unit *in general*. Table 4.14 lists the researchers' perception of conflict over what should be the objects of research of the research organisation they belong to.

Table 4.14 Level of conflict in problem choice at organisational level. Percentage and mean score ("no conflict"=0 to "strong conflict"=3). N=264

Conflict between..	Degree of conflict				
	No conflict	Small	Some	Strong	Mean score
Institute and sectoral Ministry	38	41	18	2	0.85
Institute and Directorate of Fishery*[1]	43	39	16	1	0.75
Institute and sectoral research council	30	35	30	5	1.09
Institute and other public agencies	37	39	22	2	0.89
Institute and aquaculture industry*[1]	35	50	15	-	0.80
Institute and primary industry	27	39	29	6	1.13
Institute and environmental groups	34	30	30	5	1.07
Different groups of users	36	28	31	5	1.05
Colleagues with different scholarly background	10	33	42	15	1.63
Different subunits within organisation	12	27	49	12	1.61
Researchers and leaders of organisation*[2]	18	51	29	2	1.16

*[1] Only relevant for respondents in fishery research. N=99

*[2] Only relevant for respondents in research institutes. N=143

As we can see from Table 4.14, the strongest conflicts occur within the organisation among colleagues with different scholarly backgrounds and between different subunits within the research organisation. The least amount of conflict in such matters is perceived to be between the institute/university departments and public agencies, within or outside the sector. There are three possible interpretations of this result. First, it could be that there is general agreement between research institutions that perform agricultural and fishery research and civil servants. Or, the case might be that these public agencies have in practice little to do with the research organisations we have studied, consequently there is little to disagree about. However, as will be discussed in chapter seven, the general

level of interaction between these research organisations and sectoral public agencies is high. So lack of interaction is not a very likely explanation for the absence of conflict. Rather, one could expect as a third option that the frequent contact between research and government agencies is concerned with other matters than discussions on problem choice and research profile (cf. chapter seven).

Our respondents report that the research organisation they belong to is more in contention with their sectoral research council than with sectoral Ministries and, for the fishery scientist, the Directorate of Fisheries.

Some degree of conflict in questions concerning what kind of research the organisation should be involved in, is reported to exist between the research institution and other actors in the organisations' environments. There is some amount of disagreement between different kinds of users the research organisations relate to, i.e. the research institutions are to some extent torn between different expectations from various users. Of our respondents 30 percent report some conflict with environmental groups and primary industry, i.e. agriculture and the fisheries.

It should be noted that the questions about conflicts on choice of research topics were not meant to tap how "troubled" the research organisations were. Rather, we wanted to probe what kind of different interests and perspectives mingle in problem choice at the organisational level and generating perceptions of conflict among the organisational participants. Consequently, it can be argued that conflict in problem choice at this level indicates the degree to which discussion about the direction of research activities as a collective undertaking are taking place between colleagues and that the clients and potential users are less involved in such discussions. Such an interpretation further underlines the results presented earlier on about users' participation in problem choice at a project level where the research colleagues, peers and superiors within the organisation are primarily the ones who voice their opinions and partake in problem choices directly, rather than users or other actors from outside the research organisation.

"Sectoral Ministry" is one of only two variables that are significantly correlated with the sectoral affiliation of the respondent's research unit. Fishery scientists experience more conflict at the organisational level with the major sectoral public agency, i.e. the Ministry, than their agricultural counterpart (Pearson's $r = -0.16$. Significant at the .01 level).

Finally organisational differences in perception of conflict merit some attention:

the data indicate that the level of conflict between different types of users and the research organisations are significantly higher in government institutes than in university departments. (See Table 4.15). The level of conflict between colleagues within the research organisation is on the other hand higher in university departments. Consequently, it can be argued that within university departments, issues concerning a research unit's research profile and topics for future research, are much more left to the research community itself, whereas public research institutes are more subject to contention and discussion about such matters with outside actors, even thought the main discussion is kept *within* the research organisation.

Table 4.15 Conflict in problem choice at organisational level by type of organisation. Sub group mean ("no conflict"=0 to "strong conflict"=3). N=245.

Conflict ...	Institute	University
between institute/department and sectoral Ministry	0.94*	0.72*
between institute/department and sectoral research council	1.17	0.98
between institute/department and other public agencies	1.09*	0.63*
between institute/department and primary	1.23*	1.00*
between institute and environmental groups	1.31*	0.72*
among user groups	1.17*	0.88*
between colleagues with different scholarly background	1.53*	1.76*
between different subunits within research organisation	1.67	1.55

*= significant at ≤0.05 level.

4.8 Summary

The data presented in this chapter have identified a range of actors and criteria of choice that enter into problem choice in Norwegian agricultural and fishery research.

Solving problems for users is the single most important overall factor for the selection of research problems, having the highest mean score and being most frequently cited as very important for problem choice. Yet there are two sets of criteria that operate alongside each other. One set of choice criteria is related to the "institution of applied, client oriented science". The other set is oriented

towards traditional academic criteria of choice and to factors that are important to further an academic career. The results from the analysis of these dimensions do not corroborate the notion that an academic orientation and user-orientation in problem choice are mutually exclusive. The two sets of criteria are separate dimensions, but problem choices are made where both dimensions are considered important.

There are some differences between problem choice in government research institute versus university departments. In institute research, academic criteria of choice operate side by side with user-oriented criteria of choice, and a basic difference between the two is that in problem choice in government research institutes greater weight is given to a larger set of choice criteria than within universities. The difference between problem choice in the university units and the research institutes that are part of this study is *not* that the latter are less academically oriented than university units, but that they are significantly more adjusted to both client's need and ministerial and organisational research priorities. There are few significant differences between problem choice in fishery versus agricultural science. However, fishery scientists included in this study tend to be more involved with research projects that are oriented toward public agencies' need for knowledge than their agricultural counterparts. That is not in accord with the researchers' report on who they view as beneficiaries of research, where it seems that fishery scientists are more oriented towards private actors as potential users than scientists in the agricultural sector.

Following up the research priorities of Ministry/Directorate in the sector is seen by 20 percent of the respondents as very important for problem choice. This consideration is given significantly more weight in government research institutes than in university research. Also the level of conflict between different types of users and the research organisations as regards research priorities are significantly higher in the government institutes than in university departments. The level of conflict between colleagues within the research organisation is on the other hand higher in university departments.

5 Factors influencing user-orientation in problem choice

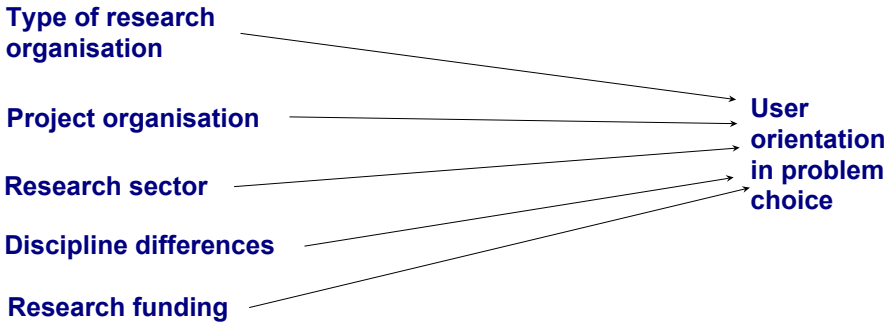
5.1 Introduction

In this chapter the main explanatory factors as presented in hypotheses 1 to 6 (see chapter three), will be empirically investigated through the application of regression analysis on the survey data. Already in chapter four, the data have given us some indications of the role of different explanatory factors in the problem choice in agricultural and fishery science. In this chapter we will approach an explanation of differences in user orientation in problem choice according to a set of explanatory factors that are controlled for the effects of the other variables. First we use a predictive model where the effects of each of the independent variables are estimated controlling for the effects of the other independent variables. We then discuss how the results from the regression analysis can be interpreted. This is done on the basis of a corresponding path model, where both indirect and direct effects of the independent variables are investigated. The research questions addressed in this chapter are the following:

1. *Is there a relationship between variations in degree of user orientation in problem choice and differences in the organisational surroundings within which each research project develops - both according to type of research organisation and characteristics of the way a research project is organised?*
2. *Do the characteristics of different academic research disciplines within which research is conducted affect the degree of user orientation?*
3. *Are the variations in user orientation to be understood as difference between research sectors, i.e. fishery versus agricultural science?*
4. *Is it possible to explain the variance as caused by the type of funding that each research project gets?*

The main variables are summed up in Figure 5.1.

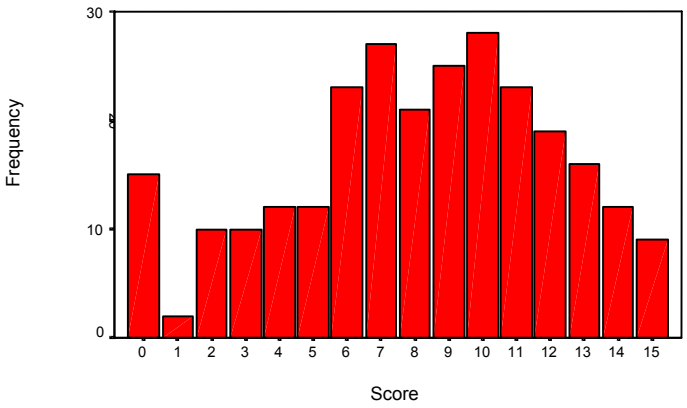
Figure 5.1 Prediction model of degree of user orientation in problem choice



5.2 The independent variable - an index for user orientation

The index is constructed on the basis of the results of the factor analysis on what constitutes user orientation (five variables) presented in chapter four. The distribution of this index is presented in Figure 5.2.

Figure 5.2 Frequency distribution on index on user orientation in problem choice. N=264.



Of 264 respondents six percent scored zero and three percent obtained the highest possible score of 15. The most common score (mode) is 10, and the mean score is 8.2. The standard deviation is 3.9.

5.3 Determinants of user-orientation

Type of research organisation

Our point of departure is an assumed difference between government research institutes and universities as a setting for performing research. The research organisations involved in this study comprise both types of research organisations, in agricultural science as well as in fishery research. Of the respondents, 45 percent are university employees, the rest work for public research institutes[17]. On the basis of this distinction we investigate the relationship between type of research organisation and user orientation as formulated in hypothesis 1, taking the distinction between universities and government research institutes as the indicator for the difference between heteronomous and autonomous research organisations. Furthermore, this distinction serves as an indicator of the type of public ownership, i.e. hypothesis 1 and 2 predict the identical pattern of variation in user orientation. The sub-hypotheses of hypothesis 2 (cf. section 3.3.) will be further investigated later in this chapter after the presentation of the main model. There the difference between internal organisation and vertical organisation and the possible effect on user orientation will be analysed and discussed.

Project organisation

We distinguish two types of formal organisational links that connect users and research projects. Hypothesis 3a posits that users and aspects of relevance might get involved in problem choice through research programmes. Of the research projects that our respondents reported, 38 percent were not part of a research programme. Most of the remaining projects are connected to programmes under the auspices of the national research councils. The distribution of the original variable is displayed in Table 5.1. The transformation of this variable divided the cases into projects that were not connected to/part of any research programme or only part of an internal research programme (132 cases) (value=0) versus those that are part of research council programmes, international research programmes or other external programmes (130 cases). In addition projects that are part of the programmes of the Norwegian Research Council for Science and the Humanities are zero-coded. Thus Research Council's programmes for basic science and the degree of user representation in their programme committees were at a minimum

[17] The Centre Soil and Environmental Research had at the time of the survey recently become an independent research foundation and is thus formally not a government research institute. However, we will for the sake of this analysis count the respondents from this institute among the latter group.

(Gornitzka and Schwach 1990). Missing cases are zero-coded.

Table 5.1 Research projects that are part of research programmes. Frequency distribution. N=262. Missing=2.

Type of programme	N	Percentage
Not connected to a research programme	100	38
Agricultural Research Council's programmes	51	19
Fishery Research Council's programmes	45	17
Research Council for Science and the Humanities' programmes	6	2
Technical-industrial research council's programmes	3	1
Research council for applied social science	1	-
Research organisation's internal research programmes	32	12
International research programmes	17	7
Other programmes	7	3

Second, we investigate the effect on problem choice of projects having advisory boards or a governing body where users were represented. We will refer to this as *organised user governance*. The frequency distribution shows that 63 percent of the cases were without such user governance (value=0). Missing cases are assumed to have no governing or advisory boards. Of projects with organised user governance 58 have a governing board where users are represented whereas 41 have an advisory board.

Scientific disciplines

With the available data, we have limited possibilities to investigate the qualitative aspects of how academic disciplines affect user orientation. Nonetheless, we are able to include type of research disciplines in our analysis to see whether there are group differences in degree of user orientation. In the questionnaire, the respondents were asked to identify their current research discipline (see Appendix I for a more detailed presentation of how this variable was handled methodologically). We used six categories: basic sciences, environmental sciences, forestry, marine biology, plant and soil sciences, and social sciences and economics. The frequency distribution is reported in Table 5.2.

Table 5.2 Research discipline of current research. Frequency distribution. N=264.

Research discipline	N	Percentage
Basic sciences	50	19
Environmental sciences	18	7
Forestry	25	10
Marine biology	58	22
Plant and soil sciences	53	20
Social sciences and economics	60	23

Initially the effects of various disciplines were explored in accordance with the open ended expectations outlined in chapter three. This was done using dummy regression (see Appendix I for a further description of this procedure). On the basis of the results, two disciplines were identified as significantly affecting degree of user orientation: plant/soil and forest sciences. On the basis of this information, the original variable was transformed into one simple dummy by merging the two discipline categories that had demonstrated a significant effect on degree of user orientation. The units belonging to this category was given the numerical code 1 on the "transformed" discipline variable, whereas the rest are zero-coded in order to simplify the ensuing analysis and to avoid having to deal with block-recursive regression. This category will be referred to in the following as "core agricultural science", the argument being that plant/soil/forest sciences can be argued to be part of the heartland of agricultural science.

Research sector

The discipline variable is based on the self-report of a respondent's disciplinary affiliation. We have also included a variable pertaining to disciplinary differences as outlined in chapter three in hypothesis 5a. Here we have made a distinction between agricultural and fishery science on the basis of the sectoral affiliation of the research organisation the respondents are part of, and not on what the respondents themselves describe as their research discipline. This variable will be referred to as the *research sector*. As follows from hypothesis 5a the assumption is that problem choice in agricultural science is more user-oriented than in fishery science. Consequently, cases from research organisation within agriculture (61 percent) have been given the numerical code of 1.

Funding

Our data on how research projects are funded come from the respondents' report on amount (in percentage) of funding from different external sources. The sectoral

Research Councils[18] are the primary external source of funding. Almost 60 percent of the reported projects had some kind of funding from these institutions. Forty-nine percent reported to have received financial resources from one or several external sources other than the sectoral research council. When asked to specify their external source for their research project, the respondents most frequently mentioned as contributors different types of public agencies in the sector. However, not all respondents with external funding specified their external source of funding, but on the basis of the answers from those who did we can take it that "external funding" here implies funding from sectoral public agencies, or other public agencies and industry in the two sectors. Research council funding is not included in the external-funding variable for two reasons. We are primarily interested in seeing the effect of *direct* funding from users on the user orientation in problem choice, and research councils can rarely be seen as an end-user. So funding in the following will include funding from public agencies, industry and private funds. More importantly, the effect on user-orientation from Research Council's programmes is already investigated in the "programme variable", in the sense that receiving project funding is an important part of being connected to a research programme.

Each project may have several external sources of funding, and the degree of external funding also varies. Here we use a dichotomised version of the original variable, the argument being that we expect to find differences in user orientation only according to *whether or not* the projects are funded by users. Seventy percent of the respondents reported no user-funding. The latter cases are zero-coded.

5.4 Main results

Four of the independent variables were found to be statistically significant. The unstandardised regression coefficients (b) indicate that projects conducted within government research institutes (bX2) and within core agricultural disciplines (bX3), funded by users (bX4), and part of a research programme (bX5), score in average 7.6 points more on the user orientation index, than university research projects within other disciplines, with no user funding and no research programme affiliation. Two of the independent variables have no statistically significant effect on user-orientation: research sector and organised user governance.

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[18] I.e, the Agricultural Research Council for the agricultural scientists; and the Fishery Research Council for fishery scientists.

Table 5.3 User orientation in problem choice. Multiple regression: Unstandardised coefficient (B), standard error (SE B) and standardised coefficients (beta). Constant (a). N=264

Independent variable	B	SE B	Beta
X1 Research sector	-0.863	0.551	-0.108
X2 Research organisation	1.346**	0.466	0.172**
X3 Discipline	2.284***	0.581	0.268***
X4 Funding	0.997*	0.494	0.117*
X5 Programme	1.631***	0.469	0.195***
X6 Organised user governance	0.795	0.490	0.099
A = 5.905***			
R^2 = .17, adjusted R^2= .15			

*p ≤ .05; **p ≤ .01; *** p ≤ .001

The goodness of fit of the regression equation as measured by R^2 is .17. This means that the combined independent variables account for 17 percent of the observed variance in user orientation. The low R^2 suggests that much variation in the degree to which problem choices are user-oriented is left unaccounted for and supports the idea that a potentially relevant variables have not been identified in the model

5.5 Hypotheses tested and discussion of results

In the following we explore the results of the regression analysis in light of the hypotheses introduced in chapter three. An overview of the hypotheses is presented in Table 5.4.

Table 5.4 Summary of hypotheses

Type of research organisation - hypothesis 1
Problem choice within autonomous research organisations will be less oriented towards users and application than within heteronomous research organisations.

Vertical organisation - hypothesis 2
Research organisations that are directly owned by a sectoral Ministry will be more user-oriented in problem choice than research organisations that are governed under the University act.
a: Research done in universities that are formally under the auspices of a sectoral Ministry will be more user-oriented in problem choice than research done at universities that are linked to a science or higher education Ministry.

b: Research organisations with a large proportion of earmarked items in their budgets at the organisational level will be more user-oriented in problem choice than research organisations with a low proportion of earmarked items.

Horizontal organisation - hypothesis 3

a: The problem choices with respect to research projects that are connected to user groups by way of research programmes will display a higher degree of user-orientation than the problem choices made with respect to research projects that are not connected to such programmes.

b: The problem choices with respect to research projects with organised user governance are more user-orientated than problem choices made with respect to research projects without such formal governance arrangements.

Institution of academic science - hypothesis 4

The more weight put on academic criteria of choice the less user-oriented choice of research problems will be.

Disciplines - hypothesis 5:

The degree of user-orientation in problem choice varies according to disciplinary differences, irrespective of the organisational context in which such choices are made.

a: Problem choice of agricultural scientists are more user-oriented than fishery scientists

b: Researchers from the basic sciences, both within fishery science and agricultural science, are less user-oriented than colleagues from other disciplines.

Research funding - hypothesis 6

User-orientation in problem choice is dependent upon the type of funding research projects get - projects that are funded by clients will be significantly more user-oriented than projects with no such funding.

Research organisation

The empirical evidence from the regression analysis findings seems to support hypotheses 1 and 2 – in this study problem choice in government research institutes is more oriented towards users and application, as measured on the user orientation scale, than problem choice that occurs in a university setting. However, the independent effect of type of research organisation is somewhat less strong than one could expect.

To test hypothesis 2a, we ran a separate model for university research. If there is support for the hypothesis that states that universities that are formally under the auspices of a sectoral Ministry will be more user-oriented in problem choice than

universities that are linked to a science or higher education Ministry, that would correspond to the difference between Agricultural University versus the College of Fishery Science at the University of Tromsø. However, we did not find a statistically significant difference in degree of user-orientation at the two university organisations, even when applied to differences in sub-groups means, or controlling for other independent variables (see Appendix I). Consequently, there is no support found for the proposition that the variation in formal ownership of universities significantly affects problem choice orientation.

Hypothesis 2b relates to differences within the group of public research institutes, asserting that the degree of budget specificity at an organisational level will affect user-orientation in problem choice at a project level. Degree of budget specificity is here identified on the basis of relative share of basic appropriations of an institute's total budget. We assume that the part of the budget that does not come as a lump sum from government sources constitutes specified funds that are earmarked for commissioned research or other institute activities. At the time this survey was conducted, the basic appropriation from the Ministry amounted to 55 percent of the total budgets of research institutes in the primary sector (Gornitzka 1995). Of the institutes that are involved in this study, two had a lower share of basic appropriation than this average. This variable did not have a significant effect on degree of user-orientation in both a general test for significant sub-group mean differences and when entered in a separate regression equation. There is consequently no support for hypothesis 2b in the quantitative material. However, in chapter seven this question will be reintroduced and further discussed on the basis of the qualitative material on the relationship between Ministries and research organisations.

Horizontal organisation

As predicted by hypothesis 3a, the problem choices with respect to research projects that are connected to user groups by way of research programmes display a higher degree of user-orientation than the problem choices made with respect to research projects that are not connected to such programmes. In this respect research programmes are inductive to user-orientation. This is not altogether obvious that this hypothesis be corroborated: Studies of research councils in general demonstrate how most such organisations have undergone a development from being an instrument of state patronage of science, i.e. serving as an extension of government bureaucracy, to being "captured" by scientific community, so as to

become "the parliament of the republic of science" and looked upon as a natural component of the institutions of scientific communities (Rip 1993; Rip and Hagendijk 1988; Elizinga and Jamison 1995). There are some indications that this applies to some extent to the workings of the Research Councils within the context of this study, the Agricultural Research Council and the Fishery Research Council. Thus we might expect that such organisational arrangements have the opposite effect from furthering considerations of potential application of research projects. Research programmes under the auspices of Research Councils might then work more as a shield from user-orientation in applied research where the pressures for relevance might permeate the regular research activities. The Fishery Research Council and the Agricultural Research Council were set up primarily to serve their respective economic sectors as an important organisational embodiment of the "sector principle" in Norwegian science policy. One study shows that representatives from the research system made up the majority of the members of the council bodies, yet in the 1980s and beginning of 1990s the criteria for appropriating funds through research programmes were increasingly oriented towards user relevance (Langfeldt 1998: 21-25). This might suggest a certain degree of organisational ambiguity. However, judging on the basis of the results from the regression analysis this has not been the case for problem choice of the projects included in this study.

Having either a governing or advisory board connected to a project where users are represented does not affect the degree of user orientation in any significant way. There is thus no support for hypothesis 3b in our empirical data. However, we might expect that having user representatives in governing or advisory boards for research might be important for the knowledge production process at other stages than in the selection of research problem.

A matter of discipline?

As proposed by hypothesis 5, degree of user orientation does vary according to disciplines. Irrespective of the organisational context and project characteristics in terms of project-organisation and funding - problem choice in what has been labelled core agricultural sciences (i.e. plant and soil sciences, and forestry), have a significant and relatively strong effect on degree of user orientation. Thus it seems that hypothesis 5a is supported by evidence. This conclusion needs to be qualified, however. It is not so that agricultural scientists in general are more user-oriented in their problem choices, as expected by hypothesis 5a. When we test this hypothesis

by way of the general sectoral affiliation of research organisation (X2) as opposed to on the basis of the self-report of the respondents, based on the empirical evidence this hypothesis must be rejected. Furthermore, the group categorised as "non-core agricultural science", consists not only of fishery science, but also of basic science or social science and so on within the agricultural research sector. In this respect it is not a question of agricultural science versus fishery science, but rather that a subset of disciplines within agricultural science has proven to be significantly more user-oriented compared to their colleagues within agricultural science, colleagues from other research fields and colleagues from fishery science. It was posited in chapter three (section 3.4) that agricultural science as a whole would have a user-oriented "ethos" generic to the Norwegian agricultural research system. This is not supported by our analysis, as there is no statistically significant research sector effect to be found in our material. The importance of the sector differences with respect to criteria of problem choice indicates that common educational background is overstated. It is somewhat surprising, however, when we consider the difference in educational background found in the two sectors. Also among the scientists included in the survey the educational background is predominantly sector specific. A typical background and career path of the agricultural scientists is to have grown up in rural areas, have a 4-5 year of education from the Agricultural University and experience from farming and/or extension service. Fishery scientists in this study have a general university education and very few have any direct experience from working in "their" sector, i.e. the fisheries, the way that agriculturally scientists tend to have. However, these differences seem according to the results of this analysis not to have any independent and significant effect on the extent to which they are user-oriented in choice of research problem.

To test hypothesis 5b, that states that basic sciences is less user-oriented in terms of problem choice than the remaining disciplines the results from the block regression analysis have to be used (see Appendix I). Here we find some support for H5b, but again problem choice in the basic sciences is only less user-oriented than problem choice within plant and soil sciences, and forestry, and not *vis à vis* the other disciplines included in the model.

Research funding

External funding is positively related to user-orientation in problem choice. Our findings support the general idea that attention of researchers can be "bought" by way of direct resource flows from clients to researchers. Thus there is support for hypothesis 6. The available evidence is consistent with the idea that having external

funding increases the likelihood of being user-oriented and that effect does not depend on organisational or disciplinary surroundings problem choices are being made in, nor the characteristics of the individual research project in terms of governance and programme affiliation. Here we must underline that this effect is not a traditional linear effect where degree of user orientation increases with increasing amount of funding from external sources. As pointed out earlier this variable taps the effect of whether or not there is such funding. One might have expected this effect to be stronger than is present in this model. However, this finding might be explained by referring to table 5.3 and the relatively low explained variance as measured by R^2 (0.17). In addition, we should take into account that the effects of funding regimes are also part of the effect that we have labelled as organisational variables. Financial structures are certainly present in type of research organisations and in the organisation of research programmes.

What matters most?

The relative importance of each variable can be read from the standardised coefficients summarised in Table 5.3. However, such interpretation should be done cautiously. Of the independent variables, the discipline factor has the strongest effect (0.268X) on degree of user-orientation. This supports the conclusion that traditions, normative and cognitive structures of disciplines matter most for the extent to which user-oriented choice criteria and users as participants are important elements of problem choice. By inference we should be able to argue that the analysis has identified that the disciplines of plant, soil and forestry science have these characteristics, so as to make problem choice more attentive to users than the remaining research disciplines in agricultural science and in fishery science. On the basis of the theoretical arguments put forward in section 3.4, we could also argue that a user-orientation has become an integral part of these disciplines, and that this disciplinary factor is more important for the orientation in problem choice than the organisational setting of research, project organisation and funding of research. This variable, however, has travelled a long way from questionnaire response to final variable included in the main regression model. Consequently, it is likely that there is some "noise" attached to this variable. Hence, declaring disciplinary factors as the overall most important determinant of degree of user orientation would be putting too much emphasis on relatively minor differences in beta-coefficients. Here we can again point to table 5.3 and the low R^2 measured in the regression equation. In addition, it can be argued that some of the parameters might change in the presence of added variables. Finally, we should take into account a possible multi-collinearity problem in this model, ensuing from including both research sector and discipline causing problems for co-efficients. High correlation between independent variables in a multiple regression will make

it impossible to derive at a unique solution for the partial coefficient, consequently this analytical technique will no longer be able to render results that can be interpreted in a reasonable way because the results will be imprecise, the coefficients cannot be compared to each other and the coefficients are unstable. Lewis-Beck mentions several indicators as to whether collinearity problem exists in multiple regression, such as difficulty in achieving significant results even though the R^2 is high (Lewis-Beck 1980: 59-60). The model above shows none of these signs, nonetheless two types of tests were run, to check for high multicollinearity. First, each independent variable was regressed on all of the other independent variables. If of one of the ensuing models show a high R^2 (close to 1.0), that is a sign of a multicollinearity problem. None of the R^2 in this case was above .50.

Path analysis

So far we have kept our discussion to interpreting the direct effect of the independent variables. One of the advantages of path analysis is that it enables us to measure the direct and indirect effects that one variable has on another. Here that seems to be of particular importance, if we are to investigate further the relative importance of each of the independent variables. In addition, such an analysis can enable us to decompose the correlation between variables into a sum of simple and compound paths with some of these compound paths being substantively meaningful with respect to indirect effects and others perhaps not (Asher 1983: 33). Nonetheless, in our case the basic rationale for doing a path analysis is not to determine the numerical values of each of the paths in the model, rather the motivation is to see the extent to which it reveals indirect effects that can add to the understanding of the substance pertaining to our research question. The path analysis was done according to the assumed model pictured in Figure 5.3. Only significant estimated path coefficients are presented. The bivariate correlations between the independent variable and the dependent variable are displayed in Table 5.5.

Table 5.5 Bi-variate correlations between degree of user orientation and independent variables.

Independent variable	
X2 Research organisation	0.225***
X3 Discipline	0.173**
X4 Funding	0.162**
X5 Programme	0.221**

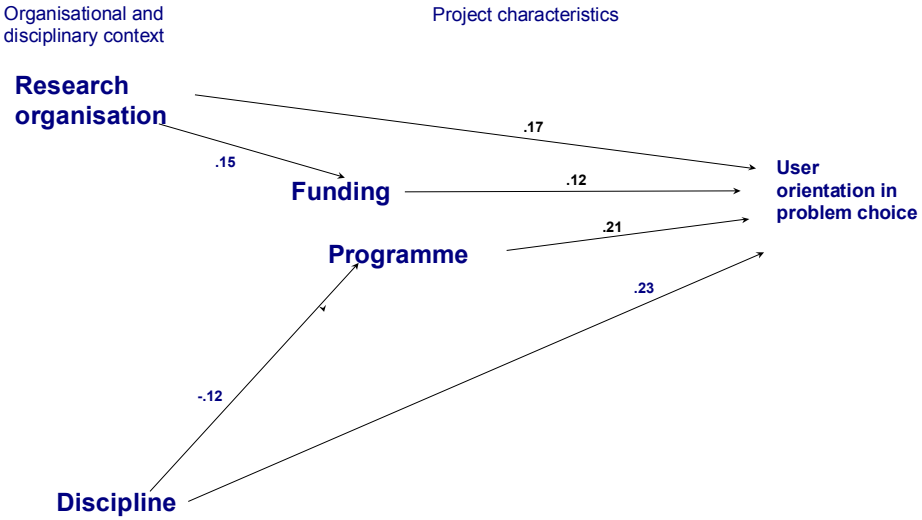
*p ≤ .05; **p ≤ .01; *** p ≤ .001

Two relevant points can be made from looking at the paths in Figure 5.3. First,

when we consider the total effect, the impact of research organisation is magnified when we also consider indirect effects. The indirect effect of this variable is materializing via funding. This implies that the organisational setting within which research is performed is important for the user-orientation. This applies not only in its own right, but because government research institutes, as opposed to universities, attract external funding for their research to a stronger degree, thereby indirectly affecting the degree to which problem choice is oriented towards users. It is granted that we accept giving causal priority in the ordering of variables to research organisation, which in this case seems plausible. However, at this point the direction of the effect that we have assumed between the variables might be questionable. That pertains particularly to the direction between funding and user-orientation, as there might be an argument made for saying that the projects oriented towards users are the ones that *attract* funding from clients, rather than that money from clients causes problem choice to be user-oriented, as would be the causal interpretation on the basis of the model displayed in Figure 5.3. The same applies to the role of research programmes.

Second, the effect of discipline includes one significant negative indirect effect, which runs through the programme variable, and a direct effect on user-orientation. This implies that core agricultural science problem choices, on average, are more strongly oriented towards users than in the remaining disciplines. At the same time, core agricultural scientists tend to a lesser degree to have their research connected to research programmes, and thus the effect of discipline is depreciated in the overall bivariate correlation between this independent variable and user-orientation (cf. Table 5.5).

Figure 5.3 Path model – user orientation in problem choice

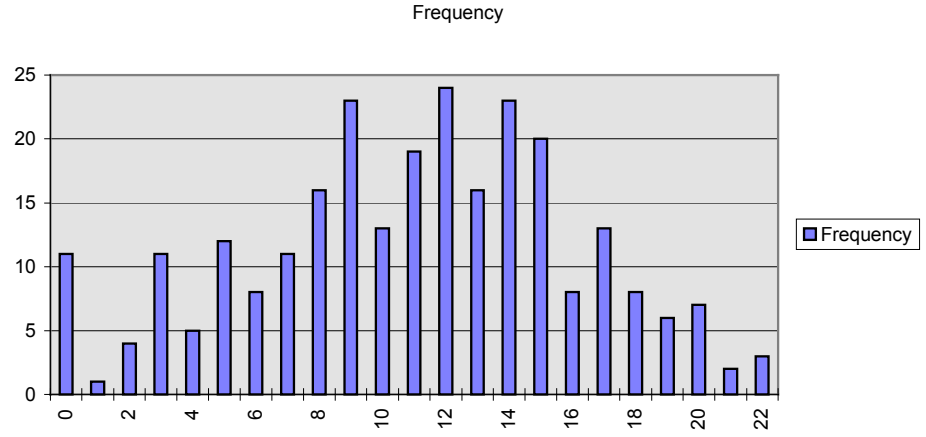


Institution of academic science - a hindrance for user-orientation?

Finally, hypothesis 4 proposes that the more weight put on academic criteria of choice the less problem choice will be oriented towards users. We have already been given an indication that in this survey there is little evidence to support such a hypothesis (cf. 4.7). Before any firm conclusion can be drawn we need to control for the influence of other explanatory factors. An index for academic orientation in problem choice was constructed on the basis of the factor analysis presented in chapter four, and the frequency distribution is presented in Figure 5.4.

This variable was then included as an independent variable in the main regression equation. First, academic orientation in problem choice does not constitute a hindrance for problem choice to be oriented towards users, consequently, also after controlling for spurious components, based on the empirical evidence, hypothesis 4 must be rejected.

Figure 5.4 Index for academic oriented criteria of problem choice. Frequency distribution. N=264



5.6 Conclusions

We have through the analysis identified four factors that have significant effects on degree of user-orientation in problem choice, i.e. type of scientific discipline; type of research organisation within which research takes place; whether research is connected to research programmes; and external funding. These factors have an effect in line with what we expected. Of these factors the impact of being part of a research programme of a Research Council for applied research is probably most surprising. The effects of disciplines do not run exactly as we expected. There are some core agricultural disciplines that seem to have a stronger degree of user-orientation in problem choice, not only compared to basic scientific disciplines or fishery science (as we hypothesised), but also to other disciplines in agricultural science.

There are methodological arguments that can be used against these conclusions; we have discussed several of them. Especially we are cautious with making causal attributions. Finally the overall model has failed to capture much of the variation that our index for user-orientation displays in our data, and as such the analysis represents only a few steps towards understanding such variations.

6 The search for, exposure to and use of scientific information in governmental agencies: a theoretical approach

6.1 Introduction

The majority of the studies dealing with the use of science and research in public bureaucracies have focused on the communicative aspects between the two systems to explain why research is either being used or not used. Most of these studies are pointing to and lamenting the frequency of the latter phenomenon, i.e. non-use (Rich 1991). These are "under-utilisation studies", rather than studies of use. The general conclusion is that research is not used by the civil service, nor by policy-makers, due to the fact that researchers on the one side and bureaucrats and policy-makers on the other side cannot communicate across the "great divide" between the two cultures: research and administration. The work often referred to in this is C.P. Snow's "The Two Cultures" (1959; 1964). However, the original contribution was not particularly concerned with the gap between science and policy practice. C.P. Snow pointed to the problems of making policy decisions with a scientific and technological dimension, caused by the fact that the British bureaucracy was dominated by civil servants with an educational background in the humanities. According to Snow, people in the two "cultures" (hard science versus humanities) have separate attitudes, standards and patterns of behaviour, approaches and assumptions (1959: 9-11). The alleged "cultural" gap that Snow talked about was an effect of differences in educational background and not a result of the differences between bureaucratic versus research systems *per se*. Furthermore, Snow's work was referring to the specific British context and it is questionable whether the cultural differences he identified carry a more general applicability.

Nonetheless, the heritage from Snow has lived on for many decades in the shape of the two cultures metaphor, leading to, for example, what has been called the "two-communities-theory" (Wingens 1990). Studies using this "theory" generally point to distrust, animosity, incompatible reward systems, and differences in language between bureaucrats and scientists (Caplan 1979). The lessons taught by these studies are generally that there is something wrong in the way these two

systems communicate. If something is done to ease the flow of information from the research system to the bureaucratic system, research results would be used in policy-making to a much larger extent. Consequently, the remedy for the non-use of research is argued to be a question of some relatively modest reform (Weiss 1977: 6). However, a logical conclusion drawn from Snow's argument is that the actual "remedy" for bridging the gap is either educational reform or reforms of the recruitment policy in civil service. Neither are strikingly modest reform measures.

This brings us to the general normative base of most of these studies that can be paraphrased like this. The more use is made of science in policy making, the better the decisions the political administrative system will be able to produce. Consequently, the result of using science more in policy-making is better policy for society (Rich 1991). The use of science is argued to be inherently good. As a result there is a call for further efforts to *disseminate* research to policy-makers. This view is most often reflected in the policy statements of research administrators and Ministries. The main argument here is that better knowledge of causal relations both in nature and society might reduce the potential for public policy to fail due to ignorance of the area the policy is directed at. There is a substantial body of literature on implementation of public policies in the 1970s that underlines this point and calls for basing policies on adequate causal theory (cf. e.g. the overview of Hill and Hupper 2002). However, such a remedy does not take heed of the possible adverse effects of dissemination, such as information overload, spread of premature information or wrong/false information (Knott and Wildavsky 1980). Furthermore the "the more the merrier" outlook seems to obfuscate the possibility that it is not irrelevant what *kind* of scientific information public policy is based upon. Some types of information might further some interests and views of the world at the cost of others. Such a position does not necessarily imply that scientists are involved in conspiratory and subversive production of twisted and cooked data to further particular interests. The rather "trivial" point is that scientific research is not neutral in the sense that it brings forward a pristine, unedited piece of nature or society that can be transformed into public policy. On the contrary, the type of information that research-based knowledge represents, along with other types of information, inherently contributes to directing the attention of decision makers to certain aspects of reality while other aspects are not covered. From this point of view the more is not necessarily better for society, "the common good" or "democracy".

Most of the more trend setting studies in this field have focused on the use of social science in American federal administration (cf. Caplan, Morrison and Stambaugh 1975; Rich 1977; Weiss 1977; Weiss and Bucuvalas 1980). Also the non-US studies have been concerned with the social sciences (Badura and Waltz

1980; Baklien 1983; Ericksson 1991; Larsen and Schultz 1984; Nausdalslid and Reitan 1994; Nilsson and Sunesson 1990). These studies are still interesting and they point to more multifaceted aspects of the topic. Yet, the bulk of the work consists of studies of the contribution of one particular type of research in a particular context, the Great Society and the attempt to make social policy a science. Later evidence suggests that the reported non-use did not predominantly concern cases of underutilisation. Social science did have significant effects on policy, but in ways that were not expected. Social science did make a difference..."but not necessarily on discrete provisions nor in the linear sequence that social scientists expected" (Weiss 1986: 217). However, these studies are to some extent marked by the attempt of the social sciences to reappraise their own role in society. This research tradition highlighted the issue whether social sciences could be as useable as the natural sciences, i.e. the idea of social engineering based on the social sciences (Albæk 1988). Weiss even suggests that the publication of non-utilisation articles in scholarly journals was a result of the tendency of social scientists to turn their own experiences into research findings (Weiss 1986: 216).

The setting of our study is different. First, this is a study that mainly focuses on the use of *natural* sciences. The research system that agricultural and fishery public administrators relate to is predominantly performing biological research, although technology studies, economics and the social sciences are also part of sectoral research. Second, the Norwegian Ministries of Fisheries and Agriculture are a far cry from Washington in the 1960s and 1970s. Yet, the literature that has been discussed in this paragraph is the basis for the framework we will apply here. Prior studies of use of research have also incorporated several elements from the theories of decision-making and organisation theory. As such it fits the general theoretical interests of our study. We also include further references to general theories on organisational decision-making in the analytical framework we present below.

6.2 What is "use of science"?

This study concentrates on the factors that regulate the access to and use of scientific knowledge and information in Norwegian agricultural and fishery bureaucracy. The study of the public agencies' use of science can be seen as an analysis of a kind of informational behaviour in bureaucracies. Following our starting point, by definition this study deals with the issue of information seeking, access and use from an "open cycle" perspective, i.e. how information from research organisations is used within public agencies and not how information is used that public agencies produce themselves. Our study deals with flows of information from *outside* the acting organisation, as opposed to studies of the use

of intramural research (Rothman 1980; Feldman 1989). In modern bureaucracies decisions rely on different types of information, information produced and stored within the decision-making organisation, information brought to the organisation by different interest groups or other agencies, and information or knowledge from different types of experts and expert structures, including the scientific system. As various scholars have indicated, scientific information in modern bureaucracies enters a crowded place, filled with people, goals, interests, information, and expertise (Knott and Wildavsky 1981; Weiss 1977), and there are competing claims to attention from practical experience and common-sense wisdom (Uliassi 1977). Research results merge with other types of information from other sources than science. This represents a methodological problem in so far as it is hard to single out the flow of information from research from all the other flows of information, people, and other happenings within a bureaucracy. Unlike when *scientists* use scientific information, in government agencies there are no norms and sanctions for the use of information without reference to its source. Consequently the written trails of information in the shape of citations, for example, cannot be used as a method of studying the use of information in these types of organisations.

Exposure, access and use

Exposure to scientific information is a prerequisite for the use of science. Thus, a point of departure in this study is to get some grip on the general patterns of contact between the research system and the political-administrative system in the sectors of agriculture and fisheries. An important focus in the empirical analysis is what one might call the dissemination of scientific information. How do bureaucrats receive this type of information? Do they go looking for relevant information in the scientific system or is science offered to them? What kinds of information channels exist between science and bureaucracy? What modes of information gathering exist in governmental agencies with respect to science?

Can "access to" be equated with "use of"? Access can signify that bureaucrats are *exposed* to information, but that does not necessarily mean that the information has any influence on what decision makers do. The "normal" way of thinking about the use of science is that science makes a difference as far as the content of the decisions is concerned. If it does not, we have a case of non-use. Behind this dichotomy use versus non-use, however, lies an interesting spectre of different types of use. On the basis of former studies of research use six main modes of use can be identified. However, we will not only investigate the use of scientific information in terms of the predefined categories described below, but also look for ways of utilisation that cannot be seen as belonging to predefined sets of utilisation forms. A central element of the in-depth interviews upon which this part

of our study is based was to let the interviewees themselves reflect upon how they use this type of information without at first instance letting the predefined concepts of utilisation guide the interviews. Relying on in-depth interviews as the primary source of data allows us to *explore* different forms of use, or non-use for that matter, in another way than a mail-survey would do. In this we partly follow what Oh and Rich (1996) describe as a self-anchored conceptualisation in utilisation studies.

Instrumental use

The instrumental use of science ties in well with the rational approach to decision making. Science is used to search for and evaluate different consequences of the goals decision makers want to reach. This type of use implies that decision makers are involved in a search for information, and that they will act on the results. Scientific information becomes "recipe knowledge", telling decision makers how to do things, as can be illustrated by the following quote:

> *Relevant information will be gathered and analysed prior to the decision-making; information gathered for use in that decision will be used in making that decision...; needs for information will be determined prior to requesting information (Feldman and March 1988: 411).*

Weiss and Bucuvalas (1980: 10) give this description of the criteria of the former type of instrumental use of research in bureaucracies:

> *...research directly relevant to an issue up for decision, available before the time of decision, that addresses the issue within the parameters of feasible action, that comes out with clear and unambiguous results, that is known to decision makers, who understand its concepts and findings and are willing to listen, that does not run athwart of entrenched interests or powerful blocs, and that is implementable within the limits of existing resources. And that is different from what decision makers had planned to do. (Weiss and Bucuvalas 1980: 10)*

Given the discussion of how decisions are made and the characteristics of research information and research results, relying on such a "strong" definition of instrumental use of science does not seem realistic. Neither is it particularly fruitful for our purpose, unless we would like to carry a dead horse along for the sole purpose of flogging. The description given above implies that science is a means of adjudicating social or political questions. In that sense we might claim that this does not refer in the first place to the use of science in making decisions, but instead to science replacing the administrators as decision makers. The role of science is akin to "mandated science". If this was the concept the social policy reformers of 1960s and 70s had as an idea of the role of research, one should not be surprised at their disappointment.

The strong definition of instrumental use also implies that research results *diffuse* from the research system to bureaucracies without being affected by the move from one context to another. Facts and research results are somehow endowed with their own inertia and are not part of a displacement and transformation that can occur when facts and knowledge travel (cf. Callon 1986; Latour 1987, and below). The strong definition of instrumental use of science rests on the clear distinction between production of scientific knowledge and other societal activities. Instrumental use is the import of scientific statements in decisions, plans, policies, and so on. Most science and technology studies in the 1990s would contest such a view of the science-society relationship (see, for example, Jasanoff *et al.* 1995; Wouters *et al.* 2002).

Still, instrumental use is interesting to investigate if we moderate how we define the concept, i.e. science is used instrumentally in the sense that research information and research results are used to point to alternatives and their consequences in solving problems and making decisions. This does not necessarily denote that decision makers, for instance, use a research report from A to Z, but that use of science in the aforementioned manner can be seen in connection with identifiable decisions, problem solving, as well as establishing the content of a particular policy. It might thus involve a deconstruction of scientific statements, and not a mere general import of research untouched by the decision-making context the information enters. A more moderate definition does, however, retain the notion of science as a vehicle in political administrative activities. The main point is that there is a direct tie between the content of scientific information and bureaucratic action - research has substantive effects on what policy-makers are doing.

The instrumentalist use of research is linked to a concept of decision-making as problem solving within an organisation and a linear view of knowledge transfer and knowledge production. Bureaucratic decision-making involves choosing among alternatives by using some decision rule that compares alternatives in terms of their expected value and on the basis of relevant information (March 1988). The logic of such actions will be anticipatory and consequential, and based on information about possible states of the world. Weiss (1977: 12) has pointed to two processes that can underlie instrumental use. When decision-making is problem solving we can have a situation of research *anteceding* the policy problem and then drawn on in need, or research can be *commissioned* to fill the knowledge gap. Both are decision driven instances of instrumental use.

Strategic use and "transactionalist" perspectives on use

The common modification of organisational decision-making as rational problem solving action in general can be used to qualify the "instrumentalist" view of research utilisation. First, the decision-making process can be seen as involving multiple actors with inconsistent preferences, i.e. decision-making is a political bargaining process (cf. e.g. Cyert and March 1963), where transactions between actors with different interests result in strategic use of research. Second, there are limits to rationality in decision-making (Simon 1976; March and Simon 1993 [1958]) so that research information is transacted and transformed in the hands of decision-makers.

In connection with viewing decision-making as a process of conflict, the concept of strategic use of research information has been developed. It denotes a situation where research results are used to legitimate the position of an agency. It is used to improve its effectiveness in relation to other agencies, interest groups or political units that the decision is directed at or dependent upon for its implementation or ratification. A component of strategic use is that it lends the authority of science to a decision or a position., e.g. when decisions need to be presented as environmentally sound and references to environmental sciences is used for that purpose.

The same strategic use might just as well apply to cases where decision makers have a need to increase the strength and legitimacy of decisions within the organisation. Information is gathered and used to persuade others to do something (Feldman and March 1988: 416), it becomes a tool in adversarial debate (Langley 1989). Such a manner of using research is probable, given the status of science in most policy sectors. Science can provide arguments that might stand out as neutral and unbiased, at least to a much larger extent than information from interest groups, other agencies, or the data and information the agency itself has produced. It is a type of use that stems from the need to document the decisions and positions that an administrative unit puts forward (Weiss 1977: Overgaard 1984: 5; Albæk 1990).

This is a different use than the instrumental use described above. It is different in the sense that it does not have an impact on the content of a decision. Strategic use may denote a situation where reference to science is coupled to decisions purely for strategic purposes (Naustdalslid and Reitan 1994). It implies that research reports are collected, stored and referred to without having any connection to the content of decisions and direction of the agencies' actions (Feldman and March 1988). This conception of use is linked to a political model of organisations viewing decision-making as a process of confrontation, bargaining, and coalition in

which the outcome of the process depends on the initial preferences weighted by their power (March 1988: 170). On the other hand, strategic use may come *in addition* to the instrumental use, i.e. research may have had substantive impacts on decisions and actions and still be used as a basis of legitimacy.

This use category generally has the connotation of distortion of facts by decision-makers and perverted use of research for political purposes. However, it can easily be made to reflect a more basic insight into knowledge transfer, linked, for instance, to theories of innovation and technology transfer. In such an interpretation it suggests that various transformations occur when knowledge research findings travel from one context to another, in science studies known as the translation model as opposed to the diffusion model. Latour (1987) uses the former model to describe how the fate of a scientific text lies in the hands of those who receive it and use it. Various transformations of initial inputs into decision-making can happen, unknowingly, through cognitive bias or organisational diffuseness, as well as through deliberate efforts to adjust research information to one's own strategic needs (Huberman 1987: 589-590). In the former case it is much less a matter of strategic use rather than a case of information being translated into a decision-making context. Humans and organisations have limited cognitive capabilities to handle information, and consequently "....information is processed in wondrous ways, few of which are replicative of the original information" (Huberman 1987: 589). Clearly this also refers back to the methodological problem of following different "pieces" of scientific information around to see whether they are adopted or not, because facts, information, and knowledge will be liable to change in the process of dissemination and utilisation.

Coming back to strategic use, one could also maintain such utilisation does not necessarily imply misrepresentation and misuse. There is a case to be made for viewing strategic use as an instance of selective use and reduction of "cognitive dissonance" by disregarding research information that does not fit the cognitive scripts of decision-makers or organisations, and emphasising information that does. Bearing in mind Allison's (1971) analysis of decision-making during the Cuban missile crisis that would not come as a surprise to students of organisational decisions. Not only where you *stand*, but also what you *see*, depends on "where you sit".

Conceptual use of scientific information

Theories of decision-making that emphasise both the political and the transacted aspects of decision-making would point to a role of information other than the one

associated with information that comes prior to decision-making and that influences the course of decisions:

> *They [students of information in organisations] have emphasised the role of information in interpretation, the ways in which information is generated more to justify decisions than to make them and the ways in which the organization of information processing in a firm is directed towards mobilizing support for action and the organization, toward creating an interpretation of history, and toward developing new purposes and new understandings, rather than toward contributing to a choice among alternatives or to facilitating learning* (March 1990: 195)

We have discussed above how the concept of strategic use of scientific information underlines the mobilising of support rather than developing meaning. Research can also be used for conceptualising and shaping how we see the world, and causal connections that operate within it. Especially in the study of the uses of social science, research used conceptually is identified as important. It is a type of use that shapes how decision-makers and even society at large think about societal phenomena and causal connections. Science and research contribute to shaping cognitive paradigms in society. Even more so than is the case for strategic use the link between specific decisions and specific pieces of information cannot be spotted. We have already discussed how scientific disciplines shape the minds of those who undergo higher education (cf. chapters two and three). Similarly, professions are a primary means of "research dissemination" and use (Eckhoff 1967). Consequently they are important in the link between practice and scientific investigation and knowledge.

Conceptual use of research concerns the language of policy discourses. Scientists can then play a major part in the constitutive processes whereby public policy-makers establish and maintain concepts and language that frame public policies (Scott 1995: 41-44). Studies of economic policy-making have amply demonstrated the role of economics as an academic discipline in shaping shifts in policy paradigms and changes in policy discourses (Hall 1996; Østerud 1979). That role is not necessarily limited to social science and economics, concepts such as biodiversity and "greenhouse effects" are all developed with the involvement of scientists, and eventually they have become household words, at least for those who participate in the policy discourses. There are two main processes by which conceptual use can come about. First, there is the paradigm shaping and "policy language instruction" that go on in higher education. These processes suggest a considerable time-lag between scientific development and the use of science in policy making. Second, the development can take place "directly" within policy discourse, if science is part of a policy network within one sector. This type of use may have far more lasting and fundamental societal implications than most

instances of single event instrumental use can be expected to have. As pointed to by institutional analysis, shaping cognitive structures may be regarded as the most profound way that people can be influenced. However, it is harder to get a firm grip on cognitive dimensions in a non-diachron study, especially since "users" of this type are unlikely to be themselves aware of their knowledge utilisation. As Keynes allegedly stated: "Practical men who believe themselves to be quite exempt from any intellectual influence are usually the slaves of some defunct economist". Studies of conceptual use and changes in cognitive structures of policy-makers, we would assume, require a historical approach in terms of research methodology. Such shifts are hard to unravel precisely because of the taken-for-granted nature of concepts and ideas that have become an integral part of cognitive structures.

Science as oversight

The concept of organisational slack is used to point to the "the difference between existing resources and activated demands" (Olsen 1976: 87). One aspect of using science might involve research as part of "knowledge slack", i.e. a pool of knowledge that is not necessarily activated instantaneously to solve problems and make decisions within the organisation. This type of use functions as a monitoring of the agencies' organisational environment - a reservoir of knowledge that might increase the organisation's ability to respond to future changes and events (Feldman and March 1988: 416). Scientific information is given attention to and accesses the organisation in order to increase the general level of knowledge in one policy area. This type of use could also be interpreted as being in line with the role of institutions of science to provide long-term and sustained attention to areas in nature and society without being determined by the short-term interest of shifting political agendas. Along similar lines science as oversight could be seen as part of the critical role of academic research in society and vis-à-vis political authorities. This type of use differs from instrumental use in one important aspect. One cannot see the connection between the pieces of scientific information and identifiable decisions. Information does not result in immediate action and the link between information and action is severed. Studies of information behaviour in general have indicated that much information is gathered in the "surveillance mode" rather than in a decision-mode (Feldman and March 1988: 415-17). On the other hand, the difference between an instrumentally-oriented use of science and science as oversight might be an effect of the time frame of the study. If one were to study an agency over a long period of time and conceptualise decision-making as an ongoing activity, research initially perceived as oversight information might eventually be used instrumentally.

Agenda setting

A related and more manifest mode of using research is when research influences the agenda of policy-makers so that it draws their attention to new issues. The instrumental view of science in public administration emphasises scientific information as problem solving. When research becomes an agenda setter, it creates problems for decision makers rather than contributing to solving them. Bureaucrats are exposed to scientific information to the effect that research becomes an agenda setter or the producers of information bring solutions to problems that have not yet been invented (Feldman 1989). The decisions and actions of policy-makers in governmental agencies involve more than mere problem solving, it involves identifying and interpreting policy problems. When science is an agenda setter it shapes the way policy areas are constructed and perceived, as well as what areas are singled out for attention. Scientific information will then have a role in shaping the cognitive structures of policy areas and how those policy areas are interpreted similar to the conceptual use discussed earlier in this chapter. This type of use of scientific information has been taken as a sign of "scientification" of the policy process. Especially environmental policy is cited as an area where issues that are products of perception *through science* are put on the political agenda (Weingart 1999: 155).

Symbolic use of research

A view of decision-making in organisations as something more than the outcome it produces, would lead us to see information as used symbolically.

> *It [decision-making] is an arena for exercising social values, for displaying authority, and for exhibiting proper behavior and attitudes with respect to a central ideological construct of the Western Civilization: the concept of intelligent choice. [....] There are no values closer to the core of Western ideology than these ideas of intelligent choice, and there is no institution more prototypically committed to the systemic application of information to decisions than the modern bureaucratic organization. (Feldman and March 1988: 417-8).*

In addition, considering the weight put on the scientific method as the mark of the rational man, the use of research should carry considerable symbolic weight signalling the scientific foundation of policies. We would then expect to find use of science as symbol of an agency's commitment to rational and scientific decision-making, e.g. when research is asked for and research reports collected, stored and referred to without having any connection to the content of decisions and the direction of the agencies' actions, but because it is the appropriate thing to do. This is what Feldman and March (1988) launch as a more general explanation as to why one can see that organisations often gather more information than justified by conventional decision theory. It thus becomes an instance of "conspicuous

consumption" of information in organisational decision-making to manifest the virtues of the organisation. If it is a deliberate strategy to increase organisational legitimacy, such use is a very close relative of what is described as strategic use of information. Further, it can be the result of information seeking and storing being taken-for-granted as part of the natural way of making decisions. Nevertheless, symbols can gain a life of their own, and over time information gathered and displayed for symbolic reasons can come to have a substantive impact on contents of decisions (Scott 1995).

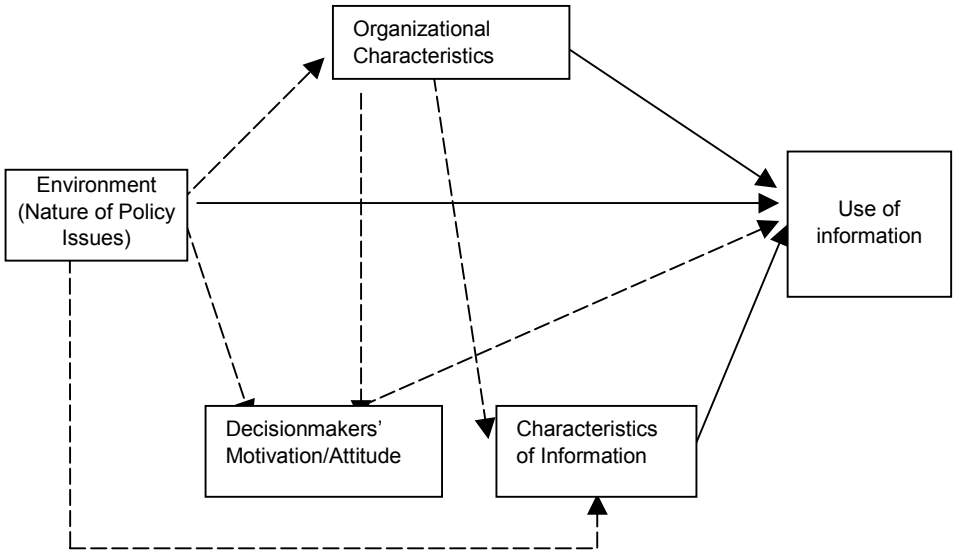
6.3 The use of scientific information – overview of explanations

Just as there are many ways of conceptualising use of scientific information, there are several ways of categorising the factors that former studies have identified as explaining use of information in decision-making. Generally one can speak of two traditions in utilisation studies in distinguishing explanatory factors. The first has already been introduced earlier as the "two-communities-theory", which must be seen as an explanation of use and non-use that accentuates the attitudes of the public policy-makers and turns the attention to the gap between the expectations of the information producers (mainly studied as social scientists) and what decision-makers do. An alternative explanation is found in what Rich and Oh (1993) label as the "organisational interest perspective", that focuses on organisational rules, norms and structures, rather than on the inherent attitudes of decision-makers, as the key explanatory factors. Some have tried to make competing perspectives complementary through the use of one integrated model (cf. especially Huberman 1987; Oh and Rich 1996). The ensuing list of pertinent and relevant explanatory factors is virtually endless, when key concepts are operationalised. The number of factors in a fully integrated model would in most empirical contexts far exceed the numerical value that can be used for the purpose of quantitative predictive models with the necessary parsimony. The data used in this study are derived from in-depth interviews without quantification. That allows us to handle more variables, even though the number of units is limited. Nonetheless, some choices in terms of conceptual and analytical focus have to be made. In the following we will go through some of the main contenders in explaining research utilisation, in order to profile our theoretical starting-point against the background of the theoretical landscape in utilisation studies in general.

In their call for an integrated model for explaining use, Oh and Rich (1996) identify four sets of factors that affect information use. The model can serve as a good overview of the explanatory factors introduced and discussed in the fairly

long tradition and scholarly efforts put into utilisation studies. Their four sets of factors are: environmental factors; organisational characteristics; decision-makers' characteristics; and characteristics of information. Their model is presented in Figure 6.1. Environmental factors are described as the nature of policy issues, or rather the decision-maker's perception of the nature of problems from the environment as to whether policy problems are routine (familiar) or non-routine (unfamiliar). Organisational characteristics refer to the decision-maker's position in the organisation and the organisation's reward system for information utilisation. Decision-makers' characteristics include decision-makers attitudes toward information, their perceived need for information and their perception of the decision-making process (the degree to which decisions are made through political activities and compromise between different stakeholders). Characteristics of information comprise type of information, source of information, the amount and content of information received, and finally, interaction between researchers and decision-makers.

Figure 6.1 Integrated model of information utilisation.



Note: Solid line with arrow represents direct effect; dashed line with arrow stands for indirect effect.
Source: Oh and Rich (1996: 8)

Many of the factors and arguments that this model, and prior studies that this model is founded upon has identified, can be retrieved in the approach applied in our study. The analytical framework presented below has a slightly different way of

categorising the potential explanatory factors. Also, there are certain factors that do not feature as part of the analytical framework that will be applied.

First, compared to most of the other studies in this field, we are less attentive to negative value differences between science and bureaucracy, such as mutual distrust, and lack of understanding between science and civil service (Caplan *et al.* 1975; Weiss 1977; Rich 1991), although we have argued in chapter two that there are significant differences in the rules and norms that surround science compared to politics/public administration. However, the "gap" is not our starting-point. This is a consequence of the choice made with respect to the analytic focus of the study and of the assumption that such factors may be overrated in this particular empirical context. First, as discussed in preceding chapters, the world of politics, power and policy-making is not unfamiliar to this part of the Norwegian research system. Second, bureaucrats in public agencies in primary sectors have some knowledge of the way science works. For instance, 40 percent of Norwegian civil servants even view their role as similar to that of a researcher (Olsen 1983: 135).

Second, we do not assume that characteristics of information are central factors in explaining use. The discussion of the significance of inherent qualities of scientific information usually centres on the following three issues:

1. How researchers present their work (e.g. degree of user-friendliness in presentation, etc.).
2. Whether research information is bedridden with scientific controversy.
3. The inherent practical relevance of science.

Summing up the results from utilisation studies on the characteristics of "useful research", Weiss claims that decision-makers use two tests to judge the research they encounter. First, there is a "Truth Test", where the user tries to make up his/her opinion as to whether a study is reliable. Does it match the user's knowledge and values? If not, is the study methodologically so strong that they can accept it as true, at least provisionally? (Weiss 1993: 65). The second is a "Utility Test", where the user screens research according to whether it provides action-oriented recommendations that do not challenge the status quo. If so, the research is considered useful. However, research can also be useful if it does challenge the status quo. In that case it is useful not for pushing policy-makers into immediate action, but for providing them with "food for thought".

Overall the connection between research quality and use of research is contested in utilisation studies. We will not deny that quality aspects of knowledge production might be important. However, we would assume that the utilisation potential of science and its relevance to decision-making is related to the context of the

potential users rather than to a stable, intrinsic quality of science (Tennenbaum and Wildavsky 1984). Focusing on the quality of scientific research as an explanatory factor concerning the use of science requires a methodological approach where specified research projects, programmes or publications are the centre of attention. Several evaluations of the relevance of research (Brofoss and Narud 1990, Brofoss 1989, Nausdalslid and Reitan 1994) as well as evaluations of the use of research evaluations (Brofoss 1998) have used this approach.

This is not the methodology used in this study. Our primary focus is on the organisational conditions for the use of research and that is reflected in the framework presented here. Our aim is to analyse how the organisational context of decision-makers affects their information behaviour with respect to scientific research. Below we start with presenting relevant factors within an organisation and discussing how the internal structure of bureaucracies can affect the use of information. Next we point to inter-organisational structures, and finally we introduce individual characteristics of decision-makers that are independent of the decision-makers' position in governmental agencies, but that we expect can mediate or interact with the effects of the organisational context.

6.4 Intra-organisational factors and use of scientific information

When focusing on intra-organisational factors we depart from the assumption that organisational structure defines what tasks an organisation and its members are set to perform and how these tasks are to be handled. This influences the search for, exposure to and use of information. Consequently, this might affect the role of a research system as a provider of information. Here we assume that information behaviour, search for, use of, and interpretation of information, is strongly influenced by a decision-maker's organisational position. Organisations in themselves are information handling systems and the set up of organisations implies that communication follows certain paths (Hall 1991: 164). This applies also to the handling of extra-mural scientific information.

Type of tasks

From the point of view of a Weberian bureaucracy, one would expect information behaviour to be closed, i.e. the information used in decision-making is internally produced and processed (Badura and Waltz 1980). This is retrieved in empirical findings that point to the tendency of public agencies to be "closed cycles" that rely on information which is either produced or held within the agency (see Rich

1991). The "closed cycle" view is contested by Oh and Rich (1996: 27). On the basis of their study on utilisation in mental health policy they argue that public agencies are not per definition "close cycled", but that their openness is dependent on whether decision-makers deal with old and familiar problems or new unfamiliar ones. In the latter case the information behaviour is much more extrovert.

If we see research and scientific information as data or knowledge about new aspects of reality, this type of information is likely to be less relevant when the tasks assigned to a unit or bureaucrat are routinised and consists of established responses to well-defined stimuli. Making case to case decisions according to a well-defined set of rules and engaging in control of activities can be seen as programmed activities. When we approach "problem solving" activities such as planning, writing briefs and reviews, establishing new governmental programmes, new rules and laws, we expect decision-makers to be more oriented towards external and new information (March and Simon 1993 [1958]), research results and scientific information included. Consequently, the "newness" of a policy or policy topic might also influence the degree of routinisation versus problem-solving dimension. The less agencies have knowledge of and traditions in dealing with a policy area, the more they rely on outside information. In working with a stable and well-understood policy area there are few incentives to use new and external information (Nausdalslid and Reitan 1994: 77).

How can the type of tasks be identified? Formal descriptions of the tasks of governmental agencies usually give indications of what types of tasks exist within an agency and its subunits. At the level of the individual decision-maker the type of tasks may vary so that a bureaucrat's work involves both programmed and problem-solving activities. In our study we will use the interviewees' descriptions of their own tasks and the tasks of their units as the primary indicator for this dimension. In turn we pose the question: in what type of decision-making situation do decision-makers seek and use scientific information?

However, openness to scientific information might have less to do with the intrinsic qualities of policy problems that governmental agencies are set to address. In addition to providing descriptions of what to do, organisations such as governmental agencies indicate how such tasks should be performed. There might be procedural rules, norms, and incentives, indicating what type of information belongs to a set of tasks, i.e. the norms and rules surrounding the use of information. Using scientific information can in itself be a routine activity or part of a set of routine activities. Such routine can be so ingrained and repetitive that the decision-maker is barely aware of the fact that he/she is "using science". An important question to raise is the extent to which there are formal or informal

rules and organisational routines concerning the use of and search for scientific information. Just as organisations carry traditions and scripts for action in other areas (cf. chapter two, section 2.6), the information behaviour might be significantly affected by the history and traditions with respect to the mode of information gathering and use of information. The effects of the type of tasks on information behaviour do not necessarily pull in the same directions as the rules and routines for information gathering and use.

Modes of decision-making

Different modes of decision-making have been put forward as an important factor in explaining information behaviour (cf. Langley 1989; Oh and Rich 1996). First of all there is a distinction between actors and agencies that operate in a technical versus those that operate in a political mode of making decisions. This points to a difference between a machine bureaucracy versus a professional bureaucracy as described, for example, by Mintzberg (1983). This distinction has a potential relevance for the present study. In the history of Norwegian government agencies, a central dispute with respect to structural choices has been how to organise professional public agencies. The growth of directorates and professionally-oriented administration units weakened a relatively homogenous and hierarchical central administration dominated by a legalistic administrative tradition (Christensen 1984). The administrative history of agriculture and fisheries has been marked by the development of an independent professional expertise (Jacobsen 1978 ; Nikolaysen 1989). The two sectors have an organisational design that blends expectations of professionalism and political loyalty in different ways. In the fishery sector there is a big independent Directorate with strong traditions and a small, more recently established Ministry. In the agricultural sector the organisation of professionalism is different, since there is no independent Directorate, and the professional agencies are organised within the structure of the Ministry[19].

In government agencies that are organised to emphasise professional aspects, one would expect that it is more common that scientific information is used in decision-making. The researchers dealing with the corresponding areas of the professionals in the government agencies can be regarded as the scientific counterparts of the professional experts in a public bureaucracy. This should lead us to expect a greater openness towards the use of scientific information in the Directorates compared to the Ministries that are close to the political leadership and thus presumably expected to stress considerations of political loyalty. In our

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[19] This was the case at the time the data were gathered for this study. Since then the central administration in agriculture has been reorganised.

particular context this implies that the Ministry of Fisheries should be less open to scientific information than the Directorate of Fisheries.

Bratbak and Olsen's 1980 study on the use of feedback information in Norwegian Ministries might give some indication of how plausible it is to expect organisational blends of political loyalty versus professional autonomy to affect information behaviour. This study suggests that the Ministry of Agriculture relies heavier on the universities and research institutions for information about the effects of the Ministry's policies than the Ministry of Fisheries (Bratbak and Olsen 1980: 136-137).This might be an indication of the effects of differences in modes of decision-making on information behaviour .

We might also expect the *type* of use to vary according to the organisational differences between Directorates and Ministries, as well as within Ministries. In cases where the expectations accompanying a professional autonomy are dominant, the instrumental use of science could be more prevalent than in the politicised context of a Ministry where scientific information is but a part of different sets of relevant information and decision criteria. From studies of the way in which civil servants emphasise various decision-making criteria, we can deduce the potential decision-making context of science utilisation. In other words, these studies might tell us *how* crowded the bureaucratic space that science enters is. There is no difference between Directorates and Ministries in the degree to which professional decision criteria are emphasized. In the Ministries, however, these criteria operate in a much more politicised decision arena than in the Directorates (Christensen and Egeberg 1993: 111). Accordingly, the strategic use of science can be expected to be more prevalent in Ministries than in Directorates.

However, we might argue that the effects of professional autonomy versus political loyalty are less important when attempting to explain why some Ministries are more dependent on research institutions than others. It might well be that the type of *tasks* the civil service has is much more significant. For instance, with the development of aquaculture as a major part of the Ministry of Fisheries' field of work, the informational behaviour might have changed considerably. Aquaculture is a research intensive activity, and the development and implementation of policy measures in this sector can be expected to rely much more on scientific information in the 1990s than it did in the late 1970s. As a consequence, with the rise of aquaculture, the policy area for the fisheries might have become more like that of agriculture - in the latter scientific knowledge has for over a century been an important input (Busch and Lacy 1986). In identifying the mode of decision-making in governmental agencies we rely on the descriptions of the position and functions of governmental agencies. In addition, we intend to treat this as a

conceptual variable, i.e. depending on how decision-makers view decision-making processes.

Hierarchy

A civil servant's pattern of contacts seems to be strongly linked to his/her hierarchical position in the political administrative system (Lægreid and Olsen 1978; Christensen and Egeberg 1989: 48). Heads of units are more extrovert than their subordinates. If this is reflected in also their contacts with the scientific system we might expect that this leads heads of units to use science to a lager extent than their colleagues. Another expectation might be that superiors are the links between the research system and their subordinates, i.e. hierarchical leaders are the intermediaries and the subordinates the real end users of scientific information. However, there is some evidence to support the opposite. According to Bardach (1984), decision-makers in higher positions in bureaucracies request smaller amounts of information than subordinate staff members, mainly due to the limited time they have for processing all of the information sent to them. Also the position in the hierarchy influences the conception a bureaucrat has of the required mode of decision-making - the higher the rank the more politicised the required mode, and that might moderate the effect of hierarchical position in the government agency.

"Internal Science Policy"

As far as the Ministries are concerned, during the 1980s most have established units within the organisation dealing specifically with R&D questions (Larsen *et al.* 1991). That is the case for the Ministry of Agriculture as well as for the Ministry of Fisheries. Such formal arrangements are primarily a result of the increasing interest in and preoccupation with research questions at this level. These can be seen as structural means to make government agencies more open to scientific information. Such arrangements represent the organised attention put to matters of research and development at an agency level. The question remains, however, if these units have some responsibilities as disseminators of research information within their Ministries (and maybe to the subordinate units in the sector), or whether their role is different. In the latter case they could either be symbols of the weight and importance attached to knowledge and innovation within an agency (cf. section 6.2). Or it could be that they serve primarily as controlling and management units in relation to research organisations that are supported and funded by the agency. One would assume that if these units have a dissemination responsibility, they would be decisive factors in the entire organisation's use of science, including the search for science, exposure to it, and storing and spread of

that type of information. After all, these are bureaucrats that are in a position to be concerned with science full-time, thereby they may represent an element of organised learning and systematic knowledge diffusion within the Ministries.

6.5 Inter-organisational factors: matching science and bureaucracy by design

In agriculture and the fisheries, science is organised according to the so-called sector principle, as described in chapter one. These are organisational structures for applied research, with strong formal links between research institutions, research councils and the public administrative apparatus. They are long-term and relatively stable formal arrangements linking science to bureaucracy. This is not only an expression of the political wish to keep research within these sectors tied to the needs of the sector in general, but also a formal representation of the government agencies' need for scientific knowledge in their own work (cf. chapter 2). The formal closeness between the two systems is meant to secure the relevance of research from the perspective of the tasks of the bureaucracy. This closeness can be interpreted as an organisational design that systematises the Ministries' attention towards the research system as part of the Ministries' information systems. It is an attempt to design a system that will systematically produce relevant information. A fair assumption is that this design has an important impact on the access to and use of scientific information, since these agencies are formally open to research-based information through their participation in and links to these inter-organisational arrangements.

The Ministries and their subordinate agencies are represented in different bodies, such as the governing boards of research institutes or bodies in the research council system. Does a bureaucrat's participation in bodies that link users and science make him/her a more ardent user of science than his/her non-participating colleagues? One ought to expect this, given the fact that these actors are "exposed" regularly to scientific information. They have their attention focused regularly on the research system, by merit of their participation in these bodies. In addition, is it possible to see any connection between these individuals and the road that scientific information travels within the organisation, i.e. are these individuals information brokers?

Note that the way the two systems are linked in these two sectors makes it possible for the government agencies to influence the selection of research problems in their affiliated research institutions. They are potentially able to have "tailor-made"

scientific information, either through involvement in science governance or through buying research. One assumption might be that those agencies that are able to influence what becomes the topic of research have an easier time to find and use scientific information (Stankiewicz 1979).

An important distinction between the two sectors is the degree to which the rest of the research system is organised to be an information partner of the bureaucracy. Particularly within agriculture, the sector principle of organising research has been fully applied. Every major sub-unit in the Ministry has its own research institute in the corresponding field, for example, the department of agricultural policy and economics has its own Agricultural Economics Research Institute; the Forest Department has its Forest Research Institute, and so on (cf. chapter one). We do not find this carefully designed pattern in the fishery sector. There is one government research institute performing research in all areas relevant for government agencies, except fishery economics. The rest of what is labelled "fishery science" is conducted by other institutes and within sub-units at colleges and universities. These are either independent or formally linked to other Ministries. We expect this to affect the direction in an agency's contacts with the scientific system, i.e. cases of having one or two strong formal links to the scientific system versus cases with multiple, but less tight connections.

Modes of research communication

The following three conditions have been identified as factors that increase use with respect to practitioners (Weiss 1993: 66):
1) Direct communication between users and scientists.
2) Interaction: mutual influence between the two.
3) Time: interaction is maintained over time.

The inter-organisational linkages between research and government agencies that promote "face to face" communication and secure some reciprocity between the two parties can be expected to affect the use of research in public policy making. The third factor mentioned above underlines the so-called linkage theorem of dissemination and utilisation: "researcher organisations having a long history of collaboration with target users operate in a more user-friendly institutional context with a corresponding reward structure" (Huberman 1987: 606). From such a perspective we can argue that formal links that are sustained over time give rise to traditions for utilisation and norms that endorse the use of research.

In some national policy sectors these three factors are conditioned by the size and degree of formalisation in policy sectors. When conditions for direct interactive

communication sustained over time are hard to establish, there are other modes of research communication, such as government commissions, working groups, and also "third party" mode of research communication, such as mass media and research disseminated through interest groups. The latter two are not fora specifically designed for research dissemination purposes, nevertheless they seem to play an important role in larger policy-making systems where interpersonal contact between researchers and policy-makers is rarely taking place.

6.6 Information behaviour and the individual

The preceding paragraphs are based on the assumption that the organisational surroundings of a civil servant influence his/her informational behaviour, either through providing him/her with standard routines for seeking science and for being exposed to it; norms and traditions for where to go for information and how to use it; or as a system for incentives and constraints that regulate exposure to and search for information. Nevertheless, joining an organisation does not necessarily imply that your prior experience and knowledge are erased. To return to part of Snow's argument, the educational background and training of decision-makers will affect how they are able to use and understand scientific information. Education as a background variable significantly affects how civil servants act in different Ministries, including who they are in contact with (Lægreid and Olsen 1978; Lægreid 1988; Egeberg 1989). Their role perceptions, however, do not seem to be affected by their educational background (Christensen 1991: 313). The general assumption is that highly trained organisational members operate under less programmed job specifications. Furthermore they bring with them internalised knowledge of how to perform (Katz and Kahn 1978: 440-43).

At this point the comparison between the two sectors is potentially fruitful. There are marked differences in educational profiles cross-sectorally where all governmental agencies in agriculture are predominantly inhabited by graduates from the Norwegian Agricultural University or the Veterinary College (i.e. civil agronomists or veterinarians), while agencies for the fisheries are dominated by lawyers and economists. The establishment of a separate agricultural higher education system and profession was central when the current governmental agencies in agriculture were institutionalized (Jacobsen 1978 [1964]). This agricultural profession is said to have a special client orientation towards its sector. This has had consequences for the information upon which agricultural policy decisions have been based (Jacobsen 1965) (cf. Chapter three).

This view has also been expressed in relation to agricultural scientists with the same educational background, i.e. that these are as client oriented in their research as the agricultural civil servants are science oriented in their administrative activities (Stokholm 1986: 63). Over 65 percent of the civil servants with a university degree in the Ministry of Agriculture have a "sector specific education". Until the establishment of the College of Fishery Science in the 1970s there were no possibilities to have a degree equivalent to the "civil agronomy" degree in the agriculture sector.

Higher education provides the individual with certain skills and qualifications that are specific for each educational speciality. In addition it gives the individual a set of values, and behavioural patterns that are built in the educational "hidden curricula" (Badura and Waltz 1980). In this connection one might hypothesise that this type of educational correlation between bureaucracy and science is highly productive in the sense that it eases the flow of information from research institutions to bureaucracy. First, one might assume that civil servants seek and use information, including scientific information that corresponds to their own frame of reference provided by their educational background. The decision-maker will have an easier time finding, understanding and using knowledge emanating from the scholarly discipline within which he/she has passed years of formal training. The language and way of thinking of the scientific system will be familiar to the bureaucrat. This is corroborated by previous studies that indicate that the educational background of users and decision-makers does significantly affect their use of research (Naustdalslid and Reitan 1994; Rieper 1995). Second, the common educational background of the civil servants and scientists in the agricultural sector not only makes the bureaucrats cognitively capable of using science. It may also be the basis for personal networks that have an impact on flows of information also in connection with bureaucratic decision-making. The bureaucrat can use his/her personal network to access information from science on an informal basis, or he/she is exposed to it by being in regular contact with researchers in his/her network.

No matter what the mechanisms linking educational background and use of science are, these links affect information behaviour differently than the factors described in previous sections. Here the ability to use and access, or be exposed to research information is not an effect of the civil servants' role in a bureaucratic organisation. It is a characteristic that the individual has brought with him from outside the organisation. Traditionally, professional knowledge, certainly, and possibly science literacy, are part of the formal qualifications upon which civil servants are hired. As Perrow points to, the Weberian bureaucracy relies fundamentally on expertise. This can be illustrated by the following quote from

Weber`s The Theory of Social and Economic Organisation: "The primary source of bureaucratic administration lies in the role of technical knowledge" (Perrow 1986: 44). A traditional bureaucracy is not only a hierarchy, but a hierarchy populated by educated persons with knowledge of administration and factual knowledge acquired mainly from training in higher education. Hence, the effect of education on informational behaviour is not some extra organisational erratic force.

Another "background variable" that may have a similar function is former experience as scientist/ researcher. Such experience may affect the use of science by way of general science literacy and by way of an information network that accompanies an individual into the bureaucracy.

6.7 Summary

The issue of science utilisation is in this study seen as a type of information behaviour, encompassing questions of access of scientific information to bureaucracy, i.e. contacts between civil servants and science, and search for and exposure to scientific information, and different ways scientific information can be utilised by bureaucratic decision-makers. The outline of our theoretical framework presented in this chapter has underlined how different concepts of use of research correspond to a large extent to different perspectives on organisational decision-making in general. The dominant theory of rational decision-making has its counterpart in the instrumental use of scientific information in its strict definition. In addition, a "weaker" definition of instrumental use has been developed based on notions of bounded rationality. Both in its weak and strong definition instrumental use allude to a view of organisational decision-making as problem solving. The relaxation of the assumption that governmental agencies are one unitary actor with people sharing the same goals and interests caters for a view on use of scientific information as strategic, where organisational decision-making takes place under conditions of conflict. Aspects of ambiguity of relevance in decision-making point to the elusive link between information and action that can be related to the conceptual use of scientific information. In addition it is argued that research produces diffuse changes in perceptions and cognitive structures of decision-makers rather than contributing directly to decisions (Feldman and March 1988). Finally, a view of decision-making as expressions of meaning and values clearly ties in with the symbolic use of scientific information.

As Olsen (1996: 92) points out humans have a potential for a variety of decision-making behaviours. They may act instrumentally according to self-interest and for strategic reasons. They may act according to rules and routines. They may also act

irrationally and according to sentiments. We have in our analytical framework assumed that information behaviour is in this respect no different from other types of organisational behaviour. Our theoretical approach to the study of use of scientific information has a primary focus on organisational factors. The analytical framework has been constructed to serve the overall purpose of this part of the study, i.e. to clarify how properties of organisational context influence the search for, exposure to, and use of scientific information in organisational decision-making.

7 The search for and exposure to scientific information in public administration of agriculture and the fisheries

7.1 Introduction

In this chapter the main characteristics of the interaction as well as flows of information between research units and government agencies in the public administration of agriculture and the fisheries are presented and analysed. We address three main issues with respect to the informational behaviour of bureaucrats that are related to bureaucrats' exposure to, search for and access to scientific information. First we describe and analyse the interaction patterns between scientists and bureaucrats in the two sectors. What characterises the general patterns of contact between scientists and bureaucrats? How often are these two groups of actors in contact with each other? Who takes the initiative and how stable are these patterns? Next we discuss the nature of the contacts. What are the interactions about? Third, we look at need for information as perceived by the bureaucrats. In what situations do informational needs arise and how are they acted upon? The chapter closes with a discussion of how organisational factors affect the patterns of contact and nature of contacts and the informational needs. In line with the analytical framework introduced in chapter six, we focus on three sets of factors: the internal organisational structure that surrounds the bureaucrat; the arrangements that link state agencies to the research system and personal characteristics of bureaucrats, especially the educational background

The presentation in this chapter is based on the in-depth interviews with bureaucrats in the public administration of agriculture and the fisheries, and on the data from the survey among agricultural and fishery scientists (cf. Appendices I and II).

7.2 Patterns of contact

Direction and frequency

From our survey among agricultural and fishery scientists we get a first indication of the general patterns of contact between researchers and government bureaucrats. *Openness* between research system and government agency is a primary characteristic of the interaction between the two. This reflection on the interaction between science and the bureaucratic practice of two public sectors obviously starts with an examination of the patterns of contacts between the scientific researchers and bureaucrats. According to our survey scientists interact frequently with government agencies in their own sector. Table 7.1 gives an indication of the level of openness that scientists report based on their experience with different government agencies. The overall interaction pattern as seen by the scientist corresponds with the "open cycle view on information behaviour" we argued for in chapter six (section 6.3). With respect to their general pattern of contact with the research system in their sector, Norwegian government agencies are not closed systems. More than half of the scientists that are included in our survey have been in touch with the main state agencies in their sector. As we have argued in previous chapters, scientists within these two sectors do not operate in isolation from "the world of practice". Likewise, the world of public management of agriculture and fisheries does not seem to be insulated from contacts with the research system.

However, contacts with governmental agencies does not involve all scientists, and certainly not when it comes to more frequent contacts between the two. Among the agricultural scientists very few have contact on a weekly basis with the Ministry of Agriculture, with regional agricultural agencies or with the agricultural extension service. In average over 60 percent of these researchers are in contact with one or more of these government units during a year. For more than 1/3 of this group it is not uncommon to be in touch on a monthly or even a weekly basis. Among the fishery scientists the interaction as shown in Table 7.1 is first and foremost centred on the Directorate of Fisheries. This corroborates the argument we raised in chapter six about how a professionally oriented independent Directorate would have more open information behaviour with respect to research than a politically oriented Ministry. Nonetheless, it must be underlined that there is not only proximity in terms of expertise between the Directorate and fishery research. For the major institution included in our survey (Institute of Marine Research) there is a very close geographical proximity, i.e. a large number of fishery scientists in our survey are literally next-door-neighbours to the Directorate of Fisheries. Both are located in the harbour area of Bergen. Compared to their research colleagues in agricultural science, a slightly higher percentage of the fishery scientists is never in

contact neither with "their" Ministry in Oslo, nor with the regional governmental agencies in their sector. It is also noticeable that the only governmental agency organised outside the two primary sectors that we asked specifically about in our survey, Directorate for Nature Management, is the most distant in terms of contact with agricultural and fishery scientists.

Table 7.1 Contact between individual scientists and governmental agencies as reported by scientists. Frequency distribution in %.

	Frequency in contact				
	Weekly	Monthly	annually	never	N
Ministry of Agriculture	0,5	22	42	35	(160)*
Ministry of Fisheries	4	19	35	42	(100)**
Regional agricultural agencies	2	23	38	37	(160)*
Regional fishery agencies	2	13	32	53	(100)**
Directorate of fisheries	10	31	31	28	(100)**
State agricultural extension service	4	17	46	35	(160)*
Directorate for Nature Management	1	7	27	63	(260)

*Agricultural scientists only, ** Fishery scientists only

According to the results of our survey scientists are both *seeking* contact with and are *exposed* to contact with the government agencies (see below). Both sides initiate contact, predominantly by phone or as a result of meeting face to face, either in formal meetings involving both sides of the science/government agency divide, or through mutual participation in other organised fora (conferences, seminars, boards, etc.) (see Table 7.2)[20].

Table 7.2 Means and venues of contact between scientists and governmental agencies as reported by scientists. Percent N=264

Scientists having contact with government agencies via…	
Face to face formal meetings	27
Other face to face contact	16
Research council committees	11
Other type of committee work	30
Talking on the telephone	75
Written communications	54

[20] The survey was conducted before the time that e-mail became a general means of communication in the state bureaucracies.

Also the interviewees in the governmental agencies point to the fact that the communication pattern is a two-way street. This will be discussed in more detail in section 7.3.

In the public agencies in the fishery sector all the bureaucrats we interviewed describe their direct and personal contacts with the two main institutions in fishery science, Institute of Marine Research and Norwegian College of Fishery Science. As we have seen already, the pattern of contacts is especially strong between the two neighbouring institutions in Bergen, the Institute of Marine Research and the Directorate of Fisheries.

Contact though ideas – dissemination of research through research publications

All interviews included a set of questions relating specifically to the use of written information from research. The answer to these questions reveal that the interviewees in government agencies for the fishery sector and in the Ministry of Agriculture are relatively well informed about what goes on within core institutions in their fields. This takes place either through written material that is sent automatically to the agency, such as newsletters, annual reports from the Research Councils, or research reports, or through professional journals. The interviewees do not claim to actually read all of the material that passes their desk; in practice they rarely do. "Glancing through", gives them some idea of who does what in fishery or agricultural science, i.e. in the part of sectoral science that pertains to their area of responsibility. In that sense their attention is very specialised. What goes on outside that area is in general not closely followed or even ignored. So, for instance, a bureaucrat in the area of aquaculture has little knowledge of what goes on in science relating to capture fisheries and management of marine resources, and vice versa. The degree of specialisation within government agencies clearly leaves little room for the "generalist" in the public administration of fisheries and agriculture. The attention structures within Ministries and Directorates are highly specialised with respect to research publications.

There are few if any clear formal organisational expectations concerning the bureaucrats' reading of research reports, articles, etc. In that sense there are no formal organisational routines in this, with only a few exceptions. All interviewees mention the collection of written material ("circulation folder") that is circulated in the department on a regular basis. In this folder information also from research is included, if not the original publication then at least information leaflets from the research council, overviews of publications, and so on. In addition, in many of the sub-policy areas there are special professional journals aimed at researchers and

public managers or other professionals. These are professional journals with respect to which researchers are invited to contribute and in which research is presented often in an "edited" way. As such these are convenient publications that allow the bureaucrats to be informed first hand on new research without having to read entire research reports. This grey literature as we have seen also in the management of the fisheries and in agriculture, is important for the reading habit in government agencies, as a "reader's digest" for the men and women of practice. Despite the well-established direct contacts, written information is still an important inlet to research, as one interviewee was saying:

> *… it is more important to know it exists than to actually have read it all. I save them for rainy days, but somehow it doesn't seem to rain enough in this country… (MA14).*

No one complains about a lack of written information from research. Several complaints are uttered about the sheer volume of research reports and articles. The hard task is to sort out and, most of all, find the time to read reports and other pieces of information on research. Some also claim that there are few organisational incentives and that there is not enough organisational encouragement to invest in that kind of reading activity. There is, however, an *implicit*, general expectation to be informed and up-dated.
When questioned about whether there are internal conditions within the department that impede use of research, one interviewee says that the major impediment is lack of time.

> *We have ad-hoc issues to deal with and tight time limits and deadlines. And, I am serious about this, it is a dilemma that we are faced with, that we simply don't have the time to keep ourselves abreast and update us professionally. Thus building up our competence/expertise is somewhat of a problem here - some periods we don't have the time to attend a course, even. We don't run our own time schedules all the time - there are people on the floor beneath us [political leadership of the Ministry]. And there are factors that they don't control either. (MA3)*

Ad-hoc contacts or stable networks?

The data on frequency of contacts can tell us little about the qualitative aspects of the general patterns of contact. The structure of the direction and the means of communication reported by agencies and scientists indicate that contacts that exist between government agencies and science are more than just random encounters of various kinds. Based on the interviews, we see that these contacts represent in some respects networks of information. Some units within governmental agencies and some individuals have two separate kinds of information networks that involve scientists. First, there is the communication network operating in connection with specific tasks a civil servant is involved in at a given point in time,

i.e. the information network is determined by the agenda of the government agency. This kind of network is not stable, in the sense that the same bureaucrats and scientists interact independently of the topic that the bureaucrat deals with. The network's stability depends on the permanence of the bureaucrat's decision-making agenda. With respect to this set of contacts in the fishery sector, the interviewees claim that they are highly selective in terms of whom they get in touch with and where they seek information.

The second type of information network is characterised by stable and long-term ties between researchers and bureaucrats. Bureaucracies have stable contacts with scientists in their sector they maintain regardless of their immediate task-related information needs. Such networks were established during their student days or during work experience in the research system or in other government agencies in the sector. This type of network is sometimes used in connection with tasks or as a way of finding the appropriate person to contact in a given case, but the links are maintained also when it does not directly pertain to specific decision-making tasks. Stability of contacts seems in these cases to be sustained by personal characteristics rather than by organisational arrangements.

Not all interviewees have this double network, and with the present interview data we are not able to determine what factors are at work when such double networks are established.

There are some differences in contact patterns that we can attribute to internal organisational factors and to differences in the way that the relationship between research and government agencies is organised. In the agricultural sector there is a high degree of organisational differentiation according to both policy problem and research area. This is also reflected in the patterns of contact described by the interviewees. Both in terms of direction and form, the research/bureaucracy interaction is more diverse and more specialised in the Ministry of Agriculture than in the Ministry and Directorate of Fisheries. In the Ministry of Agriculture we see two basic forms of contacts between bureaucrats and researchers. First there is the *project-based contact* concentrated around a specific subject matter that does not represent any regularised contact with research institutions. Second basic form is the type of *contact "amongst experts"*. This is typical characteristic of contacts between the professionally oriented units within the Ministry and the corresponding government research institutes. The demarcation line between the research world and the bureaucracy seems in these cases less pronounced than in the units that operate under a more politicised mode of decision-making. The interaction between the ministerial professionals and the professionals on the research side is swift, regular and easy. The easy interaction is supported organisationally through

the formal ties between the departments and the core research institutions in the corresponding policy area.

Effects of having a "corresponding" research institute

Thus, for certain ministerial sub-units it is hard to escape the influence of research institutions that are in a matching field directly linked professionally and administratively to them. Such parallel structures of specialisation, as we see for example within the area of plant policy/science and forest policy/science, foster regularity, familiarity and case-to-case bureaucratic interaction with research. The units without such arrangements have less stable, more ad-hoc contacts with the world of research. Such contacts can either be based on specific contracts, projects, and programmes or they are established through bidding rounds for ministerial evaluations or other projects. However, for these units ad-hoc contacts do not mean lack of contacts in any way, they have as one interviewee puts it "many acquaintances, but no best friend" (MA9).

The sub-units with corresponding research institutes are predominantly very satisfied with this arrangement, and most of the interviewees in these units in the Ministry of Agriculture deem it as very important for the way they work. The organisational arrangement caters for a personal and efficient relationship between bureaucracies and research. In comparison the contacts they have with *other* potentially relevant research institutes for research groups, for instance, within the university and college sector, is peripheral. To some extent such a tight organisational link between research and sub-units within the Ministry of Agriculture verges on monopolising the units' contacts with the research system. Units with no "corresponding" research institute do not have that one organisational link around which contacts to research revolve. Their contacts seem to be broader, but less intensive, and less based on face-to-face interaction. The other means of communication and venues of contacts, such as written material, seminars, research council meetings, etcetera, seem somewhat more prominent in the interaction with research for these units, than in the cases where research and ministerial sub-units are matched.

It is not possible to directly cross-examine these observations against data from the scientists' survey. The information on the researchers' contacts with government agencies is not sufficiently detailed for that particular purpose. On average we see that researchers employed by research institutes report a more or less similar frequency concerning their interaction with the sector Ministry as the researchers in the university sector. This is the case both for contacts of fishery researchers' with their Ministry and for the contacts that agricultural scientists have with their

Ministry (cf. Table 7.3). The differences between researchers in agricultural science and their colleagues in fishery science with respect to how often they are in touch with the Ministry in their sector are on average not significant.

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There are some interesting differences in contact patterns within the agricultural sector, when the data are broken down according to research area. Scientists in *forest research* (The Norwegian Forest Research Institute and Department of Forest Sciences at the Agricultural University) are more often in touch with the Ministry of Agriculture than researchers within other departments at the Agricultural University or other agricultural science institutes. This corresponds with the findings on user orientation and participation in problem choice that also suggest that this sub-field of agricultural sciences have especially tight connection with clients and users (see for instance Figure 4.1 and chapter five).

Table 7.3 Frequency of contact with Ministry according to research organisation (university versus research institute) and research sector (fishery versus agricultural science).(Group means: 1=weekly, 2=monthly, 3=annually, 4=never)

	Fishery science	Agricultural science	N
University	3.27 (n=33)	3.12 (n=81)	114
Research institute	3.08 (n=66)	3.12 (n=77)	143
Total	3.14	3.12	
N	99	158	257

Effects of type of tasks in bureaucracy

The differences in patterns of contact found in the Ministry of Agriculture serve as indicators for the effects of type of tasks on information behaviour, at least when it comes to the contact patterns. We have in our theoretical framework highlighted the potential effect of type of policy area that bureaucracies deal with. There are a number of units that serve as illustrations of how a new policy area implies different sets of contacts with the world of research, when compared to the patterns found in predominantly professionally oriented departments focusing on established, core policy areas in agriculture. One of the units in the Ministry of Agriculture for example, has traditionally been dealing with a very long-established legally oriented policy area, involving little interaction with research. This unit has more recently incorporated a new policy area as part of its responsibilities, and that has changed their attentiveness towards the research system. Here there is no segmentation of departmental contacts with research communities. This can be contributed to the fact that the unit's policy area and area of responsibility are relatively new. Here the contact pattern is "pragmatic" following formally

established channels, i.e. projects and programmes organised to promote contacts between the unit and the research community. We would hesitate to label it proper network characterised by organic and relatively stable inter-personal ties. A new public policy area and a new area of responsibility have to be constructed not only in terms of content and mode of operation, but also in terms of defining the actors that are to be deemed relevant to the policy arena. In this case researchers are seen as relevant at least in the constitutive phase of the history of a policy area.

In general we see some differences at the level of the individual bureaucrat with respect to networks. The interviews provide some information on the difference between *established patterns of contacts* versus *networks in the making*. One interviewee provides an interesting description of the latter that is related to type of policy area. This interviewee tells the story of when he/she started to work in the Ministry in a field that was new territory as far as ministerial responsibility goes and how he/she developed a personalised set of contacts to researchers doing research in corresponding areas to his/her own work. The main matchmaker in this case was a research programme under the auspices of the research council.

> *…[C]ontacts were established through a 'common' research programme, which brought together key people in a very narrow area - we have become a 'family' that comes together in seminars and other meetings. The threshold for getting in touch with each other is low. The development of the network is based on subject matter and common interest." (MA14)*

However, the contact pattern described is more atypical for the Ministry as a whole and for the interviewee's sub-unit as well. The area of ministerial involvement is new and is at the fringe of the core policy area of the Ministry. The modus operandi is not that of adjudication and restriction but of stimulation and information. The contacts are not institutionally based, or not yet institutionalised. In general there is more of a common interest both with researchers and people with similar areas of responsibility and comparable interests in other Ministries than with people in the interviewee's own Ministry. The contact is two-way, researchers wanting information from her/him. Her/his network is continuously maintained through travels and conferences.

Intermediaries in information networks - information brokers

Our interviewees from the Ministry of Fisheries indicate that they use the R&D section in the Ministry as a means to guide them to the proper source of information within the research system. This section works as an intermediary between bureaucrats and scientists, but only for employees in the Ministry and not for bureaucrats in other government agencies within the fishery sector. The R&D unit in the Ministry of Agriculture has only a very limited role in disseminating research within the Ministry. Some interviewees have mentioned the more formal

role the unit has in the process of presenting the Ministry's wishes to the Research Council. But there is little of the "servicing" role that is partly described by the interviewees in the Ministry of Fisheries with respect to their R&D unit. This can probably be attributed to the size of the Ministry of Agriculture and to the fact that the ministerial staff was at the time of the interviews fully occupied with administrative and financial matters in relation to the research and higher education institutions under the auspices of the Ministry. Judging from interviews the expected role of "internal science policy" that we outlined in chapter six, only in part supports the idea that organised attention towards research as found in R&D-administrative units within the Ministries provides systematic knowledge diffusion within the Ministries.

"Science is not the only source"

Among the professionally oriented units research is perceived as indispensable information and the information behaviour with respect to research is fairly open. However, it must be kept in mind that not even in these units does research have a monopoly as information provider. In the agricultural sector the regional administrative units have a central role in the information system of the professionally oriented departments. These regional agencies provide, for instance, feedback on how the specific policy measures in agriculture are working and being received by the farmers. A main stream of information to the Ministry passes through these channels. In combination with the professional information on the biological aspects of the policy measures, this information is the bedrock whereupon policy is based and decisions are made. The regional and other central state units in agriculture provide the information relevant for "implementation" processes.

Several interviewees see research as information, but a kind of information that is of vital importance to what they do in their policy area. Research represents a source of information for technical know-how without which policy initiatives and instruments would be inefficient and ineffective. But research is only one element among a range of actors and information that enters the policy process. Most importantly, the social/political information does not come from research, i.e. how farmers respond, react and adapt to policy initiatives. That kind of know-how comes from information from local and regional units in the agricultural administration.

7.3 The "content" of contact: what do they want from each other?

So far we have analysed patterns of contact with a primary attention to the direction of and frequency in contacts. But contacts we can assume are not empty – there is content and motivation underlying the ties we have identified between research and bureaucracy. According to our survey among agricultural and fishery scientists, government officials approach researchers to ask for information. In the majority of instances where bureaucrats have contacted researchers, they have asked for the researchers' professional advice in relation to specific decisions and questions that the agency deals with. The data from the survey paint a picture of bureaucrats that are *instrumental* in their communication with this part of the research system. Note that this is the way the scientists in our survey interpret the approaches made by the civil servants. The motives of bureaucrats they have been in contact with might be misconstrued or hidden. However, the survey data predominantly match information from our interview study (see below). According to the researchers (Table 7.4) the contacts civil servants make are motivated by their specific decision-making agenda. As a consequence the contacts are not only instrumental but also short term. Search for a more general overview of ongoing research is less frequent as an impetus for this type of contact. The motives for seeking contact have more to do with extracting research information than with trying to influence future research topics. It is also relatively rare that bureaucrats use their contacts to check how a research project that they have funded is progressing.

"Keeping in touch with the research community" can be seen as a form of network maintenance, i.e. bureaucrats trying to keep the lines of communication open towards the research system. According to our survey respondents, this is rarely the reason why bureaucrats get in touch with them. Also the interviewees do not report this as being very high on the agenda, at least not as a conscious goal in its own right. From the viewpoint of scientists, the general information gathering on the part of the bureaucrats is done in a "decision mode" rather than in a surveillance mode (cf. chapter six, section 6.3).

Table 7.4 Reasons why government agencies have contacted fishery/ agricultural researchers (according to researchers). Frequency distribution (%). N=164[1]

Government agency wanted to be updated on the latest research developments in my field	49
Government agency asked for advice in making specific decisions	79
Government agency wanted just to keep in touch	17
I was requested to do research on a particular topic of interest to the government agency	23
Government agency wanted to check on a research project they had contributed funds to	32
Other reasons	17

[1] Only those who have reported being contacted by government agencies in the past year are included.

On the part of researchers the motives for contacting government agencies can be divided into two broad categories. First, there is what one might call the *dissemination rationale*. Scientists possess information stemming from their own research, from research of their colleagues, or they have general information on scientific developments in their field. According to the data from our survey the dissemination motive concerns especially the presentation of one's own research. Of the respondents that have contacted a government agency 60 percent give this as their reason. Likewise 60 percent have made contact in order to volunteer advice with respect to specific decisions that they know the agency have to make. Thus, also from the point of view of the researchers included in our survey the primary reason for contacts between government agencies and the research system is an attempt to couple scientific knowledge or information to specific decisions.

The underlying reasons for researcher-initiated contacts are presented in Table 7.5. Naturally the responses reported on in this table only refer to those researchers who actually have initiated contact with one or more government agencies. We underline that the number of respondents who report having approached government agencies is surprisingly high (163 out of 264 respondents). In fact it is as common for the researchers to contact a government agency as it is for the researchers to have been approached by government units. This gives the impression of a professionally rather active body of scientists. However, judging from these data there is no evidence that can support the assumption that government agencies are exposed to a set of researchers operating as political activists. Reflecting on the statements made by our interviewees there are, with one or two exceptions, no descriptions of researchers exerting overt political pressure on government agencies through the research-bureaucracy link. However, the

interviewees might be reluctant to talk about such incidents, since overt political activism on the part of expert is somewhat of a taboo. This will be discussed further in chapter eight. Here it is sufficient to assume that the data in Table 7.5 depict a research system that is not unwilling to actively volunteer its professional advice and disseminate its knowledge to the "world of practice".

Table 7.5 Reasons why fishery/agricultural researchers have contacted government agencies (according to researchers). Frequency distribution (%). N=163[1]

Dissemination rationale	
Present own research results to government agency	60
Present the research results of other researchers to government agency	18
Keep government agency abreast with current research in my scientific area	51
Give professional advice relating to decisions to be made in the government agency	60
Extraction rationale:	
Ask for research funds for myself or other researchers	38
Advocate my research organisation's interests to the government agency	18
Keep in touch with the government agency in general	38
Get input (not monetary) to new research projects	19
Receive information from the government agency	71
Other reasons	6

[1] Only those who have contacted government agencies in the past year are included.

The second category of motives for scientists to get in touch with government agencies refers to a rationale related to extraction: a researcher might ask for money or ideas relevant for a project, or for information. He/she might also act as an advocate for his/her research organisation. The most compelling reason why researchers make contacts with bureaucrats merits special attention. Researchers often want information from the agency. Over seventy percent of the researchers give this as a motive for getting in touch with a public agency. Clearly, this a further indication of the two-way nature of communication between science and public administration, not only in terms of who makes the initiative, but also in the flow of information. Bureaucrats ask for advice to help them with decisions they are faced with. In return they are attractive as communication partners for researchers because they possess information that researchers need in their own work. Several of the bureaucrats in the interview study indicated that their government unit is a data provider for research. We have seen this, for example, in the Directorates for Fisheries where the statistical data gathered are vital for research.

In our unit the essence in our relationship with research is providing them with statistics that they need for their research (DF3)

Also some of the senior bureaucrats in the Ministry of Agriculture describe themselves as providers of information on developments in international regulations in food and agricultural regimes. This implies in practice that they report from international policy conferences, such as in the area of regulations on genetics and genetic engineering in food production. Furthermore, professionally government oriented agencies have as part of their mission the dissemination of research results to clients in their sector. For the extension agencies in agriculture and the regionally based state agencies in the Fisheries that is their main task. But also several of the interviewees in the Directorate of Fisheries and Directorate for Nature Management underline this as important part of their relationship with the research system. They see themselves as serving the role as translators of scientific information to "third party" clients in their own sector. They are the professional link between science and clients, and especially in the fishery sector, the science literacy is not high:

In many respects we are better at expressing scientific knowledge in a language that is understandable for our specific audience. If people in the fisheries are even going to lend an ear – then we must write in a way they understand. (DF1)

7.4 Need for research

When is there a need for scientific information?

The bureaucrats in our study were specifically asked to account for how they perceived their need for research. In this section we give a short presentation of how important research is as a basis for the work of the interviewees as bureaucrats and in terms of in what situation the need for research arises. The descriptions of the need for research are an integral part of descriptions of how research is used by our interviewees. Consequently this issue will also be addressed in chapter eight. Second, we present the ways in which bureaucrats deal with this type of information needs, both internally within their agency/Ministry and in the interaction between agency and research institutes and researchers.

In the fishery sector there is a common voice coming from all of our interviews: science is indispensable for bureaucratic practice. This "message" is both a statement used to describe the individual interviewee's work, but also a normative statement. Scientific information forms the foundation on which Norwegian

fishery policy rests. This is the overarching principle within which the civil servants' need for research is framed. In policy-making fishery bureaucrats are expected to act accordingly. That is an expectation both from the political level and from the traditions of the agencies. It is a clear and strong norm that overarches the descriptions of "every-day needs" that bureaucrats give in the interviews.

In the agricultural sector the descriptions of the government units' need for research are more versatile. Considering the apparent homogeneity of the government units where the interviewees are employed the descriptions of why and to what extent their units need research reflect rather diversified bureaucratic lives and work practices. The range varies from seeing research information as the basis of everything the Ministry does to the other end of the scale where one interviewee claims: "there is a need, but we can do without it!" The latter position is, however, rather exceptional. In general the interviewees in the Ministry of Agriculture are rather discriminate when portraying their needs and quick in pointing to areas and conditions under which there is no such need. This can be interpreted as an indication from the interviewees that they do not pay lip service to their reliance on and need for research and scientific information. An alternative explanation is that it reflects a "self-subsistence" attitude of the agricultural government agencies when it comes to their need for information. The latter, however, is not in accordance with the overall patterns of contact between science and bureaucracy in the Ministry of Agriculture that we have described earlier in this chapter. Below the main "need-for-research-stories" in this sector are paraphrased:

The first story represents one end of the scale and is very similar to the need for research as perceived among the fishery bureaucrats. The most senior officials that was interviewed, with most experience in various areas on the Ministry gave the following description of the need for research in his/her work and in the area of responsibility of the Ministry of Agriculture. Again scientific information is described as a pillar of public policy towards the sector.

> *…., [T]he entire activities of this Ministry have been based on research results, I would argue that there is no sector that to this extent has had a need to use and apply research as the agricultural sector. There is a very short distance between researchers and users, and in all my activities I have felt the need for this, not in the least when I think of all the subsidy arrangements and programmes that should be based on facts, and research results are foundations on which these have been built. (MA13).*

A parallel claim comes from the Directorate of Fisheries and one of its senior bureaucrats:

From a historical perspective, as state agency, I would say that we are an extreme user of research. I don't think you'll find many other agencies that use research to such an extent and so directly as we do in our field. And historically that research basis has been in biology. (DF1)

Although some need for research is recognised by all interviewees in the Ministry of Agriculture, not all of them make similar statements about the pivotal role of research in their department's work. The most common position is reflected in the following statement given by a bureaucrat in one of the most professionally oriented departments:

Yes, we need research and we need different types of research: We need both development of methods and theory, and then we need facts and statistics to put on the table. Prose only won't do! (MA5)

With respect to the importance of the organisational context for the perceived need for research, the interview data provide basis for two general conclusions. First, in the Ministry of Agriculture bureaucrats whose units operate in a political rather than technical mode of decision-making, generally see a much less pronounced need for research in policy-making. They tend to start out by giving a general acknowledgment of a diffuse, but important role of basic research, but downplay the actual need and use of research in their own work.

Second, both agricultural and fishery scientists describe how *changes in their policy area* trigger the need for research. Thus refers to changes within their traditional area of responsibility, i.e. changes that alter the make up of the area in question. Changes can also occur when new areas are included as target of policy initiatives and responsibilities of a governmental agency.

We are involved in new areas that interface with new knowledge all the time. In environmental issues, there is still a great need to see the causal chains, and there are different schools of thought and there is a continuous stream of new knowledge, we work in groups to arrive at new insights and understanding) and get research projects going. So we do have a great need for research. (MA8)

Even in the units with the least perceived need for research information, changes in the policy area definitely unleash a need for this type of information. For example, the radical changes in the interface between the national and international arena (GATT/EU) created some sort of *tabula rasa,* with little empirical experience within the national context to build on in policy-making.

One relatively new area of policy-making for the Ministry of Agriculture portrayed by our interviewees is an example of a policy issue where the role of research is very evident and almost acute. The need for research felt in this area, represents a kind of administrative knowledge void that has to be filled. The role of research is described as to define standards, delimit which professional questions are important, and give advice on new solutions. The trigger of need for research is in this case not found in the small questions that arise on a short term basis, but in the overarching issues that come up bureaucrats are entering into a new area of bureaucratic practice. This specific unit also looks at the experiences of other units with long traditions in interacting with researchers and research institutions. Having been assigned the responsibility for a new area of policy has changed this unit's research needs. In describing this need for research information a comparison is drawn with another, more traditional policy area for this particular unit:

> *[In our new area of responsibility] we need knowledge that can be the basis of practical measures. We need knowledge on the system side as far as surveillance and result control is concerned, to keep track of what is actually happening in a field that is very composite and compounded. As far as [our traditional policy area] is concerned it is possibly more debatable [whether we need research or not] because there the administration of it is much more established. But it is interesting nonetheless to get the critical outlook of research on what is actually happening. But I don't feel in this field that there are tasks that cry out for assistance from research, from where we stand. But that is connected to our position that we are merely one of many actors, and we are without the responsibility to be a locomotive, which is the case, for instance, for the Ministry of Environment.*
>
> *When you say that this area is established, is that in terms of rules and regulations being established? (Interviewer)*
>
> *Yes, and some years of practice, where routines have been established, and we know how things are to be done. But something that is of interest in this connection, and that is to better target the measures of the Ministry of Agriculture, e.g. vehicles and methods to handle the information that we have, and use that as input into the planning process. (MA7)*

A similar "need-story" is told in relation to another relatively new area of intervention in agricultural policy that deals with specific aspects of development of rural areas[21]. Here the contact between social scientists and government agency is personal and reciprocal. This is an area where there is an interdepartmental and cross-sectoral interaction, and where there is a network being established – the typical implementation approach in this policy area is government stimulation

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[21] To protect the anonymity of the interviewee further specification of the policy areas is not provided

measures rather than use of legal policy instruments. Here the interviewee reports on a great need for research based information, both for "facts" and for the theoretical and qualitative underpinnings of quantitative facts, and also for the conceptualisations that researchers can provide.

Dealing with need for scientific information

The interviewees are in general hesitant to describe how they act upon their research needs. It seems easier to talk of the use of information and the general relationship towards research, than about the exact procedure followed when there is a perceived need for research. However, there are some interesting points to be made on the basis of the interviews, especially since it involves insights in to how information needs are dealt with internally in these agencies. Furthermore "dealing with need for research in government agencies" soon translates into the issue of how to influence the production of knowledge and information. The latter issue gives us the opportunity to revisit some of the questions that are addressed in chapters four and five.

There are several arrangements that affect the channelling of need for research as they arise in the departments and sub-units. For the units that have a main "corresponding research partner", the need for scientific information is predominantly dealt with through their relationship with "their" research institution. These research institutions are seen within the Ministry as having a duty to take on tasks for the Ministry within their basic appropriation, if the tasks are not too big. As one interviewee puts it "But they always have a go at it", i.e. the research institute will try to get extra funding for tasks that the Ministry sees as part of their duties. Talking about how his/her unit deals with immediate information needs another interviewee gives the following description, which is fairly representative for the department- research institute relationship in terms of channelling research needs:

> *The procedure when the need for information from research is definitely* ***directly*** *[between department and research institutions.] Then it is the case of the "two-day" issues and "emergency", then it is more like "OK, that person - call him up" type of thing, and then he sits up half the night writing a piece and faxes it over, and then he has made a memo out of what is already inside his head. That happens often, and is very useful background material that allows us to make the right decisions.*
>
> *Are the research institutions open to this type of procedure?*
>
> *Yes, that is the type of links we have with [name of institute]. We have a pot of money that we can use for those purposes, so that we can make use of the expertise that exist within our national boundaries, in areas of importance to us.*

When does the meter start running? (Interviewer)

Well, there we have come to an understanding on how to do this. It is usually people that you know pretty well. When I arrived here this morning, there was this guy here from [name of institute] and they were discussing heavily about an assignment that he had got. That is the way it is. (MA8)

For the units with a predominantly professional mode of decision-making in the agricultural sector the procedure for dealing with research needs is described also in terms of established routines involving the research unit and an underlying professional directorate. That can be the need, for instance, in the area of risk assessment and documentation with respect to EU-regulations. As a consequence the need for research information has a channel and a procedure through which it runs, and a research institution that is seen as accessible for the needs of the department.

The interviewees in the departments with a professionally oriented mode of decision-making grade implicitly their need for research in terms of long-term versus short-term needs. The interviewees from these units make a distinction between the two as a concern for their own department needs. The need for research is described as twofold. On the one hand there is a need for long-term scientific knowledge production. This is secured through the unit's responsibility for basic allocations to a set of research institutions in their policy field. On the other hand there are the "two-day issues". This refers to the need for researchers to write short memoranda on very limited issues, implying a short-term need on the part of the bureaucrats. Here there is a tight, direct, personal, organisational and tradition-based contact between practice and research. These interviewees are not the only ones to make such a distinction. Several others, including the most avid "hand-to-mouth" users of research, see the need for long-term research, but not as a part of their everyday relationship with the research system.

The Ministry of Agriculture has one special arrangement that is a potential and, to some extent, an actual channel for dissemination of research needs. The Ministry has a set of funds reserved through the annual agricultural agreement[22] that they can use for different research purposes. Most units are not directly involved in distributing and appropriating this research fund, so they cannot do anything more

[22] The Agricultural Agreement is an annual agreement with a variety of economic measures for the sector. Parties to the annual negotiations in the agricultural sector are the state, the Norwegian Farmers' Union and the Norwegian Farmers' and Smallholders' Union.

than signalling their needs. One unit has the secretariat of the funds. So any department or section in the Ministry can approach the secretariat with its needs.

Collective procedures concerning the dissemination of the need for research information are not firmly established within either sector. Bureaucrats seem better at looking and asking for answers than formulating researchable questions. The main exceptions to this general conclusion are first the systematised arrangements with respect to appropriations to underlying corresponding research institutes, and second the formal procedure on the Ministry's budget allocation to the Research Council. Yet some voices were raised as to the effectiveness of using the traditional bureaucratic, hierarchical channels conveying ones need for research, claiming that good ideas tend to die further up in system unless backed up by sustained efforts one the part of the advisors and executive officers. Due bureaucratic procedure can also hamper the dissemination of "immediate" need for input from research.

Both the Ministries of Agriculture and of Fisheries have an R&D-unit that deals amongst others things with science policy issues. Generally, the R&D unit's role is having the responsibility towards the Research Council and the total research funds from the Ministry. As far as the Ministry of Agriculture is concerned, the overall impression is that there is very limited room for this unit to act as the natural channel for receiving the "smaller needs" of the many units and sub-units within the Ministry. That can be a consequence of the size of the unit but it also is related to the hierarchical procedures of a government Ministry.

For those units with a corresponding research institute there were at that time no formal or informal go-betweens between the professional ministerial unit and the research outfit. Much of the channelling of the need for research could and did go straight from the department to its underlying research establishment. When it comes to dealing with information needs that arise in the advisor/executive officer stratum, the Ministry of Agriculture is an organisation that can get entangled in bureaucratic procedures and "line-problems". However, this is not the case when individual initiatives from such officials are directed at the "corresponding" research institutes. These are examples where information needs are met without the extended bureaucratic apparatus being involved. There are also occasions where the departments can act collectively and according to bureaucratic hierarchical procedures to define their information need towards research providers.

Channelling through the Research Council

Various descriptions are given concerning the way in which need for research are channelled through the Research Council. However, the assessments of the Research Council's role that the interviewees in the Ministry of Agriculture give were flavoured by their experiences with a newly merged Research Council. The merger was realised less than two years prior to these interviews[23]. At that time there was a sense of loss among the interviewees in the Ministry of Agriculture. For some of these interviewees the Research Council at that time was seen as an important channel of dissemination of the need for research information, though there was discontent after the merger and the loss of the sector specific Research Council. According to some, the Ministry's "grip on research" had traditionally been good, but the control was perceived to be better when they had their own Research Council. The description of the role of Research Council programmes as a channel for the need for research identified in the Ministry also echoes the results from the analysis of problem choice in chapter five, when we take into consideration that the survey data stem from before the merger of the research councils.

The role of the Research Council as a channel for the Ministry of Agriculture's needs for research is seen as less central after the merger:

> *Under the regime of the Agricultural Research Council there were projects that we followed closely. We had personal contacts with the council, on the whole much closer relationship than is the case today. Definitely, we notice that. We see that also the priorities given to agricultural research have been downsized every year since the amalgamation. Agricultural research has suffered as a consequence of the amalgamation. The merger has not been beneficial for our sector. (MA2)*

Several interviewees reported of their experiences with the Research Council's research programmes as a channel for disseminating need for research. Not all of those accounts were stories of mutual understanding and responsiveness on the part of the former Agricultural Research Council. One interviewee who had participated as an observer in the governing board of research programmes commented on the role of Research Council programmes as a channel for the Ministry's research needs. He/she felt that the signals were taken into consideration, but that the major problem was the research dominance in the

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[23] Interviews with bureaucrats in the fishery sector were conducted just before the merger of the research councils into one – consequently we will refrain from making comparisons on the role of Research Council between the two sectors.

programme: "We became reactive, but didn't have the time to go against what the researchers were prioritising" (MA9). This observation is not entirely consistent with data on the significance research programmes for user orientation that we found and reported in chapter five. One interpretation is that user orientation in problem choice also when channelled through participation in applied research programmes represents the researchers' interpretation of user needs.

For others interviewees with a shorter track record as users of research or with policy areas that were not within the agricultural policy "heartland", the Research Council (neither the new nor the old) does not figure at all as a disseminator of research needs. But also here we have seen how Research Council's research programmes are not so much a channel for users' research needs, but more an arena where ties between users and researchers can be forged.

Dissemination of need for research through steering of research institutes

For many government agencies and subunits, the relationship with their corresponding research institute is, as we have seen, very important for their way of disseminating and acting upon their demand/need for research. Below some further observations on this relationship are spelled out. These descriptions are based on interviews with those bureaucrats that have a particular responsibility in the administration and funding of the research institutes.

The main steering instruments are the annual budget and the almost continuous processes of interaction between Ministry and research institute. The budget proposal that is sent to Parliament is the main ministerial steering document. The budgetary process culminates in the Ministry's letter of appropriation. The interviewee talks of a dialogue that goes on within the framework of the budgetary processes that involves the unit and the research institute bilaterally. The research institutes provide proposals for the coming fiscal year, together with the report of last year's activities. The Ministry has formal guidelines for what these proposals should contain, and there is a close dialogue with the institutions before the budget proposal goes before Parliament. As a consequence there are few surprises for the institutions. Some departments and connections are more closed in this process, whereas with the younger leaders a more open style of leadership can be observed. And this style of leadership is described as promoting a very open dialogue.

> *There is a two-way communication so it is not that we dictate. The same open dialogue applies to the formulation of goals and indicators. There is no point in having goals and indicators that cannot be implemented. (MA2)*

When asked about the element of negotiations in this process, the interviewee in question indicated that this term is used very little. Instead he/she used the terms dialogue and communication to describe the interaction between the Ministry and the research institution. Such a dialogue does not imply that the Ministry cannot be explicit in their communication with the corresponding research unit. In some cases the interests of the Ministry lie at the level of an individual project, particularly in issues of high political and bureaucratic saliency. Consequently the budget specificity on the part of the Ministry can be quite high, especially when it comes to politically and administratively visible projects, i.e. the ones that are mentioned explicitly in the budgetary proposal to Parliament.

Many of the interviewees who have been explicit in their views on how their unit directs its underlying research institutes have a general perception that the ministerial (and "directorial") steering is increasingly conscious, if not stronger. The ministerial needs are (or are in the process of becoming) more consciously translated into signals and directions for the research institutes that receive basic funding from the Ministry:

> *One thing that we need to put more effort into is strategies when we make the letters of appropriation to the institutions. We are very conscious about the basic competence they should have to do their job. We have started to steer, or at least be conscious about this, with respect to the basic appropriation so that we don't simply appropriate the money, but also make statements about what type of competence that should be focused, what are their strong points and what should be left for others to do. In particular the latter - there are after all other research institutions and often everybody wants to do everything and the result is not always the best. That is to single out areas that research needs to focus more on, and secondly to make sure that there is the basic expertise available that we can use. (MA8)*

Based on the interviews alone, we should be hesitant about making any firm generalisation about Ministries' steering of research institute becoming stronger. However, it is interesting to note that a recent study seems to confirm this trend in the relationship between Ministries and research. According to Brofoss and Wiig (2000: 110-111) the ministerial role as contractor for research projects has become more active during the 1990s.

The Ministry of Agriculture has well-established traditions for dealing with their "informational scientific partners", i.e. the research institutes directly under the auspices of the Ministry. Most of the interviewees show sensitivity with respect to the issue of balancing wishes of the Ministry in terms of research needs against scientific considerations. We have already indicated how that balance is struck in problem choice of scientists in this sector.

However, several of the interviewees comment on a central and general aspect concerning the research institutions' response to their need for research, i.e. the *institutional slowness*. According to these interviewees they are "willing, but slow". Apparently there are natural limits to institutional responsiveness. Some interviewees also have these comments as regards the Ministry's attempts to have some bearing on the research profile of research institutes in the annual budgets. In this connection they see "institutional slowness" as an ingrained characteristic of research:

> *What about the response to the signals that you give? (Interviewer)*
>
> *There is some slowness in the system, but with the talk of a less subsidised agriculture, the researchers are coming on to this change in policy. "How to reduce costs in production?" has after a while gained acceptance as a legitimate question to research. But that is something that cannot be turned around in a year or so, and to throw out all that one has done research on and try to do research on something new. But I notice now that it is no longer a question of doing research on yield per acre and so on. Even though that is after all much easier to measure (MA2).*
>
> *Is it the Ministry that has contributed to this change in focus? (Interviewer)*
>
> *Yes, we give the input in the form of signals that we want a different direction and strategy, and then they in turn respond with ideas for research projects and research questions, etc. (MA2)*

7.5 Patterns of contact, search for and need of research: conclusions

In the following the main findings of the analysis in this chapter are summarised. These findings will be discussed in light of our theoretical framework for the study of government information behaviour.

The science - government agency relations in the two sectors are characterised by a high degree of interaction. We have seen two types of networks that operate in the interface between government agencies and the research system: the decision specific network that is determined by the bureaucrat's decision-making tasks and the network that is based on the bureaucrat's career-experiences and educational background. Both types of links between bureaucracy and science are predominantly face-to-face and involve *interaction* rather than one-way communication. In addition there is a generally more diffuse type of

communication that revolves around substantial amount of documents, research reports articles and journals that reach the bureaucrat's desk, or his/her unit.

When we summarise this part of what we have labelled the bureaucratic information behaviour, i.e. search for, exposure to and perception of need for research, some overall striking structures come to the surface. First, the decision-making agenda of the bureaucrats structures both direction and content of contacts between science and the state agencies. Second, the search for research information varies according to type of tasks and characteristics of the policy field. Working in new areas of policy clearly is associated with a need for research than can assist in developing a policy language, and to establish a delineation of the emerging policy field. There is a search not only for relevant information, but good information *partners* in the research system. The conception of the need for research as well as the pattern of interaction is different here than in established, well-defined areas of policy. That does not imply that in the latter cases there is no need for research, but the "need stories" told by the interviewees are of a different kind. Even in the traditional core policy areas that are well defined with a long history within the agencies, there are issues that trigger the need and search for research information and thus generate contacts between government agencies and researchers/research organisations.

We have also noted pronounced effects of organisational arrangements. Agencies and research organisations are organised around a narrow range of policy or research problems. In the particular case of the Ministry of Agriculture several of the interviewees work under conditions where they have subordinate research organisations directly linked to their unit and where there is considerable overlap between specialisation in terms of research and in terms of policy problem. This is what we have referred to as "corresponding research units".

Nevertheless, such links are not only found in these specific units but in other parts of the agencies included in out study. For instance the relationship between bureaucrats in the fishery sector and the Institute of Marine Research is marked by common traditions and overlapping areas of competence. Much of the same is found between the Directorate for Nature Management and the Institute for Nature Research (NINA).The latter directorate has since its establishment fought to gain access to institutions in the traditional fishery science, whereas NINA has always been a close informational partner. This Directorate has had to use political means to gain relevant information: they buy their way into the production of knowledge and get involved in dialogue bordering on bargaining to acquire information. Their bargaining chips include R&D funds and the professional competency of the agency. There seem to be considerable "transaction costs"

involved in the search for information and use of information from research institutions that the agency does not have "organisational proximity" to, or lack traditions for dealing with. Our interviewees in the fishery sector rarely describe such transaction costs in information gathering.

We have argued that the contact patterns between research and Ministry/Directorate are heavily influenced by organisational structures. The parallel specialisations in the Ministry of Agriculture and the institutes for agricultural research clearly foster interaction that is maintained over time and in a reciprocal manner. Yet, the patterns of contacts and search for research information are not *determined* by them. If that was the case we would see that bureaucrats in departments with a "corresponding" research unit would have identical information behaviour. Despite our finding that the formal organisational lines fall, at least as concerns the Ministry of Agriculture, into two categories, the patterns of contact are far from dichotomous. In general patterns of contact are rather varied. The effect of the characteristics of the task and decision mode within the government agencies crosscut the effect of this particular type of organisation of research/Ministry relations. Table 7.6 gives a broad summary of the information behaviour according to type of policy task and type of research organisation. The table underlines that organisational arrangements together with the type of policy tasks are highly salient dimensions for the understanding of patterns of interaction between research and Ministry. This is not just a question of formal organisational structures but also of the history and traditions that these organisations share. These make communication a part of the patterns of interaction that are sustained over time, independently of the shifts in the people who work within these organisations. In addition, the mode of decision-making (technical/professional versus political) is significant in order to understand the nature and patterns of contacts between research and Ministry. The differences in perception of need for research follow broadly the mode of decision-making dimension that runs from the professional/technical mode to the political mode.

Table 7.6 Information behaviour in state agencies. According to organisational links to research and type of policy area

		"Corresponding research unit"	
		No	Yes
Policy area	New	Defining partners in research, programmes as a midwife – yet various ways of establishing contacts	Using the established contacts to institute to redirect information production
	Established	Two versions: A. Legally oriented tasks: Little contact and little perceived need for research B. Tasks involving planning, information, revisions of regulation: several acquaintances no tight connections.	Two versions: A. Relatively close relationships, but politically dominated agenda B. Close interaction and professionally dominated agenda (the exchange between experts).

The decision mode of information gathering is dominant in the public management of the fisheries and agriculture. That at least is the image as portrayed by the interviewees and confirmed by the results from our survey among agricultural and fishery scientists. It is certainly the case with the information gathering at an *individual* level. Faced with an information gap in dealing with immediate tasks, the perceived need for research information is described as a deliberate and issue-focused search on the part of the bureaucrat. But information behaviour also involves a diffuse set of exposures to scientific information, either through written material or more personal networks. The s*urveillance mode* for information gathering is typically connected to the bureaucrats' way of handling written information from various research groups, i.e. storing and saving information "for a rainy day". Research information is gathered and stored by the individual staff of the agency, and as part of agency's procedure. The information stored far exceeds the capacity of the agency for information processing and the informational needs that are identified in connection the bureaucrats' tasks. The duality in the mode of information gathering is more pronounced when we look at the departmental and ministerial level. The Ministry's involvement in defining research tasks and managing the affiliated research institutes echo the duality of the sector principle as a principle for organising the ministerial research policy. The differences in mode of information gathering bring us right to the heart of the question of the many uses of scientific information in state agencies.

8 The uses of scientific information in governmental agencies in the Norwegian agricultural and fishery sector

8.1 Introduction

In this chapter we analyse the many ways in which scientific information is used in the governmental agencies in question. We identify multiple meanings attached to the utilisation of information from science in the context of bureaucratic decision-making. The presentation is mainly organised around the concepts of research utilisation discussed in chapter six. Yet, when confronted with the realities of bureaucratic life these predefined categories and what were identified as their defining characteristics, had to be nuanced and modified. A core purpose of this chapter is to bring to the surface such nuances and adjustments. The uses of scientific information cannot be seen in isolation from the more general information behaviour of bureaucrats in their relationship with science. Consequently, we draw on the analysis of search and exposure patterns presented in the previous chapters, but highlight the data that directly pertain to the different kinds of use of research. Having examined these aspects of the ways in which sciences are used, this chapter will summarise and bring to a conclusion its central theme namely, what use does science serve in the public management of the two related sectors of agriculture and fisheries?

8.2 Science as a tool

The instrumentality that was present in the ways in which bureaucrats search for information is paralleled with respect to the impact that research information has on decision-making in the Ministries. The instrumental use, where it is possible to identify a direct link between decision and scientific information, ranges from use in "small" decision-making tasks, i.e. formulating the regulations for the size of sea-cages[24] in fish farms along the coast, to more fundamental issues as the

[24] i.e. the fenced off parts of open waters used for fish farming.

decision to allow commercial whaling for mink whales[25]. Other instances demonstrate how science is used to cope with unexpected decision-making problems on an ad-hoc basis, such as when fungus attacks on a fish species are discovered and the Institute of Marine Research is used to evaluate the consequences for mortality of the species, and the need for adjustment in quota-size.

The core version of instrumental use is found in the Resource Management Section in the Ministry of Fisheries. Every year, information from the relevant section of the Institute of Marine Research and from the International Council for the Exploration of the Sea (ICES) is presented to this section. This information contains an estimate of the population size of every species of fish and marine mammals, and different alternatives for the level of harvest of each stock. This is information produced and presented for resource management purposes and thus particularly adapted to the receiving end in the Ministry. Furthermore, this arrangement has a very long tradition. ICES was established already in 1902, and in its advisory role is exemplifies a highly institutionalised form of instrumental use of research. Using scientific information can in itself be a routine activity or part of a set of routine activities. An example of this is the Ministry of Agriculture's standard use of agricultural economic models as a basis for the negotiations preceding the discussions on the annual Agricultural Agreement. This would not be considered the use of new insights from research, but it is certainly use of information from a scientific research institute. Here the results of economic studies have practically been black-boxed. The economic models have become part of a standard package for how to prepare for the negotiations, somewhat comparable to how we act when we use a computer or a car, the scientific results that have gone into the machine are not questioned, and we employ the "black-box" while we hardly are being conscious that we use science (Latour 1987). The examples above refer to cases of research-based information coupled to bureaucratic decision-making on a routine basis and in a standardised manner. The same goes on every year. Research does not represent the delivery of unexpected information and it is not used to solve radically new problems. Rather it represents a case of fairly standardised science-based information used to solve recurring "problems", namely the size of quota for each fish species.

However, we must add that no matter how tight the link between science-based information and the content of the agencies' decision, the interviewees are quick to add that science may "think for them", but scientists do not replace them as

[25] At the time of the interviews in the Ministry of Fisheries this was a hotly debated issue.

decision-makers. There is no automatic effect running from scientific results to bureaucratic decisions. One interviewee puts it this way:

> *In making the decision between the different alternatives coming from research, we, as bureaucrats, stand on another basis than the purely biological one. Science does not solve our problem, but scientists narrow down the options considerably, and establish the framework within which we reach our decision.(DF1)*

Why is not research the ultimate decision-maker, particularly in questions of quotas and the management of marine resources? Interviewees have a clear conception of the differences in the role of scientists and the role of civil servants in the public management of the fisheries. Political-administrative decision-making involves something else than taking the dictate from science. The role of bureaucrats is to incorporate signals from the political level in the bureaucracy and to incorporate the proper balance between recommendations from research and other interests attached to fishery policy decisions. The latter is their role, their raison d'être.

This distinction between the political/bureaucratic and the scientific realm is, however, by no means clear-cut. Interviewees recognise their role in balancing different interests, including the recommendations from research. Nonetheless, they sometimes blame the scientists for sticking too much to their "role" as non-committed scientists. This pertains particularly to areas that have not yet been "routinely" handled by governmental agencies and research establishments in the sector. The area of multi-species management is, for example, a relatively new arena for science and bureaucrats. Traditionally, the management of fish is conducted on a single-species basis. Single-species management takes no account of the mutual influence *between* species. For instance, in the Barents Sea it is known that the species may interact strongly, as with the relationship between capelin and cod (Hoel 2000). But the research that multi-species management entails is different from the traditional research methodology involved in estimates of fish on a single-species basis. A multi-species approach is, for instance, based on an analysis of the stomach content of fish. Here there are few traditions concerning the contributions of researchers and the way in which bureaucrats deal with this type of fishery management, although both parties recognise the need for this type of knowledge and public management practise. There was at the time of our study a general expectation that this approach eventually would become the new fishery management regime, replacing the traditional single species management approach. A rather substantial amount of funding was put into researching this issue, also by the Fishery Research Council. Both in the Ministry and the Directorate the dissatisfaction with what research had contributed and the scientists' reluctance to be more "specific" and relevant to decision-making was clearly articulated. Some of the bureaucrats claimed that the research area suffered from scientists

"overselling" the potential applicability of their research in order to secure funding for their project, and that had added to the feeling that the expectations had not been met.

This illustrates one aspect of instrumental use of science in government agencies, at least in this sector. The unproblematic traditional use of research results and scientific information in the area of resource management is made possible largely because there are *long traditions* within government agencies involved and within the corresponding fields of research. The mutual expectations are relatively clear cut. In addition the primary research institutions in this field have a particular history and tradition in relation to both the Ministry and the Directorate. The Institute of Marine Research, for example, was formerly a part of the Directorate (now owned by the Ministry) and this makes the science/civil service interaction relatively easy. At least this is a claim from some of our interviewees.

> *In as far as we are in the **biological** tradition, the dissemination is much easier. The biologists are much more aware of what the relevant questions are. Those who are within the traditions of the Institute of Marine Research, they are themselves some sort of bureaucrats, or at least a cross between scientists and bureaucrats.(DF1)*

When researchers work with research questions that represent a new "paradigm" in fishery management, the dissemination towards the government agencies is much harder to master. First, researchers are unwilling to make clear recommendations on the basis of premature knowledge. Bureaucrats in the Ministry of Fisheries claim that researchers have not understood that the use of some elements of multi-species management is in itself an improvement to the single species practice, no matter the scientific reservations. So the bureaucrats are left without the necessary translation of scientific insights into the framework of management processes. Second, bureaucrats have to interact with a group of researchers they until now have had less experience with, as much of the relevant new research is performed within bio-economics as opposed to traditional biological sciences.

Science is also a tool for public management of aquaculture and the management of the ecology of near-coastal waters, rivers and lakes (i.e. the responsibility of the Directorate for Nature Management). Faced with a semi structured opening question on how bureaucrats use scientific information, the typical bureaucrat response was to describe relatively clear-cut cases of instrumental use. In the management of aquaculture the link between science and the content of political-administrative decision-making is not so tight and biologically oriented as we found in marine resource management. Yet in the management of aquaculture instrumental use is particularly prevalent in formulating laws and regulations for

the aquaculture industry on a case to case basis. Here there is more variation in the sources of information that are used, varying from biology, technology, to economics and social science. In aquaculture management some of the interviewees point to the fact that they are involved in policies directed at people and organisations, so their information needs are more oriented towards the interface between nature and human action.

With respect to the agricultural sector, we find the most explicit and direct descriptions of instrumental use of research in the professional units of the Ministry of Agriculture. The strong interaction between research and Ministry involves, or has at least as a consequence, research being used instrumentally. That is clearly a conclusion to be drawn from the interviewees in the included departmental units. All of the interviewees in these units report on research used to that effect. Research is being described as having direct consequences for what the department is deciding or doing. Research results and references to research reports are put into memos and proposals, for instance, when there is a need to document the need for exceptions to EU regulations. Research is also used in assessments of the effectiveness of the department's policy measures. "To us it is in the long-term perspective very much the case that research is an important foundation upon which our administrative work is based" (MA6). But as with the bureaucrats in the fishery sector, the interviewees clearly convey their awareness of the conditions under which departmental work is done. Even though there are direct links between research and the content of decision making, it is not always the case that politics and professional considerations come or go together. It is not always that what the interviewees perceive as the best professional result carries the strongest clout. One of the interviewees puts a humorous twist to it saying: '… but when our good proposals aren't accepted, we say 'it's just politics!'" (MA6).

The transformation of agriculture policy and the attached policy instruments is described as increasing the use of research according to this line of reasoning:

> *And then it is important to formulate those conditions so that they hit their target and get assistance to measure what is happening to react appropriately and also if necessary to change the measures. Knowledge about how farmers' behaviour is affected by the regulations, political signals in a broad sense - that is essential. Does it result in behaviour that is in accordance with what we want?*
>
> *So this regards both the evaluation and development of measures? (Interviewer)*
>
> *Yes. This is something that we are now in the middle of. I don't see it as something that we do in one big effort and then we are finished with it; it is a continuous need. It will be a need to adjust policy continuously. (MA7)*

What is described here is using research to find out the effects of policy measurements and specific policy instruments, and how objects of policy respond to government initiatives. This is part of how government agencies learn about effects of policy instruments and en element in the "surveillance" of their policy area.

In the Ministry of Agriculture, however, we also find units where instrumental use of research is portrayed as marginal or only taking place in rare occasions. In these units the role of research as "instrument", is downplayed. For example one head of section starts the interview by generally acknowledging the diffuse, but important role of basic research. However when it comes to assessing the actual need and instrumental use of research in her/his unit the interviewee does not leave a grand role for research. What is put forward is a distinct "paradigm" in terms of research use. On the one hand the long-term "unnoticed" useful basic research is deemed as important. On the other hand the short-term decision oriented research, is seen as having little applicability value because it arrives "too late". i.e. there is a temporal mismatch. Such research rarely matches the swiftly changing decision-making agenda and attention span of political-administrative decision making. By the time research can present the answers, the decision-makers are busy posing other questions. Still in some areas the latter type of research is used, but then primarily in order for policy-makers to judge the effectiveness of different government programmes and initiatives.

> *Apart from that what we use so-called "utredninger"[26] a lot. That is what we use the most, really. You can't call it research, but that satisfies our need to a larger extent [than research], because then we get the answers when we need them. These "utredninger" have a time frame of one day to one year.*
>
> *The flexibility we have in being in the position of using [name of corresponding research unit] in that way is what definitely is most useful to us. In that way we use them all the time. They get their answers from research. Research is what they build their professional expertise on, and what makes them capable of doing that type of "utredninger". In that sense there is an indirect connection. (MA3).*

So the conclusion is that the institutional arrangement that exists between this unit and its research counterpart is what allows this flexible usefulness of information.

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26 This Norwegian term does not have an adequate English translation, it refers to commissioned reports that are not deemed as research. Commissions are often given to research institutions to produce this kind of document to feed the policy process on specific issues.

The non-research reports from this particular research institution have a direct and instrumental influence on departmental decision-making – but…

> *…of course politics is politics. It isn't necessarily so that [decisions are made] purely rationally on the basis of wholly professional considerations. There is a far broader basis for the decisions made. But it [the information] is a direct basis for the decision-making process. And "utredningen" is after all in general directed specifically at the issue we are making a decision about. That is to a lesser extent the case with research. It does not give us the direct answer - research is not made with that focus. (MA3)*

Other policy units draw similar conclusions with respect to instrumentality of research. The main association in terms of their own unit's instrumental use is drawn to the use of "*utredninger*". In one section direct instrumental use is said to feature even less than in the case above. In this unit the head of department refutes the instrumental use of research in the sense that research has directly consequences for decisions and initiatives from this unit. This interviewee also accords this to the fact that research operates with a different time frame. By the time the results and analysis are out - they are irrelevant. Good, solid and use-oriented research can be completely irrelevant because the world of practice has changed so much while the research has been going on. The time lag from the original research question to the finished analysis is thus seen as a major impediment to use of research, and research will per definition arrive too late. Therefore it cannot be used. Such descriptions fit the "gap-explanations" in the study of use of research, as pointed to in chapter six.

Another interviewee from the same unit, however, shows a less sceptical attitude towards the instrumentality of research, while also pointing to the pivotal role of evaluations when instrumental use is described. She/he also works under the overarching condition that political directives determine the actions of bureaucrats, i.e. a political decision-making mode. The instrumental use is primarily linked evaluations that directly run into the work of adjusting the guidelines and regulations of governmental development initiatives. The use of evaluation is practically automatic. But she/he is not sure whether this is to be called use of research, but the interviewee acknowledges that there are vague boundaries between research and evaluations. At the same time this interviewee interacts frequently with research. Consequently, lack of instrumental use in this case cannot be explained by lack of general interaction with, access to or even knowledge of research in this policy area.

One of the sections in the Ministry of Agriculture that has changed its relationship with research as an informational partner because of incorporation of a new area of policy sees a strong need for research in its new area of policy. So far there are

no concrete examples of applied use. The reference to instrumental use is rather an announcement of intent:

> *"…but the idea is,… it is a goal for us to use research results from this [programme] and from similar sources to shape and to "put our mark on the set of instruments under the agricultural agreement, that is to define under which conditions we should channel our subsidies to farmers" (MA7).*

Based on how our interviewees describe their own use of research, there are several aspects of bureaucratic decision-making where science-based information is gathered prior to decision making, and there is a link between the content of science-based information and the content of decisions being made. In other words what was labelled instrumental use in chapter six. However, instrumental use in every-day bureaucratic life has different shades and is not always a very prominent feature of how bureaucrats relate to scientific information. Furthermore, instrumental use is far from the only role that science based information takes on in the bureaucratic practice.

8.3 Professional justification - strategic use of science?

When talking about their use of science, our interviewees frequently recur to phrases such as "professional justification for bureaucratic action" or "we need professional justification for what we do". One could interpret such a statement as a way of describing their actions as *professional bureaucrats,* i.e. they act on the basis of professional knowledge within the agency. But judging from their statements, the use of research and the reference to science is a major part of what constitutes "professional justification". Reference to science seems to vindicate their actions and decisions in face of other actors and institutions they are involved with.

Professional justification is first of all a normative requirement in many of the units and policy areas described by the interviewees. In many cases there is no reference to specific actors that overtly require them to provide such professional justification. Professional justification is a decision-making norm. In this respect a *logic of appropriateness* (see chapter two and six) is at work for bureaucrats in the public management of the primary sector. The need for a professional grounding that research references can provide, is not necessarily addressed to specific targets. Rather, it is employed in proposals and written document as a way to strengthen bureaucratic work by giving it an air of solidity However, it is not a logic that relates to all of their actions and to all of the decision-making processes that they

are involved in. The need for professional justification is also operating on the basis of logic of consequentiality. One refers to science as professional justification of a bureaucratic decision because one assumes that the decision will carry more weight. Justification from research often has a specific "addressee". An interviewee in the Ministry of Agriculture puts it this way:

> *It is clearly connected to developing public measures. To have a professional basis, that is important when faced with other public authorities, such as the Ministry of Environment and its agencies. The Ministry of Agriculture must balance economy and ecology, and the individual farmer has to do the same. So in face of the primary producers, we must be able tell them to in a credible way why we make demands, and then professional documentation is a strength, of course. At the same time it must not be too sophisticated. (MA7)*

Another says:

> *Yes, we use research to strengthen our argument in relation towards politicians, either to give them arguments or to give us arguments, and we also use it in relation with other Ministries - if we think they are heading off in the wrong direction. And it happens of course that they come in the same way to us, and then we have to adjust the course of action. …..*
>
> *Research both comes before and after decisions are made. If there is competence and knowledge that can be summed up quickly then it is there before decisions are made. But if one feels that the professional basis for the rules and regulations is somewhat weak then projects might be initiated,..... but if we should always wait for research we would never get anything done. Any research breeds new questions - a research report that does not conclude with the need for further research would not be a good research report! Then they would make themselves superfluous (MA6)*

As pointed out in chapter six, using research instrumentally can be an element in the strategic use of science. An example of such a "double" use is found "locally" between the Directorate of Fisheries *vis-à-vis* their Ministry, as one interviewee in the Directorate asserts:

> *When we hand over suggestions and proposals to the Ministry, the first question they ask is: ' what is the professional foundation for this?', then we have to demonstrate this by referring to research institutions.(DF1)*

The call for this kind of professional justification is also found in the relation between agencies (both at directorate and ministerial level) and non-government organisations in the fishery sector, such as interest groups and the individual fisherman or aquaculturalist. An important feature of the Norwegian management regime for the fisheries is that fisheries' authorities and the fishing industry consult on the formulation of regulations. A Regulatory Council, with representatives from the fisheries authorities and the fishing industry debate the distribution of fish quotas among various groups in the industry and give advice to the Ministry of

Fisheries. This is a forum where the triangle of science, clients and the state come together. This is a highly politicised environment for use of scientific information. Often the justification from science goes athwart the interest of fishermen, the fishing industry and their associations. Our interviewees claim, nevertheless, that interests groups do recognise the need for a management based on science, and research stands out as neutral information that is accepted by most parties.

We find the most apparent strategic instances of utilisation of science when interviewees portray situations of conflict between government agencies from *different* sectors. Our interviewees talk of this particularly in connection with disputes between environmental agencies versus agencies within both the public fishery management and the public administration of agriculture. In the fishery bureaucracy interviewees describe conflict situation between own agency and other agencies. In such events it is not unheard of that the agency will refer to the kind of information that is most useful for its purpose. But so will the other adversaries, as pointed out by the interviewees. In that sense all relevant scientific information will be presented, in situations of conflicting research results as well as conflicts of interests between different agencies.

The need for professional justification, also in the strategic sense of the term, is evident in examples provided by the interviewees in the Ministry of Agriculture. Here not only other agencies are mentioned but also the clients in the sector. One interviewee says:

> *,for example, in the discussion with the Ministry of Environment and its agencies, it is important - extremely important - to have a firm professional foundation, That is one thing. Another thing is in formulating regulations and direct users. For instance, prescription of how much land is required per animal unit to be allowed to do animal production. Then it is no good to be superficial in your arguments, it may be a question of financial ruin or not for single individuals. So such restrictions must have a firm professional foundation. […] Without that firm foundation there would be no basis for us to act upon. (MA8).*

There is considerable variation in the way the interviewees see the strategic component of the research use. Especially in the Directorate of Fisheries the interviewees are reluctant to portray their use of science as "purely" strategic, they clearly see how reference to research is indispensable as legitimisation of their actions, but dislike the invidious connotation of the term:

> *You must have a scientific basis for making decisions about cod and capelin, but we do not simply wave science around as a legitimating flag (DF1)*

Our interviewees in the Directorate for Nature Management, on the other hand, are much more succinct when describing the role of science as political ammunition, especially when they refer to situations where they confront fishery agencies. But using science strategically is not an easy way out. The effective use scientific information "as ammunition" in adversary debates and conflicts involves considerable investments in being updated on what goes on in science and being able to understand rather complicated and specialised scientific knowledge, i.e. a high level of science literacy. Not only is the quality of research important, but also the qualities of the users. The strategic value of research is dependent on a decision-makers ability to distinguish good from bad research in order for research to be useful in political-administrative conflicts. This is corroborated by findings of other studies of science utilisation (Weiss 1993: 64).

Also in parts of the Ministry of Agriculture dominated by a political mode of decision-making the strategic use of research is not seen as something illegitimate, rather it is assumed that when possible everybody will use research to legitimise their actions. But as indicated by these interviewees there are limits to strategic use. The interviewees point the characteristics of research (lack of clear "answers"), and the nature of decision-making in the political administrative apparatus. The interviewee emphasises that the ministerial positions are political rather than purely professional. That sets limitations to the effectiveness of strategic use of scientific information; political issues are resolved with reference to political considerations and not merely professional ones. From such a perspective, one interviewee claims, research can never really be used as an arbiter of controversial political issues. Finally, one limitation to strategic use of research is linked to the status of science among decision-makers and stakeholders. The interviewees in this study have high confidence in science. In general they see science as having the kind of authority that allows it to be used as professional justification and as political ammunition. Only one in the entire set of interviewees presented the argument that the strategic use of research would be impossible because research relevant to his/her particular field of policy did not have that kind of authority that would be required for having a legitimising effect.

8.4 Science as oversight and conceptualiser

Almost half of the scientists included in our study report that government agencies had contacted them in order to be updated on ongoing research in general (cf. Tables 7.2 and 7.3). Over fifty percent said that they had contacted government agencies to keep them informed about research in their own field. This might indicate that science in the area of the public management of the agriculture and

fishery sector, functions as a way of monitoring what goes on in the bureaucratic task environment. Few of our interviewees, however, described this phenomenon as their way of using science. Only in the Directorate for Nature Management did the interviewees point to the fact that they utilised their contact with the research system as oversight. The information they got from science did not always result in substantive effects on the agency's decision-making, but it was considered important in as far as it made them alert to changes in their environment.

There is, however, one aspect of the way the other agencies relate to science that may illustrate one important aspect of use of science that can be related to science as oversight. A common description interviewees give of their use of science can be paraphrased in the following manner. Bureaucrats are assigned to work on a particular issue, and often they turn directly, or through intermediaries, to scientists to find relevant research information that can be incorporated into their agency's decisions, plans and so forth. Government agencies are rarely directly involved *ex ante* in directing the attention of the research system in one particular direction perceived to be relevant to future decision making. Bureaucrats are left to use the information that is already there in the research system; their information behaviour is thus fairly short term. In that respect science functions as a "pool of knowledge" at the disposal of the bureaucrat when the need arises. The interviewees themselves do not perceive this as a way they use science. That type of utilisation is something one can infer from investigating the totality of information behaviour in the interface between Ministries and science. We have identified parts of this information behaviour as information gathering in the "surveillance mode", especially at the level of ministry or departments. Consequently, we can argue that the characteristics of the information gathering are descriptions of using science as oversight.

This mode of information gathering is in some ways connected to conceptual use of scientific information. The latter form of utilisation is not something that is often described by the interviewees. However, when they talk about the flow of information stemming from science that is not gathered in the context of a specific decision, bureaucrats acknowledge that research information is also used in more diffused ways. It is important because it can change the way bureaucrats think about their own bureaucratic practice or policy area. We have already seen aspects of this phenomenon in chapter seven, in how bureaucrats in new policy areas look for informational partners in the research system in an attempt to define what that area is all about. Some interviewees also refer to similar use of research in more traditional areas and in connection with a more diffuse exposure to scientific information:

There is another thing when it comes to use of research. It is not always the case that we can pinpoint a specific research report that had an impact on what we do. I think it is also a question of things coming from the forefront of research especially, that just sort of gradually sinks in, slowly but steadily, with no big "I've seen the light" kind of experience - Things that were unthinkable in fishery management and among the practitioners just ten years ago […..], we have come to accept. (DF1)

8.5 Science and agenda setting

Does science contribute to setting the agenda of the government agencies included in our study? Our interviewees only rarely talk of such a use of science. When asked specifically about it, the most common answer is: "It may be, but I cannot think of any specific examples". One could conclude that other parties than the research system set the agenda of the government agencies. At Directorate level the routine tasks and signals from the Ministry decide in general what issues and tasks these bureaucrats work with, whereas the interviewees in the Ministry of Fisheries "Jump when the political leadership of the Ministry tells them to". This corresponds well with data concerning who takes the initiative to new programmes and policies in the Ministries (Olsen 1983:110).

Interviews in the Ministry of Agriculture convey the same message. The interviewees provide few examples of research putting new issues on the agenda. When asked whether research had been involved in changing the paradigm of agricultural policy, and making other concerns enter the parameters for subsidising and supporting agriculture, a head of section says:

Here I think research has been less of a deliverer of premises. That is more the political arena and the administration, I think, they are the ones pushing for this change. In our field, it has been a quite necessary change of agricultural policy according to many, and it has coincided with a period where environmental issues has been in the forefront, e.g. the Rio-conference, and the follow up of that has been important in our field as well. From my point of view, from where I stand, research has ***not*** *been the one to provide the central premises (MA7)*

When research has a clear agenda setting function, interviewees in the Ministry of Agriculture, for instance, indicate that effect runs indirectly through media. Issues hit the bureaucratic/political agenda when research has triggered a public debate on a specific issue.

The smaller issues and smaller agendas might, however, be overlooked both by interviewees and by those who study the use of research for that matter. Especially

in units where there is a continuous flow of information and interaction between research and bureaucrats it is hard to trace the origin of ideas.

> *[…], but it is a bit difficult to describe it in that way, because the contact [with research] happens too often. A small input might come and then it is "chewed on" a bit here and there and in the end it is hard to tell where it came from. (MA8)*

One might even assume that research may sometimes have the opposite effect on political-administrative agendas. One of the interviews in the Ministry of Agriculture undertaken in connection with another study on Norwegian Ministries' relationship with the research system (cf. Larsen *et al.* 1991), indicates that the established relationships between science and bureaucracies may contribute to the stability or even conservation of the bureaucratic decision-making agenda. Science can contribute to keeping issues of the bureaucratic agenda, rather than "creating new problems". According to this interviewee, decision-makers in Norwegian forest policy were late to add an environmental dimension. One contributing factor was that forest research establishments that the Ministry interacted with did not enter core environmental parameters, such as biodiversity, in their research until the mid 1980s. It was not part of their research tradition. They were educated and trained as researchers, had their scientific interests and expertise in doing research where increased and effective production of timber was the baseline. As long as traditional forest research was a major source of information in the Ministry's forest policy, the change of perspective was presumably delayed. However, none of the bureaucrats interviewed for this specific project gave evidence to corroborate such an "inverted" agenda setting function of research.

8.6 Note on the methodology of identifying use

The method used in this study bureaucratic information behaviour relies mainly on an analysis of in-depth interviews with bureaucrats. In presenting the theoretical framework for this part of the study, the defining characteristics of different types of use of scientific information were introduced. The empirical analysis rests on the interviews providing information that can be interpreted within this analytical framework. Apart from "self-anchored conceptualisation" (cf. section 6.3), interviewees answered questions that were particularly designed to probe the different categories of use. However, the farther away from the conventional perceptions of use the more difficult it became to tap use-categories. Furthermore general descriptions given by the interviewees did not provide information fitting all of the categories of use we identified in chapter six. In the interviewees' descriptions of instrumental and strategic use and agenda setting there was considerable overlap between the language of theoretical concepts and the language in which utilisation in practice was described. Interviewees also provided

accounts of instances of use that could be interpreted in terms of conceptual and descriptions of how scientific information is used as bureaucratic oversight, even though these categories of use were less part of the common perceptions of the role of science. However, with respect to the symbolic use, we found very little data in the interview material that could be useful to an analysis of the symbolic functions of science.

8.7 Use of scientific information - conclusions

There are several meanings and actions that fall under the umbrella of utilisation of scientific information. We end this chapter by drawing some overall conclusions about how such variations can be interpreted in light of our theoretical framework. These conclusions also incorporate and summarise the relevant findings with respect to communication patterns, and search for scientific information that were highlighted in chapter seven.

Through the interviews with bureaucrats in Norwegian public management of agriculture and fisheries we have encountered government agencies that have an instrumental approach to the use of scientific information. We have seen how scientific information is used on a "short-term" basis where such information is incorporated in bureaucratic decision-making, for instance, to adjust policy measures and formulate regulations. Instrumental use also features in more fundamental changes in management regimes, such as in the management of the capture fisheries.

In light of the findings the meaning of instrumental use, however, needs to be modified. Instrumental use does not simply mean that scientists replace the bureaucrat as decision-maker. There is a pronounced perception that a role is reserved for the bureaucrat in decision-making that is different from the scientist's role. A research report will not be used unedited in bureaucratic decision-making processes. Scientific information blends with other types of information and with considerations other than the scientific-professional one. Bureaucratic decision-makers have to incorporate what they see as the proper balance between the recommendations or input from research and other considerations, most notably political considerations. Yet the distinction between the political/bureaucratic and the scientific realms is by no means clear cut. Rather it is open for definitions and bureaucrats are not always unequivocal in what they expect from the research establishments.

Public management in the two sectors provides various examples of the significance of *routines* for using scientific information. The use of science

information in the management of capture fisheries exemplifies, for example, how utilisation is in part surrounded by institutions, such as the ICES. The research results may not be the same every year and the decision taken by the agency may vary from year to year; but the nature of the links between the researchers and the bureaucrats, and the procedure for interaction are expected to remain the same. These expectations are passed on to bureaucrats entering the agencies and established as formal routines. Also outside formalised and repetitive use of research, instrumental use is facilitated by the *traditions* of use. Bureaucrats are familiar with a specific kind of research area and scientists are familiar with public management practices. There is a high degree of common expectations in science and government agencies on how research information is to be incorporated in bureaucratic practice.

In the bureaucratic practice of the two sectors *strategic use* is phrased not primarily in terms of being ammunition in a political bargaining process. Rather, the interviewees refer to the need for professional justification. Professional justification takes on at least two meanings. First, it represents a reference to an overarching norm of decision-making in especially the professionally oriented units in the Ministries and Directorates – a norm that prescribes reference to science. The second meaning is the need to strengthen the units' positions in the interaction with potentially adversary actors, or at least actors that expect to see decisions having a scientific-professional foundation. Such actors have been identified as other public agencies, international bodies, other units within the sector, and not in the last place, the primary producers in these sectors, farmers and fishermen. There is overall high confidence in science being able to provide the kind of authority that is needed. Otherwise the reference to professional justification cannot be used effectively.

The uncertainty of what is going to be relevant for decision-making in the future is an incentive for bureaucracies asking for more information than they need. That is also typically embodied in the duality of the sector principle in science policy: funding research for "own consumption" versus funding for the general knowledge in the sector. The shifting decision-making agendas in policy-making make the relevance of research not an intrinsic quality of the information, since this is more influenced by shifts in decision-making attention. Consequently, it is indeed very hard to design systems through which scientific information is directly linked to specific decision-making problems. That is probably why we can see the contours of information behaviour where the long-term and systemic information gathering processes and use of information are conducted in the "surveillance mode", while the short-term specific information search and use fit the "decision mode".

A dual message seems to come from some of the interviewees on research as instrument and basis for professional justification. On the one hand what they presented was a nuanced description of the role of research in their bureaucratic lives. At the same time their reflections also give some insight into their personal understanding of and attitude towards science. Some of the descriptions of use of research may have been flavoured by this underlying attitude towards science and research. If so, it might have reduced the validity of their stories as evidence of their actual behaviour when it comes to interaction with research. However, our conclusion is rather that it is their experience as civil servants in the interface with research institutions and researchers that has influenced their attitudes. If that is the case then their attitudes displayed in the interviews can be seen as useful information about their bureaucratic practice and histories. What is more striking than homogeneity is the diversity in the experiences with and attitudes towards research. Likewise our analysis of the interviews in this sector has hinted at a mix of logics operating in the area of research utilisation – similar to what has been labelled the ambiguity of appropriateness: "Although analytically separable, it is often hard to separate arguments of appropriateness from arguments of consequentiality in concrete decision-making processes" (Christensen and Røvik 1999: 177). The empirical data are in this study of utilisation drawn from bureaucrats in state agencies that are at the high end of the use-scale, even at the extreme end, as implied by one interviewee. We have in these agencies seen indications of a *norm* of instrumental use, that overarches their relationship with research. Consequently, it can be hard to untangle different logics of utilisation. The hegemony of the "decisionist" type of use and rationality as a decision-making ideal, could even lead us towards interpreting our findings as an artefact of our methodology, i.e. interviewees overemphasise instrumentality both in terms of search behaviour and use in their eagerness to demonstrate their commitment to the "norm of consequentiality". Interviews have indeed provided information on values and identities that are activated when the issue of use of science is investigated. But their accounts of use of information are not homogeneous and stylised to match such a norm. These accounts represent a variety of everyday bureaucratic practices and different aspects of science utilisation.

What conclusions can we draw with respect to factors that affect the use of scientific information? Are we closer to an understanding of science utilisation in bureaucratic decision-making? As we have seen in chapter seven, the framework carries weight when it comes to analysing and explaining aspects of communication patterns, and the search for and perceptions of the need for scientific information in government agencies. The analysis of effects of variations in type of tasks and modes of decision-making, has added to our understanding of

the way in which science is used in bureaucratic practices. Parts of the theoretical framework for the analysis of information behaviour used in this study have been an adequate analytical tool.

Two of the aspects we have referred to in chapter six as *intra-organisational* factors are also especially relevant for understanding bureaucratic information in a wider sense, including the use of scientific information. The types of tasks and mode of decision-making in state agencies are central factors for understanding how bureaucrats relate to and use research. Political loyalty versus professional autonomy as a dimension does not affect informational "openness" as much as it affects the way in which scientific information is used. For example, there is little evidence that would lead us to conclude that the Ministry of Fisheries is significantly less open to scientific information than its subordinate Directorate, as suggested earlier. However, the relationship between the Directorate and the dominant institution within fishery science, the Institute of Marine Research, is somewhat different. The organisational history and physical proximity make the relationship more tightly knit. This does not, however, imply that science information is more often coupled to the Directorate's decision-making. Furthermore, decision-making in the Ministry goes on under more politicised conditions, and that seems to affect not so much the openness to science, but rather the strategic use of it. Also the type of tasks in government seriously affects the way in which needs are perceived and information is used within the agencies we have studied.

The other intra-organisational factors mentioned in chapter six play a far less important role. We have not found any clear patterns of how bureaucratic hierarchy affects the search for, exposure to, and use of science. Contacts with scientists, the search for scientific information, and the use of science, are not activities that are reserved for leaders in the Ministries, nor do heads of sections function as disseminators or intermediaries. At least this is the case in the day-to-day interaction with science. With respect to science *policy* issues the higher levels of the bureaucratic echelons are more active. Also the effects of "internal science policy" are not particularly apparent.

With respect to the *inter-organisational* factors identified in chapter six, we see that research organisations formally organised to be informational partners to government agencies are in fact the pivot in science – government agency interaction. The nature of these organisational arrangements is especially important for understanding the general patterns of information gathering and communication between research and bureaucracies. Furthermore, these are arrangements that facilitate what we have identified as short-term instrumental use

of scientific information. But such organisational arrangements are not a necessary condition for using research instrumentally. Interviews with civil servants clearly reflect a duality in the Ministries' relationship towards their research institutions. On the one hand they treat these, especially the government institutes, as part of the administrative hierarchy. At the same time they acknowledge their role as stable institutions protecting values and ideas that reach beyond the immediate needs of the political administrative apparatus or demands from other interests and consumers. This reflects not only a *norm* in the state-research relationship; clearly the civil servants see it in their organisation's *interest* to avoid tying research too closely to the Ministry's immediate needs. It is in the administrative agencies' long-term interest to have independent research performed and to have a pool of knowledge one can revert to in an unpredictable future. Ministries acknowledge the need to curtail their short-term interests for promoting their interests in the long run, much like a ministerial version of the story of Ulysses and the Sirens (Elster 1979). These organisational arrangements are also conductive for establishing a "use-friendly" *mode of research communication* characterised by direct communication between scientists and practitioners, with mutual influence between the two and an interaction that is maintained over time.

We have found few strong indications to support the assumption that use of scientific information can be explained by reference to *characteristics of individual* decision-makers. There are no clear patterns that emerge to suggest that sharing the educational background with someone makes it considerably easier to use scientific information provided by that person. Thus, the expectation outlined in chapter six, about the easy flow of information when there is an educational correlation between bureaucracy and science, cannot be traced back to any great extent to our interview data. Also there are some indications that the opposite effect might be at work. The closer the bureaucrat has been to knowledge production in one particular field (either through personal experience or as a researcher in the same field), the more problematic the use of such research might get. The bureaucrat seems to be more sceptical, critical and more demanding *vis-à-vis* former colleagues or former fellow students than otherwise. They use the research information with more caution and demand more applicable research from these researchers, than from researchers with whom they do not share educational training.

However, we might have underestimated the effect of educational background in this analysis simply because there are few (if any) that can be said to have limited insight into the respective policy areas. In general, there is a rather high scientific literacy among those we interviewed, and as such we have no data on how research utilisation proceeds when science literacy is at the other end of the scale. Based on

our data, it is not simply a question of sharing educational backgrounds. It is also of relevance that a tradition for interaction between bureaucrats and scientists is shared. Common educational backgrounds and/or a common history of interaction are conductive for bureaucrats and scientists to become familiarised with and mutually recognise cognitive structures of relevance both to scientific and bureaucratic practices. For the individual bureaucrat, sharing educational background with the part of the research institution with which one interacts is conductive to maintaining personal networks. Also, we have heard accounts of how solid scientific literacy is extremely important in order to use science strategically.

We end this chapter by referring to one potentially important factor that was not included in our analysis of search for, exposure to, and use of scientific information in governmental agencies. As pointed to by one of the interviewees, even in this well-organised system for "planned use of research" the accidental element in information seeking and use is still present, albeit within the frame of organised use:

> *I have often pondered on how, while I am working with an issue or task, something accidentally comes up - something that one person might have mentioned during lunch and said "read that one", and then you do and that can contribute to changing your conception of the issue you are working with. I have experienced that I have accidentally come across information that has possibly made me change my opinion, and if I hadn't talked to this or that guy during lunch, I would have done something completely different. Every once in a while there are decisions made on incidental information (MA1)*

9 Reflections and Conclusions

9.1 Introduction

This study has addressed two main issues that refer to aspects of the relationship between producers and users of research. First we have focused on the stage of the research process where research problems are selected. We have investigated the role that potential users of research play in the selection of research problems and the extent to which potential applications of research results are defined as important in problem choice. Second, we have analysed the way in which scientific information is used by government agencies and we have examined the factors that affect the use of such information in bureaucratic decision-making, and in other activities of government agencies. The two main issues have been addressed with a core focus on the possible effects of the organisational context within which research processes and bureaucratic utilisation of research are conducted. Our empirical setting consists of the agricultural and fishery sectors in Norway. Norwegian fisheries and agriculture are sectors where nature, science and public management are intertwined. The two sectors have organisational arrangements that underline the strong ties between science and public administration. In the final chapter we take the opportunity to reflect upon the main findings of this study. We will also discuss the appropriateness of our theoretical framework and the possible biases stemming from the theoretical approach and research design used in this study.

9.2 Central findings

Problem choice in Norwegian agricultural and fishery science involves a range of different actors. There are, however, great variations in terms of how strongly these actors are directly involved in the actual choice process. The number one participant is the performing researcher himself/herself, followed by the research colleagues from the performing researcher's own unit or department. The actors most involved are thus predominantly from within the research community. Non-academic users and Ministries are in far less cases directly involved in problem choice. In addition to Ministries and other governmental agencies in the sector, the concept of "user" includes various sets of actors ranging from industry/private enterprise, organised interest groups, and governmental agencies in other sectors.

The process of problem choice is revealed as a complex process, not so much in terms of a complexity attached to the involvement of different actors in the process, as with respect to the many considerations that enter into the choice. There are several considerations that operate alongside each other, and these can be related to two basic dimensions. First there is an academic dimension clustering various criteria linked to the incentives and norms of academic careers and to the wish to contribute to the scientific discussion and theoretical development in the field. The second dimension refers to a range of user-oriented criteria. When research problems are selected substantial weight is put on solving specific problems in the fishery or agricultural sector respectively and on providing knowledge needed for public administration. Researchers working in the Norwegian agricultural and fishery sciences see their research in the first place as part of a problem solving effort for their sector. The single most important criterion of choice is: taking into consideration that research should contribute to solving problems in the sector. Our study has corroborated an expectation that the organisational context of research affects the orientation towards the potential applicability.

We have found three sets of factors that can contribute to explaining varying degrees of user-orientation in problem choice. When controlled for the influence of the other factors, first problem choice in government research institutes is more user-oriented, than problem choice that occurs in a university setting. Second having some funding from external sources, and third being connected to research programmes, also positively affects the degree of user-orientation in problem choice. There are no significant differences in degree of user-orientation that can be traced back to differences between fisheries and agriculture as research areas and sectors. However, a significant effect is stemming from the discipline as a variable, i.e. problem choice in core agricultural disciplines is more user-oriented than problem choice within other disciplines. Consequently, the empirical evidence suggests that the expectations that we outlined as part of our theoretical framework have met with support. Together with funding the organisational context of research is important for understanding user-orientation in problem choice. The implication of this finding, we could argue, is that science policy instruments, such as research organisation and funding, are potent factors affecting the research process. However, much of the variation in user-orientation is left unaccounted for by our theoretical framework.

Relatively few conflicts with respect to problem choice have come to the surface in this study. Contrary to our expectations the few observed conflicts with respect to problem choice both at project and organisational level, are not primarily interpreted as signs of disagreement between users, clients and research. They are

first of all perceived as resulting from conflicting interests between researchers from different disciplines, and between different research units within a research establishment. This indicates that there is a living scientific debate that concerns issues of problem choice, but that debate is primarily kept within the frame of the research community and the organisation/department in question. Furthermore there is little evidence to support the assumption that putting weight on academic criteria of choice is an impediment to considering the potential applicability of research results in the process of choosing research problems.

Our study of the use of scientific information in the public management of the two involved sectors generally points to the importance of how such information is translated for use in a decision-making context. Bureaucratic information behaviour is framed by an instrumental approach to the search for and use of scientific information, and the need for decisions to be professionally justified. The instrumentality that was very present in the ways in which bureaucrats search for information is paralleled with respect to the impact that research information has on decision-making in the Ministries. Yet, no matter how tight the link between science-based information and the content of the agencies' decision, scientists do not replace bureaucrats as decision-makers. There is no automatic effect running from scientific results to bureaucratic decisions. Public management in the two sectors also provides various examples of the significance of *routines* for using scientific information. In the bureaucratic practice of the two sectors *strategic use* is phrased not primarily in terms of being ammunition in a political bargaining process. Rather, the interviewees refer to the need for *professional justification*. Professional justification can be seen as a normative requirement in many of the units and policy areas analysed in this study.

The decision-making agenda of the bureaucrats structures both direction and content of contacts between science and the state agencies. Second, the search for research information varies according to type of tasks and characteristics of the policy field. Working in new areas of policy clearly is associated with a need for research that can assist in developing a policy language, and to establish a delineation of the emerging policy field. There is a search not only for relevant information, but good information partners in the research system. The conception of the need for research as well as the pattern of interaction is different here than in established, well-defined areas of policy. Contact patterns between research and Ministry/Directorate are heavily influenced by organisational structures. The parallel specialisations in state agencies and research institutes clearly foster interaction that is maintained over time and in a reciprocal manner. Organisational arrangements together with the type of policy tasks, mode of

decision-making are highly salient dimensions for understanding patterns of interaction between research and Ministry, as well as use of scientific information.

9.3 Research design – final reflections

Issues of limitations and bias

This is a study of scientific knowledge production and the use of scientific knowledge in a certain time frame and a specific empirical setting. The empirical material is drawn from the period 1990 to 1995, and is limited to one national setting of two sectors in the area of natural resources management. This poses limitations to the generalisability of the findings of this study. There are particular trajectories of development, history and traditions that are specific to our empirical context. The user-orientation in problem choice and the meanings attached to use of scientific information could uniquely be attributed to these idiosyncrasies. However, the organisational arrangements that we have found in these sectors surrounding both knowledge production and use of knowledge have aspects that are of a general kind and reflect general principles of organising bureaucratic work and organisational principles found in science policies. From that perspective, the findings of our study can be generalised to other sectors of society and to other national systems.

In this study an analytical framework was chosen that was systematically directed at the effects of the organisational context in knowledge production and use, even though our framework also contained other aspects. In addition to the organisational context factors we have seen that funding arrangements and effects, and differences between the history and traditions of sub-fields of research are relevant for understanding how user-oriented problem choices are. Nonetheless, there is considerable variance unaccounted for by our model on user-orientation in problem choice. Likewise there are several puzzles in the analysis of bureaucratic information behaviour that we are unable to solve on the basis of our data and our analytical framework (see chapter 8). A possible bias stemming from the analytical framework chosen, is that we overemphasise the structured and organised aspects of research processes and bureaucratic life. Consequently, the erratic, accidental and emotional aspects of doing research and making bureaucratic decisions do not feature prominently in our study. This bias can also be interpreted as a consequence of the research methodology. Especially the use of mail surveys brings with it an inherent tendency to order events, attitudes and actions. That may distort the "natural unstructuredness" of ordinary and extraordinary events and people. Data from the questionnaire are, on the other hand, suited for providing

general patterns and pictures without getting entangled in the thick descriptions of, for instance, a case study approach.

One of the unanswered questions in this study also relates to the issue of consequences of using a survey methodology. We have found through our analysis a link between characteristics of the way in which research is organised and criteria of choice that are considered to be important in problem choice. But the method used did not allow us to investigate the assumptions we made as regards the mechanisms that forge this link, or, in other words, what we have referred to as the underlying logic of action. In our analysis of the uses of scientific information a similar difficulty was noted and discussed, yet here the in-depth interviews conducted allowed us to identify the nature of the problem, whereas with our survey data the underlying logic of action continues to exist of untested assumptions.

Reifying metaphors and fortifying myths?

The data used in this study rely in some respects on the information one gets when the preconceived categories of the researcher interact with the statements of the respondents in a survey or of interviewees. We have seen a strong instrumental overtone in most of the descriptions of use and we have discussed how this can, at least partly, be attributed to the hegemony of the rational decision-making process as an ideal. A possible bias is that scientists systematically exaggerate their role in solving problems for the sector and being oriented towards users. However, we have seen that scientists are able to pinpoint who they see as the users of "their" research. As such the idea of the user is not merely a "mythological beast" one refers to because it fits the organisational sagas and traditions of these research establishments or is strategically important for legitimising their activities (see also: Shove and Rip 2000).

A bias of a slightly different kind refers back to the discussion in chapter two on the usefulness of distinguishing between science and politics.

> *Since the constructivist turn in the sociology of scientific knowledge, it is no longer possible to speak about the relationship between science and politics. Whereas in the older tradition of the sociology of science, one could metaphorise the political dimension of research and the political role of the scientists as an interface between two different social institutions – each with their specific norms, processes and procedures, this is hardly tenable from a perspective which stresses the constructedness of knowledge.* (Wouters et al. 2002: 3).

The way in which the major research questions in this study have been formulated may contribute to reifying categories with respect to which it is claimed that they

cannot be empirically separated. This study has taken as a heuristic point of departure that it is possible to examine the relationship between science and politics. The conclusions based on the theoretical discussions and empirical analyses in the various chapters throughout this study, do not provide many arguments for distancing ourselves from our starting-point. Science and politics interact and get entangled in many arenas and setting, but they have their feet planted in different organisations, institutions and contexts.

This study has indicated the specificities of the social and organisational settings within which knowledge production and knowledge utilisation take place. It has attempted to analyse how these settings affect actions both in the production and in the use of scientific knowledge. Neither scientific knowledge production nor bureaucratic decision-making is a black box. The respective "boxes" where these activities take place have certain characteristics that seem to impact on the activities and actions of scientists and bureaucrats, and also on the way they interact. From our many interviews it is clear that the actors themselves draw these boundaries between science and politics, between scientists and bureaucrats. The interaction we have seen indicates that even though these boundaries are often crossed, the actors clearly perceive the boundaries and relate their actions to them.

9.4 A final note on science, clients and the state

The final note of this thesis consists of a revisit to the role of science in a heterogeneous state and the role of the state with respect to science. Our study has shown that research establishments and scientists, and the knowledge and information they produce, have multiple roles and meanings in society and in their relationship to the state. The fishery and agricultural sciences have in the Norwegian context and in the time period within which this study is set, had a role as a provider of "science in politics". They have operated under a science policy regime with organisational arrangements that matched the research profile of the core research establishments in the two sectors to the informational needs of the state agencies in question. Research within these two sectors also acted in a role as provider of public services to clients in the sectors, while at the same time operating within the institution of science. There is a blend of academic disciplinary values and client/user oriented values. As pointed to in chapter one, there are signs that the particular mix(es) of roles in the science, clients and state relationship that this study has focused at, might be in transition. There are developments in other national research systems that might indicate that also the Norwegian agricultural public sector research in the end can be expected to be pushed to operate more towards the market. Agricultural scientists and their establishments are encouraged to pursue non-traditional sources of funding

outside the Ministries of Agriculture. That has been interpreted as a sign that the traditional links between politics, agriculture and science are being loosened, and that agricultural corporatism is in decline (Levidow *et al.* 2002).

This might signal a change in this type of public sector research. The present study has given a look into the relationship between science, clients and the state in a structured and institutionalised system. We have also pointed to the effects of characteristics of such organisational and institutional context on the knowledge production and knowledge utilisation. If funding and organisational arrangements are being altered in accordance with a supermarket model (Olsen 1988), new organisational arrangements may loosen the formal ties between research and governmental agencies. In such a situation we would expect that the type of public sector research investigated in this study will increasingly experience conflicting priorities between its public service function for its own sector, its role in providing a knowledge basis for national policies, and the need for being sensitive to demands from "paying customers".

Appendix I Quantitative data – the mail survey

An 8 page questionnaire was formulated that consisted of three main parts: first questions pertaining to the respondents main research projects, second questions about their research activities in general and finally questions designed to tap the user contacts and means of communication between the respondent and her/his environment. This questionnaire also contained a set of questions concerning background variables. (See Appendix III for a copy of the questionnaire).

Sample design

The questionnaire was sent to 362 Norwegian researchers in the fishery and agricultural sectors. The choice of units to be included in the survey was based on two main criteria: First, information from different *organisational settings* was wanted (most fundamentally: the university versus the research institute sector); and second, we different agricultural and fishery *research fields* were sought to be included.

In the institute sector, the questionnaire was mailed to all researchers in four government or independent research institutes within the agricultural sector and the major institute for fishery research, the Institute of Marine Research.

These institutes conduct research in the following four fields of research: forestry, plant science, soil science and agricultural economics. The Institute of Marine Research conducts research in most of the fields defined as part of fishery research (marine biology, resource management, environmental research and marine-/aquaculture) with the exception of social science and economics related to the fisheries.

To include research performed in a University/ College setting five departments at the Agricultural University of Norway and all the departments at the Norwegian College for Fishery Science were chosen. Though comparatively small, the latter covers all major fields of fishery science, including technology, fishery economy and organisation. This college is part of the University of Tromsø.

Taking into consideration the total methodological design of the research project, a random sample among Norwegian fishery and agricultural scientists was not used. In addition to survey data, the analysis relies heavily on data from in-depth

interviews with selected groups of users (see Appendix II). The intention was to use these interviews to help interpreting the survey results and vice versa. Including all scientists at selected research organisation allowed us to do this. We would, to some extent, be familiar with the idiosyncrasies of each of these organisations. Furthermore, the original intention was to include questions that would allow the use of a network analysis technique, and a random sample would not permit us to do so. The questionnaire was pretested on scientist that conducted research in similar setting to the units included in the survey – The Norwegian School of Veterinary Science and the National Veterinary Institute. Some revisions were made according to the reactions from the pretest, but the network questions were successfully completed in the pre-test. However, in the actual survey, the network questions proved to be a failure. Other practical concerns had necessitated that respondents from one of the chosen organisational units (Norwegian College for Fishery Science) received the questionnaire one month before the others. The "network" questions were deleted before the remaining questionnaires were sent out.

The sampling frame was compiled through the use of the national register of research personnel at the Institute for Studies of Research and Higher Education. Certain adjustment for changes that had occurred recently such as research personnel who had retired, left or those who were on leave had to be made. After these adjustments, the list comprised 362 researchers: 141 in the fishery sector and 221 in the agricultural sector. Two follow-up mailings to the respondents were made.

Response rate

The response rate is 72.9 per cent, which for a mail questionnaire of this length must be considered satisfactory. Seventy per cent response rate is usually considered to be a realistic expectation (Arber 1993). Dillman has found that in mail questionnaire with more than 150 items to respond to, as is the case in this survey, the average response rate was 68 per cent for specialised populations (Dillman 1978: 56). Thus, the response rate is above what could be expected.

We have background information on three variables for the list of respondents: sex, organisational affiliation, and type of research position. Table 2.1 gives an overview of those who answered our mail questionnaires.

Table I.1 *Number of people included in the survey (N), number of people who completed and returned the questionnaire (n), and response rate (R) by organisational affiliation, position and by sex. N=362*

	N	n	R
Agricultural University of Norway	118	85	72,0%
Norwegian Centre for Soil and Environmental Research	8	6	75,0%
Norwegian Plant Protection Institute	38	31	81,6%
Norwegian Agricultural Economics Research Institute	14	13	92,9%
Norwegian Forest Research Institute	43	27	62,8%
Norwegian College of Fishery Science	45	34	75,6%
Institute of Marine Research	96	68	70,8%
Professor	39	29	74,4%
Associate professor	52	37	71,2%
Assistant professor	17	11	64,7%
Researcher	170	126	74,1%
Research director	22	16	72,7%
Research recruits	62	45	72,5%
Men	311	226	72,7%
Women	51	38	74,5%
Total	*362*	*264*	*72,9%*

As we can see from Table I.1 the response rates vary according to type of organisational affiliation, from 92.9 per cent in one of the smaller institutes to a low of 62.8 per cent in one of the bigger research institutes.

There are some differences according to academic rank and formal position held in the research organisation. "Researcher" is by far the most common position held in our sample. People with the title "researcher" are found primarily within the independent or government research institutes. Except for assistant professors, the response rate does not vary much according to position. The assistant professors have the lowest response rate in this study. This might be explainable given the content of the questionnaire (focusing on research activities) and nature of this position that has traditionally been more focused on teaching than on research (Kyvik 1991: 179), i.e. one might assume that the questionnaire seemed less relevant to this group of academics. Furthermore, this group has in other studies been less prone to complete and return questionnaires (Kyvik 1991: 32-35).

Though women constituted less than 15 per cent of our sample, but they are more likely to respond than male colleagues (74.5 per cent response rate versus 72.7).

To test whether these differences in response rate represented a significant over

representation of some groups, a chi-test was conducted. This was done to investigate whether those who filled out and returned our questionnaire were significantly different from the total number of researchers to whom we sent our questionnaire. Three zero hypotheses were tested saying that those who responded are not representative in terms of organisational affiliation, formal position and sex. We chose a level of significance of .05.

Table I.2 Test of independence between response to questionnaire and the organisational affiliation, formal position and sex of scientists included in the survey.

	Chi-square	Degrees of freedom	Significance
Organisational affiliation	6.36	6	.38
Formal position	1.69	6	.95
Sex	.82	1	.67

Despite the variation in tendency to respond (cf. Table I.1), neither organisational affiliation, formal position, nor sex is statistically dependent on response to our questionnaire. The statistical independency is shown in Table I.2.. Since none of the qui-squares were significant at .05 level the zero hypotheses must be rejected. The analysis of those that completed and returned the questionnaire versus those that did not thus reveals no significant systematic skewness in our data, according to the information we have about the scientists approached with the questionnaire.

Dealing with non-response

Non-response rates for individual questions on the questionnaire were generally low. For some of the questions the respondents had not used any of the categories, even though ample opportunities to use "don't know" or "not relevant" categories were available in the questionnaire. This was particularly the case for questions that had many sub-questions. These sub-questions are more of a type of category where the respondents' answers the main questions (see in particular questions 12 and 14 in the questionnaire in Appendix III). These two questions (question 12 and 14) will be used to illustrate the logic behind the choice on how to deal with "don't knows"/"not relevant" and missing values. First, those who had not ticked off any of the "sub-questions" would have been included in the file as "missing", however, for these questions there were none. Those who answered some of the sub-questions were entered into the data file as a case of not finding the remaining sub-questions relevant. In other words they are not coded as "missing", rather they are seen as respondents who "economised" the time it took to fill out the questionnaire. Second, in this type of questionnaire, when respondents use "don't know" or "not relevant" it can be seen as a meaningful "result". The respondents are highly educated and one could assume that the questionnaire asks questions about things they care a lot about, i.e. their work. By excluding these from the

analysis as "missing", we would lose quite an amount of interesting and relevant information. In fact, the "real" missing cases proved to be limited in the material.

Unit of analysis

In the survey data *each scientist* who completed and returned the questionnaire represents the unit of analysis. However, in part of the questionnaire each respondent was asked questions about her/his research project (see questions 9 to 15 in Appendix III). Respondents were asked to report from the research project that had been their main research task the preceding year. The questionnaires were mailed in February/March 1992. Consequently, in this part of the survey, each respondent is "represented" through her/his research project, i.e. the *project* is the unit of analysis. Or to put it more accurately, the research project "as perceived" by the respondents. Naturally, gathering data about events related to the instigation of research projects and choices made in that connection by way of a questionnaire of this kind, entails some methodological difficulties. The data represent the respondents' *reconstruction* of past events and choices that might have taken place some time ago.

Data analysis techniques

Below the main techniques that have been used to analyse the quantitative data are described briefly.

Test of significance

Usually test of significance is used to test whether one can generalise from a selected sample to a finite population from which a probability sample is drawn. The survey data in this study are not drawn form a probability sample thus significance-testing cannot be used in the above manner. In this case the test of significance cannot be interpreted in the standard way, i.e. drawing conclusions based on significance of results from *sample* to population. Measurement error can, however, lead to randomness even if one has information on the entire population (Schroeder et al 1986:53). Aaberge and Laake (1984) argue that significance testing is applicable as a way of generalising from the data to the *mechanism* that generates the data. Significance testing thus allows us to test whether the results at hand can be explained - with a known probability - as the result of chance and measurement error, irrespectively of whether we analyse data from a random sample or not.

Bivariate measures

In addition to cross tabulation two statistical measures for bivariate association between the variables that are part of the quantitative data set are used. For ordinal level variables *gamma* is used, which is a standardised measure of association between two variables based on the difference between the number of concordant

pairs and the number of discordant pairs. It varies between +1 and - 1, where 0 indicates no statistical dependency between the variables (Norusis 1990:300). However, if the relationship between a pair of variables is curve-linearly *U*- or *A*-shaped, gamma equals 0 even though statistical dependency is present. When the variables are measured on an interval level Pearson's r is used. Pearson's r also varies between +1 and -1, but in order for it to be other than 0 there has to be a *linear* association between two variables in addition to statistical dependency.

Factor analysis

Factor analysis as analytical technique is a tool for measuring an underlying dimension by using a number of variables that are measurable. In this case factor analysis can be used to see whether what we, on theoretical grounds, have considered to be different aspects of the same underlying phenomenon - user-orientation in problem choice - are internally correlated. Factor analysis is based on an assumption of a linear model, and of factual causation where one latent variable or factor (F) influences a set of observable variables (X_{1-n})and cause them to intercorrelate. The observable variables must belong to the same causal level in the causal order, and least be ordinal level variables.

Regression

Regression analysis applied to the survey data has allowed us to investigate the issues of effects of different variables controlled for the effects of other independent variables and not solely a "pair by pair" comparison. Most of the variables are non-metric, and not natural dichotomies. Consequently, a transformation of polytomous variables to dummy variables was essential in order to use regression and perform *dummy* regression. Below follows a specification of the way the most important variables in this analysis have been transformed and a discussion of the limitations and advantages of using dummy regression on this type of survey data.

Data processing

Making the variables manageable - Transforming variables into dummy variables

The original data in the database contained quite a large amount of specified information about a respondent's research projects, his/her work in general and background. To be able to analyse the main research question, the variables had to be transformed into manageable entities. Basically this was a series of simplifications. The point of departure was the original research questions. We were about to analyse data from a survey we had designed and carried out ourselves, with at least some of the theoretical groundwork present when the

survey questions were formulated. That had given us reasonable control of what the data-file contained. Simplifying beyond the limits of "meaningfulness" for the sake of the technical requirement of the analytical technique was of little value in this study. The interest lay in using quantitative methods in an attempt to couple empirical data to theories, rather than in the methodological issues of analytical techniques.

However, considerations of a more technical kind proved to be important in order to carry through the analysis. In transforming the variables, it had to take into consideration that the distribution of units on the new variables could not be too skewed (Hardy 1993). This was particularly important, considering the relatively small sample size. The risk of having empty categories in the final analysis could not be taken and it was impossible to foresee a priori the actual distribution of variables on the "original" variables, even though the choice of units had been taken with this in mind for some of the important parameters. One could expect that the criterion of theoretical meaningfulness and the criterion of even distribution of units might not be as compatible as one could wish for. In the analysis this possible opposition proved to be less of a problem than expected. For most of the independent variables the transformation to dummies was a rather straightforward procedure where the variables were given two values that made reasonable sense. In the end the distribution of the variables on each of the final independent variables are satisfactory (see chapter 6 for information on distribution of the independent variables included in the regression model).

One of the independent variable merits some more methodological discussion because of the series of transformation that went into its construction. This concerns the dummy used in the final analysis for "discipline". With the available data, possibilities to investigate the qualitative aspects of how research disciplines affect user orientation were limited. Nevertheless, it was possible to include type of research disciplines in the analysis, to see whether there are group differences in degree of user orientation.

The respondents were asked to identify their current research discipline. The question was open-ended and the research discipline identified varied greatly in specificity and terminology. For the purpose of the analysis, the answers were categorised in six broad categories: basic sciences, forestry, marine biology, plant/soil sciences and social sciences/ economics. (See chapter five for frequency distribution). Missing values were coded in the following manner: Based on information on the respondents' affiliation with organisational subunits, e.g. university department, the missing cases were given the same value on "the discipline variable" as the majority of the researchers working in the same subunit.

The use of several dummies to represent one variable has the advantage that each dummy variable captures one piece of information from the original variable (Hardy 1993:79). This can be done without altering the content of the original variable, as opposed to when one uses a simple dichotomisation. As prescribed by the statistical textbooks, *j* - 1 dummies were constructed to represent the original qualitative variable (Hardy 1993; Lewis-Beck 1980). Here *j* stands for the number of categories. In choosing what category that is to be "left out", i.e. become the reference group that all dummies are compared to, Hardy (1993:78) suggests some guidelines. In this case two of these are highly relevant: A reference group should

> 1) ... be well defined, i.e. not consist of "others". Only then it is possible to make subgroup comparisons that make sense.
> 2) ... contain a sufficient number of cases. This is important, as Hardy puts it, ". to allow a reasonable precise estimate of the subgroup mean.

As reference group for the discipline dummies "basic science" was chosen. This choice satisfied the "sufficient number" criteria. However, it is more problematic to claim that "basic science" does not consist of leftovers that did not fit in to any of the other categories. In all fairness, these are fields of science that normally would not be lumped together. Have in mind that this variable was constructed on the basis of an open-ended question in the questionnaire, so many transformations were made on the road from the respondents' hand-written answers to the six categories that were taken as a point of departure in the transformation process. However, it is fair to say the "basic science" represents in the material, fields of science that do not contain issue orientation or is sectorally defined, i.e. plain biology and not fishery or plant biology, chemistry and physics. That is a characteristic that sets it apart from the other categories, and lends itself to a meaningful substantial interpretation of subgroup differences, within the context of our research question. In addition, the social sciences/economics have not been included in the "basic science" category, since it could be assumed that it is of interest to study a potential difference between the social sciences and the natural sciences.

Using several dummies to represent a polytomous variable in regression does not give us <u>one</u> single coefficient that captures the effect of the original variable as a whole. To get the gist of any such effect we have looked at the increase in R^2 resulting from inclusion of these variables, i.e. comparison of R^2 of the model in the different steps of the regression to look for the increase in explained variance. With the SPSS command CHA and the "significant F change statistics" that this gives us (Hardy 1993: 92), we can also see whether this increase is significant or not. Although the increase was relatively high, it was not significant at the .05 level.

This did not stop us, however, from considering the effects of the dummies separately. Two of the "discipline dummies" stand out. The effects of projects being conducted within the field of forestry research and plant/soil science are significant and relatively strong.

In the final model we chose to revert to the simple dichotomisation of the original variable by using the two fields of research that have commented upon above that we knew were related to variation in user orientation as the basis for discriminating between two values, the values were labelled "core agricultural science" versus none-core agricultural science.

Dependent variable "user orientation" - the construction of an index

The main argument for using a common measure for user-orientation is that this will allow us to measure degree of orientation towards different users and usage in one common scale. Factor analysis was used in order to investigate the interrelationship between the variables that make up the index. See the presentation in chapter 4 for information on the substantive results of the factor analysis upon which the index for user-orientation is based. Suffice it to say that the results of the factor analysis corresponded well with the preconception and expectation we had to the "behaviour" of the original indicator variables. Hence the choice of variables to be included in a user orientation as a dependent variable that was made based on the empirical induction of the results of the factor analysis corresponded well with our *a priory* theoretical deduction

The user orientation index is a combination five "criteria variables", all of which have values ranging from 0 to 3. Equal weight was given to respondents scoring high/low on one aspect of user orientation, to respondents scoring high/low on other aspects. In the analysis degree of user orientation is measured by means of a simple additive index. A cause for concern may be the use of a simple additive index as a dependent variable and a measure of user orientation. An obvious advantage of tolerating the use of such an index is that variables at lower level together make up a variable with the appearance and qualities of a continuous variable. Transforming the original variables in this way has thus made us able to fulfil one major prerequisite of regression.

Using a simple additive index and giving equal weight to scores obtained on all five original variables could also be deemed problematic. How plausible is it, for instance, that to some degree "following up research priorities of the Ministry as a criterion for problem choice" equals the user orientation represented by considering to some degree the criterion "user's expressed need for research"?

Using a weighted approach was tried out as an alternative. The difference in results from using this approach to constructing such an index added little to the reliability. Consequently, the additive index is used as the main dependent variable, because it has a major advantage the intuitive interpretation of the variable.

Appendix II Interviews

Choice of cases and sample of interviewees

The field work of this study was carried out in several government agencies between 1992 and 1995. The first set of interviews was conducted in the spring of 1992 within government agencies in the fisheries sector. The second series of interviews were carried out in the agricultural sector in the in spring 1995. These series of in-depth interviews were conducted with middle and lower level bureaucrats in selected units in the government agencies. These units include three departments in the Ministry of Agriculture[27], two sections in the Ministry of Fisheries [28] and the Directorate of Fisheries[29], two of the government agencies for the fisheries located regionally, and parts of The Norwegian Agricultural Advisory service. In addition, interviews in one section in an agency that is not formally part of the sectoral bureaucracy were conducted, the Directorate for Nature Management. This is an agency with responsibilities connected both to fisheries and agriculture, but from the perspective of environmental and wildlife protection.

The selection of interviewees was guided by the intent to interview bureaucrats who did not only relate to the management of research and development in these two sectors, rather a main criterion was to include bureaucrats with other administrative duties as their main tasks. Based on this criterion the research and development units within the ministries, for instance, would not be part of the interview study since their primary administrative responsibility would be research management and research policy.

At the same time we wanted to include interviewees that we had a reason to believe were in some respect involved with research in these two sectors, i.e. potential users of science, given that the main research interest lies in investigating the use of science rather than the non-use. It may be argued that this represents selecting units on the basis of expected value on the *dependent* variable, which is methodologically problematic. However, these potential users of research were considered to be the *universe* from which the interviewees could selected.

Descriptions of the task of the different departments in government agencies

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[27] The agronomy-, forestry and agricultural policy department.

[28] Resource management section and Aquaculture section

[29] Three departments: capture fisheries, fishery economy and aquaculture

within agriculture and fisheries were used to single out the relevant units to include in the interview study as potential users of science. In the case of the Ministry of Agriculture the parallel design aimed was also taken into account. The departments that did bureaucratic work within fields corresponding to the scientific fields that were covered by the mail survey of scientists were chosen. The interviews conducted within the Norwegian Agricultural Advisory Service have a different status than the rest, since this agency does not fulfil the criterions mentioned above, rather it was a government agency especially directed at giving the public, other bureaucratic units, farmers and other actors in the sector advice on professional and scientific basis. The interviews with these civil servants are then used as supplementary material from people who have as their main task being disseminators of scientific information.

Interviewees were selected from advisor/executive officer stratum and from among heads of sections in the chosen units. This choice was made as a result of the insight gained in the course of a research project in prior to this study. As part of this research project a series of research interviews with top ranking civil servants within the Norwegian Civil Service were conducted, including the ministries of Agriculture and Fisheries (see Larsen *et al.* 1991). These interviews pertained to science policy issues of great relevance to our own study - however, it became apparent that at this level within government bureaucracy one would not find the information necessary to conduct an analysis of science and bureaucracy relations in every day bureaucratic life would, as was indented. Middle range managers and advisors/executive officers we assumed would have the appropriate closeness to bureaucratic every day praxis and decision making.

In practical terms official job-descriptions and descriptions of tasks and responsibilities of units within state agencies were used in order to select the persons with whom we would request an interview. In addition the units for research and development policy and administration in the two ministries helped to check the list of potential interviewees. Table II.1 gives and overview of the number of interviewees.

Table II.1 Number of interviewees according to administrative unit and formal position

	Code	Head of section	Advisors/ executive officers	Total
Ministry of Agriculture	MA	7	7	14
Ministry of Fisheries	MF	1	5	6
Directorate of Fisheries	DF	3	3	6
Directorate of Nature management	DN	2	1	3
Regional state agencies for the fisheries	RF	2	2	4
The Agricultural Advisory Service	AA	1	2	3
Sum		16	20	36

Each interview was given a code number that indicated to which government agency the interviewees belonged, interviewees from the Ministry of Agriculture were for example denoted with MA followed by a number. The codes used are listed in Table II.1

Content of interviews

The interviews were non-standardised and they were conducted on the basis of an interview guide (see Appendix IV). All the main questions were pre-formulated. Follow up questions were prepared in case the original main question fell through, was misunderstood, or it became apparent that the replies needed to be elaborated. The main object was to establish a "guided conversation" that would yield the best possible information, so the original guide was used with caution so that the pre-selected order of questions and phrasing would not disrupt the rhythm of the interviews.

The guide contained four main sets of questions. Section one included questions about the interviewees' professional background and bureaucratic track record, and questions that induced interviewees to describe their daily work and characterise their tasks without specific references to science related issues. This part of the interviews thus contains information that pertains to some of the "independent" variables in the analysis of bureaucracy-science interaction. These sections also served as an introduction to the main topic of the interviews.

The second section of the interview starts out with questions about easily describable phenomena, such as their contacts with research groups and establishments, both in terms of regularity, frequency and direction. This usually proved to be a comfortable transition to questions about why they are in contact with scientists, and perceptions of their own need for scientific information. The

next set of questions was on how information from science was used in the interviewees bureaucratic work - a question going to the crux of the 'dependent variable' in this part of the analysis. We took care to let that latter question sink in and allow the interviewees to answer in their own words and with their own interpretation of the issue 'use of research'. However, their statements were followed up, in order to probe the categories of utilisation that we, based on prior research on this topic, wanted to investigate. In that respect we received information that allowed us to study the relevancy of preconceived values on the dependent variable, but also to explore new aspects of the issue. In order to abate the problem that interviewees might exaggerate the role of scientific information in bureaucratic action (see below) they were specifically asked to compare the significance and characteristics of this source of information to/with other information providers. At the end of this section the interviewees were given the opportunity to impart their views on more general science policy issues. This section of the interview proved to be a key part of the interviews, by the time the interview reached the end of this section the interviewees had usually already brought forward the essence of their relationship to scientific information and research communities in their every day bureaucratic life.

The third part of the interviews relates to the question of dissemination of information needs, ie. issues of search for scientific information. Here interviewees gave information of high relevance for the issue of user orientation in the problem choice of scientists. In the fourth section we returned to question of the general pattern of contact between the interviewees and research communities as a way of summing up and introduce the following questions on the role of indirect contacts between state agencies and research, and the role of written sources of dissemination. The interviews ended with a hypothetical question that was intended to allow the interviewees to bring forward their opinions on the role of science bureaucratic action in general and their view on possible impediments for use of research in their own agency.

In sum, the questions in the guide were for the most part intended to make the interviewees describe their *actions* rather than their attitudes. Can their statements be regarded as a valid representation of what they do? First, the interviews do not deal with issues that are particularly controversial in the context of these government agencies, none of the interviewees signalled that these were uncomfortable questions to answer. The questions do not treat personal matters, rather they focus on their actions and, to some extent, the attitudes they hold in their capacity as part of a particular government agency. The chances of misrepresentation due to political or personal sensitive issues we deem to be low. The possibility of interviewees wanting to present themselves in a "favourable"

light is a more salient point. Taking into account the status of science in rational decision-making paradigm (see chapters six and eight for a further discussion) for example, one might expect the interviewees to *overrate* the importance of research as basis for their daily work. This possibility is dealt with in several ways. First, it was emphasised to the interviewees that this was not part of an evaluation of neither research activities in the sector nor bureaucratic practise. Second, being face to face to the interviewees gave the possibility of checking the answers and asking them to explicate and illustrate. This is a type of control that using mail surveys or documents as sources of data would not allow. Third, as mentioned above, one of the questions in the guide deals specifically with this issue. Fourth, the transcript of the interview for internal consistency/ inconsistency of interviewees' statements and descriptions were checked, and very little evidence of this type of cosmetic answering was found. The overall impression is that the interviewees gave a balanced account of search for, exposure to, and use of research in their work. However, an experience during many of the interviews was how the interviewees started to reflect on the topic at hand and the interview situation heightened their own consciousness of how they related to science. In most instances such interaction was an integral part of their daily bureaucratic life that they normally had little occasion to reflect on. One might consider this as an undesirable "interviewer effect", in the sense that presence of the interviewer made them think of and talk about issues they otherwise would hardly be aware of and thus their statements are to be regarded as an artefact of the interview. However, this is not necessarily a methodological problem. Rather, it could be seen as a necessary part of a successful interview without which interviews would be of very little informational value. Daily life, both in bureaucracies and other social contexts, does consist of many shades of "taken-for-grantedness" and using interviews is an important way of making this surface and become the object of a social science study while at the same become the object of the interviewees' own reflection.

The interview guide worked well in the Ministries and the directorates, but in the regional state agencies considerable flexibility was needed in how closely the interview guide was to be followed. In that sense, the latter were the least structured of the interviews. Interviewees were primarily asked to speak for themselves and not on behalf of their units, however heads of sections were given particular questions pertaining to the practices of the unit they headed. The interviews lasted from one to two hours and the average time used was one and a half-hour.

Appendix III Questionnaire

KONFIDENSIELT

Navn .....
Fødselsår .....
Stilling .....
Institutt .....
Avdeling/senter .....

1) **Hvor lenge har du vært i din nåværende stilling?** .....
2) **Hvor lenge har du til sammen vært ansatt ved instituttet?** .....
3) **Hvilke typer arbeidsoppgaver har du i din nåværende stilling?**
   (Angi omtrent hvor stor del av arbeidstiden som går med til de forskjellige oppgavene i løpet av et år)

   % av arbeidstiden

   ☐ forskning .....
   ☐ undervisning og veiledning av studenter .....
   ☐ utredning .....
   ☐ rådgivning og kontrolloppgaver for forvaltningen .....
   ☐ annet .....
4) **Hvilken fagdisiplin forsker du innenfor?** .....

OM FORSKNINGSPROSJEKT I 1991

5) **Hvilket forskningsprosjekt har vært ditt hovedprosjekt i 1991?**
   Hvis du har deltatt i mange prosjekter i 1991, velg det prosjektet som du anslagsvis har brukt mest tid på. Hvis du ikke har deltatt i noen prosjekter i 1991, velg da det forskningsprosjektet du siste gang var med på ved dette instituttet

   Tittel .....
   Startår .....

6) **Karakteriser dette prosjektet mht. type forskning:**
   ..... % grunnforskning
   ..... % anvendt forskning
   ..... % utviklingsarbeid

7) **Hvordan finansieres dette prosjektet?**
   ..... % over instituttets grunnfinansiering
   ..... % med bevilgninger fra NFFR
   ..... % med bevilgninger fra andre instanser, spesifiser: .....
   ☐ vet ikke

8) **Er dette den vanligste finansieringsformen for de forskningsprosjekter du har deltatt i ved dette instituttet?**
   ☐ Ja
   ☐ Nei, vanligvis har prosjektene denne finansieringen:

..... % over instituttets grunnfinansiering
..... % bevilgninger fra NFFR
..... % bevilgninger fra andre instanser, spesifiser: .....
☐ Vet ikke
☐ Jeg har ikke deltatt i andre prosjekter

9) **Er dette prosjektet del av et større forskningsprogram?**
☐ Nei
☐ Ja, program i regi av forskningsråd, Hvilket forskningsråd? .....
☐ Ja, program ved mitt institutt
☐ Ja, internasjonalt forskningsprogram

10) **Er det en styringsgruppe eller et rådgivende utvalg <u>der brukere er representert</u> knyttet til dette prosjektet?**
☐ Styringsgruppe med brukere
☐ Rådgivende utvalg med brukere
☐ Ingen av delene

11) **Er det <u>konkrete</u> instanser eller grupper <u>utenfor</u> forskningssystemet som du mener vil kunne anvende kunnskap og forskningsresultater fra dette prosjektet?**
☐ Nei, prosjektet er primært av interesse for mine forskerkolleger
☐ Nei, prosjektet er primært av almen interesse
☐ Ja, spesifiser: .....

12) **Tenk tilbake på hvordan dette forskningsprosjektet kom i stand - i hvilken grad var følgende personer/ instanser med på å ta initiativet og/eller komme med ideer til prosjektet?**

	Helt sentral	Noen grad	Liten grad	Ikke med	Ikke aktuelt
Jeg selv	☐	☐	☐	☐	☐
Forskerkollega v/ mitt institutt	☐	☐	☐	☐	☐
Fiskeriforsker utenfor mitt institutt	☐	☐	☐	☐	☐
Forskerkollega utenfor fiskeriforskningen	☐	☐	☐	☐	☐
Min faglige veileder	☐	☐	☐	☐	☐
En overordnet/ instituttledelsen	☐	☐	☐	☐	☐
NFFR	☐	☐	☐	☐	☐
Fiskeridepartementet	☐	☐	☐	☐	☐
Fiskeridirektoratet	☐	☐	☐	☐	☐
Bruker (spesifiser:.....)	☐	☐	☐	☐	☐
Andre (spesifiser: .....)	☐	☐	☐	☐	☐

13) **Da dette prosjektet var etablert, var det andre personer/ instanser enn de du har nevnt under spørsmål 12 som i stor grad var med på å diskutere nærmere hvilke spørsmål prosjektet skulle ta opp?**
☐ Nei, de samme personer/instanser var med
☐ Ja, følgende personer/instanser var sentrale: .....
.....

.....

.....

.....

14) **I hvilken grad var noen av disse faktorene av betydning for at dette prosjektet ble satt i gang?**

Kryss av for hvert av alternativene

	Stor grad	Noen grad	Liten grad	Ikke aktuelt
a) Prosjektet var en naturlig videreføring av min tidligere forskning	☐	☐	☐	☐
b) Bidra til utvikling av teorier innenfor mitt fagfelt	☐	☐	☐	☐
c) Bidra til utvikling av nye metoder og teknikker	☐	☐	☐	☐
d) Få forskningsresultater som kunne publiseres i vitenskapelige tidsskrift	☐	☐	☐	☐
e) Følge opp en sentral vitenskapelig diskusjon innenfor mitt fagfelt	☐	☐	☐	☐
f) Muligheten for å jobbe sammen med dyktige kolleger	☐	☐	☐	☐
g) Forskerkolleger/faglig veileder mente det var et interessant tema	☐	☐	☐	☐
h) Tilfredsstille brukeres uttrykte ønske om forskning på området	☐	☐	☐	☐
i) Løse konkrete problem i havbruksnæringen	☐	☐	☐	☐
j) Løse konkrete problem i øvrig fiskerinæring	☐	☐	☐	☐
k) Løse konkrete problem i andre sektorer	☐	☐	☐	☐
l) Bidra til generell kunnskapsoppbygging for fiskerinæringen	☐	☐	☐	☐
m) Fylle kunnskapsbehov i offentlig forvaltning av fiskerinæringen	☐	☐	☐	☐
n) Muligheten for å få prosjektet finansiert ☐	☐	☐	☐	
o) Muligheten for å få tilgang på vitenskapelig utstyr for prosjektet	☐	☐	☐	☐
p) Følge opp instituttets planer for forskningsinnsatsen	☐	☐	☐	☐
q) Forske på tema med relevans for andre arbeidsoppgaver ved instituttet	☐	☐	☐	☐
r) Forske på tema som passet inn i et forskningsprogram	☐	☐	☐	☐
s) Følge opp Fiskeridepartementets signaler om tema som burde prioriteres	☐	☐	☐	☐
t) Følge opp Fiskeridirektoratets signaler om tema som burde prioriteres	☐	☐	☐	☐
u) Andre faktorer som var av stor betydning for at dette prosjektet ble satt i gang (spesifiser):				

15) **Hvilken av faktorene nevnt under spørsmål 14 vil du si var den <u>utslagsgivende</u> faktor som gjorde at prosjektet ble satt i gang?**

Faktor ..... *(bruk bokstaven)*

OM ØVRIG FORSKNING

16) **Er det noen deler av din vitenskapelige virksomhet som ikke faller inn under bestemte forskningsprosjekt?**

☐ Nei

☐ Ja, spesifiser:

17) **Hvilke personer/instanser har i løpet av den tiden du har vært ansatt ved dette instituttet påvirket deg i følgende faglige spørsmål?**
Vil du krysse av for flere alternativ under de tre spørsmålene så ranger med 1 som størst innflytelse

Valg av forskningsmetode	**Valg av teori**	**Diskusjon om mulige praktiske anvendelsesområder for din forskning**	
Rangering	Rangering	Rangering	
☐ ( )	☐ ( )	☐ ( )	Forskerkolleger v/ mitt institutt
☐ ( )	☐ ( )	☐ ( )	Min faglige veileder
☐ ( )	☐ ( )	☐ ( )	Fiskeriforskere utenfor mitt institutt
☐ ( )	☐ ( )	☐ ( )	Forskere utenfor fiskeriforskning
☐ ( )	☐ ( )	☐ ( )	En overordnet/ instituttledelsen
☐ ( )	☐ ( )	☐ ( )	NFFR
☐ ( )	☐ ( )	☐ ( )	Fiskeridepartementet
☐ ( )	☐ ( )	☐ ( )	Fiskeridirektoratet
☐ ( )	☐ ( )	☐ ( )	Bruker, spesifiser:
☐ ( )	☐ ( )	☐ ( )	Andre, spesifiser:

18) **I hvilken grad har du inntrykk av at det eksisterer uenighet mellom disse personer/ instanser med hensyn til hva ditt institutt skal forske på?**

	Stor grad	Noen grad	Liten grad	Ingen uenighet	Ikke aktuelt
Mellom kolleger med ulik faglig bakgrunn ved instituttet	☐	☐	☐	☐	☐
Mellom ulike avdelinger/sentre ved instituttet	☐	☐	☐	☐	☐
Mellom instituttledelsen og øvrig ansatte ved instituttet	☐	☐	☐	☐	☐
Mellom instituttet og Fiskeridepartementet	☐	☐	☐	☐	☐
Mellom instituttet og Fiskeridirektoratet	☐	☐	☐	☐	☐
Mellom instituttet og NFFR	☐	☐	☐	☐	☐
Mellom instituttet og andre offentlige forvaltningsorgan	☐	☐	☐	☐	☐
Mellom instituttet og havbruksnæringen	☐	☐	☐	☐	☐
Mellom instituttet og øvrig fiskerinæring	☐	☐	☐	☐	☐
Mellom instituttet og naturvernorganisasjoner	☐	☐	☐	☐	☐
Mellom ulike brukergrupper	☐	☐	☐	☐	☐
Mellom instituttet og andre brukere	☐	☐	☐	☐	☐

spesifiser .....

KONTAKTMØNSTRE OG FORMIDLING AV FORSKNING

19) **I hvilken grad oppfatter du disse instanser/personer som et viktig publikum for din forskning?**

	Svært	Ganske	Litt	Ikke

Forskerkolleger v/ mitt institutt	☐	☐	☐	☐
Fiskeriforskere utenfor mitt institutt	☐	☐	☐	☐
Forskere utenfor fiskeriforskningen	☐	☐	☐	☐
Offentlig forvaltning	☐	☐	☐	☐
Fiskere	☐	☐	☐	☐
Fiskeoppdrettere	☐	☐	☐	☐
Industri/ bedrifter knyttet til havbruksnæringen	☐	☐	☐	☐
Industri/ bedrifter knyttet til øvrig fiskerinæring	☐	☐	☐	☐
Fiskernes og fiskeoppdretternes frivillige organisasjoner	☐	☐	☐	☐
Naturvern- og friluftslivsorganisasjoner	☐	☐	☐	☐
Samfunnet generelt	☐	☐	☐	☐
Andre, spesifiser:	☐	☐	☐	

20) Hvor ofte bruker du følgende kanaler til å fortelle andre om den forskning du holder på med og de forskningsresultater du kommer fram til?

	Ofte	Av og til	Sjelden	Aldri
Foredrag og seminarer i ikke-vitenskapelige fora	☐	☐	☐	☐
Konferanser og seminarer med andre forskerkolleger	☐	☐	☐	☐
Vitenskapelige bøker og artikler i vitenskapelige tidsskrift	☐	☐	☐	☐
Vitenskapelige rapporter	☐	☐	☐	☐
Populærvitenskapelige tidsskrift eller blader	☐	☐	☐	☐
Dagspresse, radio og TV	☐	☐	☐	☐
Personlig kontakt med brukere	☐	☐	☐	☐
Personlig kontakt med andre forskere	☐	☐	☐	☐

21) **Har du vært i kontakt med noen av forskningsrådene i løpet av de siste fem årene du har vært ved instituttet?**

Hvis du har vært ansatt kortere enn fem år, svar for den tiden du har vært ved instituttet.

	Søkt om midler til forskning	Mottatt utdanningsstipend/forskerstipend	Mottatt prosjektstøtte	Vært medlem av råd eller styret	Medl.faggr.programstyrer eller andre lignende grupper	konsulent eller rådgiver for forskningsrådet	uformellkontakt	Ingen
NFFR	☐	☐	☐	☐	☐	☐	☐	☐
NAVF	☐	☐	☐	☐	☐	☐	☐	☐
NTNF	☐	☐	☐	☐	☐	☐	☐	☐
NLVF	☐	☐	☐	☐	☐	☐	☐	☐
NORAS	☐	☐	☐	☐	☐	☐	☐	☐

22) **Hvordan vil du karakterisere NFFRs rolle overfor ditt institutt?**

Hvis du vil krysse av for flere alternativ så rangér (med 1 som viktigste rolle).

Rangering

☐ ( ) NFFR formidler kontakt mellom instituttets forskere og ulike brukergrupper
☐ ( ) NFFR formidler Fiskeridepartementets forskningsprioriteringer til instituttet
☐ ( ) NFFR er instituttets talsmann overfor Fiskeridepartementet
☐ ( ) NFFR formidler instituttets forskningsresultater til brukerne
☐ ( ) NFFR er en arena der forskere ved instituttet konkurrerer med forskere fra andre forskningsinstitusjoner om midler til forskning
☐ ( ) NFFR er en møteplass for fiskeriforskere
☐ ( ) Vårt institutt har ikke noe forhold til NFFR

23) **Hvor ofte er du i kontakt med andre forskere i forbindelse med ditt arbeid (både forskning og annet arbeid) ved instituttet?**

	Ukentlig	Månedlig	Årlig	Aldri
Fiskeriforskere utenfor mitt institutt	☐	☐	☐	☐
Forskere ved norske universiteter	☐	☐	☐	☐
Andre forskere utenfor fiskeriforskningen	☐	☐	☐	☐
Forskere ved utenlandske forskningsinstitusjoner	☐	☐	☐	☐

24) **Er du i kontakt med noen av disse instanser/personer i forbindelse med ditt arbeid (både forskning og annet arbeid) ved instituttet?**

	Ukentlig	Månedlig	Årlig	Aldri
Fiskere	☐	☐	☐	☐
Fiskeoppdrettere	☐	☐	☐	☐
Industri og bedrifter knyttet til havbruksnæringen	☐	☐	☐	☐
Industri og bedrifter knyttet til øvrig fiskerinæring	☐	☐	☐	☐
Annen industri og andre bedrifter	☐	☐	☐	☐
Ansatte i forskningsrådene	☐	☐	☐	☐
Kommunale forvaltningsorgan	☐	☐	☐	☐
Fiskernes og fiskeoppdretternes frivillige organisasjoner	☐	☐	☐	☐
Naturvern- og friluftslivsorganisasjoner	☐	☐	☐	☐
Andre brukere av din forskning, spesifiser.....	☐	☐	☐	☐

KONTAKT MED STATLIG FORVALTNING

25) **Har du i løpet av det siste året vært i kontakt med følgende statlige forvaltningsorgan?**

	Ukentlig	Månedlig	Sjelden	Aldri
Fiskeridepartementet	☐	☐	☐	☐
Fiskeridirektoratet	☐	☐	☐	☐
Rettledningstjenesten i fiskerinæringen	☐	☐	☐	☐
Direktoratet for Naturforvaltning	☐	☐	☐	☐

Andre departement/statlige forvaltningsorgan du har vært i kontakt med:

.....	☐	☐	☐
.....	☐	☐	☐
.....	☐	☐	☐
.....	☐	☐	☐

Hvis du ikke har hatt kontakt med noe statlig forvaltningsorgan så hopp til spørsmål 29.

26) **På hvilken måte foregår denne kontakten?**

Rangér (med 1 som hyppigst kontaktform) hvis du ønsker å krysse av for flere alternativ

	Rangering	
☐	( )	Via egne formelle møter mellom forvaltningen og mitt institutt
☐	( )	Via felles deltakelse i styrer, råd og utvalg under NFFR
☐	( )	Via felles deltakelse i andre styrer, råd og utvalg
☐	( )	Telefonisk kontakt
☐	( )	Skriftlig kontakt
☐	( )	Kontakt på fritiden
☐	( )	Andre måter Spesifiser

27) **Har det hendt i løpet av det siste året at ansatte i noen av de statlige forvaltningsorganene du har krysset av for under spørsmål 25 har henvendt seg til deg?**

☐ Nei ☐ Ja

Hvis ja, kryss av for hvilke grunner du mener de har hatt for å henvende seg til deg:

- ☐ Holde seg generelt orientert om forskningen på mitt felt
- ☐ Faglige spørsmål knyttet til konkrete beslutninger i forvaltningen
- ☐ Generelt for å opprettholde kontakten med forskningsverdenen
- ☐ For å få meg til å forske på problemstillinger forvaltningsorganet er interessert i
- ☐ Sjekke hvordan det går med et prosjekt organet har vært med på å finansiere
- ☐ Andre grunner, spesifiser:

28) **Har det hendt i løpet av det siste året at du selv har tatt kontakt med noen av de forvaltningsorganene du har krysset av for under spørsmål 25?**

☐ Nei ☐ Ja

Hvis ja, kryss av for hvilke grunner du har hatt for å henvende deg til de ulike organene:

- ☐ Presentere egne forskningsresultater
- ☐ Presentere andres forskningsresultater
- ☐ Holde forvaltningen orientert om hva som skjer på mitt fagfelt
- ☐ Gi faglige råd mht. til beslutninger som skal fattes i forvaltningen
- ☐ Spørre om midler til min eller andres forskning
- ☐ Tale mitt institutts sak overfor organet
- ☐ Holde kontakten med forvaltningen
- ☐ Få innspill til nye prosjekter
- ☐ Få opplysninger og informasjon fra forvaltningsorganet

Andre grunner (spesifiser):

BAKGRUNNSSPØRSMÅL

29) **Driver du eller eventuelt din ektefelle eget oppdrettsanlegg eller annen form for fiskerinæring?**

☐ Nei ☐ Ja

30) **Har du bistillinger?**

☐ Nei ☐ Ja Hvor?

31) **Har du yrkeserfaring <u>som forsker</u> fra andre forskningsinstitusjoner?**

☐ Nei ☐ Ja, Hvor?

32) **Har du annen yrkeserfaring etter endt utdanning?**

☐ Nei ☐ Ja

Hvis ja;

☐ Forskningsadministrasjon ☐ Offentlig fiskeriforvaltning
☐ Egen næringsvirksomhet ☐ Øvrig offentlig forvaltning
☐ Privat bedrift ☐ Annet
☐ Fiskernes og fiskeoppdretternes frivillige organisasjoner

33) **Har du planer om å gå over i en annen stilling utenfor instituttet?**

☐ Nei ☐ Ja

Hvis ja, til:

☐ Forskningsinstitutt ☐ Egen næringsvirksomhet
☐ Universitet/høyskole ☐ Privat bedrift
☐ Forskningsadministrasjon ☐ Fiskernes/oppdretternes frivillige org.
☐ Offentlig forvaltning ☐ Annet

34) **Hva var din hovedforsørgers yrke under din oppvekst?**

☐ Fisker, fiskeoppdretter eller liknende yrke i fiskerinæringen
☐ Annet yrke

35) **Oppvekstkommune**:

☐ Landkommune
☐ Bykommune

36) **Hvilken utdanning har du etter endt videregående skole eller tilsvarende utdanning?**

Grad	Utdanningsinstitusjon	År	Fagområde
Lavere			
Høyere			
Dr.grad			

TAKK FOR INNSATSEN!

Har du kommentarer til spørreskjemaet eller til de tema som tas opp i skjemaet, så bruk gjerne resten av denne siden eller legg ved et eget ark.

Appendix IV Regression models

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	5,647	,738		7,648	,000
Research sector Fishery=0 Agriculture=1	-,901	,773	-,105	-1,165	,246
Part of external programme Yes=1 No=0	3,038	,735	,392	4,132	,000
Discipline Core agri=1 Other=0	2,824	,802	,320	3,522	,001
Organised user governance Yes=1 No=0	,106	,775	,013	,137	,891
User funding Yes=1 No=0	-1,737	1,608	-,090	-1,080	,282

a Dependent Variable: SCALE3 –degree of user orientation
b Selecting only cases for university/college sector
R^2=.22

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.990	.609		13.119	.000
Research sector Fishery=0 Agriculture=1	-1.114	.848	-.149	-1.314	.191
Part of external programme Yes=1 No=0	.787	.630	.105	1.248	.214
Discipline Core agri=1 Other=0	1.648	.875	.207	1.884	.062
Organised user governance Yes=1 No=0	1.181	.642	.155	1.838	.068
User funding Yes=1 No=0	1.510	3.764	.034	.401	.689
Degree of budget specificity High=1 Low=0	.965	.897	.101	1.076	.284

a Dependent Variable: SCALE3 –degree of user orientation
b Selecting only cases for research institute
R^2=.08

Samenvatting

Wetenschap, cliënten en de staat

Inleiding

In deze studie staat de relatie tussen wetenschappelijk onderzoek en overheidsbeleid centraal. Deze relatie is onderzocht op basis van twee aparte, doch verbonden vraagstukken. In de eerste plaats is de studie gericht op die fase van een onderzoeksproces waarin de probleemstellingen voor onderzoek worden geselecteerd. In de onderhavige studie is onderzocht welke rol potentiële gebruikers van onderzoek spelen in de selectie van probleemstellingen. Ook is geanalyseerd in welke mate mogelijke toepassingen van onderzoeksresultaten zijn gedefinieerd als belangrijk bij de keuze van een probleemstelling (hierna probleemkeuze genoemd). In de tweede plaats is bestudeerd hoe wetenschappelijke informatie wordt gebruikt door overheidsorganen. Daarbij is gekeken naar welke factoren van invloed zijn op het gebruik van wetenschappelijke informatie in ambtelijke besluitvormingsprocessen, en in andere activiteiten van overheidsorganen. Met betrekking tot beide vraagstukken is met name onderzocht welke effecten de organisatie-context heeft op probleemkeuze en op ambtelijk gebruik van onderzoek. Het theoretisch kader voor de studie reflectereert deze gerichtheid op de organisatie context en bevat, onder andere, elementen uit de sociologische en politicologische richtingen binnen de neo-institutionale benadering met betrekking tot het openbare bestuur.
De empirische setting van het onderzoek bestaat uit de Noorse landbouw- en visserijsectoren. Landbouw en visserij zijn in Noorwegen sectoren waar natuur, wetenschap en openbaar management samenkomen. De twee sectoren hebben organisatie-arrangementen die een uitdrukking zijn van de sterke banden tussen wetenschap en openbaar bestuur.

Centrale bevindingen

Verschillende actoren zijn betrokken bij de probleemkeuze in de Noorse landbouw- en visserijwetenschappen. Er zijn echter belangrijke variaties in de mate waarin deze actoren direct betrokken zijn bij het eigenlijke keuzeproces. De belangrijkste deelnemer is de uitvoerende onderzoeker zelf, gevolgd door de

onderzoekscollega's van de eigen eenheid (vakgroep, instituut, faculteit) van de uitvoerende onderzoeker. De meest direct-betrokken actoren komen dus voornamelijk uit de wetenschappelijke gemeenschap. Niet-wetenschappelijke gebruikers en ministeriële medewerkers zijn veel minder vaak direct betrokken bij de keuze van probleemstellingen.
Het proces van probleemkeuze komt naar voren als een complex proces, niet zozeer als gevolg van de betrokkenheid van vele verschillende actoren bij het proces, als wel vanwege de vele overwegingen die in het keuzeproces aan de orde komen. Er zijn verscheidene overwegingen die naast elkaar opereren, en deze kunnen worden gerelateerd aan twee basis dimensies. Ten eerste is er de academische dimensie die verschillende criteria samenbrengt die te maken hebben met de incentives en normen van wetenschappelijke carrières en met de wens bij te dragen aan de wetenschappelijke discussie en theoretische ontwikkeling binnen het eigen vakgebied. Ten tweede de dimensie die bestaat uit een reeks van criteria met betrekking tot gebruik van wetenschap. Bij probleemkeuze wordt veel waarde gehecht aan het oplossen van specifieke problemen in de visserij-, respectievelijk landbouwsector en aan het toeleveren van kennis die relevant is voor het openbaar bestuur. Onderzoekers werkzaam in de Noorse landbouw- en visserijwetenschappen zien hun onderzoek in de eerste plaats als een onderdeel van de inspanningen om de problemen in hun eigen sector op te lossen. Het meest belangrijke keuzecriterium per se dat in dit onderzoek naar voren is gekomen is dan ook dat onderzoek moet bijdragen aan het oplossen van problemen in de sector. In dit licht gezien heeft de onderhavige studie de verwachting bevestigd dat de organisatie-context van onderzoek de oriëntatie op de potentiële toepasbaarheid van onderzoek beïnvloed.

In het onderzoek zijn drie groepen van factoren gevonden die kunnen bijdragen aan het verklaren van verschillende gradaties van gebruiksoriëntatie in probleemkeuze. Gecontroleerd voor de invloed van andere factoren is ten eerste probleemkeuze in de onderzoeksinstituten van de overheid meer gebruiksgeoriënteerd dan probleemkeuze die plaatsvindt binnen een universitaire setting. Ook externe bekostiging van onderzoek, en de mate van verbinding met onderzoeksprogramma's, zijn van positieve invloed op de mate van gebruiksoriëntatie in probleemkeuze. Er zijn geen significante verschillen in de mate van gebruiksoriëntatie tussen visserij-onderzoek en de visserijsector enerzijds, en landbouwonderzoek en de landbouwsector anderzijds. Echter, een significant effect is wel afkomstig van de discipline als variabele, dat wil zeggen probleemkeuze in de kern van de landbouwwetenschappen is meer gebruiksgeoriënteerd dan probleemkeuze binnen andere disciplines. Verder suggereren onze empirische gegevens dat bekostiging en de organisatie-context belangrijk voor het begrijpen van gebruiksoriëntatie in probleemkeuze. De

consequentie van deze uitkomst is dat wetenschappelijke beleidsinstrumenten, zoals onderzoeksorganisatie en bekostiging, belangrijke factoren zijn in het beïnvloeden van het onderzoeksproces. Hierbij moet wel worden aangetekend dat een deel van de variatie in gebruiksoriëntatie onverklaard blijft in ons theoretisch kader.

Onze studie van het gebruik van wetenschappelijke informatie in het openbare management van de twee betrokken sectoren wijst in het algemeen op het belang van de wijze waarop deze informatie is vertaald voor gebruik in een besluitvormingscontext. In het algemeen wordt de nadruk gelegd op een instrumentele benadering met betrekking tot het zoeken naar en het gebruiken van wetenschappelijke informatie, en de behoefte dat beslissingen professioneel gerechtvaardigd moeten zijn. Professionele rechtvaardiging is vooral een normatieve vereiste in een groot aantal van de eenheden en beleidsgebieden geanalyseerd in deze studie. De besluitvormingsagenda van de ambtenaren structureert zowel de richting als de inhoud van de contacten tussen wetenschap en overheidseenheden.
Ten tweede varieert het zoeken naar onderzoeksinformatie al naar gelang het type taken en kenmerken van een beleidsveld. Werken in nieuwe beleidsgebieden is duidelijk geassocieerd met een behoefte aan onderzoek dat kan bijdragen aan het ontwikkelen van een eigen beleidstaal, en het vaststellen van de afbakening van het nieuwe beleidsveld ten opzichte van gevestigde terreinen. Er wordt niet alleen gezocht naar relevante informatie, maar ook naar goede informatiepartners in het onderzoeksysteem. In dergelijke nieuwe beleidsvelden is de conceptie van de behoefte aan onderzoek en het interactiepatroon anders dan in gevestigde, duidelijk gedefinieerde beleidsterreinen. Contactpatronen tussen onderzoek en Ministerie/Directoraat zijn duidelijk beïnvloed door organisatiestructuren. De parallelle specialisaties in staatseenheden en onderzoekinstituten leiden tot vormen van interactie die langere tijd worden aangehouden en die duidelijk wederkerend zijn. Organisatie-arrangementen samen met het type beleidstaken zijn uiterst prominente dimensies voor het begrijpen van interactiepatronen tussen de werelden van onderzoek en overheid.

De instrumentele benadering die duidelijk zichtbaar is in de manieren waarop ambtenaren naar informatie zoeken, loopt parallell met de impact die onderzoeksgebaseerde informatie heeft op de besluitvorming binnen de ministeries. Echter, hoe nauw ook de banden tussen wetenschappelijk gebaseerde informatie en de inhoud van een besluit van een overheidsafdeling, wetenschappers vervangen nooit ambtenaren als beslissers. Er is geen automatisch en direct causaal verband tussen wetenschappelijk resultaat en ambtelijke beslissing.

Openbaar management in de twee sectoren laat ook verschillende voorbeelden zien van het belang van *routines* voor het gebruik van wetenschappelijke informatie. In de ambtelijke praktijk van de twee sectoren wordt *strategisch gebruik* van wetenschappelijke informatie voornamelijk omschreven in termen van de behoefte aan *professionele rechtvaardiging*, en niet in termen van de behoefte aan munitie in een politiek onderhandelingsproces.

Tenslotte

Deze studie heeft aangetoond dat onderzoekseenheden en wetenschappers, en de kennis en informatie die zij produceren, meerdere rollen en meningen hebben in de Noorse samenleving in het algemeen en in hun relatie met de staat in het bijzonder. De landbouw- en visserijwetenschappen hebben in de Noorse context, in de periode waarin deze studie is uitgevoerd (1990-1995), een rol als leverancier van "wetenschap in beleid". Ze hebben geopereerd onder een wetenschapsbeleidsregime met organisatie-arrangementen die het onderzoeksprofiel van de belangrijkste onderzoeksorganisaties in de twee sectoren koppelen aan de informatiebehoeften van de overheidseenheden in kwestie. Onderzoek binnen deze twee sectoren treedt in deze periode ook op in een rol als leverancier van openbare diensten aan cliënten in de sectoren, terwijl zij tegelijkertijd ook opereren binnen de wetenschappelijke institutie. Als gevolg hiervan bestaat een mengeling van academische, disciplinaire waarden en de cliënt/gebruik georiënteerde waarden.
Er zijn indicaties dat de specifieke mix van rollen in de relatie tussen wetenschap, cliënten en staat, waarop deze studie is gericht, aan het veranderen is. Er zijn bijvoorbeeld ontwikkelingen in andere nationale onderzoeksystemen die er op duiden dat ook het Noorse openbare onderzoek met betrekking tot de landbouw sector uiteindelijk meer marktgericht zal moeten worden. Landbouwkundige wetenschappers en hun organisaties worden al sinds enige tijd aangemoedigd om niet-traditionele bronnen van onderzoeksbekostiging te vinden. Dit is geïnterpreteerd als een indicatie dat de traditionele banden tussen politiek, landbouw en wetenschap losser worden, en dat het agrarische corporatisme aan belang en invloed verliest.

Dit kan wijzen op een fundamentele verandering in dit type van openbare sector onderzoek. Deze studie heeft inzicht gegeven in de relatie tussen wetenschap, cliënten en de staat in een gestructureerd en geinstitutionaliseerd systeem. Er is in de studie ook gewezen op de effecten van de kenmerken van zulk een organisatie en institutionele context op de kennisproductie en het gebruik van kennis. Als bekostiging en organisatie-arrangementen veranderd worden in lijn met een markt-model, kunnen nieuwe organisatie-arrangementen er voor zorgen dat de formele

banden tussen onderzoek en overheidsorganen losser worden. In een dergelijke situatie kan worden verwacht dat het type openbare sector onderzoek, dat is onderzocht in deze studie, in toenemende mate te maken zal krijgen met tegenstrijdige prioriteiten tussen zijn openbare dienstverlenende functie voor de eigen sector, zijn rol in het leveren van een kennisbasis voor nationaal beleid, en de noodzaak om gevoelig te zijn voor de eisen van betalende cliënten.

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