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**The Policy and Practice of Interdisciplinarity  
in the Swedish University Research System**

INGRID SCHILD & SVERKER SÖRLIN

*with contributions from*  
CAROLINA SIGFRIDSSON





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 **SISTER**



THE POLICY AND PRACTICE OF INTERDISCIPLINARITY  
IN THE SWEDISH UNIVERSITY RESEARCH SYSTEM



## PREFACE

This SISTER Report, *The policy and practice of interdisciplinarity in the Swedish university research system*, was commissioned by MISTRA, the Foundation for Strategic Environmental Research, in the autumn of 2001. The working team was Dr Ingrid Schild and Lina Sigfridsson, assistant. Professor Sverker Sörlin coordinated the project, co-authored the report, and as a specialist in environmental studies and a member of the MISTRA Board since 2000, provided well-informed insights into the subject matter. He has contributed to this report in the context of his role as an independent researcher at SISTER.

SISTER publishes all its project results, including those of commissioned projects. This report is one of several that SISTER has published on interdisciplinarity over the last year. Interdisciplinarity is an important but controversial aspect of contemporary science and science policy, we are therefore particularly pleased to be able to address the topic with new empirical material.

As with all SISTER reports, the content of this report is the sole responsibility of the authors and does not necessarily reflect the opinion of SISTER.

November, 2002

Dr Lillemor Kim  
Associate Director  
SISTER



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## COMMISSIONER'S COMMENTS

MISTRA's statutes stipulate that the Foundation is to fund research capable of solving key environmental problems. MISTRA-funded research should thus be mission-oriented. This naturally requires MISTRA to be an exception among research funders. Mission-oriented research can only flourish as part of a wider research scene, where ideas and inspiration flow from many different sources.

MISTRA-funded research aims to bridge the valley between academic research and the knowledge and expertise necessary for solving real world problems. We sometimes refer to a Death Valley – a valley littered with bones, skulls and skeletons, the bleak remains of frequently brilliant ideas that for one reason or another never made it across the Valley.

Donald E. Stokes, in his study of mission-oriented research, *Basic Science and Technological Innovation* (1997), uses a two-by-two matrix to illustrate the same basic thoughts. Let scientific excellence define the vertical axis. The horizontal axis represents usefulness, or considerations of use, of the research results. Stokes mentions the following archetypes: in the upper left hand quadrant one finds Niels Bohr. In the lower right hand quadrant one finds Thomas Edison. And in the upper right hand quadrant, where excellent science is primarily driven by the need to solve practical problems, one finds Louis Pasteur. Not for nothing is the book called *Pasteur's Quadrant*. MISTRA-funded research should aim for Pasteur's quadrant.

The MISTRA statutes are based on the assumption that research which is successful at solving environmental problems differs in some important respects from research aimed at identifying environmental problems. The latter may concern acidification, the bio-accumulation of a certain chemical, or the increasing concentration of CO<sub>2</sub> in the atmosphere; this research may take place within one scientific department and discipline. The former type of research may on the other hand aim at providing scientific input into complex multilateral negotiating processes; it may seek to identify and commercialize micro-organisms that can replace the pesticide; or develop and implement new CO<sub>2</sub> extensive energy technologies. In cases such as these, several different disciplines may be necessary, supplemented with expertise from patenting offices, venture capital, and so on.

MISTRA believes that meeting the terms of its statutes requires mobilizing all the different skills that are necessary for solving a particular environmental problem. For this reason, MISTRA needs to gain a better understanding of the conditions for mission-oriented research within the Swedish academic setting. This was the basis for MISTRA to commission SISTER to carry out a study on the conditions for interdisciplinary research in Sweden.

The conclusions of this study are not particularly encouraging. Acceptance of interdisciplinary research is high on the rhetorical level, as indicated by official statements from the government, university leaders and so on. But practice is different. SISTER illustrates the challenges facing those Swedish institutions which depend on the university sector's capacity for delivering solution-oriented research.

Some of the challenges are generic to the way academic research is organized, regardless of country. Disciplines have strong roots, and conducting research within well-established disciplines generally represents the shortest route to an academic career. This is partly

reflected in the fact that high prestige scientific journals tend to be intra-disciplinary. Further, interdisciplinary research tends to take more time, and to be intellectually as well as emotionally more challenging. As long as there is no explicit system of support for doctoral students wishing to dare the unconventional, very few will regard the extra effort worth their while.

SISTER's conclusions are echoed by a less ambitious but nevertheless telling report written by a group of doctoral students from a number of MISTRA programmes (*Aterväxten – en rapport från MISTRAs doktorandråd*), which also offers some suggestions on what MISTRA could do.

Other challenges are probably generic to the rather strict (not to say orthodox) way in which scientific research is organized in Sweden. Take the two-by-two matrix once again. The Swedish way of thinking is that excellence in the upper left hand corner, as measured by citation indexes and so on, will somehow by itself trickle down into applications. Many other countries have various kinds of institutions along the edges of (or within) the matrix, with explicit tasks to bridge the Death Valley. Germany, which arguably has the most thought through system, has a series of institutions along the edges (Max Planck and Fraunhofer Institutes). The Netherlands has RIVM; the US has various national laboratories; Norway has a number of environmental research institutes which combine research and monitoring. The Swedish idea reflects the concern that other forms of institutes would drain resources which would be more productively put to work within the universities. Institutes threaten universities.

Or at least the traditional universities. Medical faculties, institutes of technology, agricultural universities, and schools of economics tend to be more application-oriented than the traditional universities. This of course reflects their different historical roots and their continuing networks with industrial and other users of research.

MISTRA is currently undertaking a review process in which the first ten years will be scrutinized both in terms of whether the Death Valley actually has been bridged, and in terms of whether the research could be organized in other and more efficient ways. The review will be completed in the early fall of 2003, and the MISTRA board will formulate the strategy for the coming ten years or so, around the new year thereafter.

For MISTRA

Måns Lönnroth

## ACKNOWLEDGEMENTS

This study of the policy and practice of interdisciplinarity in Sweden was commissioned by MISTRA, the Foundation for Strategic Environmental Research. MISTRA supports strategic environmental research with a long-term perspective and with the aim of solving major environmental problems. The main part of MISTRA's funding, currently approximately 250 million SEK (ca. 28 million Euro) per year, goes to supporting broad-based interdisciplinary programmes.

Interdisciplinarity is gaining increased significance as science is asked to contribute to socially relevant issues and complex problem-solving, not least in the environmental arena. Yet little attention has been paid to the actual role of interdisciplinarity in achieving these goals. As a first step towards understanding more fully the merits and meanings of interdisciplinarity in this regard, it is necessary to take a further look at interdisciplinarity itself: How is it actually practised? Is it increasing? What is the driving force behind the emergence of interdisciplinarity in universities? What is the attitude to it, among researchers, university managers, and more particularly in MISTRA programmes and among their scientists?

In carrying out the research and fieldwork for this report we have enjoyed the support of many helpful administrative staff in a number of universities and university colleges: Blekinge Institute of Technology, Chalmers University of Technology, Dalarna University College, Umeå University, Uppsala University, and Örebro University. We are very grateful to them for providing background information and for assisting us during our site visits. We would also like to thank all our interviewees for taking time to talk to us, and MISTRA programme researchers for filling out questionnaires. Finally, it is our pleasure to express our gratitude to Carolina Sigfridsson, research assistant at SISTER, who collected basic data and kept notes during our site visits, and to Gina da Correggio, also at SISTER, who kept logistics flowing and made sure we arrived where we should and got back home in time.

Stockholm, November 2002

Sverker Sörlin, project coordinator  
Ingrid Schild

## ABBREVIATIONS

<b>BASTU</b>	Bantning avsedd för strategisk tillväxt av Uppsala universitet (projekt, Uppsala universitet)	Cut-backs to facilitate the strategic growth of Uppsala University (Uppsala University project)
<b>FAS</b>	Forskningsrådet för arbetsliv och socialvetenskap	Swedish Council for Working Life and Social Research
<b>FOI</b>	Totalförsvarets Forskningsinstitut	The Swedish Defence Research Agency
<b>FOOD 21</b>	MAT 21: Uthållig livsmedelsproduktion (MISTRA program)	Sustainable Food Production (MISTRA Programme)
<b>Formas</b>	Forskningsrådet för miljö, areella näringar och samhällsbyggande	The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning
<b>FRN</b>	Forskningsrådsnämnden	Swedish Council for Planning and Coordination of Research
<b>IVA</b>	Kungl. Ingenjörsvetenskapsakademien	Royal Academy of Engineering Sciences
<b>KK</b>	Stiftelsen för kunskaps- och kompetensutveckling	The Knowledge Foundation
<b>MiMi</b>	Åtgärder mot miljöproblem från gruvavfall (MISTRA program)	Mitigating the Environmental Impact of Mining Waste (MISTRA Programme)
<b>MISTRA</b>	Stiftelsen för miljöstrategisk forskning	The Swedish Foundation for Strategic Environmental Research
<b>RJ</b>	Stiftelsen Riksbankens Jubileumsfond	The Bank of Sweden Tercentenary Foundation
<b>SLU</b>	Sveriges Lantbruksuniversitet	The Swedish University of Agricultural Sciences
<b>SSF</b>	Stiftelsen för strategisk forskning	The Swedish Foundation for Strategic Research
<b>STINT</b>	Stiftelsen för internationalisering av högre utbildning och forskning	The Swedish Foundation for International Cooperation in Research and Higher Education
<b>SUHF</b>	Sveriges universitets- och högskoleförbund	Association of Swedish Universities and University Colleges
<b>SULF</b>	Sveriges Universitetslärarförbund	Swedish Association of University Teachers
<b>Urban Water</b>	Urbana VA-system (MISTRA program)	Sustainable Urban Water Management (MISTRA Programme)
<b>VINNOVA</b>	Verket för innovationssystem	Swedish Agency for Innovation Systems
<b>VR</b>	Vetenskapsrådet	The Swedish Research Council
<b>Vårdal</b>	Stiftelsen för vård- och allergiforskning	The Vårdal Foundation for Health Care Sciences and Allergy Research

## SUMMARY

This report investigates the extent to which the various parts of the Swedish university research system are pulling together towards greater interdisciplinarity. Do national policy initiatives foster greater interdisciplinarity at the local level of universities? How far is interdisciplinarity embedded in university practice, and what is the driving force behind the emergence of interdisciplinarity in universities? Further, what is the attitude to it among university leaders and researchers? These questions are particularly pertinent to the Swedish research system, where the basic research councils, along with direct government funding to universities, have dominated the research funding system for most of the postwar period, and where research activities outside the corporate sector are concentrated to the universities. To answer these questions, data on interdisciplinary policy and practice were collected at three levels of analysis: the political/policy level, the organizational level of the university, and at the grass-roots level of interdisciplinary programmes.

### *Interdisciplinarity at the policy, university, and project level*

The past decade has seen the introduction of national policy measures designed to encourage interdisciplinary research. These policies should be understood in the context of a broader attempt on the part of the state to increase the effectiveness of the research system, particularly in terms of wealth creation. The reason for the specific emphasis on interdisciplinarity is less clear, but can probably be largely explained by the dominance of the university sector in the research system, and its concomitant central place in innovation policy.

Universities appear to be priming themselves for a more 'interdisciplinary' outlook by instituting a number of types of organizational changes. These include: developing more flexible academic management structures; giving greater prominence to research groups and research centres; introducing performance-related systems for the internal allocation of government research funding; and tending to concentrate resources in specific profile areas of research strength. These changes may be interpreted as part of a process of adjusting to the new 'terms of trade' resulting from recent national policy reforms. But university differences in the nature and degree of changes introduced, show that they are responding to their changing circumstances in different ways, and in line with their particular institutional characteristics. In other words, there is a degree of path dependency in universities' response to their changing funding and policy environment.

In turn, universities' varying strategies for adapting to their more competitive environment, simultaneously constitute different modes of fostering interdisciplinarity, illustrative both of the centrality of interdisciplinarity in government policy and of the observation that interdisciplinarity is a differentiated form of research. Interdisciplinarity is, however, largely incidental to the prime motive for change, which is to create research environments likely to succeed in the external funding market. Some universities consider this to be best achieved by pursuing excellence in basic research, partly through facilitating 'science-driven' interdisciplinarity; others are keen to compete largely through promoting problem-relevant research, which often goes hand-in-hand with the 'problem-solving' form of interdisciplinarity. To the extent that the university changes described can be read as ways of responding to a changing policy environment, the various forms of interdisciplinarity

thereby fostered may be said to reflect a degree of ambiguity in the concept of interdisciplinarity at the national policy level.

At the micro level of research practice, the results indicate that the old tension between problem-driven interdisciplinary work and discipline-based academic career structures has not diminished. Difficulties of reconciling mission-oriented interdisciplinary work with academic careers, accounted for a certain lack of enthusiasm amongst the researchers for the interdisciplinary programmes in which they were involved.

### *Policy implications*

Swedish policy rhetoric appears to have appropriated 'interdisciplinarity' as somewhat of a catch-all for achieving a number of different policy goals for science. Policy focus on the responsiveness of the research system to interdisciplinarity is perhaps somewhat misguided. For not only does interdisciplinarity have many guises, but other phenomena are at least as important for explaining the research system's ability or otherwise to deliver on a broad range of research needs. One such set of phenomena is the mission and orientation of research institutions themselves. Research institutions and groups differ; not all are open to an interdisciplinary research approach; and among those which are, some are more adept at interdisciplinarity as in-depth basic science, and others at problem-solving interdisciplinarity. Funders would do well to pay heed to the mission and orientation of research institutions when selecting research partners. Research funding agencies whose goal is to solve extra-scientific problems, and bridge the gap between research results and applications, might consider seeking out other partners than traditional disciplinary-based academic actors.

## 1. INTRODUCTION

### 1.1 Aims and Questions

This study is an empirical inquiry into the policy, organizational context, and practice of interdisciplinary research in Sweden. Particular focus is on the extent to which, and how, the Swedish university research system promotes interdisciplinarity. Disciplinary research has enjoyed significant growth in Sweden since 1945, and disciplinary culture is strong, partly because the universities with their direct government funding, and the research councils, have dominated the publicly funded research sector throughout the postwar period. Yet significant research policy developments during the 1990s, such as the injection of foundation funds into the system, and toughened demands on universities to conduct 'third mission' work, might reasonably be expected to act as motors of change, reorienting academic life towards a culture more sympathetic to interdisciplinary interests. Certainly, hopes are now invested in interdisciplinarity as a way of making the research system more responsive to a range of politically identified needs, such as wealth creation and solving complex social and environmental problems. Policy-makers and funders, however, seem unconvinced of universities' current ability to deliver effective interdisciplinary research.

Against this background, it is of interest to ask to what extent the various parts of the university research system are pulling together in the same direction towards greater interdisciplinarity. Do initiatives at the policy level foster interdisciplinarity at the local level?

This question is addressed through a series of sub-questions posed at different analytical levels. Some of the questions receive more thorough treatment than others, but all play a role in guiding the study.

*At the national policy level:*

- How has the state framed its arguments for interdisciplinarity?
- What attempts has the state made to further the cause of interdisciplinarity?

*At the level of research funders:*

- Why do the foundations stress the importance of interdisciplinarity?
- What methods do funders use to achieve greater interdisciplinarity?

*At the organizational level of universities:*

- How deeply embedded is interdisciplinarity in the organization of research?
- What is the driving force behind the emergence of interdisciplinarity in universities?
- What kind of obstacles hinder greater interdisciplinary practice in universities?
- How significant is the question of interdisciplinarity when faculties and departments build up their activities?

*At the grass-roots level of research practice:*

- What is the attitude to interdisciplinarity among researchers and research managers?
- How do existing career incentives and reward structures relate to interdisciplinarity?

These questions are asked in an impartial manner; it is not the aim of this study to pre-empt or promote the cause of interdisciplinarity.

## 1.2 Modes of Interdisciplinarity

Different agencies, universities, and academics operate with different concepts of interdisciplinarity. Picking up on the research literature, we suggest the following main typology: a) ad hoc interdisciplinarity as an effect of normal scientific development in the disciplines; b) political interdisciplinarity motivated by demands for social relevance in areas such as environmental issues, sustainable development, third world and global issues; c) strategic interdisciplinarity motivated by industrial interests and the notion of knowledge-driven economic growth. It is not easy to locate these categories sociologically, but a rough attempt can be made. By and large a) is typically advocated by the research community, who argue that disciplinary skills are essential to any successful interdisciplinarity. Category b) is typically advocated by those with a strong sense of ethical commitment in their view of science, who may be within the research community or external to it. Finally, c) has advocates among practitioners, not least in the private sector, and among scientists working on the applied side. There is also a time-arrow in the emergence of the three categories, a) appearing already in the 1960s, b) thriving in the 1970s, and c) dominating the 1990s. It should be pointed out that these modes of interdisciplinarity are not necessarily mutually exclusive. Researchers developing a basically science-driven interdisciplinarity research framework may well give some consideration to potential applications, and an interdisciplinarity research framework for solving an extra-scientific problem may in part be motivated by basic research questions

This study draws on this general tripartite division, but it also adopts, throughout, an operational understanding of interdisciplinarity, as collaboration over traditionally understood disciplinary boundaries in some kind of, normally transient, organizational form. The study is also sensitive to how each group of actors in the system understands the concept of interdisciplinarity. It is not always the case, indeed far from it, that researchers, research planners, and the funding agencies involved have located themselves in any particular category or camp.

## 1.3 Data Sources

Data were collected at three levels of analysis: the policy level, the organizational level of universities, and the researcher level of MISTRA programmes. The policy context was mapped by drawing on policy documents of various kinds. These include, Swedish Government Official Reports (SOU), Government Bills (*forskningspropositioner*), and documents from funding agencies. Secondary literature was also drawn upon for this phase.

In order to map university-level policies relating to interdisciplinarity, data were collected from the following six institutions: Blekinge Institute of Technology, Chalmers University of Technology, Dalarna University College, Umeå University, Uppsala University, and Örebro University. These six represent different 'types' of institutions in the Swedish university system. Four are universities and two have yet to gain university status. Chalmers and Uppsala are old universities, Chalmers a specialized university of technology, and Uppsala a large, generalist university. Umeå is a modern, medium-sized, generalist university. Örebro gained university status in 1999, before which it was a regional subsidiary college of an established university. Dalarna University College is an upgraded college of further education. And Blekinge Institute of Technology is a new 'greenfield' regional college in the sense that it had little prior history when it was established as a

university college in 1989. The data sources for this stage of the study were university websites, official guidelines, policy statements, annual reports, and personal communication with administrators.

The four universities proper among the six, Chalmers, Umeå, Uppsala and Örebro, were subsequently studied in greater depth in order to analyse actual practice in relation to interdisciplinarity. Data collection at this stage was in the form of semi-structured interviews with university management, deans and vice-deans, and managers of interdisciplinary research centres. Twenty-five such interviews were conducted at the four universities in question.

In order to analyse interdisciplinary practice at the researcher level, three case-study MISTRA programmes were selected on the advice of MISTRA and studied in some detail. These are: Sustainable Food Production (FOOD 21); Mitigating the Environmental Impact of Mining Waste (MiMi); and Sustainable Urban Water Management (Urban Water). Interviews were conducted with the chairmen of the programme boards and with the programme directors of each of the three programmes. (The chairman of Urban Water was not interviewed.) A central question for this round of interviews was how interdisciplinarity is secured in the programmes. Second, an e-mail questionnaire was sent to all the active researchers in the three programmes. This questionnaire contained a small number of open-ended questions, yielding a qualitative data set relating to participants' experiences in the programmes. Of the 146 questionnaires sent out, 81 were returned, a response rate of 55%. As a complement to the e-mail questionnaire, in-depth interviews were conducted with two active researchers in each programme. The interviewees are listed in appendix A (p.55ff.), and the interview questionnaires can be found in appendix B (p.58ff.).

#### **1.4 Structure of Report**

The following chapter sheds historical light on the place of 'interdisciplinarity' in Swedish research policy. It traces the various emphases placed on different forms of interdisciplinarity since the 1960s, and asks what motives the state has for promoting interdisciplinarity. Chapter three outlines key changes in the funding and policy environment in which universities and other research performing agencies reside. In many respects chapter three forms a backdrop to the following two empirical chapters. Thus chapter four draws on the interview data to record current organizational changes in the four case-study universities. Focus is on the implications of the identified changes for interdisciplinary practice. Chapter five reports how project managers and researchers in three MISTRA programmes experience working on interdisciplinary projects in university settings. The final chapter draws together the main findings of the study and discusses the policy implications that flow from them.

## 2. INTERDISCIPLINARITY AND RESEARCH POLICY

### 2.1 Guises of Interdisciplinarity in the Postwar Science Debate

Interdisciplinarity is an old ideal, with roots in Renaissance polyhistor and polymath icons of learning, and in even older visions of religious and philosophical wisdom. The beginning of its modern career is, however, far more recent and connected to the development of threatening technologies and the use of science for technological warfare, in particular the nuclear bomb (Klein 1990).

Characteristically, interdisciplinarity was looked upon as an antidote to the dangers of specialization. In the 1950s, Kenneth Boulding, the American economist, formulated the first version of his long-standing critique of the tendencies of modern science, using the phrase 'specialized deafness' (Boulding 1956, 1978). It was the increasing specialization that made the scientist a dangerous social character, not only because the scientist risked missing important developments in other areas of knowledge, but more particularly because the use, and the ethics, of science were taken over by other powers in politics, industry, and the military - powers that made sure they had overview, and thereby control. It was in a similar vein that C.P. Snow gave his famous 1959 Rede Lecture on the 'two cultures', the scientific and the cultural. He lamented the gap between them, and saw a risk in it (Snow 1964).

Interdisciplinarity became the ideological recipe to cure this narrow-minded patient from his illness, an illness he did not, however, suffer too badly from. While criticism grew in the Boulding-Snow tradition - a kind of professorial grunting, in particular among the most senior and well-to-do members of the academic community - science itself thrived as never before, helped along by increasing grants from all corners of society, not least the military. Legions of new arrivals in the student movement also jumped on the critical bandwagon in the 1960s; they were surprisingly orthodox in their academic ideals, contributing to the anti-instrumentalist rhetoric of the older ranks. It may be argued that this tradition of political interdisciplinarity reached its peak around 1970. Since then it has certainly been around and delivered ideological references and rhetorical underpinnings to initiatives of various kinds - to build new centres of excellence, start cross-departmental courses and programmes, etc. But the interdisciplinarity that has been growing in the last decades of the twentieth century has by and large had other motives, although the general background of ideas should not be underestimated. This type is based on the observation made in the 1980s that science-based technologies were increasingly important, a notion that gradually grew into strategic interdisciplinarity.

In Sweden, as in other countries, the Boulding-Snow tradition sided with other tendencies such as an interest in social planning, environmental issues, and a general tendency to reorient universities and higher education for societal goals of a possibly more noble character than war and weapons. In its more articulate versions this resulted in the establishment of new centres for interdisciplinary studies, the first created at Gothenburg University in 1972, and a second one at the young Umeå University in 1974 (Abrahamsson et al. 1992). Both soon started new courses and programmes which were at times quite attractive, although marginal to the system at large. Linköping University, aiming to establish humanities and the social sciences on a campus heavily leaning on technology and medicine, found that interdisciplinary studies were indeed a more favourable route to take,

and state money was secured for a large programme under four 'theme' research areas (they have since doubled in numbers), linking an impressive array of disciplines into new research environments.

## 2.2 The State: Battling for Interdisciplinarity

At about the same time, in the mid-1970s, interdisciplinarity started to become an issue in official research policy. It is by no means clear why and how this occurred, although it seems evident that some of the general discussion entered into politics. The 1970s, particularly its first half, were years of considerable political turmoil, with energy issues and ecology high on the agenda. But it was also a period of change in the university system. In 1977 Sweden adopted a general university reform bill after more than a decade of commissions and inquiries, necessitated by a rapid increase in student enrolment and a growth in research as well. With the reform, a new agency was created, the FRN (Swedish Council for Planning and Coordination of Research), which had a special mission to initiate interdisciplinary research of high social relevance. Forecasting and research motivated by long-term social and technological change was high on FRN's agenda, and leading social scientists were given prominent roles in setting up new programmes that addressed important social issues.

FRN can be seen as a concrete manifestation of a certain distrust on the part of the state that the regular research councils would not be able to fulfil the demands for more interdisciplinary research (Sandström and Harding 2002a). This distrust has, by and large, been there ever since, expressed in government research bills and other government documents, and is one of the motives behind several of the most far-ranging research policy decisions since 1990. It is not too far-fetched to see the creation of the new semi-public research foundations in 1994, MISTRA being one of them, and the new state research funding system of 2001, as outcomes of an ambition to find political solutions to the perceived inability of the regular research performing system, the councils and the universities, to deliver on interdisciplinary research (Sandström and Harding 2002b).

Both sets of institutions, the new semi-public foundations (the largest of which are KK, MISTRA, the new division of RJ, SSF, STINT, and Vårdal) and the new 2001 research councils (VR, FAS, Formas, and VINNOVA) were given explicit missions to work in an interdisciplinary fashion (for abbreviations see list on p.8). With the foundations it was written into their statutes, and was expressed clearly in the governmental process. With the new research councils, it was an explicit ambition to create institutions capable of targeted, massive funding of emerging research areas and technologies, to avoid the risk, often observed in the Swedish system, of under-critical funding of new areas and over-funding of old, and of diluting the value of funding because of diminutive grants. The new agencies were supposed to give out handsome support to those who deserved it. Though whether this implied more money for interdisciplinarity, is an open question.

One may still want to know more about why the state took it upon itself to articulate this distrust so often and with such persistence, both in social democratic and in centre-right governments. One quite obvious factor is that interdisciplinarity is an ambiguous and evasive concept which is hard to account for and which in practice appears in several quite distinct forms (Sandström and Harding 2002a), and indeed with sometimes clashing agendas. It is, however, quite evident that it was not just a matter of anti-specializing

rhetoric. Most, if not all, of the governments in question have been decidedly pro-science in the post WWII Swedish tradition.

We do not have the answer (more research is needed on post-1970 Swedish research policy), but some reflections may be relevant. First of all, it seems obvious that the government's concern was primarily to do with the societal effects of research rather than the quality of the research itself. In 1984 the Minister for Research, Ingvar Carlsson (who was to become Prime Minister in 1986) said that the new computer sciences lacked a natural 'home' in the university and thus also lacked adequate funding. A government research bill of 1987 forwarded the idea of 'interdisciplinary environments' as important for the future. The same year the Minister for Industry argued for interdisciplinarity as a factor in innovation and competitiveness, albeit based in the disciplines. The 'freedom reform', propagated in the government research bill of 1993, was motivated by the need to break up from old trenches and build new structures, with less centralist (meaning 'socialist'; these were the Unckel years) dictates to bend under. Winds of change blew in the direction of interdisciplinarity. All in all, however, there were more demands in the government research bills of the 1970s and 1980s than there was evidence of anything really happening on the shop floor. Which was why the demands were repeated.

So, why? One may say that Sweden has not been unique in this regard. Other countries have also had governments demanding interdisciplinarity. But our impression is that this tendency became stronger in Sweden than in most countries, as if there was a lack of confidence at the political level that the universities would deliver the expected product. There is, however, a logic to this which has to do with the unique character of Sweden's research system: it had closed the door to institutes. The institute sector in Sweden grew until the 1960s and has not expanded since then; public research funding has by and large been directed to the university sector. This has been a conscious policy against which little protest has been heard. There was no single decision taken, rather there was an understanding that emerged gradually and that also spread to industry, in particular from the early 1980s, when it spread to other sectors beyond telephone and communication systems (Ericsson), pharmaceuticals (Astra), and electrical systems (Asea).

In 1980 a public inquiry coined the phrase that universities were to serve as 'society's research institute' (*samhällets utredningsinstitut*) (SOU 1980:46 p.42). This has ever since served as the ideological backbone of a policy which, in principle, makes sure that research funds from any state sector ultimately reaches a university or a school of technology, medicine, or agriculture (defence has been the big exception with a relatively large sectoral institute, FOI). The proportion of public funds funnelled to universities has regularly been above 80 per cent ever since the 1970s. Behind this reasoning is of course a core of linear model thinking, sprinkled with a *Beamten* ideal of the academic profession, a thinking that maintains that basic science is the innate and original driver of all technological change and that this science should be performed in Sweden where it is also to be utilized in innovations and industry.

Our interpretation is that the proactive interdisciplinary stance of Swedish governments is an indirect consequence of this policy of basic research. The results in basic science have been remarkable and impressive; Sweden climbed the ladder of the Science Great Powers and rose to the very top, during precisely the same period, c.1970 to the late 1990s, that the country suffered a relative decline in economic performance, with sliding growth. Performance in science has not been matched by a similar level of innovation in high-tech

sectors; if the policy had worked, the outstanding research results ought to have created a bustling combination of new companies, jobs, and a growing share of the national income from emerging economic sectors. That has not happened, at least not on a scale comparable to the input of public and private research funding (Edquist and McKelvey 1998, Henrekson and Rosenberg 2000). As a consequence, it should come as no surprise that politicians have felt increasingly eager not only to argue for, but in recent years also to take action in favour of more substantial interdisciplinarity.

But let us go deeper. Again: why? Why interdisciplinarity? It is by no means evident that interdisciplinarity is the key solution to increased relevance and the driver of strategic technologies. How that belief entered research policy is still a question open to further research (but see Granberg 1987 for an early discussion); yet it seems to have arrived in the 1970s and become particularly apparent in the 1980s and 1990s. And it should be recalled that it is a belief, an unsubstantiated hypothesis, albeit a quite reasonable one. The best suggestion we can provide, based on present knowledge, is that interdisciplinarity grew at the same time and at the same pace as governments began to recognize the increasing significance of science-based innovations for economic performance. This notion had grown with the human capital school in the OECD in the early 1970s and became widespread in the 1980s, spurred also by the success story of Japan and its Ministry of Trade and Industry.

Science-based innovation and competitiveness became a 'double helix' of economic success. But in most countries, this development was met with less anxiety than in Sweden. Here was the one country that had transferred all its trust in technological progress to the universities. Did it matter that the universities did not heed the new gospel of efficiency? Did it matter that they did not adopt a problem-solving ethos, aiming for hot new technologies in the spirit of the old Swedish inventor-Pantheon of the Ericssons, Wenströms, and Johanssons? Did it matter that academic degrees and high impact scores in science journals did not provide the increasingly problem-ridden Swedish industry with what it needed in terms of new and improved products and processes? The questions are rhetorical: it mattered, but it did not, for a very long time, matter much to the universities.

Further evidence of the distrust between government and the research community became manifest in the research policy discourse of the 1990s (Benner 2001). This was taken to its most extreme in the middle of the decade, a period of severe economic downturn and state budget crisis. The universities and in particular the research councils were not entirely saved from budget cuts. More importantly, the government proposed that the universities' 'third mission' to cooperate with industry and society at large, be made law, and this was adopted by Parliament in 1997. In the same year, the research councils were given new directives to report back to the Ministry of Education on their efforts to promote interdisciplinary research. And, as already noted above, the research council reform of 2001 was motivated in large part by the perceived need to open up new interdisciplinary research areas, and to focus and coordinate research and reallocate funding (the three catchwords are: 'concentration, renewal, interdisciplinarity', '*kraftsamling, förnyelse, tvärvetenskap*'). In fact, the distrust is in part unwarranted. The few studies that exist indicate that the research councils do not seem to discourage interdisciplinarity, and that interdisciplinary projects get approximately as much funding as any other project of similar quality (Sandström and Harding 2002b). If interdisciplinary projects do not thrive in the research council environment, it is because the research community does not provide more proposals.

The research performing system can in fact point to a number of arrangements and activities over the last thirty years – we shall return to what they are – to foster interdisciplinarity. Even the research councils, bastions of orthodoxy as they undoubtedly have been perceived, can prove their willingness to comply, if not more: some of the hot research areas which councils have been spearheading have been interdisciplinary. But the state wants more. The state wants real action to lift the nation. It wants economic growth on the average OECD-level, at least. It wants the university system to take responsibility on a scale that the latter is unlikely to want to, or to be capable of, unless its fundamental modes of operation and norms (in the Mertonian tradition) are changed through substantial political intervention.<sup>1</sup> And this again is something that the government (as it repeats over and over to the academic community) has no intention of doing. And when occasionally it does, as was the case during Carl Tham's years as Minister for Education and Research in 1994-98, tensions between government and academia increase.

With 'post-academic' norms (Ziman 2000) entering the system, this whole logic may change. Indeed, we believe that some of the changes in practice, observed in the empirical sections of this report, follow the post-academic pattern, although in an early emerging phase.

### 2.3 The Universities' Rhetoric of Interdisciplinarity

What have universities done in relation to the official demands for interdisciplinarity? It is hard to answer this question, simply because until the 1990s, universities did not spell out their policies very well. Their intentions are visible in budgetary documents and annual reports to the government. But universities were, and are, government authorities, organs of the state, with no real policy of their own.

However, with the decentralizing reforms and with competition gradually built into the system over the last 10-15 years, universities have become more articulate on their own futures. Policy documents, almost unheard of before 1990, are now commonplace and grow ever more sophisticated. The thinking behind them is also more coherent and independent. There is still a considerable tendency to 'follow the herd' – which is unsurprising, given that they all operate within the same national funding and regulatory system – but individual variation has increased. Innovativeness is perceived to confer a comparative advantage, and new centres and labs are popping up along with new programmes with fancy names, often in rare and strange combinations of fields.

In this local policy process we have found clear evidence of interdisciplinarity being not only accepted, but openly advocated and even boasted about as a prime feature and fundamental academic concern of a particular university or university college (see appendix C for examples and quotations). However, language varies, as may commitment to the gospel. An overall observation is that smaller and more recent universities and colleges tend to be more eager in their willingness to declare adherence to the official policy of

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<sup>1</sup> The social norms or 'institutional imperatives' which functionalist sociologist of science Robert Merton identified as distinguishing the scientific community from other social groupings are: universalism, communality, disinterestedness, organized scepticism, originality and humility (Merton 1973). Sometimes referred to as the CUDOS-norms, these provided a foundation for further sociological interpretation of the internal social processes of scientific development.

interdisciplinarity. Older and larger universities tend to be more modest, not necessarily because of lack of commitment, but rather in a rhetorical status game, where it is as important for them to show that they are unwilling to serve as anybody's instrument, as to actually declare what they want and why. Thus whilst Chalmers admits to a strong commitment to interdisciplinarity in the early 2000s, it still uses the word with some caution because, as one senior administrative officer told us, 'everything is interdisciplinary these days, we don't have to spell it out all the time'. The intention is presumably to give the impression that it is the government that is lagging behind with its flimsy talk and niggardly, intrusive proposals. We shall return later to this tendency, which is certainly evident in the current situation.

All in all, though, there is no reason to believe that universities, if they are to be taken at their word, have anything to say against interdisciplinarity. But it is hard to know whether they mean what they say. As we have seen, government and parliament appear to have high hopes for the potential of interdisciplinary research to deliver on a variety of research needs. Further, there are clearly strong internal scientific arguments for more interdisciplinarity. But owing to the difficulty of distinguishing between motives for interdisciplinarity in university policy statements, we find it necessary to conduct an empirical study of the practice of interdisciplinarity on campus, which is done in chapter four.

## **2.4 The Contrasting Agendas of the Funding Agencies**

A few words also need to be said about the missions of the funding agencies, which are truly diverse. Generally speaking, old money in the Swedish research funding system has a low level of mission specificity, and new money a high level of mission specificity.

State budget funds are allocated according to tradition rather than according to any specific rule of government. This has not always been the case. Until recently, the state was quite particular in its resource allocation; in fact, it guaranteed each professor a lifelong salary by government-decision, and a university could not easily reallocate that resource. Since the 1990s, the entire system of professorial appointments, as well as those of all other university faculty and staff, has rested with the local university, its board and rector. The government now gives broad-brush grants to four 'science areas' (technology, science, medicine, and humanities and social sciences). Universities can reallocate money within each of these areas at their own discretion (though they do not tend to do so to any significant extent), and they can reallocate three per cent annually between 'science areas'. The best way to describe the funding pattern of the core-grants from the state is still to say that the money goes to professorships in disciplines and to postgraduate and postdoctoral grants in the same disciplines.

Other old players in the system are the research councils, with an equally strong commitment to supporting basic research. As we have seen, that basic research can indeed occur across established disciplines. But in the 1990s the former Natural Science Research Council still allocated less than ten per cent of its funding to projects straddling two or more of its sixty-plus sub-fields (Sandström and Harding 2002b). Governmental directives to the councils do signal an encouragement of more interdisciplinary funding, in line with the thrust of national policy. On the whole though, the research councils' statutes and directives do not stipulate with any level of precision how they are to allocate their funds, such that they are largely free to do what they want. Path dependency and strong internal

demands from review committees and suchlike have served to maintain a strong disciplinary funding pattern, at least up until now.

Interestingly, a similar observation seems to hold true for the sectoral research money that grew considerably in the 1960s through to the 1980s. One would perhaps have expected this money to have boosted the establishment of interdisciplinary research centres catering for societal problems and knowledge needs. Although research in the area is still scarce, it seems rather that with time, sectoral research funds were subsumed under the academic research norm system and became, *de facto* if not *de jure*, part of a regular departmentally-based research agenda in the universities (Edqvist et al. 1995, Svensson 2001, Edqvist 2002).

A general observation, then, is that whatever their origins, university funds tend to be allocated according to the university's internal organization, and by implication used mainly in ways that support the (academic) interests and agendas of that organization. And given the universities' pivotal role as research performers, funding agencies have had no realistic choice in this regard. But one actor has opted out: private industry. Swedish firms, regardless of size and sector, have not increased their funding in the university system (industrial funding of publicly performed research remains static at approximately four per cent). We do not know why, but we do know that firms have chosen to perform their research themselves, by substantially increasing their R&D budgets in the last two decades (though only in a relatively narrow range of sectors). It is tempting to hypothesize that private industry is unwilling to substantially fund a system whose ways of working do not square easily with the research needs of firms. State agencies have not been given the choice of opting out, restricted as they are by policy, or by budgets too small to allow them to act independently. Three decades of sectoral research, mostly undertaken in the universities, have yet to be evaluated, so we do not know the extent to which this research has been undertaken in an interdisciplinary way, but even without research in this area, it is clear that it is a small share.

Against this background, new funding agencies with stronger mission-statements and binding statutes, which include interdisciplinarity as an explicit method to achieve their goals, are likely to bring about some change, or at least cause some disturbance in the system. Foremost of these actors are the new research foundations, originating in the dissolved 'employee investment funds'.<sup>2</sup> European Union funds, increasingly open to Swedish researchers after membership in 1995, and the reformed research councils of 2001, point in the same direction. These actors are now shaping a new funding landscape, with possible implications for interdisciplinarity, a landscape to which we shall now turn.

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<sup>2</sup> These new foundations are known as *löntagarfondstiftelserna*, the 'employee investment fund foundations' in reference to their origins. 'Employee investment funds' refers to capital derived from company profits, which, from the early 1980s, labour unions were permitted to invest on the stock market. The centre-right Government of 1991-1994 dissolved these funds, and established a number of research foundations with the capital.

### 3. A CHANGING FUNDING AND POLICY ENVIRONMENT FOR THE UNIVERSITY SECTOR

#### 3.1 The Traditional Academic System

The traditional academic system is discipline-based. And disciplinary culture is strong, featuring what Tony Becher has so tellingly described as its 'academic tribes and territories' (1989). The full implications of this observation should not be underestimated; the strength and the status of disciplines are deeply rooted, and Sweden is no exception. The centralized system, with governmentally appointed professors endowed with personal chairs, certainly created the image that there was indeed a higher authority that had ordered reality for research in a given discipline. This system was further reinforced by the idea that professors had a virtual monopoly on research training in their discipline, selecting students at will and training them the way they felt best.

Departments were created around the chair, the incumbent of which was typically head of department and chair of the departmental board, and also selected students for the postgraduate research degree courses which he led; thus virtually all the academic power was collected in the hands of one person. The faculty, a decision-making body made up of a number of authoritative professors, each representing his discipline, was not inclined to interdisciplinary initiatives. The typical pattern in the 1970s and 1980s was that interdisciplinary initiatives were regarded with much scepticism, and in so far as they were accepted by the university, they were almost invariably poorly funded. The evidence for this is scattered, but it seems that whilst such initiatives had to make do with a little seed money and perhaps a small amount of core-funding, growth in the disciplines, and even the creation of new disciplines, was rarely an issue.

This led to another feature typical of interdisciplinary units in Swedish universities: in order to survive as research institutions they had to become excellent fund-raisers.<sup>3</sup> They were typically only granted a minimal amount of faculty core-funding, if any at all, though they did sometimes benefit from grants bestowed directly by the university rector or board, who considered the long-term interest of the university to be well-served by the new interdisciplinary activities.

There is no systematic research on how interdisciplinary centres in Sweden operated between the 1970s and 1990s, but we have the impression that they were commonly administered directly under university central administrations or university boards, probably in a bid to protect them from the harsh funding climate of the faculties. This was certainly the case for the Gothenburg centre for interdisciplinary studies and its Umeå counterpart, as well as for several of the centres for women's studies established in the late 1970s and early 1980s in Gothenburg, Uppsala, Umeå and elsewhere. There were exceptions however. At Umeå University, for example, some of the growing number of interdisciplinary research centres were administered under faculty umbrellas, including the Centre for Arctic Cultural Research (Arts) and the Centre for Regional Science (Social

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<sup>3</sup> Information supplied by Chalmers, Umeå and Uppsala Universities on the funding of their research centres certainly seems to bear this out.

Science), the latter with earmarked funding from the government, a core-grant which the Faculty Board has not increased in almost two decades.

This pattern seems to be internationally valid. A study of three American and three European universities, some of which have sizeable units for interdisciplinary research (notably Bielefeld in Germany), demonstrated that regardless of the level and quality of the interdisciplinary work, the latter was invariably funded by external sources. The author of the study goes on to comment that he had 'not seen any case where the university on its own has stepped in and funded an interdisciplinary centre or institute [of any magnitude]' (Stolterman 1996 p.42).

Universities' attitudes towards interdisciplinarity, as described above, are historically intertwined with the nature of academic career structures. And the latter seem to offer few incentives – indeed in some respects provide active disincentives – to established and young researchers alike who might otherwise have sought to pursue an interdisciplinary academic career path. Thus our document and interview data relating to university practice at the six universities and university colleges, yielded scant evidence of any reward systems (in salary or tenure terms) or appointment systems designed to encourage interdisciplinary work. In this sense, a disjuncture may be observed between universities' policy announcements which indicate that they are positively disposed towards interdisciplinarity (chapter 2 section 2.3), and the hiring practices and incentive systems in place at the faculty, departmental, and research group level.

In short, interdisciplinarity in the university setting is something that academics cannot be against, but that they can avoid doing. Career paths and regular positions in departments and faculties tend to be inextricably bound up with the disciplinary structure. We found very few examples of positions funded by faculty funds which were not based in a disciplinary department. That is not to say that they do not exist, but they have not been reported to us, and we can say with some confidence that they are not very numerous. The message to young scientists and scholars is clear: if you want to succeed in this system, you should work in a discipline.

Added to this formal lack of incentives to pursue interdisciplinary work in the university system, are the strongly entrenched informal aspects of disciplinary culture, which serve to inhibit a more interdisciplinary outlook among academics. As we have already seen, academic behaviour is to some extent universal (Merton 1973) (footnote 1 p.18), but it is also local, moulded in a rigid cast of the discipline and paying scant attention to the realities, theories, and readings of other fields. Disciplines have their cherished methods, their founding fathers, their saints and heroes, and their standard texts, journals, and conferences; identities, even ideologies, are rooted in disciplines (Becher 1989). But disciplines are not static; as a consequence of the general growth of knowledge and of social and scholarly 'boundary work' (Gieryn 1983, 1995), disciplinary boundaries are under constant tension and renegotiation, only to be reproduced in ever new forms. The growth of knowledge and of universities does increase differentiation, but the resulting new academic units tend also to emulate the *modus operandi* of existing units. As Hollingsworth and Hollingsworth observe, 'academic departments are inherently socially conservative and tend to select people who reproduce their thinking' (2000 p.244). This is not to suggest that the individual, curious researcher has no interest in grasping the insights of other disciplines, but given the competitive environment, most academics tend naturally

to seek the safest career path rather than trying the 'road not taken', to cite Robinson Jeffers' famous poem.

The effect of the conservative nature of academic career structures on interdisciplinary work is compounded by a set of disincentives which are inherent in the very nature of interdisciplinary work. Studies of large multidisciplinary research projects show that their considerable advantages in terms of results and networking, are at times outweighed by the sheer workload entailed. One such study empirically identifies three types of work which increase with project size and degree of interdisciplinarity (Schild 1997). 'Production work': collecting and analysing data and disseminating results, is likely to expand because there are more measurements, more methods, and more comparative work involved. 'Articulation work' is a pronounced feature of multidisciplinary collaborative projects; this refers to the work of pulling together everything that is needed to carry out production tasks: planning, organizing, monitoring, evaluating, adjusting, coordinating, and of course integrating activities. Such 'articulation' tasks are exacerbated in multidisciplinary projects by the need to combine several scientific perspectives, and undertake mutual learning in the face of differences in research training and in ways of working. Finally, 'emotion work', entailed in the construction and maintenance of interpersonal relations, is likely to be a feature of multidisciplinary collaborative projects, owing to possibly vulnerable relationships between researchers from different disciplinary cultures, who may not have worked together before, and who may have different motives for joining a project.

### **3.2 Recent Developments in the University Funding and Policy Environment**

As a culture with its own values and practices, the traditional academic system is, in many respects, still in place, and is unlikely to change very quickly. However, as we shall see in the following chapters, change can be discerned, and this seems to be an international phenomenon. Such change may well be spurred on by the recognition that interdisciplinary research environments actually tend to perform well. This is demonstrated, for example, in a study of the organizational origins of a set of major discoveries in biomedical research (Hollingsworth and Hollingsworth 2000). This study found that these discoveries occurred more frequently in research environments characterized by diversity, interdisciplinarity, and strong, nurturing leadership; environments in fact that are more typical of integrated programmes and interdisciplinary units attached to universities, than of ordinary departments, whose path-dependent tendencies may not be conducive to very innovative research.

As a backdrop to the following chapter's observations on recent changes in the Swedish university sector with a bearing on interdisciplinarity, this section describes some important developments in the policy and funding environment in which universities and other research institutions reside. Some of the main policy changes have been touched upon above (chapter 2 section 2.2, see also Benner 2001 for an overview).

The policy changes affecting universities include: the introduction of a performance-related funding system for undergraduate teaching in 1993; an efficiency-oriented reform of postgraduate education in 1998; reform of the faculty career-structure in 1998; and in 1997, universities became bound by law to fulfil their 'third mission' of communicating and cooperating with the community at large.

On the research funding side, a number of new mission-oriented research foundations (of which MISTRA is one) were established in 1994, with the explicit aim of stimulating the Swedish economy, an injection of capital made possible by the centre-right government's decision to dissolve the so-called 'employee investment funds' (see footnote 2 p.20). From 1997, research councils were required to report to the Ministry of Education on their interdisciplinary activities. And in 2001 the entire research council system was reformed (see pp.15 and 17). Further, the Ministry of Education and Research has indicated that in the future, a greater proportion of public research funding will be funnelled through the research councils. This is likely to lead to a more competitive funding structure, which will in turn spur the already discernable tendencies towards specialization and differentiation in the university sector.

In 2001 the Government announced its intention to reform the research institute sector, a discussion which has a bearing on the division of labour between universities and institutes. At about the same time, interested non-governmental parties, notably the Academy of Engineering Sciences (IVA), were also beginning to take a renewed interest in the R&D potential of the institute sector. The government's innovation bill of 2001 *R&D and Collaboration in the Innovation System* (Prop. 2001/02:2) proposed that the role of the institute sector be strengthened, both through structural reform, and by enhancing the economic efficacy of the sector's research output. These reforms would be accompanied by moves to encourage institutes to play a more central role in their respective industrial sectors. Despite these announcements, the future of the research institute sector and the consequent institutional division of labour in the research system is difficult to predict.

#### *Research funding in the higher education sector*

The overall nature and composition of university research funding in Sweden has changed during the 1990s, in large part as a (both direct and indirect) consequence of the introduction of the new semi-public foundations with very specific agendas. The university research community – in so far as it is represented by the views of its union SULF, by the Association of Swedish Universities and University Colleges (SUHF), and by the Swedish Research Council – has voiced its concern over what it interprets as a change for the worse, an attrition of research funding (Sveriges universitetslärarförbund 2002). Actual figures, however, only partially vindicate these organizations' concerns.

The figures show that, in fact, between 1993 and 2000, the university sector enjoyed a net increase in research funding of the order of three billion SEK, or almost 20 per cent (Figure 1). Over this period, direct government funding of university research has remained stable, and research council funding has actually shrunk, but the various sources of external funding have all grown. These external sources comprise: private non-profit foundations, among the most important of which are the Wallenberg Foundations, the Swedish Cancer Society, and the Crafoord Foundation; the new semi-public research foundations; public agencies and European Union funds; contract research; and a general 'other' category which includes donations, local and regional funds, and stipends. The funding from the semi-public foundations represents an entirely new funding source which came on stream from 1994/95; in 2000 these new foundations funded university research to the tune of approximately 1 billion SEK (Hällsten and Sandström 2002 p.82).

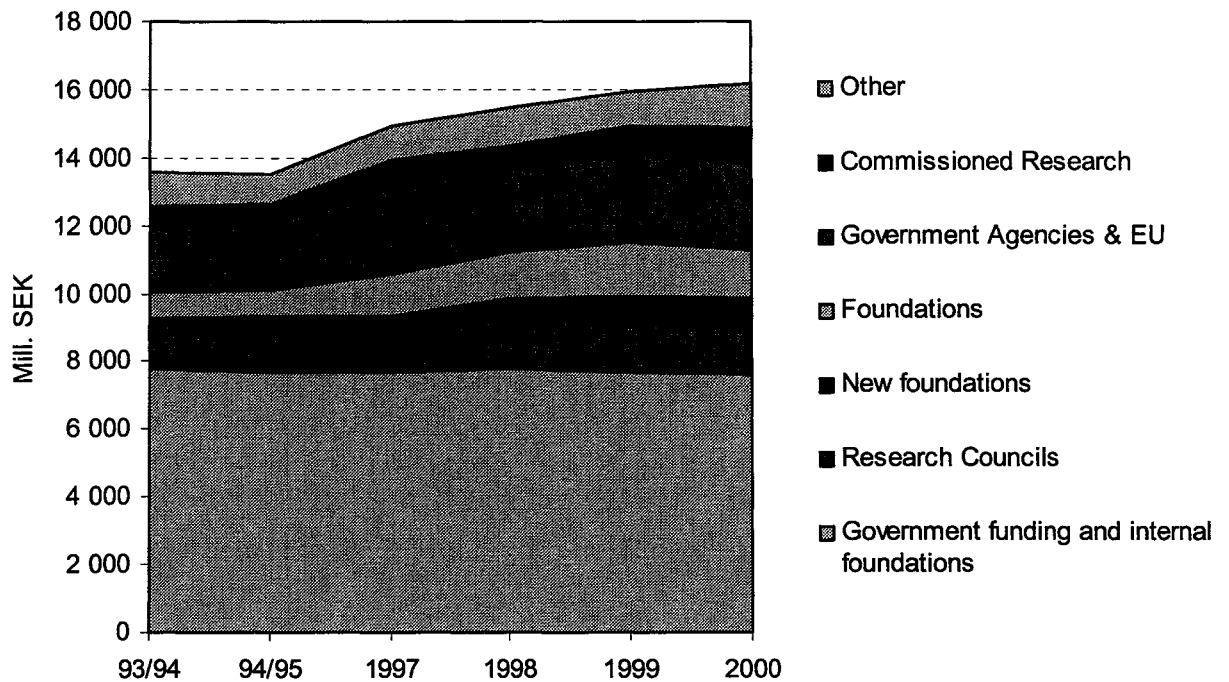


Figure 1. Research funding in the Swedish higher education sector 1993-2000 by source of funding. Figure from Hällsten and Sandström (2002)

As well as revealing an overall increase in university research funding, actual figures also show that an ever-decreasing share of university research funding is accounted for by government core-funding and the research councils – the very two funding sources which permit the greatest degree of researcher autonomy in the allocation and use of resources. It is on this point that the research community's critique of the funding situation may well hold up to scrutiny. The observed dwindling share of government core-funding of university research is an international phenomenon – in Sweden caused by the increase in foundation and public agency funding, and in other countries often a result of increasing levels of contract research – and as such warrants some discussion.

Levels of external funding in a research system might well be expected to be positively associated with research productivity and impact scores; for example through the effect of increasing competition for the available research funding. The Swedish university system has the lowest share of government core-funding amongst the four largest Nordic countries (Figure 2); it also has the best overall research performance, as measured by conventional output indicators. And in a context in which the Finnish and Danish university sectors are experiencing declining shares of core research funding, these countries' research performance is rapidly catching up with that of Sweden. There is evidence of a positive correlation between levels of external funding and research performance at the university level also (Krull 2000, Jonsson and Sörlin 2002).

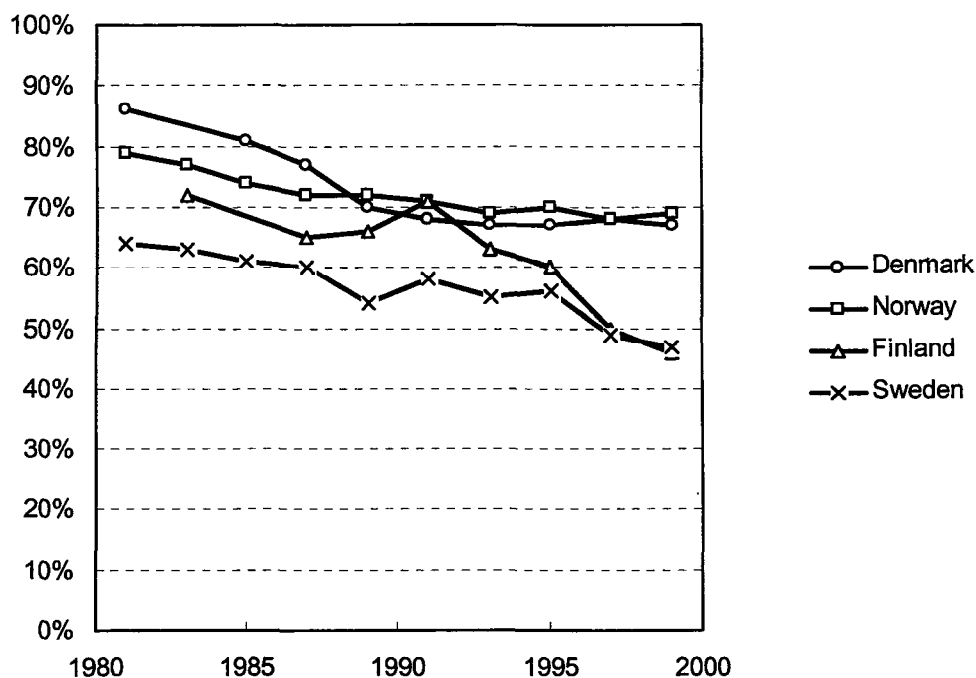


Figure 2. Government core-funding as a share of R&D expenditure in the higher education sector in the Nordic countries, 1981-1999.  
Sources: OECD *Basic Science and Technology Statistics 2001* and national R&D statistics.  
Figure from Kim (2002).

Despite these observations, and as mentioned above, universities and researchers' organizations have voiced their dissatisfaction with the current research funding structure, and particularly with the increasing levels of external university research funding. Not only does the latter entail a relative weakening of the forms of funding traditionally earmarked for so-called curiosity-driven research, but more seriously, high levels of external funding tend to undermine the value of the existing core university funding. This is because some external funding agencies, notably the European Union and the new research foundations, operate policies of co-funding; that is, recipients must match their grants with additional funding from other external sources such as industry, or indeed from existing university resources. In the latter case, the effect is of course to undermine the qualities of the core-funding – the very funding which has to some degree protected the independence of universities as research organizations.

A further development which seems to undermine the impact of government research grants to universities, and against which the research community has protested partly for this reason, is the sharp increase in student numbers without a comparable increase in teaching budgets. Block grants for teaching and research are in principle separate, and developments in one sphere should not in theory impinge on activities in the other. Reality however suggests otherwise. Undergraduate teaching is comparatively poorly funded, those who teach are expected to do more in the same amount of time. And those who teach are often those who also research. As teaching time is inflexible and research time tends to be fluid, it is inevitable that in the *mêlée* of everyday life, teaching at times eats into research time, with possibly adverse consequences for research productivity, and

tending to increase frustration among faculty members. Though evidence for this is almost entirely anecdotal, the experience seems sufficiently widespread to suggest a degree of substance to the observation.

## 4. ADJUSTING TO CHANGE: UNIVERSITY RESPONSE AND ITS IMPLICATIONS FOR INTERDISCIPLINARITY

This chapter focuses on five key areas of university policy and practice to ask whether and how universities are priming themselves for a more interdisciplinary outlook. By the same token, the chapter also shows how universities are responding to the changing external conditions outlined in the previous chapter. The five areas of university life focused on, and through which interdisciplinary policy and practice at four universities are traced, are: the formal organization of academic activities; policies towards research centres; practices of allocating core-funding; the development of research profiles; and recruitment practices. The findings recorded here draw largely on interviews conducted with senior academics and managers at Chalmers, Umeå, Uppsala, and Örebro Universities. As mentioned in the introductory chapter, these four universities represent different types of institutions within the Swedish university system (p.12). A short note on each institution follows, both to outline their main organizational features, and to clarify some of the terminology used to designate their organizational units.

### 4.1 The Four Universities

#### *Chalmers University of Technology*

Chalmers was established in 1829; it became a foundation 1994. The University has approximately 8,200 undergraduates, and a staff of 2,445, of whom 1,577 are teaching/research staff and 141 are full professors. As a specialized university of technology, Chalmers has only one faculty. Its academic activities are organized in a number of *schools (sektioner)*. Each school, of which there are ten, is headed by a dean, and each has a number of *departments (institutioner)*, and some departments have a number of *divisions (avdelningar)*. Some departments are administered jointly with Gothenburg University. There are also research centres both in and outside the schools (Chalmers University of Technology n.d.). More information on Chalmers can be found in appendix C (p.63ff).

#### *Umeå University*

Umeå University was formally established in 1965. The University has approximately 25,300 undergraduates, 1,300 doctoral students, and a staff of 3,679, of whom 245 are professors (as of December 2000). It has five faculties: Arts, Medicine and Odontology, Social Sciences, Science and Technology, and Teacher Education; each is led by a dean, and each has a number of departments. There are a number of research centres both in and outside the faculties (Umeå universitet n.d.). More information on Umeå University can be found in appendix C (p.67ff).

#### *Uppsala University*

Uppsala University was established in 1477 and is the oldest university in the Nordic region. Its student body numbers 36,000 undergraduates and 2,300 research students. It has a staff of 5,500, of whom 3,000 are teaching/research staff. The University has nine faculties: Theology, Law, Medicine, Pharmacy, Arts, Language, Social Science, Science and Technology, and Education and Teaching Professions. Since 1999, these faculties have been organized under three *disciplinary domains (vetenskapsområden)*: Medicine and Pharmacy;

Science and Technology; and Arts and Social Sciences. Each disciplinary domain is led by a domain board with a vice-rector as its chair. The Medicine and Pharmacy Disciplinary Domain has two faculties (Medicine and Pharmacy) with their own departments and centres. The Arts and Social Sciences Disciplinary Domain has six faculties, most of which have a number of departments and research centres. The Science and Technology Disciplinary Domain is also a faculty and appears to be moving towards an institute of technology model: it has six *sektioner*, which in English it calls *divisions*, and which seem to be broadly equivalent to Chalmers' *schools*. Each *division* has a division dean and a number of departments and centres (Uppsala universitet n.d.). More information on Uppsala University can be found in appendix C (p.68ff.).

### *Örebro University*

The origins of Örebro University are as a college emphasising teacher training. In 1963 the college became a subsidiary campus affiliated to Uppsala University. Örebro University College was formally inaugurated in 1967, and gained university status in 1999. It now has 13,000 students, and a staff of 1,000, of whom 68 are professors. The University has two faculties: Humanities and Social Science, and Medicine, Science and Technology. There are 11 departments, five of which have at least one multidisciplinary research group (Örebro universitet n.d.). More information on Örebro University can be found in appendix C (p.69ff.).

## **4.2 The Trend towards Larger Administrative Units**

Academics at all four universities stressed that the way their research activities are formally organized is a significant factor affecting their ability to work in an interdisciplinary fashion. They reported that the traditional faculty-and-department structure, with relatively rigid divisions between faculties (or schools in the case of Chalmers) hindered collaboration across disciplines. As an example of the way such structures served to impede interdisciplinary work, an Uppsala dean pointed out that interfaculty collaboration can be thwarted by such an apparently mundane administrative issue as disagreement over credit-sharing for a doctoral thesis, reflecting the premium placed on the allocation of faculty core-funding. Respondents also cited the 'territorial mindset' to which rigid departmental structures can give rise (and which presumably partly accounts for their rigidity); this kind of territorial attitude could reportedly be passed on through generations of researchers within a particular department. A particularly striking instance of this kind of thinking in his own School provoked one Chalmers professor to dub his university 'the most modern and the most unmodern [university]'.

Against this background, the universities studied were all attempting to foster greater intra-university collaboration. One way in which Uppsala especially, but also Chalmers and Örebro are seeking, or have sought, to achieve this is through creating larger administrative units both at faculty and departmental level.

The clearest instance of the trend towards larger administrative units is the creation of the three disciplinary domains at Uppsala University in 1999. Each disciplinary domain is made up of one or more faculties, such that the faculties are drawn closer together by the disciplinary domain upper tier. The disciplinary domains have assumed many functions previously the remit of the nine faculties. Thus the Medicine and Pharmacy, and Science and Technology Disciplinary Domains allocate university core-funding directly to their

respective departments, whilst the Arts and Social Sciences Disciplinary Domain allocates its core-funding first to its six faculties. Though the faculty level has been largely retained, its position in the university hierarchy has been considerably weakened. Part of the thinking behind this reorganization is that it will enhance research excellence by stimulating cross-university collaboration and interdisciplinarity in the development of new research areas. In this instance, collaboration and interdisciplinarity are seen as central routes to increasing the University's success in winning external funding.

This organizational change at Uppsala University also has significant implications for the way in which the University is led. Each of the three disciplinary domains is led by a vice-rector, who together with the University's rector and chief administrative officer constitute the small but powerful university leadership of five individuals. The small size of this group is designed to facilitate communication across the broad scientific areas of the University, as well as increase the effectiveness and speed of decision-making. This style of university management contrasts with the more traditional and unwieldy leadership, normally consisting of all faculty deans and the rector. One of the deans at Chalmers observed that his university's Management Board, which consists of 20 individuals – the ten School deans and ten others including various administrators – was too big for anything to be done effectively and quickly. Umeå also retains a traditional leadership structure.

A further development at Uppsala University of a different sort, which facilitates intra-university collaboration, is the considerable physical reorganization of the campus which was initiated in 1996 and is ongoing. The idea behind this initiative was to physically co-locate groups and departments which have a natural affinity, in order to encourage collaboration, and in recognition of the need to share expensive instrumentation. Sharing instrumentation itself can promote an interdisciplinary mindset amongst researchers; as one Uppsala professor commented 'there are few things that unite [researchers] as much as instrument sharing'. Examples of the resultant new research units on the Uppsala campus are: the Ångström Laboratory accommodating the physical sciences; the Biomedical Centre housing biomedical departments from across faculty divides; and the Rudbeck Laboratory, which carries out aspects of medical research and is located close to the Biomedical Centre and the University Hospital (see description p.69).

At the departmental level, the trend in all four universities is also towards larger organizational units. In 1990, Örebro merged departments to create eleven large departments. Umeå has also merged some small departments which had a natural affinity. At Chalmers, discussions are underway on reorganizing the departmental structure and creating fewer and larger departments, both to streamline the organization, and again, to facilitate collaboration over traditional boundaries. However, representatives of the University emphasized the enormity of this task; introducing any change to the current configuration of schools-and-departments was bound to pose considerable challenges, both owing to a predicted resistance against change, presumably reflecting the 'territorial mindset' mentioned above, and because of the administrative complexity of such an operation.

Not only the size, but also the role of departments, and in particular their relationship to looser research centres and groups, is now a significant issue and under scrutiny at the four universities. In order to understand the significance of departments' changing role, something needs to be said about research centres.

### 4.3 Policy towards Research Centres

Each of the four universities has a large number of mostly interdisciplinary research units (documented in appendix C). These centres have arisen for different reasons. Some have their origins in initiatives taken by individuals or research groups, and serve as a means of attracting funds to a particular research area; others originate in a central university or government decision to initiate research in a particular area. Common to most centres is that they represent a research area that does not fit into the existing university structure (see p.21ff. for a discussion on centres).

The research centres at which interviews were conducted for this study fall into two broad categories. Centres in the largest group saw themselves moving towards a more department-like organizational form. These research centres were keen to increase their visibility within their respective universities, build up a critical mass of researchers on-site, and formally employ these researchers themselves. Many were eager to offer postgraduate research training, and perhaps undergraduate courses too. In short, they were interested in increasing the level and range of in-house activities. The second category of research centres wished to remain flexible structures, akin to 'research hotels' or matrix organizations. Researchers based in disciplinary departments worked intermittently on centre projects as and when necessary. These centres saw a need to remain open, collaborative organizations, and to maintain strong links with participating researchers' disciplines and departments in order to avert the risk of stagnation. They did not see themselves growing to a large permanent staff. These differences between centres were not related to particular host universities, but were evident across the universities.

All four universities studied are in the throes of making strategic choices over three key administrative issues relating to interdisciplinary research centres. They are pondering; the extent to which they should financially support interdisciplinary research centres; how they should administer research centres; and the role centres should have vis-à-vis disciplinary departments.

Current practice on supporting centres with core-funding differs. Umeå University, which has retained a relatively strong departmental structure, does not in principle support centres through core-funding beyond an initial one to two years; there may however be change afoot on this issue. Despite this approach, the University hosts a large number of centres, several of which conduct cutting-edge research. Örebro University is shortly to integrate its research centres into the profile research areas which define the University's research policy, at which point its centres will presumably also receive core-funding (see p.70). Uppsala's rector keeps back 0.9% of the core-funding annually to be able to make strategic investments, often in the form of supporting new researcher-initiated research centres for an initial few years. Thus Uppsala does support some centres with core-funding, but is shortly to address this issue, 'to ensure departments aren't hollowed out', as a dean put it.

Current practice regarding the formal organization of centres again differs both between and within the universities. Managers at all four universities are now keen to incorporate interdisciplinary research centres into existing faculty structures. It could be argued that this reflects an ambivalent attitude towards research centres: managers are naturally very keen for academics to initiate research in lucrative, often interdisciplinary, areas and gain external funding, but they are also keen to integrate resulting centres into established disciplinary structures. Certainly, some representatives of research centres felt it

incongruous to expect centres whose distinguishing feature is interdisciplinarity to belong to established faculties or departments. A number of them did not feel that their organization fitted under any particular faculty.

The difficult, and to some extent arbitrary choices faced by centres over where to belong can be illustrated with two examples from Uppsala University. Most centres at the University are today administered directly under the rector, but the current policy is to transfer them to a disciplinary domain. A representative of the Centre for Disability Research described the dilemma of having to choose a disciplinary domain, pointing out that her Centre's activity is relevant to all three domains. In a second example, the director of the Centre for Surface Biotechnology eventually chose to belong to the Chemistry Division rather than the Technology Division of the Science and Technology Disciplinary Domain, not because the Centre's activity is closer to chemistry than anything else, but because she happens to be a chemist herself. Though this choice may have been somewhat arbitrary, its consequences are not insignificant. The chosen division affects the nature of the research training offered by the Centre, whose research students teach undergraduates in the Chemistry Division, and gain degrees in 'Chemistry with a specialization in Surface Biotechnology'.

On the role of centres vis-à-vis departments, the majority of university managers interviewed voiced a similarly ambivalent attitude towards departments. They stressed the importance of departments: a firm disciplinary base was seen as the *sine qua non* of a quality research organization; an interdisciplinary research group in which researchers lose touch with their respective disciplines risked becoming second-rate. The idea that centres need to anchor their activities in disciplines is in turn reflected in the four universities' strong preference for research staff of interdisciplinary centres to be formally employed by departments. At the same time, senior academics and managers hinted at the gradual relegation of departments to becoming back-up organizations for research centres: traditional departments are no longer automatically promoted as 'homes' for prestigious research projects. Indeed, some senior academics at Uppsala and to a lesser extent Chalmers and Örebro, voiced the opinion that departments have already to some extent become relegated to the role of employers of research staff, and are burdened with the associated bureaucratic tasks, whilst the researchers themselves spend much of their time in research centres. As one senior academic at Uppsala put it, 'the research centres do their research projects, the departments do the residual work'.

#### *The uneasy symbiosis between research centres and departments*

One of the consequences of the policies described above is an uneasy symbiosis between departments and interdisciplinary research centres. One perennial source of potential conflict concerns funding issues; another concerns the *de facto* division of labour.

Representatives of research centres at times expressed the concern that they were subsidizing university departments through the external funding they brought in. Two ways in which they believed departments to be unfairly benefiting from centres were: through the high rents paid by centres to the university; and through the credit given to departments for doctoral examinees funded by a centre but examined through a department. As number of doctoral examinees is one of the criteria used to apportion faculty core-funding, departments could gain financially without having been very involved in the research student's training. Department representatives had similar concerns that

they were subsidizing the work of research centres. They noted that scarce core-funding was drained by research centres, because it was at times used to match external funding with co-funding, and because core-funding was at times used to cover centre overheads, in cases where these were not entirely met by external grants. Concerns such as these were voiced particularly at Chalmers.

University policy of encouraging centre research staff to be formally employed by a department was the root of some discontent among certain centres, largely those which saw themselves as future department-like organizations (see p.31), and which by definition would prefer to employ their own research staff. Certainly, centres' lack of control over research staff salaries could give rise to problems. One set of problems related to the possibility of centre staff, working on similar tasks in the same centre, being employed by different departments and thereby subject to different salary scales. This problem was faced by a centre manager at Uppsala University whose doctoral students enjoyed different salaries because their respective departments had different accounting systems. A related set of problems, with more serious implications, was particularly faced by centres collaborating closely with industry. Unable to determine staff salaries themselves, they lacked the power to offer salaries that could compete with industrial salaries, and thus faced an ongoing risk of losing staff. The manager of the Competence Centre for Catalysis at Chalmers acknowledged that all his research staff had received tempting offers from industry with lucrative salaries.

Those centres which operated more like 'research hotels' (p.31), had no ambition of employing their researchers on a full time basis, and seemed to enjoy closer links with the departments from which they drew their researchers. Centres which saw themselves as future department-like organizations on the whole seemed to enjoy less easy relations with departments.

The combined effect of the kinds of changes taking place at Uppsala and to a lesser extent Chalmers as described in this and the previous section, seems to be that the traditional faculty and to a lesser extent department level are gradually losing their influence in favour of the upper leadership tier and research groups, the latter being better resourced and better placed to contribute to the university's research strategy. Thus at Uppsala, influence and resources seem largely to be located at the level of disciplinary domains and the research group level, with departments consigned to a more administrative role. Similarly at Chalmers, since becoming a foundation, the School Boards tend to 'hang a bit in the air' according to one dean, as they lack a clearly defined role. The department level at Chalmers is also reportedly at somewhat of a loose end, and can only really impact upon staffing questions; research groups have concrete influence also at Chalmers.

#### **4.4 Practices of Allocating Core-Funding**

The amount of money individual departments generally have at their disposal from university core research funding may be small in relation to their total activities, but core-funding does account for a significant, albeit decreasing, proportion of the research funding in the Swedish higher education sector (Figure 2 p.26). The significance of this source of funding for this discussion, however, lies not so much in the amount of research money it represents, as in its character as the only research money available to universities to be disposed of more or less as they see fit. The way the government and universities

choose to allocate this funding is thus highly relevant to a discussion of the conditions for interdisciplinarity in the Swedish university system.

The way core-funding is distributed between and within universities today still owes much to the quirks of history. However, the four universities studied are currently reviewing their systems for apportioning this money. The main question with which the universities, or more accurately their faculties, are grappling, is whether departments should have automatic access to this funding, such that all research areas currently represented in the university are eligible, or whether the money should be apportioned to departments according to a number of quality criteria, and in effect go to profiled areas of university excellence.

A consideration faced by all universities is the widely projected shift in the character of research council funding away from project funding towards larger support of programmes, centres of excellence, and research groups (pp.15 and 17) (Åberg 2002). To attract this type of funding, universities must of course be able to demonstrate excellence in certain research areas. Against this background, perhaps the most rational use of core research funding would be to concentrate on existing areas of strength within a university. Senior academics and managers at the four universities acknowledged the inevitability of introducing more quality criteria to distribute core-funding, and of departing from automatic funding for all. All four universities were pursuing discussions in this vein, some of them having gone further down the path of reform than others.

Örebro University operates the principle that no groups are automatically entitled to core-funding. Only groups within the University's five identified multidisciplinary profile research areas are eligible to compete for the money (these areas are listed on p.70). However, since the profile areas were identified on the basis of current research conducted at the University, this practice is unlikely to exclude active research groups.

The question whether all departments should have a right to core-funding is one currently being addressed by Uppsala University. The University does not today operate university-wide rules for allocating the funding; each disciplinary domain has its own system. Of the four universities in this study, the Medicine and Pharmacy Disciplinary Domain at Uppsala University has adopted the most radical system for allocating core-funding, with a concerted use of performance indicators. The criteria for allocating funds within this Disciplinary Domain are as follows: a proportion of the money goes to strategic initiatives (short term support), promised commitments, and professors' salaries. The rest is allocated according to the level and quality of research activity within departments. This is measured by: number of newly examined doctoral candidates (this weighs quite heavily); number of newly promoted senior lecturers (*docenter*); amount of external funding brought in; and quantity and quality (or impact) of publications. The publications criterion, which was introduced three years ago, is the most controversial, as different research fields have different publication patterns. The vice-rector for the Medicine and Pharmacy Disciplinary Domain observed that this system does not only encourage research excellence; it also has its own logic, tending to encourage departments and groups to act strategically in order to reap maximum rewards from the system.

Chalmers currently operates a more traditional system for allocating core-funding. Schools are apportioned funding according to some or all of the following: number of funded doctoral students; number of newly examined doctoral and *licentiat* candidates; number of

senior lecturers (*docenter*); and number of professors. This is broadly similar to that of Uppsala's Medicine and Pharmacy Domain but without the key quality criteria of level of external funding and publications. Indeed, managers at Chalmers reported the current system to be too conservative, and the University has now begun to find ways of measuring successful research. In particular, Chalmers is discussing whether to include publication measures in the criteria, but has so far decided that it is unfeasible owing to different publishing practices across fields.

Umeå University currently adopts a standard formula to allocate core-funding, which gives particular weight to number of newly examined doctoral candidates. A report by a former Dean of the Social Science Faculty notes that this system, which has been used by his faculty since the early 1990s, in effect rewards the departments with the most research activity, owing to the strong relationship between number of doctoral examinees and research volume. Indeed, as well as providing extra resources to departments which bring in external research funding, the system is designed as an incentive to departments to build up and maintain a high level of research activity. However, over and beyond this reward component, the Social Science Faculty still guarantees all its departments a basic level of core-funding, reflecting its commitment to the Humboldtian university model with integrated research and teaching (Åberg 2002). The question of whether to continue guaranteeing core-funding to all has been addressed by the Social Science Faculty, but resistance to change is strong.

The trend of introducing more quality criteria for allocating core-funding has dual implications for interdisciplinarity. Whilst increasing use of publication indicators is unlikely to encourage interdisciplinary research, rewarding and matching external grants with core-funding may well serve to promote interdisciplinarity. On the former point, several respondents reported that quality interdisciplinary research has a longer lead time than disciplinary research. Researchers in faculties which put a premium on publication rates are thus unlikely to prioritize such projects.

To the extent that external research funding now has a greater steering influence on how core research funding is spent, the developments described above may well encourage more interdisciplinary research within universities. The tendency to concentrate on profile areas in order to strengthen them further and so attract external funding, probably promotes the cause of interdisciplinarity. Further, the observation made particularly by academics at Chalmers and Uppsala Universities – that much core-funding in practice goes to overheads of externally funded projects, and to matching external funding (p.33) – indicates that greater proportions of core-funding are already supporting interdisciplinary research, given that external grants are more likely than core-funding to fund interdisciplinary projects.

Some senior academics viewed this tendency for core-funding to follow external funding, with dismay. Lamenting that 'there is no curiosity-driven research left', a dean at Chalmers, unable to employ a single doctoral student with core-funding, had suggested to his University Board that the University reduce the amount of external funding it attracted, as it drained the core-funding.

## 4.5 The Development of Research Profiles

The need for universities to promote areas of excellence in order to attract their share of external research funding, combined with government directives to universities to identify areas of strength, have resulted in universities developing profile research areas. Universities generally identify their profile areas in a bottom-up fashion, with researcher-initiated ideas and initiatives forming the base around which profiles are defined.

Each of the four universities studied was in the process of identifying, or had already identified, profile research areas. These tend to be interdisciplinary in nature (as listed in appendix C). Significantly for our purposes, the degree to which these profile areas define the universities' overall research strategies, differs. Profiles play a defining role in Örebro's research strategy, and a significant but somewhat lesser role in Chalmers', Uppsala's, and Umeå's research strategy.

Örebro University acted seriously on the Education Minister's directive of 1999 that universities, university colleges, research councils, and other public research organizations should report their research strategies. In response, Örebro initiated a dialogue with its researchers, out of which emerged a number of multidisciplinary areas covering most of the University's activity (p.70). The University places great emphasis on its profile areas, and one of its aims is to achieve greater integration of these areas with undergraduate teaching. However, as a new university needing to be perceived as a serious research organization, and reflecting the all-important status of disciplines in the academic world, the University prefers to de-emphasize the profiles' interdisciplinary character, in favour of the putatively more disciplinary-anchored 'multidisciplinary' label; the University does not want to be associated only with interdisciplinary research. Thus senior academics at Örebro were keen to point out that disciplinary-based research had an important role to play in their organization; as one commented, 'disciplines are important, because we are a university today'. However, Örebro's research activities seem to consist largely of the profiled areas.

A central element of Uppsala University's profiling work is the so-called BASTU project, the aim of which is to foster new areas of research excellence by re-prioritizing expenditure (Uppsala universitet 2001). Each disciplinary domain was instructed to make savings of 5% and reinvest this amount in new areas of activity. Many of the best project suggestions were reportedly interdisciplinary in nature. However, owing to the current difficulty of securing large amounts of long-term funding for this kind of initiative, the BASTU project failed to win external funding at the first attempt. Another recent development at Uppsala University, which may be considered a different type of profiling work, concerns the physical reorganization of the campus initiated in 1996 (mentioned on p.30). The process of moving departments and building new premises is a massively cumbersome operation, but has resulted in a number of campus units with a large volume of research in designated areas, lending visibility to the University's strong research areas.

As a foundation, Chalmers has extra funds which it invests particularly in identified prioritized areas, including bioscience and environmental research (see p.64 for more details). And as at Uppsala, though on a lesser scale, there is an ambition to physically gather expertise in particular areas in large research centres, again to facilitate interdisciplinary collaboration; one area targeted for such an initiative is energy research. Such co-location is likely to have a 'profiling' effect on undergraduate teaching too, since

moving researchers implies moving teachers also. Indeed, more radically than at Uppsala, and in a similar way to Örebro, Chalmers intends to integrate its strategic research areas into undergraduate teaching. In doing so, the University will be able to deliver undergraduate programmes 'with an interdisciplinary spirit and direction' as the Rector's Strategy Adviser phrased it, hastening to add that a disciplinary base was central, but that research questions should be interdisciplinary.

Like Uppsala, Umeå is a generalist university and has perhaps not ventured as far as the other universities discussed here in promoting profile research areas. There is however ongoing discussion on the issue, and the University has initiated a process of mapping its research strengths in terms of themes spanning departments, and has identified seven areas of excellence on which to base a research strategy (see p.67ff.). This exercise is somewhat controversial within the institution as it is linked to the ongoing discussion on access to core-funding. The controversial nature of the profiling work, combined with the University's commitment to its generalist status as a teaching and research institution for the whole of northern Sweden, may partially explain why the University has so far been unable to profile itself more strongly.

#### **4.6 Recruitment Practices**

The conservative nature of academic career structures, and their inbuilt disincentives to pursue interdisciplinary work, were noted in chapter three (p.22ff.). One hypothesis at the outset of this study was that we would find evidence to suggest that university recruitment procedures discriminate in some way against candidates with an interdisciplinary research profile. The findings neither confirm this nor do they suggest otherwise. In short, none of the recruitment committee members interviewed could recall an instance of interdisciplinarity ever being raised as an issue in the recruitment process. Some of the evidence does suggest, however, that already at the postdoc stage, a candidate with an interdisciplinary background will tend to lose out against a traditional disciplinary researcher. For as several senior academics pointed out, depth tends to win out over breadth at this stage.

However, perhaps in part reflecting the increasing specialization and differentiation of the higher education sector, it does seem that academic recruitment practices are gradually changing. Two developments, one linked to the need to attract quality candidates in what is becoming a job-seekers market, and one linked to the need to attract recruits able to work in the multidisciplinary areas that increasingly characterize university research, may well open up the academic job market to individuals with a more interdisciplinary outlook. On the first count, certain types of post descriptions are reportedly less prescriptive and detailed than before, leaving the position open to less traditional candidates. A dean at Chalmers explained that his School used to define the research field in question quite specifically when advertising for postdocs and lecturers, but that it no longer does so, leaving the position open to individuals with broader and interdisciplinary understandings of the field. On the second count, the need to recruit researchers with specific types of expertise to fit with profiled areas, may of course provide interdisciplinary career opportunities.

Other evidence suggests that qualities beyond the purely academic are increasingly being recognized and rewarded by universities recruiting at the postdoc and lecturer level. These include an entrepreneurial ability to network and bring in research money, the ability to

work in a team, and to coordinate research. Valuing these attributes does not however imply that recruiters do not prize a thorough theoretical grounding in one or more disciplines. For example, the manager for the interdisciplinary Bioethics Research Programme at Uppsala scouts out new doctoral graduates precisely because they are often better versed in current theoretical thinking than their more senior colleagues, but also because they are unlikely to be as entrenched in a particular disciplinary approach.

#### 4.7 University Changes and their Implications for Interdisciplinarity

The data suggest that the four universities studied are going through a process of adjusting to their new, more competitive, policy and funding environment as identified in chapter three. A logic of competition seems to drive these adjustment processes; the need to create organizations well-placed to succeed in the market for external research funds appears as a clear force for change. Further, many of the adjustment processes can be interpreted as implicit strategies to foster interdisciplinarity. It may therefore be surmised that interdisciplinarity, or perhaps more accurately collaboration, is a central, if implicit, currency of the greater competition which now exists between universities

However, this chapter has also highlighted that the four universities are not adapting to their increasingly competitive environment to the same degree nor in a uniform manner. Their strategies for change and for competing vary in line with their differing histories, size, geographic location, wealth, vision, and doubtless many other factors. An element of path dependency is thus reflected in the way they respond to policy, which ranges from the responsive to the competitive.

##### *Örebro University: Interdisciplinarity by design*

Örebro University may be labelled 'the flexible newcomer' to the competitive university landscape. Without much historical baggage, it is able to adapt to its environment by responding diligently to government initiatives to foster interdisciplinarity. This is particularly apparent in its aggressive promotion of its profile research areas. This mode of fostering interdisciplinarity by design dovetails neatly with the University's need to create a separate identity for itself as a new university. However, because this identity needs to reinforce the image of a quality research institution, Örebro University was the most keen amongst the four visited to disassociate itself with 'interdisciplinarity', preferring to embrace the putatively more disciplinary-compatible 'multidisciplinary' tag.

##### *Uppsala University and Chalmers University of Technology: Interdisciplinarity by default*

Of the four universities, Uppsala and Chalmers are at the forefront of change as collaborative competitors or 'avant-garde adapters'. They have made the most radical reforms of the universities studied, but tend only to respond to prevailing policy on their own premises (see also chapter 2 p.19).

A strong rationale for change at Uppsala and to a lesser extent Chalmers is an awareness of the importance of creating a more collaborative organization in order to become more competitive. They see an untapped synergy potential in their breadth of activity, which can give rise to innovative areas of strength within the institution. They are therefore encouraging more intra-university collaboration through: the trend towards larger

administrative units; the tendency to physically co-locate researchers within profile areas or in other promising constellations; and new management structures. The generation of innovative research areas through collaboration is more central to these restructuring processes than interdisciplinarity per se. Interdisciplinarity is fostered not for its own sake, but by default, by virtue of the competitive edge such collaboration can confer. However, both institutions also emphasize the important role of disciplines by rewarding and prioritizing disciplinary excellence and in-depth research.

#### *Umeå University: Interdisciplinarity by delegation*

Of the four universities, Umeå seems so far to have undergone the least radical changes. As a 'restricted regionalist' it cannot allow any specialization to impact negatively on the breadth required by its central role as a regional educator and research resource. Umeå has only made modest strides towards becoming a collaborative university. It retains a traditional structure of relatively autonomous departments and faculties, with as yet relatively little incentive to collaborate across the university. The interests of interdisciplinarity are formally taken care of by a fledgling 'Delegation for Interdisciplinarity' which does not enjoy high visibility; interdisciplinarity happens 'elsewhere'.

#### *Modes of interdisciplinarity*

The different ways the Universities are adapting to their changing environment is partly expressed in different ways of fostering interdisciplinarity, reflecting the centrality of the latter as a currency of competition. This illustrates that interdisciplinarity is in practice a differentiated mode of research. This section makes explicit the link between the Universities' adaptation strategies and different modes of interdisciplinarity. Note that the categories used are stylized generalizations.

The flexible newcomer, Örebro, seems to be adapting by being responsive to policy directives; reflecting this, it is happy to acknowledge the importance of problem-oriented interdisciplinarity in its own as well as in national policy. The avant-garde adapters, Uppsala and Chalmers, are seeking to turn themselves into collaborative competitors, fostering interdisciplinarity by default through its association with collaboration. Yet a premium is still placed on scientific excellence, and the type of interdisciplinary fostered tends to be science-driven, anchored in disciplines, and serving to bridge them. The more generalist stance, represented here by Umeå University, is not conducive to any particular mode of interdisciplinarity.

## 5. CONDUCTING INTERDISCIPLINARY RESEARCH IN A UNIVERSITY SETTING: THE CASE OF THREE MISTRA PROGRAMMES

This chapter discusses interdisciplinary practice at the level of research programmes by focusing on the experience of managers and researchers in three problem-oriented interdisciplinary MISTRA programmes. It specifically asks what problems they face when working in university environments. The findings derive from interviews conducted with programme managers and a small number of researchers in each of the three programmes, and from an open-ended questionnaire sent to all 146 researchers in the programmes. More information on the data can be found on p.13.

The three programmes, chosen in dialogue with MISTRA, are FOOD 21, MiMi, and Urban Water (for abbreviations see p.8). Two of the criteria used to select the programmes were that they should involve researchers from at least one of the four universities discussed in the previous chapter, and that they should be regionally dispersed. Several of the participants interviewed were based in one of the four universities discussed above. The programmes are organized as geographically dispersed collaborations; each is hosted by a university and involves researchers from a number of other universities around the country. FOOD 21 on sustainable food production, is the largest of the three programmes with approximately 70 researchers; it is hosted by SLU in Uppsala. MiMi, which deals with the environmental impact of mining waste, has approximately 43 researchers and is hosted by Luleå University of Technology. Urban Water, dealing with sustainable urban water management, has approximately 33 researchers and is hosted by Chalmers. It should be noted that just as MISTRA programmes are not necessarily representative of interdisciplinary research in general, nor is this group of researchers necessarily representative of Swedish university researchers; those who choose to partake in MISTRA programmes are to some extent a self-selected group.<sup>4</sup>

The first part of this chapter discusses some of the problems faced by programme managers as they seek to secure interdisciplinarity in their programmes. The second part adopts the perspective of active researchers to discuss how they experience their participation.

### 5.1 A Programme Manager Perspective: Securing Interdisciplinarity in the Programmes

The three programmes have entered a second phase of operation after an evaluation marking the end of the first stage. The first phase of programme work appears to have been largely characterized by relatively traditional disciplinary research, much of it carried out by research students. Significant emphasis during the second phase is on the component of the programmes which is regarded as genuinely interdisciplinary, variously termed *synthesis* work, *system analysis*, or in the case of MiMi *performance assessment*. The problems enumerated by the programme managers were remarkably similar across the three programmes, and may be grouped into two interrelated themes: organizing collaboration and organizing synthesis work.

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<sup>4</sup> Whilst this chapter deals with a range of problems, this does not imply that all respondents were disgruntled. Most respondents had both positive and negative comments to make about their programme participation.

### *Organizing collaboration*

Programme managers faced the considerable challenge of reconciling the divergent interests and activities of the different groups of participants, including users, research students, and established researchers, to ensure that they all worked towards the same interdisciplinary goal.

A feature of two of the programmes, which seemed to facilitate collaboration between actors with differing interests, was that research activities were centred around physical facilities over which participants collaborated. Urban Water and MiMi both have agreed field sites for collecting empirical data, which serve to unite the researchers. Urban Water operates with a number of model towns, examples of which are Vasa Stan in Gothenburg and Hammarby in Stockholm; and MiMi researchers use the slag-heap at Kristineberg in Västerbotten as a sampling site for their projects. To some extent these sites have the effect of holding the programmes together. Perhaps the apparently more fragmented character of FOOD 21 is partly attributable to the absence of such a physical entity over which to collaborate, though this programme is also considerably larger than the other two.

Though collaboration over the field sites worked well, managers complained of the difficulty of engaging established researchers and students' supervisors in the holistic goals of the programme, a disengagement which tended to undermine the very *raison d'être* of the programme. Managers found that the narrow research interests of some of their established researchers did not square well with the systemic approach required in the programme. In a vain attempt to encourage researchers to take greater interest in the overall aims of the programme, the programme director of Urban Water gave his researchers the title 'Urban Water Faculty'. Another solution used on rare occasions was simply to eject 'non-team players' from a programme.

In view of this problem, a central question with which programme managers were grappling, related to the division of labour between established researchers and research students. In general, managers thought it easier to engage research students in the holistic goals of the programme. Research students were thus to varying degrees encouraged to be standard-bearers for the interdisciplinary cause of the programme; one programme director talked of research students as 'Trojan horses' entering the 'academic fortress'.

Expecting research students to work in an interdisciplinary fashion naturally calls for the appropriate supervision to be offered. During its first phase, Urban Water had sought to guarantee all its research students access to a secondary supervisor from a discipline other than the student's own. Despite resources being made available for this purpose, this policy was never fully implemented. Three possible reasons for this failure have been offered by the programme's leader: funding for secondary supervisors may not have been made available by students' departments, owing to the latter's tendency to pool research grants for the benefit of the department as a whole; in cases where secondary supervisors were appointed, main supervisors may have nominated individuals within their own field; and finally, professors may not always have deemed a secondary supervisor necessary. Urban Water's compromise policy is to offer all students access to a secondary supervisor from abroad, who can be active in any field.

### *Organizing synthesis work*

Securing success in the core interdisciplinary synthesis work was the programme managers' Achilles heel. One concern, as hinted at above, was of insufficient genuine interdisciplinary input from the researchers. Expressing this worry, a board chairman called for researchers in his programme to adopt more 'high risk', 'truly interdisciplinary' methods. Thus the most taxing question faced by programme managers was how best to organize the synthesis work.

Each programme had its own model for implementing the synthesis component, and each programme manager was working hard to improve the process. The most serious challenges facing programme directors were: securing the input of users to ensure that the programme results were based on their needs; gaining the involvement of established researchers; deciding on the degree of research student participation in synthesis work; and more conceptually, integrating social and natural science components. None of the project leaders felt they had entirely solved these conundrums.

Urban Water's initial synthesis strategy involved users in the work itself. This was ineffectual, reportedly because users were not sufficiently engaged to put in the hours required. The model was consequently revised, and the synthesis group now consists of active researchers and is chaired by the programme director, with users assigned a reference group role. All researchers in the programme, including research students, are expected to participate in synthesis work, and contribute insights into how their own project contributes to the whole.

Involving research students in synthesis work is not entirely uncontroversial, owing to the arguably different character of this activity from academic research. Most of the research students in the programmes are registered in disciplinary university departments, and all are naturally expected to meet the normal academic criteria of a research degree. Views among programme participants on the appropriateness of involving students in synthesis work, differed. Programme chairmen were perhaps the least sceptical, one calling for 'more daring' research student projects. Not surprisingly, established researchers were the group most likely to comment that this type of work is best carried out by researchers who have already gained their doctorates. Interviews with students themselves indicated that they can be a little overwhelmed by the need to contribute to programme synthesis before they have completed their thesis.

A contrasting way of organizing synthesis work is exemplified by FOOD 21. This programme operates with a clearer division between the synthesis group and its work, and project researchers who feed the synthesis group with their results. Significantly, research students in this programme felt their projects were not dissimilar to those of other research students in their departments.

## **5.2 A Researcher Perspective: Conducting Interdisciplinary Work**

This section draws on the questionnaire sent to MISTRA researchers in the three programmes, as well as on the small number of interviews conducted with these researchers. The social and the conceptual or more accurately cognitive, dimensions of the programmes both gave rise to some concerns amongst programme researchers. Foremost amongst these concerns was that interdisciplinary research was perceived to take longer

than more traditional forms of research, because it involved extra work, detracting from researchers' productivity. A second concern related to the cognitive compatibility of the project work with academic research.

### *The social organization of project work*

Researchers pointed out the considerable 'organization work' involved in participating in the programme, and felt this was not always properly acknowledged by others inside or outside the programme. Amongst extra tasks mentioned by respondents which are linked to the programmes' organization were: collaboration, communication and the associated meetings; and tasks linked to MISTRA's management and control mechanisms.

Many researchers reacted negatively to the general form of collaborative programme organization. A research student described the time-consuming collaborative activities as somewhat of a burden,

It takes time to start collaborations with other people, in order to organize work, see connections, discuss etc. It is very energy draining and difficult to enter collaborations which are over and above one's own research. The direct relevance of interdisciplinary collaboration in terms of building up one's CV is perhaps not apparent. This can mean that you choose not to do it. So collaboration to a certain degree is OK, but not too much.

The extra tasks linked to collaboration seemed to have fallen particularly to research students. Another student described the unrewarding nature of these tasks, 'I have to work for free organizing seminars, writing newsletters...'. An added imposition mentioned by yet another research student was the expectation that researchers would communicate with users. This was not as straightforward as at first appeared, as the information and the way it was delivered needed to be tailored to users' needs and prior understanding.

Successful collaboration is naturally based on reciprocity, and researchers' frustration grew in cases where they felt they did not gain as much from a collaboration as they put in. This was particularly evident amongst established researchers. Owing to the different backgrounds of the researchers, communication could be difficult; thus meetings in particular took time but were not perceived to bring concomitant rewards, adding to the risk of ineffectual collaboration. This appears to account for one professor's critical attitude,

there are even more meetings that one maybe doesn't feel one has time for, and that don't always give as much in return as one gives. It can be difficult to prepare for very broad [disciplinary-wise] meetings, and the discussions can therefore easily end up at a level of chit-chat. Is this an effective use of time and money?

In an attempt to make the time spent on collaborative activities more productive, some researchers tried to limit these activities to partners based in their own university. Others tried to avoid collaborative activities altogether.

Yet both established researchers and research students appreciated the positive, often unplanned, spin-offs that collaboration could bring, such as finding new collaborative partners in unexpected places, and engaging in rewarding discussions. Indeed, for some research students, the programme brought only benefits in the form of: access to networks in their field, broadening their intellectual interests, and opportunities to attend interesting meetings and seminars.

Regarding the management and control mechanisms instituted by MISTRA, there was some dissatisfaction amongst researchers who perceived that the associated tasks were too cumbersome, took too long, and interrupted the 'real' research work. Despite his positive experiences of the intellectual side of his programme, one professor was sufficiently unhappy with the reporting requirements, as to be deterred from joining a similar programme again,

this form of work is very interesting, but it is demanding on one's time and I don't think that everyone, especially the research funders, is fully conscious of this. Each doctoral project has to go into depth, and this takes time and demands accuracy and exactness. Planning is extremely important, and when this is done the researchers should be left in peace for a while. But this does not happen, because of all the evaluation and control that goes on nowadays in these big projects.

As hinted at by this professor, there is no evidence here to suggest that MISTRA's evaluation, monitoring, and follow-up requirements are any greater than those required by other agencies funding comparable programmes.

This section has shown how collaborative, and particularly interdisciplinary, projects tend to generate more articulation work – the work of making all the pieces of the project fit together – than more straightforwardly organized disciplinary projects. Though articulation work is necessary to get the project work done, it is experienced as particularly burdensome as it is not rewarded and takes time away from the production tasks of gathering, interpreting, and disseminating data – those tasks, in fact, which reap the greatest rewards in academia (chapter 3 p.23 for a further discussion).

#### *The cognitive dimension of project work*

The two concerns raised relating to the cognitive dimension of the work were that it took more time than disciplinary work, and that it was of a different nature from academic research. Accordingly, project work was perceived to result in lower publication rates, and in other forms of publication than the high status academic journals.

By definition, interdisciplinary work requires researchers to bridge disciplines; to do this effectively, researchers need to acquire knowledge in other fields than their own. And this takes time, the fruits of which will not be immediately evident in higher productivity. This was reported more as a problem by research students than by established researchers, presumably because this extra learning takes place whilst students are absorbing the culture and methods of their own disciplines, and because students are under pressure to publish internationally to gain their degrees. Data from supervisors show that some actively encouraged their MISTRA students to learn from other fields, as well as to become conversant in their own, seeing this as one of the benefits of belonging to such a programme. But not all students felt they had the necessary supervisory support, as one commented,

everything takes time if you want to immerse yourself in other disciplines (...). More supervisors should get resources to [allow] [supervision] from different disciplines.

A recurring theme in responses from MISTRA researchers was the compatibility of their interdisciplinary project work with mainstream academic work. Some felt the differences

between the two were great enough to have negative implications for their academic careers.

Again, this tension seemed to be experienced more by research students than by established faculty, though the latter were not immune. Both students and their supervisors expressed worry over meeting the requirements of an academic research degree within the programme's framework. As the quote below shows, the pressure on students to publish in mainstream journals may eventually deter them from pursuing interdisciplinary careers. One doctoral student felt his project work to be almost entirely unpublishable without first making it palatable for a disciplinary audience,

A general disadvantage of working in an interdisciplinary way is the lack of journals to publish in, and that is the only measure for how well one is conducting one's work in this line of work, so we're disadvantaged as interdisciplinary researchers, whilst scientifically motivated approaches and methods are rewarded. The risk with this scientific ideal is that one is forced to write disciplinary-based articles to get through the doctoral student phase, which means that the research world loses the opportunity of fostering new researchers in an interdisciplinary approach from the beginning.

Students' remarks suggest that they perceive their options to be either to pursue a disciplinary career or to leave academia altogether. This would seem to bear out chapter three's discussion on the conservative nature of the academic career structure (p.22ff.). When asked whether he would participate in a similar programme again, another student replied:

...absolutely! - with the small proviso that if it proves very difficult to get one's interdisciplinary articles published, then I probably won't even get the chance, as that is the only measure of quality that exists in the research world.

We suggest that these comments hint at an attitude which is defensive of an interdisciplinary approach and slightly reproachful of an overly conservative academic publishing system, perhaps in turn reflecting students' socialization into a MISTRA programme almost before being socialized into a discipline.

It is not quite clear however to what extent the above is representative of all research students in the three programmes. Other evidence suggests that on a day-to-day basis, some of the research students have as much freedom in their work as most other students. Indeed, several felt there was no real difference between their own situation and that of colleagues not funded by a MISTRA programme.

Amongst established faculty, who are of course already socialized into an academic publishing culture, there was some criticism of the scientific value of the programme work. One, for example, thought the work at times 'more like consultancy work'; similarly, another maintained,

a big and important disadvantage (...) has also been that it has hindered more scientific, more productive, and more CV-enhancing work.

Bearing out this point, a third observed that for the duration of his engagement in the programme, his CV only contained publications in lower quality journals.

Perhaps this explains some researchers' resistance to participating in the time-consuming synthesis work, noted in section 5.1. Certainly, a degree of resistance may lie behind the finding from the survey that a minority of researchers within the programmes are not departing radically from their normal way of working. A quarter of the survey respondents, equal numbers of researchers/lecturers and research students, did not see their project within the programme as interdisciplinary, though this varied between the programmes; the majority of these were in FOOD 21 and MiMi.

These views were not the only ones represented amongst established faculty either. Some were positively disposed to an interdisciplinary approach, appreciating the methodological advantages thereby gained, and finding interdisciplinary work intellectually stimulating.

#### *The mismatch between MISTRA projects and academic careers*

The majority of researchers in MISTRA programmes are employed by universities and consequently work within an academic career structure. As this section has illustrated, MISTRA researchers did not always perceive aspects of the MISTRA programme as compatible with this career structure. In short, MISTRA researchers experience a conflict between the demands of this kind of interdisciplinary research and the demands of academic research careers. There are two main sources of this conflict: the cumbersome collaborative project organization created extra work which was perceived to detract from research productivity; and the problem-oriented nature of the projects was not perceived to reap sufficiently high rewards in the academic system.

It is partly for these reasons that certain participants expressed some frustration at the project organization; and may also provide an explanation for why programme leaders have had some difficulty in engaging researchers in joint programme activities. This applies especially to established researchers and students' supervisors, who, given the breadth of the programme, may not see it as entirely relevant to their interests and careers.

## 6. CONCLUSIONS

### 6.1 Discussion

#### *The state and interdisciplinarity*

We observed a tacit endorsement of disciplinary research at the state policy level; disciplines have enjoyed solid policy support throughout the post WWII period. But this has not always entailed policy bias against interdisciplinarity; indeed, the past decade has seen strong policy measures to stimulate interdisciplinary research.

The detailed reasons for the state's current pro-interdisciplinary policy are unclear, though it should probably be understood in the context of merging innovation and research policies in a research system dominated by the university sector. Universities are now expected to play a prominent role in the innovation system by conducting more problem-solving research and cooperating more extensively with industry, a role which many have been hesitant to adopt. In short, interdisciplinarity in the university sector is enjoying official policy sanction, symptomatic of the blurring between research and innovation policies, and manifested in the associated new set of rules and institutions governing university research activities. Examples of research policy measures over the last decade which have the effect of promoting interdisciplinarity in universities are: the creation of the 'employee investment' research foundations in 1993-94; the legal imposition of the 'third mission' on universities in 1997; and the new demands made on the reformed research council system.

#### *Universities and interdisciplinarity*

At the level of universities and university colleges, we found expressions of support for interdisciplinarity in institutional policy documents, apparently in line with national policy (appendix C p.61ff.). However, no documentary or other evidence was found to suggest an explicit promotion of interdisciplinary practice at the faculty or departmental level. For example, key documents regulating academic promotion and recruitment did not mention interdisciplinarity (p.62). We observed then, a discrepancy between universities' official expressions of support for interdisciplinarity and the degree to which they appear to have introduced explicitly interdisciplinary practices at the faculty and departmental level.

Yet a somewhat different story is revealed if we shift our focus away from the narrow evidence offered by specific instances of university interdisciplinary policy and practice, and towards broader organizational features of university life. Management and other organizational changes, indicating a move away from faculty dominance and collegiate decision-making, are taking place at the four universities studied in depth, though some are introducing more radical changes than others. As examples of such changes may be mentioned: the rise of research groups as prominent entities; the introduction of new performance-related criteria for allocating core-funding; and greater profiling of university research, as exemplified by the Uppsala BASTU project (p.36). The compound effect of many of these changes is to promote interdisciplinarity. Universities though prefer to describe them as the result of internal strategic planning to promote research excellence. Yet whichever way universities choose to package them, changes such as these can be interpreted as part of a gradual but significant process of adjusting to the new terms of

trade associated with the policy reforms mentioned above. In other words, changes in the research funding landscape have no doubt played a part in inducing internal university changes which tend to further the cause of interdisciplinarity.

It would however be premature at this stage to conclude that national policy initiatives to further interdisciplinarity are – albeit indirectly or indeed by default – having the desired effect at the university level, the reason being that the discussion has up to now rested on an un-nuanced conceptualization of ‘interdisciplinarity’. Are universities, and policy-makers referring to the same kind of interdisciplinarity?

The introductory chapter identified three different, but overlapping, types of interdisciplinarity: the ‘science-driven’ mode; political interdisciplinarity; and strategic interdisciplinarity (p.12). The science-driven mode of interdisciplinarity, underpinned by traditional academic success criteria, is associated with basic research: researchers judge that an interdisciplinary approach is warranted by the nature of a *scientific* goal or problem. Political and strategic forms of interdisciplinarity, on the other hand, may go under the joint banner of the ‘problem-solving’ mode, as each is driven by an extra-scientific (e.g. practical, economic, environmental) problem; in this case, researchers or funders decide that a research approach combining several disciplines is warranted by the nature of an *extra-scientific* problem. This is presumably the primary form of interdisciplinarity referred to in official policy, and encouraged by the new research Foundations.

This distinction may be used to understand the apparent discrepancy between universities’ official support for interdisciplinarity and their apparent lack of explicit overt action in support of that cause (as identified above). By the same token it can also help to shed light on the larger question of the impact of national policy on university practice. Our evidence suggests that universities did not regard the issue of interdisciplinarity as problematic per se. But they did associate it with a policy context which was the root of some concern. In fact they were keen to promote interdisciplinarity understood as a science-driven cognitive activity, whilst they seemed to have an almost knee-jerk reaction against interdisciplinarity as a science policy instrument. Thus universities’ rejection of explicit mechanisms to stimulate interdisciplinarity and their willingness to introduce changes which indirectly promote interdisciplinarity, may be seen as an expression of their genuine ambivalence towards state efforts to direct their research activities in a pro-interdisciplinary direction, an ambivalence itself rooted in the distinction between science-driven and problem-driven modes of interdisciplinarity.

In line with this reasoning, we suggest that universities are in fact adjusting to the emerging funding and policy regime in Sweden, but they are doing so on their own terms, and in ways designed to unlock their areas of untapped potential, in order to reap maximum rewards in the competition for external funding. For some, this means that the type of interdisciplinarity being fostered through their various organizational changes, is closer to the science-driven mode than the problem-solving mode. Other institutions are more responsive to the problem-solving mode of interdisciplinarity, to the extent this fits with their institutional profile.

In short, interdisciplinarity seems to be a growing phenomenon in Swedish universities, but it is also a differentiated mode of research. The relevance of interdisciplinary research to funders’ research objectives will naturally be determined by the type of interdisciplinarity

performed, which is in turn anchored in the character and goals of the research institution or group carrying out the research.

## 6.2 Policy Implications

### *The multifaceted rationale for interdisciplinarity*

The distinction between modes of interdisciplinarity may in turn be used to reflect deeper on the prevailing pro-interdisciplinarity policy. Research funding agencies, and particularly the new 'employee investment fund' foundations, are fronting an attempt to stimulate more interdisciplinary research in Swedish universities. The recognition that interdisciplinarity is a differentiated mode of research suggests that an undifferentiated pro-interdisciplinary policy may be too blunt an instrument to secure agencies' various objectives. Agencies need to reflect on how interdisciplinary work relates to their objectives, and thus on the kind of interdisciplinarity they need to fund to achieve them.

This raises the question whether indeed a funder of strategic environmental research should regard interdisciplinarity as the linchpin of its strategy for achieving the desired research goals. A clear answer is difficult to arrive at since the complex relationship between research efforts and societal impact makes it almost impossible to ascertain the value of interdisciplinarity to environmental research. The major developments in most environmental research fields (such as environmental technology, medicine, management, legislation, economics, history, chemistry) have largely resulted from the general growth of knowledge, as well as being influenced by extra-scientific factors such as politics and changes in values and behaviour. The role of interdisciplinarity in producing knowledge amenable to application is thus an unresolved question.

At one level, funders should not necessarily view disciplines as an obstacle to fulfilling their interdisciplinary problem objectives. For disciplinary skills pave the way for interdisciplinarity, are fundamental to the development of science, and should therefore hardly be looked upon as a problem by research funding agencies. Acknowledging the importance of disciplines for interdisciplinary work, and the variety of motives underpinning interdisciplinarity, suggests that research funders' apparent concern over the *amount* of interdisciplinarity in universities is to some extent misguided.

### *The heterogeneity of the research system*

Just as important as deliberating on the kind of interdisciplinarity they should fund, agencies also need to acknowledge the heterogeneity of the research system: that research institutions and groups differ. Not all are open to an interdisciplinary research approach; and among those which are, some are more adept at interdisciplinarity as in-depth basic science, whilst others specialize in problem-solving interdisciplinarity. In the joint endeavour to achieve funders' objectives, funders need to be sure they select appropriate dialogue partners. Funding agencies would do well to pay heed to the character, mission, orientation and variety of research institutions. This factor is at least as important an ingredient to secure the desired end result as interdisciplinarity per se, though degree and type of interdisciplinarity and institutional orientation are likely to go hand-in-hand.

Given the unclear role of interdisciplinarity in producing knowledge amenable to application, the discussion should perhaps focus on the promotion of strongly mission-

oriented research in universities. Our study has shown that the old tension between researchers' discipline-based career structures and targeted interdisciplinary research remains intact. Members of the scientific community, and university leaders in particular, naturally tend to argue against allocations of targeted, purpose-oriented research funds. They would prefer, all else being equal, to receive funds with as few directives as possible, and to conduct their research according to established academic procedures and norms. Given the choice, most of the MISTRA researchers questioned, would prefer funds with no mission-orientation attached – though it should be added that there are interesting exceptions to this among individual scientists and research students (section 5.2).

The academic lobby has a point. They are advocating an approach to research which is solidly anchored in experience and which is conducive to generally effective working conditions in the university research system. High levels of targeted research tend to undermine the autonomy of the academic profession, and are difficult to reconcile with the Humboldtian ethos which is important to university researchers.

### *The funder's dilemma*

This situation poses a potential dilemma for funders. Universities have a built-in inclination to redirect targeted funds. Large contributions of targeted, mission-oriented research money to traditional universities may in practice become subsumed under basic academic procedures, such that the interdisciplinary and/or mission-oriented component of projects becomes devalued in the course of university-based research practice, as indeed is reflected in many of the responses from MISTRA researchers (section 5.2, also p.20 for a discussion on the probable fate of sectoral research funding). This observation imposes limits on the level of mission-oriented interdisciplinarity achievable in an academic research environment.

But as long as the direct and short-term relationship between interdisciplinary mission-orientation and environmental 'progress' remains shrouded in its complexity, it is difficult for funders to maintain that universities are using the money unwisely. The track record of universities is after all quite impressive in terms of increasing the stock of knowledge in all areas, environmental knowledge included. Taken to its extreme, this observation could serve as an argument against any kind of strategic research in universities. But it is an observation worth remembering in circumstances such as those prevailing in Sweden, where the proportion of non-targeted core-funding to universities has diminished, in the Swedish case owing partly to the increase in funding from foundations such as MISTRA (p.24ff.).

How the Foundations choose to respond to this dilemma is important to their success in meeting their own objectives. Universities are unlikely to change their basic inclination to redirect targeted funds. If the Foundations are to maintain their significance and meet their goals over the long-term they need to rethink their relationships to universities.

There is a further observation to be made. Historically, targeted research has proved productive. Although a general expansion of knowledge always forms the base, mission-orientation is successful, as has been shown in pharmaceutical research, information technology, defence technologies, and in the social sciences. From this follows another conclusion, yet one in tune with the above: that the general development of knowledge can be left to the regular university system and its core-funding, while growing proportions of

mission-oriented research may be directed to institutions which share the mission-orientation, and whose ethos is not thereby compromised. In MISTRA's case, for example, it might perhaps be more appropriate to seek out non-CUDOS partners to do the job (see p.18, especially footnote 1). In light of this observation, it would be interesting to study the institutional division of labour in different research systems in closer detail, in order to draw comparisons with recent Swedish experiences.

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## APPENDICES

- A. LIST OF INTERVIEWEES
- B. QUESTIONNAIRES
- C. UNIVERSITY POLICY AND ORGANIZATION FOR INTERDISCIPLINARY RESEARCH

## Appendix A List of Interviewees

### *Chalmers University of Technology*

<b>Interviewee</b>	<b>Capacity in which interviewed</b>
Roger Johansson Rector's Office	Rector's Strategy Adviser
Prof. Jörgen Albertsson Inorganic Chemistry	Dean, School of Chemistry
Prof. Greg Morrison	Vice-Dean, School for Environmental Sciences
Prof. Bo Berndtsson Mathematics	Dean, School of Mathematics and Computing
Prof. Mats Jonson	Dean, School of Physics and Engineering Physics
Sten Ljungström Competence Centre for Catalysis	Centre Manager

### *Umeå University*

<b>Interviewee</b>	<b>Capacity in which interviewed</b>
Prof. Torbjörn Egelrud Dept. Public Health and Clinical Med.	Dean, Faculty of Medicine and Odontology
Prof. Glenn Björk Dept. of Molecular Biology	Vice-Dean, Faculty of Science and Technology responsible for research strategy
Prof. Erik Lundgren Dept. of Molecular Biology	Chairman of Delegation for Interdisciplinarity and Medicine and Odontology Faculty Representative
Prof. Per-Olof Westlund Dept. of Chemistry	Faculty of Science and Technology Representative on Delegation for Interdisciplinarity
Prof. Petter Minnhagen Dept. of Physics	Chairman, Faculty of Science and Technology Recruitment Committee
Marianne Hultmark Administration	Faculty Secretary, Medicine and Odontology
Anders Hanberger Umeå Centre for Evaluation Research	Centre Manager
Elisabeth Sauer-Eriksson Umeå Centre for Molecular Pathogenesis	Centre Manager
Lars Westin Centre for Regional Science (CERUM)	Centre Manager

### *Uppsala University*

<b>Interviewee</b>	<b>Capacity in which interviewed</b>
Prof. Bengt Westermark Dept. Genetics and Pathology, Rudbeck Laboratory	Vice-Rector Chairman, Medicine and Pharmacy Disciplinary Domain Board Dean, Faculty of Medicine Chairman, Pre-Clinical Recruitment, Faculty of Medicine
Prof. Jan-Otto Carlsson Dept. Material Chemistry, Ångström Laboratory	Vice-Rector Chairman, Science and Technology Disciplinary Domain Board
Outi Lundén Dept. Psychology	Dean, Faculty of Social Sciences
Prof. Jan Södersten Dept. Economics	Vice-Dean, Faculty of Social Sciences, responsible for recruitment
Prof. Karin Caldwell Centre for Surface Biotechnology Chemistry Division	Centre Manager
Mats G. Hansson Josephine Fernow Ethics in Biomedicine Research Programme	Centre Manager
Barbro Lewin Centre for Disability Research	Centre Manager

### *Örebro University*

<b>Interviewee</b>	<b>Capacity in which interviewed</b>
Prof. Bert Allard Dept. Science and Technology, Man- Technology-Environment Research Centre	Dean, Faculty of Science and Technology Centre Manager
Ingrid Åberg	Dean, Faculty of Humanities and Social Sciences
Dr Jens Schollin Örebro University Hospital	Member, Medical, Science and Technology Faculty Board Chairman, Board of Medical Division Head of R&D Örebro University Hospital

<b>Interviewee</b>	<b>Capacity in which interviewed</b>
<b><i>MISTRA Programme FOOD 21</i></b>	
Björn Sundell Federation of Swedish Farmers <i>Lantbrukarnas Riksförbund</i>	Chairman of Board
Rune Andersson Dept. of Food Science, Swedish University of Agricultural Sciences	Programme Director
Anders Biel Dept. of Psychology, Gothenburg University	Researcher Student Supervisor
Anders Högberg Dept. of Food Science, Swedish University of Agricultural Sciences	Research Student
<b><i>MISTRA Programme MiMi</i></b>	
Sten Bjurström NucWaste AB	Chairman of Board
Lars Olof Höglund Engineer, Kemakta Konsult AB	Programme Director
Prof. Bert Allard Dept. Science and Technology, Örebro University	Researcher Member Programme Steering Group Member Scientific Expert Panel
Börje Lindström Dept of Molecular Biology, Umeå University	Researcher Member Scientific Expert Panel
<b><i>MISTRA Programme Urban Water</i></b>	
Prof. Per-Arne Malmqvist Chalmers	Programme Director
Gilbert Svensson Water, Environment, Transport; School of Civil Engineering, Chalmers	Deputy Programme Director Project Leader
Frank Persson Dept of Microbiology, Gothenburg University	Research Student

## Appendix B Questionnaires

### *Interview questionnaire for faculty deans*

1. How would you describe your faculty's official stance in relation to interdisciplinary activities (especially research)?
2. How has this official stance changed over the last few years? What prompted these changes?
3. What kind of instruments has the faculty developed to further interdisciplinarity? Are there any other ways in which the faculty committee seeks to foster interdisciplinarity?
4. How important, for example, does the faculty (committee) view the role of interdisciplinary centres?
5. To what extent is there consensus within the faculty committee in relation to promoting interdisciplinarity?
6. To what extent would you describe research and research training activities in your faculty as interdisciplinary?
7. What form do these activities take? Who tends to participate most in these activities?
8. How do other colleagues in your department/faculty view these activities? How do you view these activities (e.g. their scientific quality)?
9. In your experience as dean, do researchers with an interdisciplinary background pursue equally successful careers as researchers with more traditional disciplinary backgrounds? Can you say a little more about this?

### *Interview questionnaire for chairman, faculty recruitment committee* *Intervjuguide för ordförande i fakultetens anställningskommitté*

1. Kan du beskriva kommitténs huvuduppgift? Hur arbetar kommittén?
2. Var finns kommittén inom universitetshierarkien? Var får ni saker från, vem rapporterar ni till?
3. Vem nominerar ledamöterna i kommittén?
4. Har kommittén någon officiell syn på hur man ska hantera ansökande med en tvärvetenskaplig forskningsprofil?
5. Vilken fördelar tror du en sökande med en tvärvetenskaplig forskningsprofil har i ansökningsprocessen, jämfört med en sökande med en mer traditionell ämnesbakgrund?
6. Och vilken nackdelar tror du någon med en tvärvetenskaplig profil har i anställnings- och befordringsprocessen?
7. Hur många sökande med tvärvetenskapliga profiler har blivit anställda eller befordrade under din tid i kommittén?
8. Hur vanligt är det för individer med en tvärvetenskaplig profil eller intresseområde att göra en framgångsrik karriär inom din fakultet?

*Interview questionnaire for members of the Delegation for Interdisciplinarity, Umeå University*  
*Interjúguide för Delegationen för tvärvetenskap, Umeå universitet.*

1. Kan du beskriva kommitténs huvuduppgift? Hur arbetar kommittén?
2. Var finns Kommittén inom universitetshierarkien? Var får ni saker från, vem rapporterar ni till?
3. Vet du bakgrunden till Delegationen? Vet du när Delegationen bildades? Vet du varför det ansågs som nödvändigt att bilda en ny kommitté för tvärvetenskap?
4. Vet du varför just du tillfrågades att vara med i Delegationen?
5. Vilka frågor jobbar ni med nu? Vet du om detta har ändrat sig de senaste åren?
6. Vilka frågor har varit svårast att behandla/jobba med? Varför det?
7. På vilka sätt försöker ni främja tvärvetenskaplig verksamhet på universitetet?
8. Hur skulle du beskriva universitetspolicyn angående tvärvetenskap i dagsläget? Tycker du detta har ändrat sig de senaste åren? Vilken status har tvärvetenskap på Umeå universitet idag?
9. Vad skulle du beskriva som den stora bromsklossen för utökad verksamhet över ämnesgränserna här på universitetet?

*Interview questionnaire for managers of interdisciplinary research centres*  
*Interjúguide för föreståndare för centrumbildningar*

1. Kan du kort beskriva verksamheten, och vilken typ av organisation det är?
2. Vad är bakgrunden till Centrumbildningen? Varför var det nödvändigt att grunda en ny organisation?
3. Hur finansieras centret (intern kontra extern finansiering)? Vilka är finansiärerna?
4. I hur stor grad är centrets arbete tvärvetenskapligt anser du?
5. Hur yttrar detta sig?
6. Hur integrerad är verksamheten i den övriga verksamheten vid universitetet? Skulle du vilja säga att kontakterna utåt är starkare än de inåt inom universitetet, eller det motsatta?
7. Upplever du Umeå universitet som en välvillig eller motvillig värd för centret?
8. Har du några synpunkter på universitetets allmänna policy och praktik när det gäller centrumbildningar, och/eller tvärvetenskap?
9. Hur ser du er själva i framtiden, ca 5 år framåt? Olika scenarier?

*Interview questionnaire for MISTRA programme board chairmen, research leaders, active researchers*

*Introduction*

1. Can you say a little about your background?
2. Can you briefly describe your role in the programme?
3. Why did you decide to join/initiate the programme?

*The Programme*

4. How do you feel about the programme's aims, organization, and structure?
5. To what degree is the programme working according to the initial plans? What caused any disruptions to the initial plans?

*Acceptance in university environment*

6. How integrated is the programme with other more mainstream research activities in your department?

7. How do your colleagues in your department/faculty/university view the programme? (e.g. in terms of scientific quality or other aspects)

*Affect on research practices and organization*

8. How collaborative and interdisciplinary do you regard the programme to be in practice?

9. How does the a) collaborative and b) interdisciplinary nature of the programme affect your work within it?

10. In what ways (if at all) have your research activities and interests changed as a result of participating?

11. Have your publication practises changed as a direct or indirect result of participating?

12. Have you been able to develop as a scientist through working in the programme?

13. How do you rank the scientific quality of the programme? Is it living up to expectations?

*Affect on career*

14. Would you say that participating has benefited your career in any way? What kind of professional benefit have you derived? How satisfied are you with the new opportunities open to you as a direct or indirect result of participating?

15. Is this in line with your expectations?

16. How do you think your participation will affect your career in the longer term?

17. Are you likely to join such a programme again? Why/why not?

*E-mail questionnaire for all researchers in the MISTRA programmes: MAT21, MiMi, Urban Water*

1. Bakgrundsinformation (fyll i):

Kön:

Ålder:

Högsta akademiska examen (t.ex. civ.ing./fil.dr.):

Arbetsställe (t.ex. högskolans/företagets namn):

Tjänst (t.ex. doktorand/professor):

Ämne:

MISTRA program:

2. Hur länge har du varit verksam i programmet? Vad är din roll/din uppgift inom programmet?

3. Hur kom det sig att du började i programmet? (Exempelvis: Blev du tillfrågad, i så fall av vem, eller sökte du själv till programmet, varför sökte du till programmet?)

4. Vem formulerade ditt forskningsprojekt inom programmet? I hur stor grad bidrog du till att formulera forskningsproblemet du arbetar med?

5. Uppfattar du ditt projekt som tvärvetenskapligt? Om så, på vilket sätt?

6. Har detta någon betydelse för ditt dagliga arbete? Om så, vilken betydelse?

7. Vad är för- respektive nackdelarna med att arbeta i detta program?

8. Kommer du att vilja gå med i ett liknande program igen? Varför/varför inte?

## Appendix C University Policy and Organization for Interdisciplinary Research

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### 1. METHOD

The aim of this appendix is to give a brief overview of the organizational conditions for interdisciplinary research in six Swedish universities. The six universities selected for inclusion in the survey are: Blekinge Institute of Technology, Chalmers University of Technology, Dalarna University College, Umeå University, Uppsala University, and Örebro University. This overview is largely based on existing literature and documents of various kinds.

Information pertaining to the organization of interdisciplinary activities was sought by gathering the following types of documentation:

- Policy and other documents relating to the activities of Rectors' Boards and Faculty Committees
- Documents on policy and praxis relating to recruiting and promoting staff
- Information on the role of interdisciplinarity in postgraduate programmes
- Information on interdisciplinary units or centres
- Other information reflecting the position and development of interdisciplinarity in the Universities.

#### 1.1 Data Collection

Material was collected in two ways: by exploring the Universities' websites, and by contacting administrative staff at each of the selected universities.

### *Policy and other documents relating to the activities of the Rector's Board and Faculty Committees*

Types of documents studied include strategy documents of various kinds, such as research strategies, aim and profile documents, and strategic plans, as well as the Universities' annual reports. These documents indicate that the majority of the universities studied emphasize the importance of interdisciplinarity within their research and organization. The only university which has no official policy with regard to interdisciplinarity is Blekinge Institute of Technology (further information in section 2).

### *Documents on policy and praxis relating to recruiting and promoting staff*

Types of documents collected include:

- 'Guidelines for Recruiting Teaching Staff'
- 'Guidelines for Teaching and Research Staff'
- 'Regulations for Assessing Qualifications of Applicants to Teaching Posts'
- 'Guidelines on Postgraduate Studies'

None of the universities studied had any documents indicating their policy or praxis specifically concerning interdisciplinarity and the recruitment and promotion of staff.

### *Information on the role of interdisciplinarity in postgraduate programmes*

There were no documents at the Universities specifying policy on interdisciplinarity and postgraduate courses. The Universities' general policies on interdisciplinarity (presented in section 2) do however provide a picture of the context within which postgraduate studies are pursued.

### *Information on interdisciplinary research centres*

Some of the required information on this issue could not be found in any of the written material. It was particularly difficult to find data on the Universities' interdisciplinary centres going back in time. Since the universities studied do not seem to have easily retrievable records of previously existing units, it is not possible to give a complete picture of how such units have developed over time. A number of the interdisciplinary units currently hosted by the Universities are listed in section 2.

## **2. THE UNIVERSITIES**

The following includes a short presentation of the six universities, and of their organization and policy as they relate to interdisciplinarity.

### **2.1 Blekinge Institute of Technology**

Blekinge Institute of Technology (*Blekinge Tekniska Högskola*, BTH) is a young university college founded in 1989. It has a pronounced profile of applied IT and of contributing to industrial and community development. This profile permeates all its research and teaching activities, in engineering and technology, as well as in the humanities, the social sciences and health research.

The management system at BTH consists of the governing board, a board for the undergraduate programme, and a faculty board. There are eight departments at BTH:

- Business Administration
- Health, Science and Mathematics
- Human Work Sciences and Media Technology
- Humanities and Social Science
- Mechanical Engineering
- Software Engineering and Computer Science
- Spatial Planning
- Telecommunications and Signal Processing.

Blekinge Vocational University (*Blekinge Yrkehögskola*) is affiliated with BTH and offers vocational training to about 400 students.

Research at BTH is very extensive in relation to the institution's size and age. Research is concentrated to the profile areas and to a few strong research groups, and constitutes about 30% of the activity at BTH. There are 33 professors – 14 within the area of IT, and approximately 90 postgraduate students; 90 of the teaching staff have doctorates.

In 1999, BTH gained university status for its research and teaching in technology, an area in which it can consequently award its own research degrees. Research and postgraduate studies in technical subjects are thus given priority. However, research in other areas will be promoted within designated profile areas. Today, all departments offer postgraduate courses through collaborating with other universities and university colleges. Nearly half BTH's research is pursued in collaboration with industry in the region. Enhancing the industrial capacity of the region is seen as an important task by BTH.

The central activities then, lie in technology; but IT also constitutes an expanding specialism in the humanities, the social sciences, and health research. Interdisciplinary collaborations are accordingly developing within the University College, even if these activities are not as yet very prominent. BTH has no central documents indicating its policy vis-à-vis interdisciplinarity.

There are two interdisciplinary units at BTH: the Centre for Urban Management and Regional Development (CTUP) and the Centre for Electronic Security. As an interdisciplinary competence centre established by decision of the governing board in 1998, CTUP is a clear example of the emphasis on interdisciplinary research at BTH. The aim of this Centre is to carry out contract research and projects, as well as teaching and seminar activities in areas such as spatial planning, environmental assessment analysis, and regional development.

## 2.2 Chalmers University of Technology

Chalmers University of Technology was founded in 1829. The University is named after the benefactor William Chalmers, one of the directors of the successful Swedish East India Company in Gothenburg. The first president was the industrialist Carl Palmstedt, a close friend of the chemist Berzelius. Right from the start the University focused on science and had strong links with industry and commerce.

In July 1994, Chalmers University of Technology passed from state ownership to become a new foundation, Chalmers University of Technology AB. The new statutes, which replaced the previous ordinance, have given Chalmers greater freedom and scope to

explore new paths, whilst emphasis is still on maintaining a high standard of research and teaching.

### *Management*

The Board of the Chalmers University of Technology Foundation is the supreme decision-making body; it appoints the University Board, and manages the capital of the Foundation. The University Board is responsible for overall planning, coordination, and follow-up of the University's activities. Under the University Board is the Rector, who is responsible for the University's activities. The Rector, the Deans, and the Rector of Chalmers Lindholmen University College make up the University Central Management Group which formulates common strategies. The Faculty Committee is an independent body for the Engineering Faculty and handles key issues pertaining to the running of the Faculty.

### *Departments and Schools*

Research at Chalmers ranges from mathematics and natural sciences through to engineering, industrial sciences, and community development. Teaching and research take place in the University's 80 departments; the departments are organized into nine schools, corresponding to the main areas of engineering:

- Architecture
- Chemical Engineering
- Civil Engineering
- Electrical and Computer Engineering
- Environmental Sciences
- Mathematical and Computing Sciences
- Mechanical Engineering
- Physics and Engineering Physics
- Technology Management and Economics.

The Schools of Mathematical and Computing Sciences, Physics and Engineering Physics, and Environmental Sciences are run jointly with Gothenburg University. There is also close cooperation with Gothenburg University in the field of chemistry.

Each School has a School Board, which is responsible for the strategic planning of the MScEng and MArch courses, and of research degree programmes. The School Dean is responsible for the management of the School together with Vice-Deans.

### *The Foundation Money*

As a foundation, Chalmers enjoys special financial conditions. These conditions have a significant bearing on the whole organization, and a description is accordingly in order.

The Foundation started out with a capital of 1.5 billion SEK. Profits from the investment were to go to fund activities at Chalmers. The Foundation money can only be used for strategic initiatives, such as starting up new undergraduate programmes, or funding special research initiatives; it cannot be used for running costs. The regulations stipulate that a particular activity can only be supported from this fund for a period of three to five years, after which the activity must find alternative sources of funding. Owing to a period of favourable interest rates the capital grew significantly, and for a time Chalmers was able to allocate more than 2 million SEK a year from the fund to develop its own activities.

In 1998, when a new Rector assumed office, Chalmers identified a number of areas for the strategic concentration of resources:

- Bioscience/Biotechnology
- Environmental Systems Analysis
- IT (concentrating on the three areas: developing the IT systems within Chalmers; IT undergraduate courses; and basic research).

Design studies and innovation design (design methodology) have also been singled out as areas worthy of special investment.

Chalmers also receives government core-funding to allocate to the Schools.

### *Centres*

The Corporate Relations Centre markets Chalmers as a partner for industrial renewal, research collaboration, and continuing professional development for industry employees. The Centre for Educational Development is responsible for providing central support in teacher training.

There are also seven centres of excellence at Chalmers, financed by the Swedish Energy Agency (STEM) and the Swedish Agency for Innovation Systems (VINNOVA).

- Competence Centre for Catalysis (STEM)
- Combustion Engine Research Centre (STEM)
- Consortium Gasturbine Centre (STEM). The Royal Institute of Technology and Lund Institute of Technology co-host this programme.
- Competence Centre for High Temperature Corrosion (STEM)
- Competence Centre in Environmental Assessment of Product and Material Systems (VINNOVA)
- Chalmers Centre for High-Speed Technology (VINNOVA)
- Competence Centre in Railway Mechanics (VINNOVA).

Chalmers is the host University of two MISTRA Programmes: Soundscape Support to Health, and Sustainable Urban Water Management. The University also participates in the MISTRA Programme Batteries and Fuel Cells for a Better Environment.

A large number of research programmes at Chalmers are funded by the Foundation for Strategic Research, for example: Bio-informatics; the National Network of Applied Mathematics; and the Center in Combustion Science and Technology. Other funders of research programmes at Chalmers include the Technology Bridge Foundation in Gothenburg, and the Knowledge Foundation which funds geographically dispersed industrial research schools.

### *Interdisciplinarity*

Chalmers is an institute of technology with a strong profile in the natural sciences and numerous areas of mathematics and computer science. There are strong activities in technology, particularly in micro-electronics and material science. Chalmers also has a close collaboration with Gothenburg University in the humanities, social sciences, and medicine. This breadth of research gives Chalmers ample potential for interdisciplinary

research and teaching. In *Chalmers' Strategic Plan* (n.d.) the need for an interdisciplinary focus is highlighted (p.3):

The conditions for research are more than ever related to competition and fast changes. The time between production and application of research results is now strongly reduced. Because of this, research organizations need to be flexible and able to adjust and re-prioritize quickly, if they are to achieve scientific breakthroughs. It is difficult to anticipate and plan for the emergence of new research areas which often emerge at the boundaries between established disciplines. Interdisciplinary research and systemic approaches need to be promoted in order to foster successful research environments. The latter need to be dynamic in order to adapt quickly and keep up with developments in science. (...) Besides the importance of a strong research base, there is today a need to interact across boundaries and explore new areas. Areas of humanities, social science, and bioscience will play an increasingly important role in a broad and comprehensive treatment of scientific problems that either arise within a discipline or result from the development of society. Cooperation between scientists within as well as between faculties is therefore important (...).

In its strategic plan, Chalmers also emphasizes the importance of a solid theoretical base for achieving success at the research front. But the University also stresses that successful research, especially in technology, is often characterized by a close relationship between basic and applied research.

### 2.3 Dalarna University College

Dalarna University College, with roots in a vocational training college, was founded in 1977, and has campuses in Falun and Borlänge. It has developed rapidly since its beginnings. The Falun campus offers courses in, among other things, teacher training and humanities; the Borlänge campus offers courses in social science and technology. Today the University College has about 6,000 students and 400 employees. The organization consists of a governing board, a management group, which includes the Rector, Head of Administration and Assistant Rector, and a board for teaching and research matters. Dalarna University College is working towards becoming 'the University of Dalarna' in 2005.

In 1997, Dalarna University College received a government research grant – of 21,9 million SEK – for the first time, which matched the amount the University College had built up from other sources. The same year, the governing board decided to emphasize integration between research and undergraduate programmes. The motto coined was 'researching teachers and teaching researchers'.

The University College has had an organized programme of research since the mid-1980s. The ambition is that the research should be problem-related, applied, and interdisciplinary. Research and undergraduate teaching are based on traditional disciplines but are pursued within interdisciplinary profile areas. Campus Falun concentrates research activity in:

- Research-Based Teacher Training
- Health and Nursing.

The research profiles at Campus Borlänge are:

- Material Processing
- Intelligent Transport Systems
- A Sustainable Society.

The governing board is now working on an extensive inventory of existing activities in the organization with the aim of updating these profile areas.

Dalarna University College reportedly encourages an interdisciplinary approach to both teaching and research. It has hosted interdisciplinary centres in the past, notably the Centre for Solar-Energy Research, founded in 1984. But it has now abandoned the system of interdisciplinary centres, as the governing board believes that the new organization of profile areas renders them redundant.

Another interdisciplinary initiative at Dalarna University College is the 'Wednesday Colloquium'. Every Wednesday all normal activities are suspended in favour of interdisciplinary activities, such as seminars, courses etc.

## 2.4 Umeå University

As a generalist university, Umeå University, which was formally founded in 1965, undertakes research and postgraduate teaching in areas allied to arts and social sciences, natural sciences, and medicine. The University's research and teaching are largely organized in the five faculties of: Arts, Social Sciences, Medicine and Odontology, Science and Technology, and Teacher Education. The University has three Colleges: Umeå School of Business and Economics, which is based on a unique cooperation between the Departments of Business Administration, Economics, Law and Statistics; Umeå Institute of Design - the only one in Sweden oriented towards industrial design; and Umeå School of Fine Arts, with its sculpture programme and other programmes of study.

### *Interdisciplinary research*

Research at Umeå University is broad-based. However, the University has recently marked out seven areas of strength which will form the basis for its research strategy for the coming 5-10 years. Thus the University's breadth is combined with a degree of specialization in the following disciplinary and interdisciplinary areas:

- Life sciences, especially cellular and molecular biology
- The interplay between people-machines-IT
- Social welfare
- The northern cultural boundary: changes in time and space
- The ecologically sustainable and resource adapted society
- Gender studies
- Teacher education and vocational pedagogics.

The University emphasizes the importance of interdisciplinary research in its document *Umeå University's Research Strategies* (1999 p.5):

The amount of electronically-stored information, and the possibility to retrieve and disseminate this, is increasing dramatically at present. Accordingly, university research is called upon to tackle more and more complex problems. Important competences in the future are therefore an ability to create, search for, communicate, and use knowledge across traditional disciplinary boundaries.

Further on in the same document, the University states (p.15):

Umeå University is known for its intimate and informal climate and will in different ways continue to stimulate interdisciplinary collaboration across the boundaries of departments and faculties.

There are a large number of interdisciplinary units at the University, which conduct much of the interdisciplinary research. Examples of units are:

- Umeå Centre for Molecular Medicine (Faculties of Medicine and Odontology, and Science and Technology)
- Umeå Centre for Molecular Pathogenesis (Faculties of Medicine and Odontology, and Science and Technology)
- Umeå Life Science Centre (Faculty of Medicine and Odontology)
- Umeå Plant Science Centre (Faculty of Science and Technology, in collaboration with the Swedish University of Agricultural Sciences (SLU) in Umeå)
- Umeå Marine Sciences Centre (Faculty of Science and Technology)
- Centre for Regional Science (Faculty of Social Sciences)
- Centre for Women's Studies (Faculty of Social Sciences)
- Centre for Environmental Research (off campus).

According to the document *Umeå University's Development Programme 1998-2002* (n.d. p.11), research which cannot be pursued within a department of sufficient size, should be organized in interdisciplinary units or in networks bridging disciplines or faculties.

The University has a 'Delegation for Interdisciplinarity', a designated committee to promote the cause of interdisciplinary activities at the University. One of its tasks is to contribute to implementing the University's general policy for interdisciplinarity across the University. The Delegation has a small amount of money available for the development of interdisciplinary courses and research programmes, for which both individuals and groups may apply. Each project can receive a maximum of 50,000 SEK. The aim is to stimulate researchers to develop interdisciplinary programmes which in the future may attract external funding from e.g. research councils, research foundations, and the EU (*Guidelines for the Delegation for Interdisciplinarity 1997-1998*, 1997).

## 2.5 Uppsala University

Uppsala University, founded in 1477, is the oldest university in the Nordic region. Research at the University is conducted by 1,500 researchers and 2,500 graduate students; the University graduates more than 300 doctoral candidates a year.

Since 1999, the University's research and teaching activities have been organized in three Disciplinary Domains: Arts and Social Sciences, Medicine and Pharmacy, and Science and Technology, which between them contain nine faculties; Arts and Social Sciences has six faculties, Medicine and Pharmacy two, and Science and Technology one. The new organization comprising Disciplinary Domains entails a new management structure of three Disciplinary Domain Boards (*områdesnämnder*) and new Faculty Boards. Each Disciplinary Domain is managed by a Vice-Rector who is also a member of the University's Management Group, together with the Rector and the Head of Administration. This reorganization has had considerable implications for planning and has resulted in an

entirely new accounting system. The changes were made in the expectation that they would have a long-term positive effect on the University's research and teaching.

The University has recently strategically grouped university units in a number of campus locations. Thus the Rudbeck Laboratory is a new research lab for cancer and genetic diseases. Uppsala Biomedical Centre is one of Europe's largest complexes for life sciences, which also houses the Linnaeus Centre, a new centre for bio-informatics. The Centre for Evolutionary Biology is located close to the new Geo Centre. The Ångström Laboratory is one of Europe's most advanced labs for materials research; whilst the Svedberg Laboratory is a national centre for accelerator research in particle and nuclear physics. Around the Old Square, social scientists, law scholars, and humanists collaborate on issues relating to democracy, peace, and development; the Centre for Multi-Ethnic Research is also located there. The presence of SLU in Uppsala is also an important resource for the University.

The University explains its new campus layout in terms of the greater interdisciplinary teaching and research activities it is designed to foster. Thus on its homepage, the University states:

An interdisciplinary, holistic approach is a hallmark of Uppsala University. The University is investing to create optimal environments for cross-disciplinary research and education, settings conducive to innovation and creativity. In the major campus areas researchers and students are gathered from different subject areas.  
(Uppsala universitet n.d.)

Uppsala University's stance towards interdisciplinary research is further evident in the document *Research Strategies of Uppsala University* (1999 p.8):

Uppsala University's research strategy aims at maintaining the University's position as a general research university with an international reputation, and where disciplinary research provides the foundation for conducting high-quality, in-depth interdisciplinary research. At Uppsala, both the undergraduate teaching programmes and research activities are enriched by perspectives brought from other areas of research. Progress in research is stimulated in the crossover between the different cultures and ideas that characterize Arts and Social Sciences, Medicine and Pharmacy, and Science and Technology.

The University is keen to provide an environment in which researchers' ideas can be quickly converted into action. Accordingly, the University is building up a central reserve of money for the 'Rector's strategic initiatives'. One of several aims is to foster new research in interdisciplinary areas. This reserve grows by 6 million SEK annually, and will continue to do so until it reaches 30 million SEK, approximately 1% of the University's total turnover.

## 2.6 Örebro University

Örebro University was granted university status in 1999. The University's history goes back to around 1963 when Örebro became a University College of Uppsala University. In 1977 the University College became independent and could accredit up to 80 academic points. Some research developed during the 1980s, funded by external means, since Örebro was not then eligible for core government research funding. The element of contract research grew stronger during the 1990s. By the end of 2000 there were 24 professors and 122 postgraduate students at the University, and according to the website, the University today has 68 professors, 13,000 students, and a staff of 1,000.

In 1997 the so-called 'Professors' Programme' was initiated jointly with Uppsala University. The then Örebro University College recruited ten professors for ten years, whose posts entailed a commitment to work 80% at Örebro and 20% at Uppsala University. Postgraduate students were still examined by Uppsala. This programme was funded by the county administrative board, and the municipalities, a clear indication of the considerable regional interest in an institute of higher education in Örebro. This programme doubtless eased Örebro's path to university status.

Örebro University has two faculties: the Faculty of Humanities and Social Sciences, and the Faculty of Medicine, Science and Technology. The Humanities and Social Science Faculty is historically the strongest at the University, and 70% of the core research funding currently goes to this Faculty.

The undergraduate programme at the University has since its time as a University College been disciplinary-based. Research is also disciplinary-based, but is organized into interdisciplinary themes; postgraduate teaching is disciplinary-based, but often involves collaboration between disciplines and interdisciplinary groups.

The University has developed a research strategy based on the promotion of five interdisciplinary areas, which nevertheless encompass all or most of the research activities at the University. These profile areas are:

- The human environment, communicative processes and democracy
- Human worth, health and vitality
- Business, IT and market processes
- The human senses, autonomous sensor systems and industrial processes
- Quality of life – possibilities, hindrances and improvement.

Each profile area is broad and open, gathering a relatively large number of researchers from different disciplines, research groups and interdisciplinary units in a coherent – albeit wide – area. These identified profile areas will have significant future bearing on the allocation of core research funding within the University. Within the profile areas a number of more specific areas were identified in the research strategy as worthy of particular future support. These include:

- Democracy research
- Human dignity and worth
- Biomedicine and life science technologies
- Disability research
- Electronic commerce and logistics
- Applied autonomous sensor systems
- The senses and art
- Casting technology.

(Örebro universitet 2000)

As a University College, Örebro already had a number of interdisciplinary research units. These centres are today an important element of the research organization at the University:

By creating interdisciplinary meeting places the University hopes to be able to promote creativity and stimulate research environments. (Örebro universitet n.d.).

Until now, the interdisciplinary units at Örebro University have been formally detached from the profile areas, but from January 2003 they will be incorporated into these profiles. Examples of current interdisciplinary units at the University include:

- Ahlséns Research Institute (hearing, language and deafness research)
- The Swedish Institute for Disability Research (in collaboration with Linköping University)
- NOVEMUS – School of Public Affairs
- The Centre for Housing and Urban Research
- The Centre for Women's Studies
- Man-Technology-Environment Research Centre
- Center for Applied Autonomous Sensor Systems.

As described in the document *Research strategies at Örebro University (Forskningsstrategier vid Örebro universitet)*, the University will seek to base its research activities in disciplines organized in faculties and departments, as well as to continue to foster the development of interdisciplinary research units:

The aim of this description and strategy is to illustrate the University's distinctive character. A long-term, continued development of interdisciplinary units, based on strong disciplinary research, is encouraged, in order to allow profiling and the development of excellence. The strategy also supports breadth in research activities, an effective infrastructure, and organizational flexibility, in order to harness innovativeness and promote the University's distinctive image. (Örebro universitet n.d.).

The University will continue to develop the profile areas, which in the future will also incorporate undergraduate teaching.

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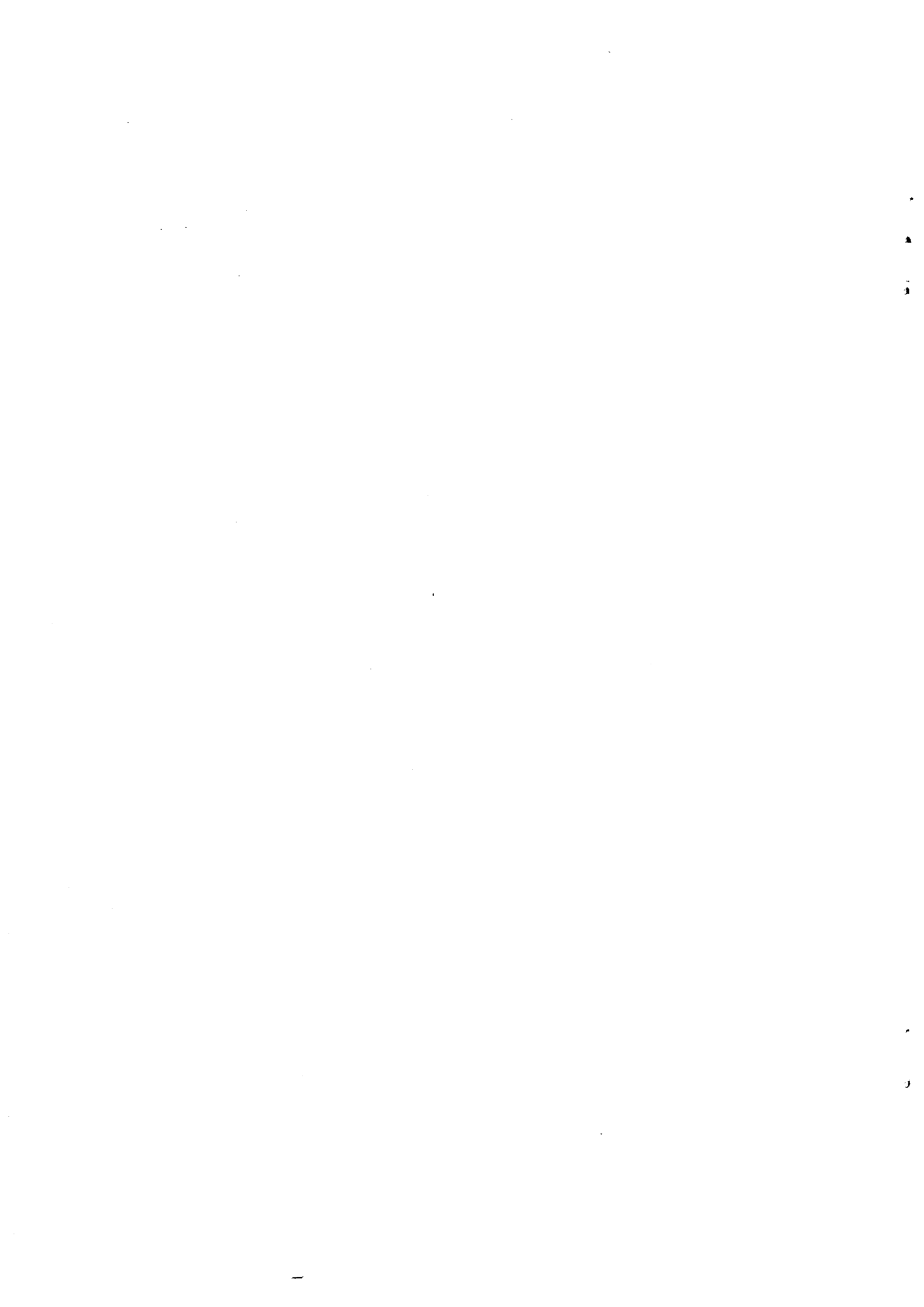
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