

**The
first
ten
years**



MISTRA

An evaluation of
The Foundation for
Strategic Environmental Research
by an international committee

Volume 1. Main report

LEARNING FROM MISTRA'S FIRST TEN YEARS



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the Foundation for
Strategic Environmental
Research by an
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*Volume 1
Main report*

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Preface

In spring 2002 the Board of Mistra decided to ask an international committee to evaluate Mistra's first ten years. Mr Lars Anell was appointed chair and entrusted with the task of setting up the committee. The members of the committee subsequently appointed were Mr Claude Fussler, Professor Gordon H. Orians, Professor Nils Roll-Hansen and Ms Gunnel Wisén Persson. The committee held its first meeting at the end of November 2002. Lars Anell resigned in December 2002 and was succeeded by Ms Gunnel Wisén Persson. Dr Elizabeth Ness joined the committee in February 2003. The evaluation was concluded in August 2003. Dr Erik Hörnell has served as secretary to the committee.

This evaluation of Mistra's achievements and modes of operation is intended to serve as a basis for future strategic deliberations by the Board of Mistra. The task of evaluating Mistra has been both challenging and instructive. The last decade has been a period of significant change in both the organization and the funding of Swedish publicly financed research. The establishment of Mistra was the beginning of something new. It was also somewhat controversial. There were opponents to the idea, as well as great expectations. Ten years is both too long and too short a time for an evaluation of Mistra. The organization has developed and learnt from experience and is different now from what it was when it was first established. Ten years is also too short a period for the full impact of the research which it has funded to be evaluated.

The committee would like to thank the Mistra secretariat for its kind assistance during the evaluation, and also the programme directors, researchers and interviewees who have given of their time to present their programmes and answer the committee's questions.

Gunnel Wisén Persson
Chair of the committee

Erik Hörnell
Secretary

Summary

In 2004 the Foundation for Strategic Environmental Research (Mistra) will have been in operation for a decade. With the anniversary year approaching, the Board of Mistra has asked an international evaluation committee to assess Mistra's achievements and modes of operation, in order to provide an input to its deliberations to determine the future strategies of the Foundation.

The main issues addressed in the evaluation have been as follows:

- Does the Mistra programme portfolio reflect a good mix of areas of strategic importance for a good environment?
- Is the Mistra mode of operation well designed with a view to developing such programmes, producing outcomes of generally high quality, and generating appropriate interdisciplinary research?

The committee evaluated the relevance of Mistra's programmes to industry, natural resource managers and public agencies. It visited laboratories where Mistra-supported research is being carried out and interviewed project leaders and participants. Interviews and hearings were held with Mistra Board members and staff, other researchers and officials in agencies and organizations. The committee also commissioned a number of studies to complement the primary evidence.

In summary, the evaluation committee was impressed by Mistra's approach to the selection, shaping and implementation of programmes. It did, however, find substantial potential for improvements. The committee made eight groups of recommendations for the three key stages in the life of a Mistra programme.

At the stage of generating new research ideas, incubating them into programmes and planning their implementation, Mistra needs to be even more deliberate and to provide more time and resources. It should foster a process of regular dialogues with a broader circle of academic, policy and business leaders in order to take stock of the challenges that need to be addressed by research programmes. It should place this process of dialogues in the context of the Swedish and international policy frameworks that set the priorities for sustainable development. It is also at this stage that the socio-economic dimensions can be highlighted and properly addressed by an appropriate balance of natural and social sciences resources.

Good management of programmes is already a distinctive fea-

ture of Mistra. It can be improved by attention to the composition of programme boards and to ensuring their flexibility and renewal as programmes progress. Mistra should also consider funding smaller programme teams.

Finally, programmes will only be truly effective when they make an impact in terms of better environmental practices and speed up the transition to sustainability. The engagement of stakeholders through the communication of programme outcomes is critical. Mistra also needs to consider pursuing the advocacy of outcomes beyond programme closure. This effort could be connected with the dialogues related to the selection and shaping of programmes.

1. Background and methods

1.1 The assignment and how the committee interprets its mandate

The mandate from the Board of Mistra asks the evaluation committee to assess Mistra's achievements and modes of operation and, based on that assessment, to provide input to the Board's deliberations to determine the future strategies of Mistra. The Board identified three main areas to be emphasized in the evaluation:

- Does the Mistra programme portfolio reflect the right balance between different areas of strategic importance for a good environment?
- Is the Mistra mode of operation optimal with respect to the strategic areas identified?
- Is the quality of programme outcomes high enough?

The evaluation committee interpreted and expanded these questions as follows:

- Does the Mistra programme portfolio reflect an appropriate scope and balance among different areas of strategic importance for a good environment?
- Is the Mistra mode of operation well designed with a view to identifying important strategic areas and developing programmes appropriate to dealing with them?
- Is the Mistra mode of operation effective in terms of
 - (a) generating and attracting truly innovative proposals,
 - (b) guiding programmes after they are funded, and
 - (c) producing outcomes of generally high quality?
- Is the Mistra mode of operation well designed with a view to generating and executing interdisciplinary research? How can Mistra more effectively stimulate interdisciplinary research involving both natural and social sciences, including economics?

1.2 Methods used by the evaluation committee

To evaluate Mistra's mode of operation, the committee assessed the pros and cons associated with major research programmes and the administrative model used by Mistra to generate and monitor those programmes. It also evaluated, where appropriate, the relevance of the projects for industry, natural resource managers, public agencies, and the general quality of life in a good environment. The purpose of this evaluation is to help Mistra plan its future activities by identifying successes and failures, analysing the reasons for them, drawing conclusions, and making recommendations that may help increase the probability of success in Mistra's future programmes.

To carry out its mandate, the committee evaluated the central Mistra model of large multidisciplinary projects funded over periods of 6–8 years. The committee studied the accomplishments of 22 programmes funded to date by Mistra. Of these programmes, only two have been completed, while two were not extended after four years. Thus, it must be borne in mind that a full evaluation of the accomplishments of the programmes cannot be made until a number of years into the future. The committee also assessed the Idea Support Programme, introduced by Mistra in 2001, recognizing that the only data available are the articulation of the concept and its intended purpose and the nature of the initial proposals.

The committee visited laboratories where Mistra-supported research is being carried out, interviewed project leaders and participants, talked with former participants in Mistra projects, and with people who declined to submit proposals. There were hearings with the Mistra Board and staff. Researchers not involved in Mistra programmes were interviewed, as were officials at the Ministry of the Environment, the Swedish Environmental Protection Agency, research councils and WWF-Sweden. To assist it in gathering the data needed for its analyses, the committee commissioned the following studies, which are presented in volume 2 of this evaluation report:

- A questionnaire sent to programme directors to collect the facts, quantifiable results and some self-assessment.
- A survey of the scientific evaluations already made of Mistra programmes.
- Presentations of the Swedish institutional structure for funding basic and applied research since the mid-1980s.
- A survey of Swedish environmental research.
- A study of benefits to industry from Mistra's research programmes.

- An interview survey with programme board members from industry about industry applications of Mistra's research programmes.
- An interview survey with board members from other organizations than industry about the policy relevance of Mistra's research programmes.
- A study of how Mistra's priorities fit into a broader international or European pattern and the relationship between Mistra's programmes and the Sixth EU Framework Programme.
- A study carried out by SIDA on the major environmental challenges facing developing countries.

From Mistra, the committee received information about their past and present programmes, such as applications, annual reports and scientific reports generated by the programmes. Additional empirical evidence for the evaluation was provided by the following:

- *Mistras varumärke. En attitydundersökning.* (Mistra's trade mark. A survey of attitudes towards Mistra.) Brandinsight, March 2003.
- The annual reviews of Mistra 1996–2000, performed by the Royal Swedish Academy of Sciences, the Royal Swedish Academy of Engineering Sciences and the Royal Swedish Academy of Agriculture and Forestry.
- "Mistra's role and some lessons learned in the first five years." Article by Mr Göran Persson, the first managing director of Mistra. *Policy Sciences* 32: 323–326, 1999.
- An academic report on Mistra's selection of programmes, based on interviews with researchers who failed to obtain approval from the Board of Mistra (by Dr Johan Hedrén, Linköping University).
- A report on the administration of the Mistra programmes, prepared by Lennart Arvedson and Hans Nilsson at ConcoursCepro AB (September 2000).
- *Guide to Mistra Programmes.*

1.3 Mistra's statutes

The political background to the establishment of Mistra explains why the Foundation's statutes emphasize the goal of improving Swedish competitiveness and possible industrial applications. Nevertheless, the statutes are broad enough to enable Mistra to support research that lacks the possibility of yielding industrial applications in the short term. Mistra's articles of incorporation indicate a medium- to long-term perspective.

Article 1 states that the purpose of the Foundation is to “fund research of strategic importance for a good living environment”. Moreover, “the research shall be of importance for finding solutions to important environmental problems and for a sustainable development of society”, and “opportunities for achieving industrial applications shall be taken advantage of”.

Article 3 states that the Foundation’s efforts should be distinguished by activities such as

- (a) fostering the development of research centres or research areas with the potential to have an international impact,
- (b) fostering projects that span boundaries between disciplines,
- (c) promoting training and recruitment of researchers,
- (d) establishing centres or research areas in close association with universities and colleges, and
- (e) promoting mobility of researchers both across international borders and among academic institutions, institutes and companies.

At the time when Mistra and the other foundations were created, the political discussion was that the foundations should spend their substantial funds in a decade. To achieve this, it was more or less necessary to support big programmes with large budgets. The Mistra management also shared the idea that large programmes should increase research productivity and lead to “quantum leaps”. This idea was, in addition, supported by an evaluation of Swedish environmental research, published in 1992. The evaluation, though mainly appreciative about environmental research in Sweden, declared that the work was too fragmented into small projects and also limited to studying effects rather than solving problems.

Mistra’s mission is based on the concept that research is a tool for solving environmental problems. The empirical foundation for this concept comes in part from the history of science, which shows that basic research often leads to unexpected applications. Another source is the engineering sciences, where promotions are based in part on successful applied research and where researchers often work closely with industry.

Devising means by which the results of basic research in environmental sciences can be applied to the solution of applied problems will continue to be difficult, since no single type of solution fits the wide range of environmental problems and challenges. In some cases the solution may require new legislation or the establishment of a new regulatory framework. In other cases changes in public attitudes, social incentives and agency cultures may be needed. The political processes and decisions that are influenced by

the results of environmental research may be complex. That Mistra's programmes fall into several, quite different categories of practical relevance – to industry, to political negotiations and to policy decisions – reflects this complexity. Nevertheless, the success of programmes in all three categories depends on high-quality research that is designed to generate data and ideas that are perceived to be both scientifically sound and potentially useful in discovering, understanding or solving some important environmental problems.

1.4 Definitions of environmental research

The word *environment* in Mistra's statutes refers specifically to the physical, biological and social components of the world that influence the quality of people's lives. In this context, the goals of environmental research are:

- (a) to determine how environmental processes generate the necessities, amenities, goods and services upon which people's lives depend,
- (b) to assess how human activities are changing the ability of environments to provide or protect those necessities, amenities, goods and services, and
- (c) to determine how people can live in and use environments so that necessities, amenities and the flows of those goods and services are maintained for current and future generations (the concept of sustainability).

Necessities, amenities, goods and services also include aesthetic benefits that contribute significantly to the quality of human life, as well as ethical concerns that deal with the stewardship responsibilities which civilized societies and cultures regard as an important element of "humanness".

Mistra attempts to be relevant socially, to industry and to the management of natural resources, for example in terms of preventing pollution, maintaining biodiversity etc. Mistra's concept of "environmental" is linked to the Swedish political agenda – perhaps more to the political agenda than to the agenda of theoretical science. In the context of Mistra, the committee interprets environmental research as research relevant to understanding and improving sustainability in the Swedish context, and to underpinning the development of appropriate policies.

1.5 Mistra's present and future mission

Although Mistra is a major funder of Swedish environmental research, it is only one of several sources of funds for such research. The Mistra programme portfolio must be evaluated in the context of Mistra's position in relation to the performance and programmes of the other Swedish organizations that fund environmental research.

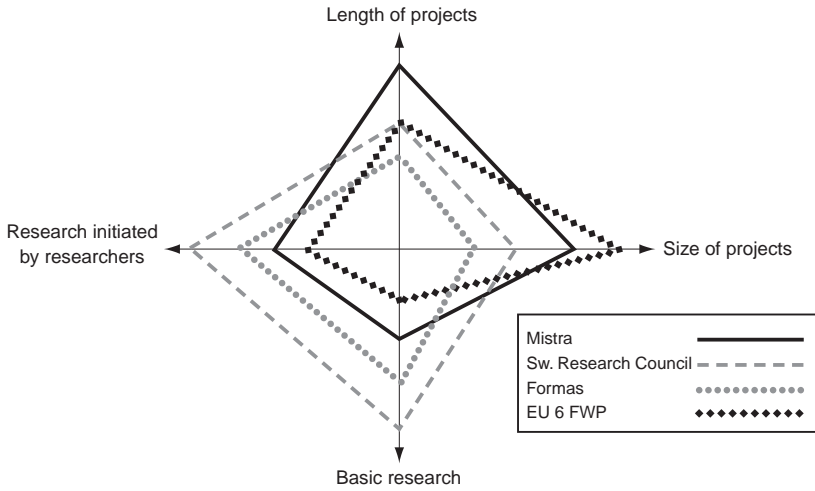
Mistra is an independent foundation with relatively non-restrictive statutes. Its independence from governmental appropriations gives it considerable freedom to explore innovative approaches to environmental research, including the creation of networks and co-operating parties. How to employ that freedom of operation in the future is the major policy decision faced by Mistra, and one to which this evaluation is designed to contribute.

In its efforts to support world-class research, increase Sweden's competitiveness and contribute to solving environmental problems, Mistra would, in effect, be a mixture of a research council, a board for promoting the development of environmental technology, and a public policy advisory body. So far, Mistra's core business has been research funding and administration. However, the statutes imply, or at least do not oppose, a more comprehensive strategy. Such a strategy would give Mistra a unique position, and distinguish it from other funding organizations.

The activities of the bodies that finance environmental research differ in certain respects. In figure 1 the committee has tried to give a simplified picture of these organizations with respect to four dimensions, using an ordinal scale. The dimensions in question are the organizations' shares of basic research funding, whether projects are initiated by researchers or from the top down, the length of the funding provided and finally the size of research projects funded. What distinguishes Mistra from the other funding bodies is above all the duration of its research programmes. The Mistra model is now probably less unique than it was ten years ago. The other funders seem to have moved closer to the Mistra mode of operation by giving more emphasis to larger research projects that include more than one discipline.

The key issue for the decade to come is whether the Mistra Board should develop and manage a more comprehensive strategy. Such a strategy should pay more attention to what the management of Mistra has called "bridging the gap between results from research and their application". One way to bridge such a gap is to define the programmes in a wider context. Environmental problems are societal

Figure 1. Comparison of four funders of environmental research.



problems and this should be the starting point. Once an environmental issue is defined as a societal problem it will be easier to see the need for syntheses of previous research, to plan new interdisciplinary research approaches and to pay attention to economic and institutional factors that are relevant to solving the problem. The committee will elaborate on this proposal later in this report. ■

2. The conclusions and recommendations of the evaluation committee

Since the Board of Mistra has given the committee explicit questions to answer, it will address them specifically. The evidence upon which the committee's answers are based will then be presented in brief. (The reports requested by the evaluation committee are reproduced in full as an appendix – volume 2 – to this report.) The committee organizes its conclusions and recommendations around the four questions posed in Part 1. Some, but not all, conclusions lead to a recommendation. And some recommendations are not based on a clearly identifiable conclusion, but on the committee's consensus evaluation overall of the evidence taken.

2.1 Does the Mistra programme portfolio reflect an appropriate scope and balance between different areas of strategic importance for a good environment?

Mistra's current portfolio developed from the scope and quality of proposals submitted to Mistra, combined with the identification, by the Mistra staff and Board, of topics and issues for which proposals would be invited. This rather ad hoc approach initially generated a good flow of proposals, which enabled Mistra to develop a full and varied portfolio of programmes of high quality. More recently, the number of proposals being submitted has declined to the point where Mistra needs to consider ways in which to stimulate more high-quality submissions.

The division of Mistra's programmes into three major categories (Industry relevance, Relevance for political negotiations and Policy relevance) is not the result of deliberate planning. However, in sum, the programmes cover an impressive array of approaches to environmental problem solving. Despite this, some important areas (particularly, but not only, in the social science arena) are under-represented in Mistra's portfolio. Among them are

- Projects that analyse people's motives for engaging in behaviour that contributes to a deterioration of environmental quality.

- Projects that study possible ways of changing existing incentive structures that encourage environmentally damaging behaviour.
- Projects that study the effects of changing cultural attitudes on behaviour that promotes or counteracts degradation of the environment.
- Projects on socio-economic processes and policies in Sweden and how they influence interactions between people and the environment.
- Projects to develop tools and/or processes which allow the integration of sustainable management into industrial or governmental activities.
- Projects on indicators of environmental quality and how they should be measured.

Continued →

Recommendation 1:

Focus on socio-economic dimension

Mistra should endeavour to identify and fund programmes on decision-making, transformation of socio-economic incentive structures, political institutions and human behaviour. No programme should overlook the fact that natural resources management is also people management.

Identify portfolio omissions

Mistra cannot, and should not, fund all types of environmental projects. However, it should review its current portfolio in the light of the Swedish and international environmental research context. This could also identify areas that are relatively neglected. Some of those areas could be particularly suited to Mistra's mission and to Swedish research capabilities.

Consider competitiveness in the global context

In a globally integrated economy, the competitiveness of Swedish industry is not just defined by its strength in its home market. In developing programmes for funding, Mistra should look at needs and opportunities in developing countries. It should also look at maintaining the competitiveness of Swedish industry in the face of deteriorating global conditions, such as the effects of climate change, diminishing resources, constraints on transport etc.

Maintain the breadth of the portfolio

Mistra should continue to fund a broad portfolio of programmes. While difficult to define, a critical range must be maintained if Mistra is to have a major impact on environmental research, policy decisions and industry competitiveness. This therefore needs careful financial planning and balancing.

- Projects on use of market mechanisms to achieve environmental goals.
- Projects on governmental institutions that could help improve the use of scientific information in environmental decision-making.
- Projects on the communication of scientific knowledge and research findings to the public – in particular the role of the media.
- Projects on how the agendas of environmental research are formed by public opinion and major political goals.
- Projects related to environmental issues in developing countries (see list of suggested programmes in the SIDA report, volume 2).

2.2 Is the Mistra mode of operation well designed with a view to identifying important strategic areas and developing programmes appropriate to dealing with them?

In its decisions the Board of Mistra has relied on evaluation reports from international panels of scientists, and on other material collected and presented by the secretariat, to identify important strategic areas and to encourage the submission of proposals in those areas. Stakeholder input has been modest at best. Interviewed representatives of Swedish industries have not known about Mistra's programmes, although they appear to be interested in them once they are informed. Thus, to date there has been little input into the design and scope of Mistra's portfolio from Swedish industry. Similarly, natural resource managers and decision-makers have been only marginally involved in project identification. Natural scientists, social scientists and economists in Swedish universities, most of whom are aware of Mistra, have likewise failed to provide much input.

Mistra appears to lack a structured acquisition plan to help guide current and future portfolio development. Identifying important strategic areas and assessing which issues and questions can be tackled with current skills and technologies are difficult tasks that require serious attention. It is easier to identify problems and challenges than to determine which ones can be addressed effectively with current intellectual, technical and financial resources, the temporal and spatial scales at which they need to be addressed, and which ones fit with Swedish capabilities. An essential element in judging research opportunities is high scientific competence and familiarity with a substantial portion of the research frontier of the area concerned.

Recommendation 2:

Focus on idea generation

Mistra should invest time and resources, upstream of programme selection, in a more formalized and public idea generation process. Such a process requires preparation (agenda and background documents etc.), funding for the time of appropriate experts, and provision of a location and the means to interact together and with other centres of excellence.

Match or fit with the accepted policy context

The idea generation stage should also take into account the strategic fit of the Mistra programmes with key national and international policies concerning sustainable development, such as:

- the UN Millennium Development Goals
- the Johannesburg Joint Plan of Implementation, and
- the EU and Swedish sustainability strategies.

Identify key stakeholders

The idea generation process should include a formal means of identifying and engaging Mistra's stakeholders.

Set up working groups

The idea generation process could be based on one or more working groups that include representatives of a broad range of scientists and user groups. Mistra should also consider including international experts in the working group(s) to provide the "non-Swedish" dimension for defining problems and challenges.

These groups would also think about emerging issues and how they might be addressed so that Swedish environmental research can be more proactive.

The membership of a working group should rotate to provide a combination of institutional memory and infusion of new ideas. It is also important that members of a working group are not led to believe that participating in its discussions is a way of generating research projects for themselves.

The committee suggests that Mistra considers a range of options for the management of idea generation processes and the related working groups. At one end of the spectrum, the working groups could be directly administered by the Mistra secretariat. At the other end, there is the possibility of founding and financing a special "institute". This last possibility is briefly presented in appendix 2.

2.3 Is the Mistra mode of operation effective in terms of (a) attracting truly innovative proposals, (b) guiding programmes after they are funded, and (c) generating outcomes of generally high quality?

2.3.1 Attracting truly innovative proposals

Initially, Mistra simply announced the availability of funds to support environmental research and solicited applications. The development of the current portfolio has been influenced by the scope of the proposals submitted, but dissatisfaction with many of the proposals led to the policy of using planning grants to assist investigators to develop interdisciplinary programmes of greater interest to Mistra.

Responses from grantees indicate that, in general, planning grants have been very useful in helping investigators develop integrated programmes and improve their conceptual organization. They have also provided a way for scientists who had not previously worked together to develop working relationships. Nevertheless, some investigators have commented that the planning process is overly complicated and burdensome. The committee talked to scientists who decided not to apply for Mistra funds because they believed that the planning process was not worth the effort. The committee cannot judge whether programmes that might have been developed by these investigators would have met Mistra's criteria, but the possibility exists that truly imaginative programmes have not been developed and funded.

The committee also heard complaints that people had invested up to two years in planning, only to have their proposal rejected at the end of the process. However, the planning process itself probably generates deliverables – maybe in the form of syntheses, or even some basic experimental data. If Mistra were to find some way in which the deliverables from this process could be used for the benefit of the researchers involved and of knowledge in general, the planning process would be considered less risky.

During the last couple of years Mistra has also introduced “Idea Support Grants”. The purpose of this programme is to support original ideas which may be too small to justify a full Mistra programme. Because no projects funded under the Idea Support Programme have been completed, the committee has not been able to evaluate it. However, the committee thinks that this scheme could be a valuable complement to the large programmes.

Recommendation 3:**Simplify the planning phase**

Mistra should explore ways to simplify the planning process without sacrificing the benefits that the process has clearly produced. Mistra should also try to develop ways of rejecting proposals at an earlier stage. The committee recognizes that it is not always possible to judge proposals until the planning process has been completed, but given the extremely high investment demanded of scientists, time that is taken away from actually doing research, serious efforts to find ways to more quickly identify unpromising programmes are warranted. Mistra should also insist on the planning process including representatives from the other disciplines required by the proposed programme.

Recognize the value of syntheses

Mistra should actively recognize the value of syntheses as an output both from the idea generation process, and from programme modules. As well as being of value as a basis for idea generation, syntheses can also play a strong part in forming policy development, in implementing the output of programmes, and as part of communication programmes.

Evaluate Idea Support Programme

Mistra should evaluate and integrate the Idea Support Programme as part of the idea generation process.

Devote a small fund to speculative projects

Mistra should also devote a small amount of money to funding speculative, or “high risk”, small-scale projects. By such projects the committee means projects that depend on hypotheses or concepts that currently lack strong empirical support but which, if correct, would lead to outcomes very different from those generated by mainstream scientific research.

2.3.2 Guiding programmes after they are funded

The central components of Mistra’s model for guiding programmes are (a) the programme director, who typically devotes him- or herself nearly full-time to managing the programme, and (b) the programme board, which is responsible for managing the programme’s funds and for directing its scientific activities. Mistra staff regard both these components as central and essential to the success of programmes. The composition of the boards varies, but in most cases they are dominated by potential users of the results, rather than by other scientists. The committee has not examined the functioning of these boards in great detail, but it appears that the degree of their involve-

ment with the programmes has varied widely. Some are intimately involved with programme operations; others meet occasionally but leave management to the programme director. Some board members view serving on the board as an important service activity; others regard it as just another task which they have to perform.

Given the varied nature of Mistra programmes, it is unlikely that a single mode of operation is either possible or desirable. Nor is it reasonable to expect that interactions between boards, programme directors and investigators will always be amicable. In a few cases, a programme director has been brought in by Mistra to save a programme that was disintegrating. In other cases, boards may have very specific ideas about the research that do not coincide with the views of the investigators. These are tensions that “come with the model”. They will continue as long as the model is employed.

Compared with the general management of scientific projects at universities, Mistra’s model is “top heavy”. That is, it is unusual in academic research to have an external board that has a management role, rather than an advisory role, in relation to a project. Normally, granting agencies leave financial management to the investigators, require less frequent reporting of progress, and ask only to be informed if and why an investigator wishes to deviate from the original research proposal. As a result, scientists in some Mistra programmes believe that the boards were established because Mistra did not trust them. Knowing that they will be subjected to such external oversight also dissuades some scientists from seeking Mistra support.

However, the committee has also learnt that the demands made by some boards in terms of planning, reporting and deadlines have had positive effects on the progress of programmes. The university researchers have been introduced to a more business-like way of working. This holds for university administrations too. Some programme board members have been rather amazed to find that a university administration is unable even to provide accountancy for their programme.

Although the creation of boards with responsibility for management clashes to some extent with the academic scientific culture, it appears to the committee that this type of oversight is required by the nature of the programmes that Mistra has developed and funded. The degree to which extensive planning has been necessary to develop programmes acceptable to Mistra indicates that, to obtain Mistra funding, academic scientists are being required to function in unfamiliar ways. They may be collaborating for the first time with colleagues in other disciplines about which they know relatively

little. They may be required to focus more clearly on potential applications of their research and to avoid being distracted by interesting scientific issues that are not relevant to the overall applied goals of the programme. They therefore need more than the usual guidance to function as desired.

In addition, it appears that, despite extensive efforts to truly integrate the components of major Mistra programmes, some programmes really never achieve genuine interdisciplinary integration. Instead, they consist of a set of individual projects loosely organized under a large umbrella. If that is the case, the programme board needs to be more actively engaged in programme management than in cases where the scientists are well integrated.

On the other hand, the domination of programme boards by “users” may introduce other problems. Board members who have little knowledge of the science being conducted under the programme may have unrealistic expectations about rates of progress and may not appreciate the relevance of some research to programme goals, especially in the long term.

Recommendation 4:

Improve the composition of programme boards

Mistra should ensure that all programme boards have some independent members with a deep understanding of both the conceptual and the technical aspects of the research being carried out in the programme. Such individuals can play a valuable role by clarifying scientific issues to other board members and assisting in the communication of concerns from less scientifically expert board members to the project teams.

Mistra should adjust the size and composition of programme boards to the nature of the programme, the range of disciplines involved, and the degree to which the investigators have already worked together and developed a scientific culture appropriate for the programme. Mistra should try to continuously infuse some new blood into programme boards, to serve the dual purpose of an expanded input into the Mistra circle and an expansion of knowledge of Mistra's programmes into the wider community.

2.3.3 Generating outcomes of high quality

The evaluation committee has not investigated in detail all Mistra programmes, and its members are not competent to judge the quality of some of the programmes. However, the development of a proposal to Mistra involves extensive planning prior to funding plus an assessment by the Mistra Board of the likely scientific quality of the outcome and its relevance to Mistra's goals. In addition, at the end of Phase I, an independent international scientific committee has evaluated each programme. These evaluations have judged the scientific quality of Mistra programmes to be generally good, but have noted that there are substantial variations in quality within programmes. This evaluation committee has neither the data nor the expertise to supplement those judgements.

Large programmes always vary in quality, and within programmes some components are inevitably better than others. To expect otherwise is unreasonable. Moreover, involvement with a large programme may help weaker components to improve and they may also provide necessary contributions to the other parts of the programme. So the committee does not find it surprising that some of the projects within the programmes would not meet the scientific criterion set by research councils.

The importance of the outcome of policy-relevant research programmes is the hardest to evaluate. The outcome of such research is not a tangible product, but rather an impact on a decision-making process. The assessments made by members of programme boards and programme directors are that the results of their programmes have been quite influential. Though the committee has no reason to question these assessments, it is concerned that there are no obvious criteria for good research in policy programmes.

Ten years is too short a period for the full impact of the research funded by Mistra to be evaluated. However, some outcomes, such as the generation of expertise for industry (e.g. KAM, MiMi), contributions to Swedish input to policy-making in international forums (ASTA, MARE) and some possible new products (ÅSC, Microbial Antagonism against Fungi), have been reported.

In addition, a new pool of skilled PhDs has been generated. The numbers of doctorates awarded varies according to how long the programmes have been running. So far the average number of new PhDs is about seven per programme, and another eight postgraduate students are expected to take their PhDs as part of the programme. All programmes have published a large number of articles in reviewed journals and popular science publications.

In terms of contributing to the competitiveness of Swedish industry, several programmes report the development of environmentally better methods, which are now in use. Another programme declared that its reports have given the industry concerned a basis for decisions on environmental investments. As mentioned, the results of some programmes have led to patents and even to the formation of companies. While some new products and services should be expected to continue to emerge, the present mode of operation of Mistra is not geared to the short- or medium-term needs of industry in terms of focused outcomes.

However, the representatives of Swedish industry who were interviewed do not particularly expect this type of result from Mistra programmes. When informed of the Mistra process and programmes, though, Swedish industry does show a high level of interest and a desire to participate. Key outcomes for industry include the generation of a pool of relevant expertise and centres of excellence in relevant disciplines, but more importantly practical tools for sustainable development and better information about Mistra's programmes.

To date, Mistra has concentrated its efforts towards large-scale programmes with anticipated funding for 6–8 years, provided that good progress is made during the first three-year phase of the programme. Nearly all programmes have been based at universities. Typically, several campuses are involved in each programme. Because most of the proposals initially submitted did not meet Mistra's criteria, the conceptualization and development of most programmes have been fostered by means of planning grants. In some cases the development process has lasted as long as three years. The committee's analysis concludes that, although this model has yielded considerable success, Mistra's goals may not be best achieved by using only a single model in the future.

Research support for Swedish environmental scientists, during the period of Mistra's existence, has been generally quite favourable. The proposal requirements of other funding agencies are, by and large, simpler than those imposed by Mistra. Thus, an environmental scientist with a specific project that can be carried out within a single laboratory has no reason to undergo the elaborate set of activities necessary to generate a Mistra proposal. Mistra was organized with special concern for researchers whose objectives are so demanding that they could not be met other than by establishing multidisciplinary teams.

Quite a few of the programmes have changed their research approach from the first phase to the second. The first phase has been

more open and characterized by basic research, while the second phase has been more focused on applied research and development. This is natural and desirable. However, such a shift of focus often requires that new competence joins the programme and that others leave their assignments.

Recommendation 5:

Develop key performance indicators

To facilitate a continuous evaluation of its activities in relation to its statutes, Mistra should develop a set of key performance indicators.

Improve transition from Phase I to Phase II

Some Mistra programmes would undoubtedly gain from being organized more like a relay race than as a long-haul team effort. It is difficult to recruit the appropriate staff to a research programme running for up to eight years. Mistra should make a clearer distinction between the two phases of programmes, in order to facilitate a partial reorganization in cases where the second phase is more focused on development and implementation.

Recommendation 6:

Consider also small teams

For some kinds of research large teams are needed. But this does not appear to apply to all or even the majority of the research programmes funded by Mistra. Truly innovative, interdisciplinary research that requires the formation of small research groups of, say, 3–6 principal investigators, plus students and technicians, should not be excluded from support because of the rather stringent requirements that Mistra has established. The history of scientific innovation suggests that small teams are often highly productive and innovative.

Recommendation 7:**Engage stakeholders**

Mistra should particularly focus on the inclusion of Swedish industry in stakeholder engagement and, as well as widening the direct involvement of industry sectors, should actively seek to communicate with Swedish industry in general. In policy-relevant research programmes, the stakeholders concerned should be involved in developing the criteria for “good research”.

Improve communication

Communication with relevant stakeholders should be a required module in every Mistra programme. As academics are not, in general, skilled in communication (other than via the normal academic routes), Mistra, in conjunction with the programme boards, should provide complementary expertise and guidance. Communication should not stop with the programme. Mistra should continue to advocate important programme outcomes to ensure that industry and policy-makers understand their opportunities.

Formalize early ownership of intellectual property

Mistra should ensure that the intellectual property aspects of its programmes are clearly delineated before each programme commences. In addition, Mistra should actively support and promote the use and application of the results of its programmes.

2.4 Is the Mistra mode of operation well designed with a view to generating and executing interdisciplinary research? How can Mistra more effectively stimulate interdisciplinary research involving both natural and social sciences, including economics?

Mistra has concentrated its funding on large programmes that involve investigators in several or many disciplines. The motivation for this focus is that solutions to many important environmental problems are likely to demand cross-disciplinary research. In addition, investigators capable of discovering and developing the technical components of a solution to a problem seldom have expertise in product development, policy formulation, or communication with the varied array of people who need to be informed about programme

results. The committee agrees with this general characterization of the situation, but it concludes that Mistra's mode of operation has not always been effective in assembling the people needed to complete the process from generation of results to their successful application.

There are different modes of interdisciplinarity. A first mode is the interdisciplinarity within natural sciences and within social and humanistic sciences. Projects in technological development are the most obvious cases, like the various space projects, more classically scientific expeditions, or projects based on a coordinated gathering of mass data from a large system, as in certain areas of meteorology, climate research etc. This kind of interdisciplinarity is already well established and there are several good examples of success (for instance the KAM programme). However, the Mistra programmes consist to a large extent of smaller projects which are not really dependent on such close coordination.

A second mode of interdisciplinarity may mean to effectively bridge the gulf between "the two cultures", natural sciences and social or humanistic sciences. There seem to be no successful examples of this in the Mistra programmes.

There are several reasons why it has been difficult for Mistra to achieve the intended results concerning interdisciplinary approaches in its programmes. Firstly, most programmes have been based in universities, where some of the most important pioneering efforts in environmental research have been initiated, but where a strong focus on basic and disciplinary research is often a barrier to interdisciplinary and applied research. In addition, when the main research personnel resource available is PhD students, it puts limits on what can be done, in terms of both the scope and the type of research performed. Tasks which are comprehensive and difficult and require large teams and cross-disciplinary work over extended periods are very hard to organize in the Swedish university system.

Secondly, most programmes have been formed by bringing together people from several universities. Such geographic dispersion guarantees that investigators seldom meet. Even in the age of electronic communication, it is difficult to acquire a real understanding of the concepts that guide different disciplines except by regular and frequent conversations among small groups of investigators. Experience shows that the most important room for generating new ideas in any research building is the one housing the coffee machine, provided that it has lounging space. Mistra's operational mode may not prevent genuinely novel interactions among investigators from developing, but it does impose significant barriers to this happening.

Thirdly, the teams assembled by Mistra's planning efforts consist primarily of natural scientists and technologists. They are likely to come up with answers to technical problems, but are unlikely to know how to implement their results in commercial and policy arenas. Experience worldwide shows that generating groups of natural scientists and social scientists that really understand one another's disciplines and learn how to work together to achieve solutions is extremely difficult. Therefore, Mistra's limited success in this arena is not surprising. However, since accomplishing Mistra's goals critically depends on success in integrating natural and social scientists, some new tactics need to be employed.

Finally, large, interdisciplinary research programmes should not only be organized around relevant topics with high-class researchers, but should also have excellent leadership. The Mistra secretariat has been quite successful in assessing prospective leaders and the committee has the impression that awareness of the importance of programme leadership has increased. Successful programme leadership is not necessarily coupled with scientific expertise. The committee has learnt that in some cases the person most fitted to be a leader might be found outside the circle of professors.

Recommendation 8:**Promote interdisciplinarity**

Mistra should require that all programmes be thoroughly reviewed, at the planning stage, for the integration of all the pertinent scientific disciplines. In order to overcome the prevailing bias towards natural science disciplines, it must call attention to the socio-economic outcomes of programmes in order to provide them with sufficient resources. Mistra should assess the social aspects at the inventory stage.

Reward success in integration

At the end of Phase 2 of programmes, Mistra should single out the research groups that have effectively coalesced and worked together. These teams should be considered for new programmes in order to capitalize on their integrative achievements.

2.5 Summary of recommendations

In summary, the evaluation committee was impressed by Mistra's approach to the selection, shaping and implementation of programmes. It did, however, find substantial potential for improvements. The eight groups of recommendations given above are connected with the three key stages in the life of a Mistra programme.

The life cycle of a Mistra programme

Idea Generation	Management	Outcomes Impact
Recommendation	Recommendation	Recommendation
2	4	1
3	5	7
8	6	

At the stage of generating new research ideas, incubating them into programmes and planning their implementation, Mistra needs to be even more deliberate and to provide more time and resources. It should foster a process of regular dialogues with a broader circle of academic, policy and business leaders in order to take stock of the challenges that need to be addressed by research programmes. It is also at this stage that the socio-economic dimensions can be highlighted and properly addressed by an appropriate balance of natural and social sciences resources. It is likely that some of the resources invested in this managed incubation process could then be recovered at the next planning stage, where programmes could take shape more rapidly.

Good programme management is already a distinctive feature of Mistra. It can be improved by giving more attention to the composition of programme boards and to ensuring their flexibility and renewal as programmes progress. Mistra should also consider funding smaller programme teams.

Finally, programmes will only be truly effective when they make an impact in terms of better environmental practices and speed up the transition to sustainability. The engagement of stakeholders through the communication of programme outcomes is critical. Mistra also needs to consider pursuing the advocacy of outcomes beyond programme closure. This effort could be connected with the dialogues related to the selection and shaping of programmes. It would thus contribute to a continuous synthesis of the advances made in

environmental research in Sweden, and provide more clarity about effective outcomes in the realm of policy and business decisions.

The connected processes of generating and shaping innovative programmes, promoting outcomes after completion and analysing progress and impacts require adequate time and financial resources. They also require a formal capability or even an institution to convene and facilitate the integration of experts and leaders from different scientific disciplines and social sectors. But such a commitment would enable Mistra, and Swedish environmental research at large, to respond to the sustainability challenges with more focused, innovative programmes and useful outcomes. ■

3. The objects of study

3.1 The Mistra model

The distinctive features of the Mistra mode of operation are its long-term programmes, a comprehensive planning process, the weight given to interdisciplinary research, an emphasis on “deliverables” and a formal organizational structure. Taken together, the committee refers to these characteristics as the Mistra model.

A Mistra programme can normally count on funding for two phases or periods, totalling six to eight years (figure 2). A typical programme is composed of five or six research groups and around a dozen projects, with a total annual budget of about SEK 10 million (figure 3). During the final year of the first phase, the programme is evaluated. One evaluation concerns the scientific quality of the work done, while another examines the usefulness of and the benefits accruing from the programme. These evaluations also cover the draft programme plan for the second phase.

It can be seen that, while Mistra usually provides more than two-thirds of the funding for programmes, there are other funders who are significant stakeholders. The committee has not investigated how

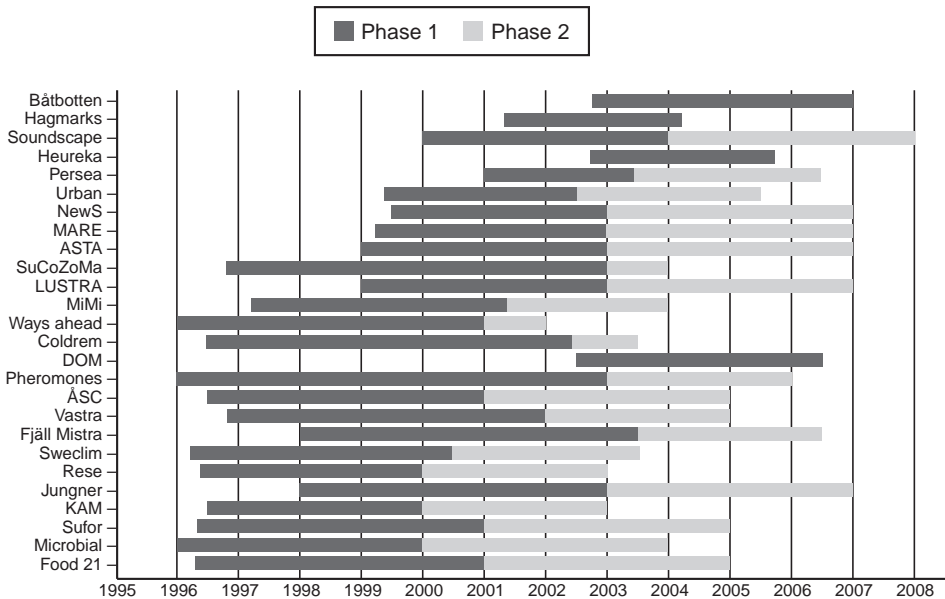


Figure 2. Duration of Mistra programmes

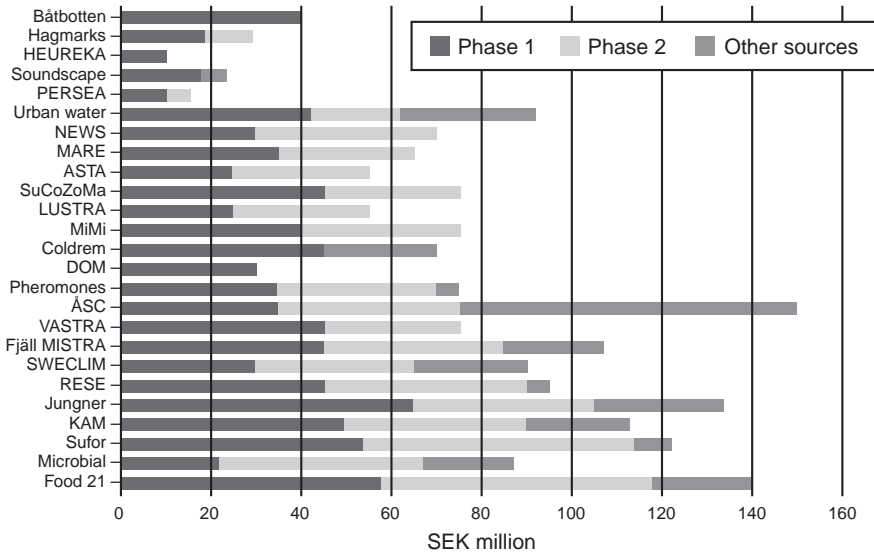


Figure 3. Funding of MISTRA programmes.

Source: Questionnaire to the programme directors.

Mistra integrates the aims and objectives of these other stakeholders. However, there is no evidence that such co-financing is a problem.

Developing a proposal for a MISTRA programme is a major undertaking. It can take up to a year or more (figure 4), and require a substantial investment of effort. Most of that time is spent developing the programme proposal and waiting for the final proposal to be evaluated.

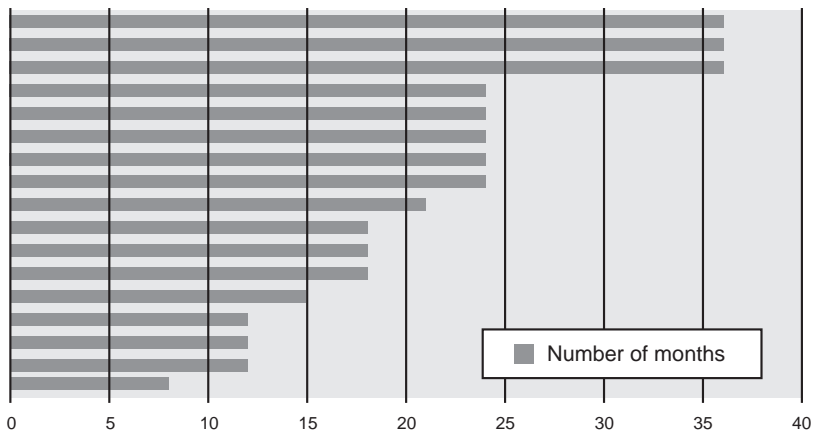


Figure 4. Length of planning phase for 17 MISTRA programmes.

Source: Questionnaire to the programme directors.

After an assessment of scientific quality, overall relevance and utility, the Mistra Board decides whether to fund the proposal. If the Board approves the proposal, Mistra recruits a programme board and enters into a contract with a main organization (“contractor”). This may be a university, a college or an industrial research institute. The programme board is asked to submit a plan for the first phase of the programme.

Each Mistra programme is designed to deal with a major environmental problem. The programmes are large-scale and complex, involving multiple research units. A successful programme is expected to achieve an overall value that is more than the sum of the results of its individual projects, owing to synergistic interactions among its components.

According to the Mistra model, programmes and their component projects are conceived in terms of concrete “deliverables” at defined moments during the programme phase. Deliverables could be products, services, models or methods and the forms in which they are packaged (reports, manuscripts etc.). PhDs and licentiates are also deliverables, as well as carriers of knowledge and competence. Programme deliverables should be few and tangible. It should be possible for potential users to understand and assess them.

The Mistra programmes have a more formal organizational structure than most other research projects. Each has a programme board, a management group and a programme director. The board of a Mistra programme has overall responsibility for the direction, quality and finances of the research programme. The management group, which includes individual project leaders, forms the scientific centre of the programme. The aim of the management group is to achieve the integration required to ensure that the programme’s value is realized. The director of a Mistra programme has executive responsibility for implementing the research programme in accordance with the programme plan adopted and the decisions of the programme board.

In its annual report for 2001, Mistra divided its programmes into three groups with respect to their overall purpose: industry relevance (table 1), relevance for political negotiations (table 2), and policy relevance (table 3).

ByggMistra	Sustainable building Chalmers University of Technology, Gothenburg
COLDREM	Soil remediation in a cold climate Umeå University, Umeå
JUNGER	Batteries and fuel cells for a better environment Royal Institute of Technology, Stockholm
KAM	The ecocyclic pulp mill Swedish Pulp and Paper Research Institute (STFI)
Microbial	Microbial antagonism against fungi Swedish University of Agricultural Sciences (SLU), Uppsala
MiMi	Mitigating the environmental impact of mining waste Luleå University of Technology, Luleå
Pheromones	Pheromones and kairomones to control pest insects Swedish University of Agricultural Sciences (SLU), Alnarp
RESE	Remote sensing for the environment Metria Environmental Analysis, National Land Survey of Sweden, Stockholm
ÅSC	Ångström Solar Centre Uppsala University, Uppsala

Table 1. Mistra programmes mainly of relevance to industry.

ASTA	Abatement Strategies for Transboundary Air Pollution IVL, Swedish Environmental Research Institute Ltd, Gothenburg
LUSTRA	Land use strategies to reduce greenhouse gas emissions Swedish University of Agricultural Sciences (SLU), Uppsala
MARE	Marine research on eutrophication Stockholm University, Stockholm
NewS	New strategy for risk management of chemicals Lund University, Lund
SWECLIM	Swedish regional climate modelling programme Swedish Meteorological and Hydrological Institute (SMHI), Norrköping

Table 2. Mistra programmes mainly of relevance for political negotiations.

FjällMistra	Sustainable management in the mountain region Swedish University of Agricultural Sciences (SLU), Umeå
FOOD 21	Sustainable food production Swedish University of Agricultural Sciences (SLU), Uppsala
HagmarksMistra	Management of seminatural grasslands – economics and ecology Swedish University of Agricultural Sciences (SLU), Uppsala
Soundscape	Soundscape – support to health Chalmers University of Technology, Gothenburg
SUCOZOMA	Sustainable coastal zone management Göteborg University, Gothenburg
SUFOR	Sustainable forestry in southern Sweden Lund University, Lund
Urban Water	Sustainable urban water management Chalmers University of Technology, Gothenburg
VASTRA	Water management research programme Göteborg University, Gothenburg

Table 3. Mistra programmes mainly of policy relevance.

3.2 Idea Support Grants

In the autumn of 2001 Mistra introduced a three-year trial of “Idea Support Grants”. The purpose of this programme was to support original research ideas which may be too small to justify a full Mistra programme. Like the standard Mistra programmes, the Idea Support Grants were to favour the development of interdisciplinary and international cooperation.

Idea Support Grants have a maximum duration of two plus two years, and a total amount of no more than SEK 8 million. Half of the resources within the programme are awarded to researchers who have completed their PhD thesis within the last six years.

No projects funded under the Idea Support Programme have been completed yet and it is too early to decide to what extent the purpose of the programme has been achieved. However, the committee thinks that Idea Support Grants could be a valuable complement to the large programmes. Mistra should evaluate and integrate the Idea Support Programme in the idea generation process as a way of securing the submission of a larger number of original programmes in the future. ■

4. Evidence

4.1 Response to questionnaire to Mistra programme directors

To solicit the opinions of programme directors, a questionnaire (see volume 2) was sent to 22 directors, of whom 18 replied. Two of the four programme directors who did not answer the questionnaire made presentations to the committee. Programme directors were asked to provide basic facts about their programmes and to comment on the operation of the Mistra model, the outcome of their programme, and current and projected impacts of the results. They were also asked to provide a self-assessment of their programmes and to comment on their interactions with the Mistra staff. The responses obtained reflect the opinions of individuals, which may not be representative of the perceptions and opinions of the researchers in the programmes, the programme boards or the stakeholders.

The responses clearly identify the tensions and difficulties generated by attempting to meet the specific Mistra requirements of interdisciplinary cooperation, a clear focus on an environmentally significant problem, and a clear focus on deliverables in addition to the normal publications in peer-reviewed literature. As expected, given the broad range of Mistra programmes, what constitutes appropriate deliverables varies greatly among programmes, but trained PhDs with broad perspectives are an unusually highly valued deliverable. A few patents have been established and a few new companies have been formed as a result of Mistra programmes, but the committee is unable to judge whether some direct applications of programme output should have been expected.

All respondents stated that at least some of the research carried out under the programmes would not have been accomplished without Mistra, but no programme director is likely to claim otherwise. Whether or not the research initiated under Mistra programmes will continue after Mistra funding ends is difficult for both programme directors and the evaluation committee to predict. The committee believes that research carried out by teams that developed genuinely integrated research activities are likely to continue, whereas those programmes that provided only an umbrella under which separate research projects were carried out will probably not survive beyond Mistra funding. Continued encouragement, and possibly funding, of truly integrated research teams should be a priority for Mistra.

Programme directors respond that their contacts with the Mis-

tra staff have been regular and helpful. Evidently the staff of Mistra manage the difficulties of carrying out large-scale interdisciplinary projects and have invested the time necessary to provide solid logistical and intellectual support to the programmes.

Not surprisingly, all programme directors believe that their programmes are of high international quality, although some of them recognize that the quality of projects varies within their programmes. They also believe that researchers in their programmes developed broadened perspectives as a result of participating in them, but responses to the questionnaire offer no direct evidence that the researchers themselves acknowledge having acquired such broader perspectives. The evaluation committee believes that only future evidence can reveal the extent to which new ideas and perspectives become incorporated into the research projects of scientists in Mistra-funded programmes. The long-term evaluation of the output of Mistra programmes will require continued monitoring of the impacts of the research and the publications flowing from it, and of the nature of new research projects initiated by Mistra.

4.2 The scientific quality and relevance of Mistra's programmes

All Mistra programmes were assessed before they were initiated. After the first phase, normally after three years, there have been mid-term evaluations. Finally, all completed programmes have been evaluated as a whole. As part of the evaluation of Mistra's first ten years, Professor Peter Högberg of SLU, Umeå, was asked to make a survey of all scientific evaluations of the Mistra programmes.¹ His assignment was to analyse and comment on the scientific assessments and evaluations of the programmes. His instructions were to investigate the following main areas:

- How were the assessments carried out?
- What did the assessments have to say about scientific quality?
- What did the assessments have to say about the relevance of the programmes?

The basis for the survey was 78 reports (several projects were assessed more than once), totalling 1,300 pages. Professor Högberg

¹ Professor Högberg's report is published in volume 2 of the evaluation report.

also considered remarks about Mistra both from recipients of grants and from unsuccessful applicants, as well as from researchers who had not applied for grants from Mistra.

4.2.1 How were the assessments of the programmes carried out?

The assessment reports were based on the applications and on hearings with the applicants. In the case of applications for a second phase of a programme, input was also provided in the form of project reports and attached scientific papers. Each application was assessed by between three and seven evaluators – 4.5 on average. With very few exceptions, the conclusions of the evaluators were presented as joint reports, i.e. they wrote up their findings as a team.

Of about 340 experts, 23 per cent were from Sweden, 16 per cent from the UK, 14 per cent from the USA, 10 per cent from Germany and 16 per cent from the other Nordic countries. Thus, most of the experts were from countries with many scientific, economic and cultural contacts with Sweden and with a broadly similar social and cultural framework.

The assessment method used by Mistra differs significantly from those used by the research councils, especially the Swedish Research Council. First, Mistra's secretariat engages in an active dialogue with the applicants about their capacity and the content and design of their applications (some researchers felt that Mistra acted as a gatekeeper). The research councils, on the other hand, send the applications out to groups of mainly Swedish experts. If a council then grants an application, it does so without any reservations about the content of the project. Mistra, however, may issue instructions as to how the grant is to be used. Such instructions may be based on the advice of the evaluators. When applications to the research councils have been processed, the applicant is notified of the relevant committee's opinion, which may also contain advice, but nothing as extensive as the detailed comments submitted by a Mistra review panel.

Second, each of Mistra's programmes consists of a rather large number of project teams, which is unusual for applications to the research councils. This creates a rather anomalous situation, since Mistra must deal with programmes comprising sub-projects of varying quality and relevance.

Third, Mistra's evaluators normally see applications for one or a small number of projects at the same time, while the members of the councils' committees often consider 50–150 applications. The latter procedure provides a way of prioritizing applications, which means that grants are only awarded for the best research (see figure 5). By contrast, the evaluators engaged by Mistra generally have to

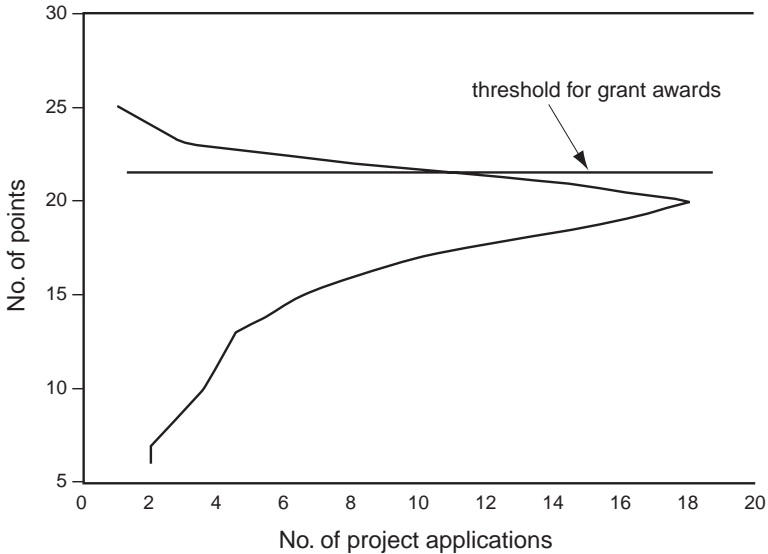


Figure 5. An example of the outcome of applications considered by a scientific committee at a research council. Projects are given points for a number of criteria (quality of the application, choice of methods, the applicants' scientific qualifications and publications, relevance). The maximum number of points is 25 in this case. The differences in the points scored by different applications are often small around the threshold for grant awards, which is determined by the resources available. Note also that grants are only awarded for a small number of projects.

decide whether or not to award a grant to a single applicant without being able to compare that application with any other.

Fourth, the councils and their committees develop and maintain a culture that encourages continuous discussion of the principles according to which applications are to be assessed. The committee members are continuously replaced, but are appointed for periods of up to six years, and this results in a certain consensus on quality and other matters. Mistra's panels are composed ad hoc and represent different research cultures. While the experts' international perspective is extremely important, a problem may arise when it comes to assessing qualifications, quality and relevance.

Fifth, the Swedish Research Council rarely permits researchers who hold PhDs to apply for funds on behalf of colleagues. According to its recommendations, such researchers must "stand on their own two feet" and not be "free-riders" on others' reputations. In con-

nection with Mistra's programmes, one or more very good researchers may bring on board research teams or individual researchers who would not receive grants from other research funding bodies.

Sixth, and finally, Professor Högberg remarked that the research councils have a mandate from the state to promote gender equality within the framework of research policy, which is not the case with Mistra.

4.2.2 What did the assessments say about scientific quality?

Among the applications that were recommended for a grant, scientific quality was characterized as good or excellent. But Professor Högberg asked what does "excellent" actually mean? In one case the evaluators talked enthusiastically about a publication in *Science* (impact factor about 25), and immediately afterwards they mentioned publications in small-circulation journals with an impact factor of less than 1 in terms of "the highest international standards". Given the uncertainty about the significance of such assessments, Professor Högberg did not consider it worthwhile to report them. He felt that there is a need for quantitative tools, especially in view of the fact that the review panels are set up on an ad hoc basis. The National Science Foundation (USA), the Natural Environment Research Council (UK) and other research funding bodies use quantitative assessments to evaluate applicants in an international and national context.

Except for a few cases in which quality was consistently high, there was obviously considerable variation in the quality of the programme components. A typical conclusion was: "We find the quality of the science in the programme varies from the highest international standards to weak . . .". In the case of first-time applications, the evaluators advised against many sub-projects because of their low scientific quality. But they also made unenthusiastic comments on the quality of sub-projects in some ongoing programmes. However, Professor Högberg concluded, there may be many reasons for the mixture of excellent and indifferent sub-projects in the same programme.

4.2.3 What did the assessments say about the relevance of the programmes?

Almost without exception, the evaluators considered that the applications related to relevant and important projects. This should probably be taken to mean that they considered the subject areas important. This is hardly surprising, since experts in the same area expressed these opinions and they could be biased in this particular respect.

Relevance is a complicated issue. Mistra gives high priority to this criterion and has issued detailed instructions to applicants regarding it. The term relevance includes applicability, a subject on which the evaluators gave very clear and detailed advice. This advice can to some extent be regarded as compensating for the rather stereotyped assessments of relevance. The only assessment written by a stakeholder group was particularly interesting. According to this assessment, and to criticism voiced in other contexts, many researchers are probably not accustomed to collaborating with non-university environments.

It is important to mention that, in addition to international scientific review panels, Mistra invites comments from companies, authorities and other organizations. The purpose is to investigate whether programmes can make a significant contribution to the solution of priority environmental problems. Mistra therefore receives comments on the relevance and applicability of the programmes from several quarters. However, Professor Högberg was unable to see how a balance is struck between these comments on the scientific quality and relevance of the programmes.

4.2.4 The evaluators' views on matters other than scientific quality and relevance

In many cases the evaluators contributed valuable comments on the aims, structure and coordination of the projects. Their criticism of shortcomings in this connection probably has to do with the fact that most researchers had not previously worked on large-scale multidisciplinary programmes. For example, there were comments such as “the entire programme gives the impression of being composed of individual and rather traditional projects”. In many cases the evaluators contributed constructive proposals as to how the programmes could be restructured. The problem of variable scientific quality and of coordinating diverse research groups is not unique to Mistra; it is also a common problem in large-scale EU projects, Professor Högberg added.

4.2.5 Are grants awarded to the researchers with the best scientific qualifications?

Professor Högberg's answer to this question is “not necessarily”. His guess is that some researchers in Mistra programmes might find it difficult to obtain grants from the Swedish Research Council or the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas). Mistra may therefore need to develop methods to assess the scientific quality of its projects. Evaluators of

future programmes should make a thorough study of whether the applicants are the best qualified in a national and an international perspective. The international perspective is especially important if Mistra's programmes are to enhance Sweden's future competitiveness, which is one of the aims.

4.3 The relevance of Mistra programmes to environmental issues

To supplement Professor Högberg's survey of evaluations of all the Mistra programmes, the evaluation committee also initiated interview surveys with members of the programme boards. As mentioned, Mistra divides its research programmes into three groups: programmes of industrial relevance, programmes of relevance for political negotiations and programmes of policy relevance. Below, the committee presents impressions from an interview survey with the chairs of nine programme boards in the two policy-relevant groups of programmes.

All chairpersons interviewed had previously served as civil servants at a national or local level. They were recruited because they were the obvious choice on account of their professional background, or were called in to "rescue" a programme that was close to collapse. Only one of the chairs had a PhD. A majority of them had extensive experience of working with researchers in their capacity as "buyers". Many of the chairpersons already knew the researchers involved in the programme, but they were not part of a close research network.

The general view of Mistra research expressed by the chairs was favourable. Their attitude was based on the following arguments:

- the way of working is more flexible than that of other programmes,
- the programmes cover problems that would not normally have been integrated into the academic community, and
- the programmes are successful in making researchers from different disciplines work together.

Though the chairpersons were positive in general, they had concerns about how competitive the Mistra model was in the "national and international market" for policy-making models. They also had many suggestions for improvements on both management and practical issues.

The chairs realized that most of the research in the programmes had to be done at university departments. But they were also very

clear about the researchers' lack of knowledge of relevant questions for policy-making. This "naivety" was in some cases the reason behind the difficulties experienced in getting some programmes from Phase 1 to Phase 2. This problem also raises the question of how the policy decision models formulated in Mistra programmes can compete with others on the European scene. Some chairpersons expressed concerns as to whether Sweden, with its relatively limited supply of researchers, really can compete with European countries with more resources.

Only two of the chairpersons interviewed said that the contributions of social scientists were of great value for the programme. This is surprising, given that so many of the programmes are oriented towards political decision-making. The negative respondents said that the social scientists did not say "anything new", or "anything I had not heard before", and that their conclusions were "common sense" and "nothing new to me".

4.4 Mistra programmes and their relevance to Swedish competitiveness

4.4.1 Relevance according to board members from industry

Interviews were carried out with nineteen members of sixteen Mistra programme boards. All the individuals interviewed had been appointed to the board concerned because of their industrial background. A majority of these business community representatives had a research background themselves, and many were responsible for research and development (R&D) activities in their companies. Twelve of the nineteen interviewees were PhDs and seventeen were involved in the R&D activities of their company.

The board members interviewed took a favourable view of the aims of the Mistra programmes. Many of them, though, did not believe the researchers' promises that they were likely to solve the problems they were addressing. However, the interviewees' perspective is coloured by the success rate of development projects in their own companies, where a hit rate of one successful project out of twenty (or even less) is not unusual. Consequently, they were not concerned if the programmes did not yield industrial applications, since they did not expect them to from the outset.

Programme aims

The views expressed on the aims of the programmes also varied as a result of the varied backgrounds of the interviewees. Their judgements can be traced back to four explanatory variables:

- *How directly relevant to an application?*
The more closely tied a programme is to a potential application, the easier it is to focus the scope and sharpen the definition of the problem. The board members interviewed favoured such limitations because of their experience of R&D in their own companies. They also reacted to the researchers' tendency to promise to solve all the problems within the scope of the programme, pointing out that this was not realistic and was motivated more by a hope of persuading Mistra to support the research.
- *How many disciplines and departments are involved?*
Many of the board members interviewed had primarily experienced difficulty in getting researchers from different disciplines and departments to work together. Their conclusion was that the more disciplines and departments are involved, the greater the risk of failure.
- *How accustomed are the researchers to working with applications?*
It is difficult to anticipate practical results if the researchers' experience is limited to university departments focusing on basic scientific research. The prospects of getting a good result improve when researchers from institutes, who often work close to end-users, are involved. Of course, there was an awareness among board members that some applied skills can also be found in university departments.
- *How many postgraduate students are involved; in other words, how much time must the programme devote to the necessary learning time for them?*
The more postgraduate research students there are, the riskier the programme, according to board members. On the other hand, most of the interviewees accepted that risk, given the beneficial long-term effect of increasing Swedish research expertise in the relevant field.

Assessment of the results

As has been mentioned, one of Mistra's aims is to strengthen the competitiveness of the Swedish economy. This is to be done either with new products, or with services based on the research carried out. Few of the board members interviewed believed in this grandiose vision, and none saw it as an important criterion of success. The argument was in many cases that it is both difficult and risky to produce new products or services on the basis of research programmes like Mistra's.

However, the interviewees did care about the results, and would be pleased to see their programme resulting in applications, methods and models. At the same time, several board members pointed out that building up a group of experts – the postgraduate students – was almost as important as the other results.

Mistra programmes are intended to be multidisciplinary. Did the interviewed board members agree that they were? Many of them did, believing that the programme with which they were involved had brought about collaboration between researchers who had never before worked together. New networks had been set up. However, there were no examples of unexpected combinations of scientific disciplines. All the programmes had a reasonably strong scientific orientation, and the researchers involved were from different science departments.

Only one programme had tried to involve economists. The interviewed board member from this programme said that it was very hard to involve qualified economists. Having a scientific background himself, he concluded that the Mistra programmes, with their often well-defined research projects, fitted in well with the career of a researcher in a scientific department, but not so well with the career of an economist.²

What will happen after the Mistra programme?

All the board members interviewed were very positive about Mistra. The approach of bringing researchers together and building up new knowledge by financing postgraduate students is seen as an excellent one. The interviewees had concerns about what would happen to the knowledge built up inside the Mistra programme when funding came to an end. Some of them considered it important for

² However, the evaluation committee was informed that at least one of the programmes (MARE) had worked very well with an economist, who regarded her involvement as very beneficial.

Mistra to develop project management methods and look more closely at ways of dealing with patents and with the consequences of the rules giving university employees the property rights to their research results³.

4.4.2 What outside people from industry think of Mistra's research

One way of estimating the relevance of Mistra programmes for Swedish competitiveness is to ask relevant people in industry what they think about the research. The evaluation group asked Mr Olle Boëthius to interview managers in selected Swedish companies to find out how well Mistra and its programmes are known within industry, how Mistra's communication efforts are perceived, what benefits industry has received from Mistra-supported research so far and what future expectations industry has of Mistra.⁴ Thirty professionals, R&D managers or heads of environmental affairs, from twenty-five Swedish companies representing fourteen business sectors, participated in this study.

The results of the survey indicate that practitioners in industry

- have so far seen very few benefits from the research,
- want to be better informed about Mistra and relevant research results,
- want to have a say in setting priorities for research, through active representation in the initiating and decision-making phases,
- are prepared to cooperate, if assigned a proper role.

The majority of the people interviewed were not familiar with Mistra and its programmes, even though they represented the most important industrial sectors, accounting for a substantial share of the Swedish economy. Possible reasons for this could be, first, that the Swedish academic research community involved in environmental research would, by tradition, be mostly oriented towards raw materials-based industries, where strong networks and shared values of importance exist. Second, since the Mistra secretariat has to a large extent delegated responsibility for communication to the respective programmes, it is not surprising that elements of the business community that are not directly involved in the programmes are not well informed. Mistra should either consider instructing or funding

³ "lärarundantaget".

⁴ *Olle Boëthius*, Evaluation of Mistra – Findings and recommendations from Swedish industry. See volume 2.

the programme boards to target their communication efforts at a wider audience, or ensure that the secretariat undertakes responsibility for communication.

One of the main reasons for conducting the interview survey was to find out how industry benefits from Mistra programmes. Only a couple of the companies – directly involved in programmes – reported useful results. However, it is too early to make a final judgement, as many of the programmes have not yet reported final results. Many will do so soon, and the poor information transfer found in this study may serve as a strong challenge to the management of these programmes to ensure the effective communication of their results.

As evidence of their involvement, the respondents in the survey submitted numerous expectations for future research, as well as many pieces of advice to the Mistra management. They feel that a large section of industry is not properly represented in the research catalogue. Transport, energy and environmental management issues have been neglected. There is a demand for greater knowledge about socio-economic and behavioural processes, and regarding a true sustainability approach.

Several respondents voiced an interest in how Mistra defines *sustainable development* in relation to its task. This comment is very encouraging, in the sense that it indicates the depth of industry's interest in a more holistic approach to sustainability. It seems desirable that Mistra should communicate its terms of reference and ideas in this field more widely.

There seems to be a thirst for practical methods among practitioners in the environmental field. One area frequently mentioned is *control of chemicals*. Others are *practical methods for end-of-life management*, *risk management*, *ethical and environmental assessment for the benefit of investors* and *LCA*. Mistra's role in this context is not clear to people in industry. It is obvious that the academic capability and experience gained from earlier research is important and needed. It is also vital that this knowledge finds its way into practical use in the form of environmental management tools. Consultants in environmental management, already an important business sector, are the main channels for spreading this knowledge to industry. It is well known that consultants have no or very limited funds to finance "product development" – they have to have customers who are ready to pay for it. An implicit question is whether Mistra could find a constructive role as an information broker.

Representatives of industry want to see more targeted and synthesized communication. Groups such as environmental consultants and analysts within banking also expressed such demands. Generally

speaking, there is a clear appreciation of the Mistra model of research management among respondents – once they are informed about it. One basic view expressed by many participants in this study can be summarized as follows: “All research aims to enhance societal growth. Mistra’s main challenge is seeing to it that the results of its investments in research are transformed into useful practice. Industry must be the main target.”

To sum up, the respondents from industry recommended that Mistra

- review the balance of interests taken into account in establishing its priorities,
- invite stakeholders to take part in constructive strategy and priority discussions,
- ensure wide dissemination of results,
- activate relations with practitioners in industry,
- improve communication and
- use innovative means to speed up the process of change.

5. Mistra and the changing Swedish research landscape

5.1 University research in Sweden⁵

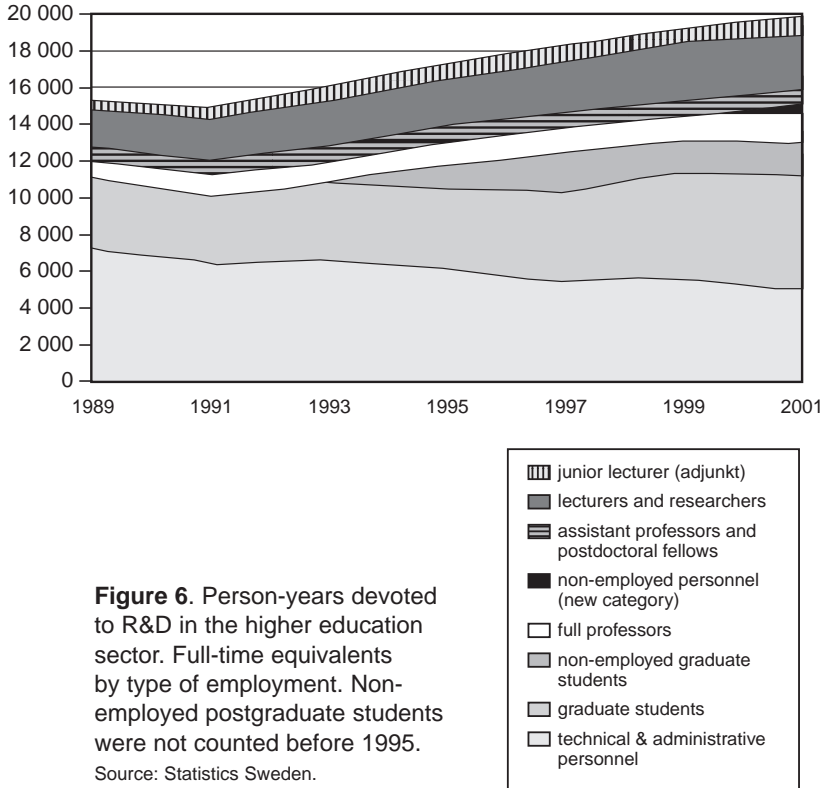
Funding for university R&D in Sweden increased strongly during the 1980s and more moderately during the 1990s. The increases sprang mainly from an increase in support from external sources such as private non-profit organizations and international sources (mainly the EU). Since the mid-1990s, public research foundations, including Mistra, have become important sources of funding.

In 2001, the latest year for which statistics are available, general university funds accounted for less than half the current cost of R&D at universities and university colleges. The other half originated from a range of different sources, such as research councils, government authorities, research foundations and non-profit organizations. The variation between research areas, universities and university colleges is quite large, depending on the attraction of the research field to external funding bodies and the regional importance of the university colleges.

The number of R&D person-years at the universities, calculated in full-time equivalents, has increased steadily since the 1990s. Postgraduate students account for an increasing share of R&D, and in 2001 they performed more than 36 per cent of all R&D in the higher education sector (figure 6).

During the 1990s the number of doctoral degrees nearly doubled. In the academic year 2000/01, 2,400 new PhD degrees were awarded. About half of the recipients were 35 years old or older. Only 15 per cent were under 30 years of age. The number of newly enrolled postgraduate students has remained fairly constant during the last three academic years, after a temporary peak in the academic years 1996/97 and 1997/98, owing to the stricter rules for admission that came into effect in April 1998.

⁵ *Stina Gerdes*, Research and Development in Sweden. See volume 2.



5.2 Mistra and the Swedish research policy context⁶

When Mistra and the other foundations began to operate in the second half of the 1990s, there was an ongoing discussion about a reform of the system of research councils and other public funding agencies. Part of the reason for this renewed interest was that the large resources transferred to the foundations were out of the sight and control of the public organizations. Another reason was that the government, now again dominated by the Social Democratic Party, wanted to reform the research council system.

What happened in the late 1990s can be seen as the introduction of a new research policy geared towards strategic opportunities, setting up research centres and programmes within the university system, and promoting innovation. This has led to an expansion of

⁶ Olle Edqvist, Swedish research policies. See volume 2.

the university research system, but also to severe strains within it as traditional values have been threatened. The utility of research is again being emphasized, but now in a different framework, in which more open forms of research are being tried. New actors have emerged, with research-intensive small companies, consultancy firms, and various other public and private bodies supporting and carrying out scientific work.

5.3 Swedish environmental research funding⁷

The key Swedish agencies funding environmental research besides Mistra are the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), the Swedish Research Council and the Swedish Environmental Protection Agency. The EU research programmes are also major funders of environmental research in Sweden.

5.3.1 Framing environmental and sustainable development research

Environmental research has remained rather vaguely defined within Swedish environmental research funding agencies. Regarding the research supported by the Swedish Research Council, the concept is primarily empirically defined, i.e. it is what the researchers define it as in their applications. According to the definitions used in project catalogues, environmental research is empirically defined as research on nature. It also seems to include natural science research that is perceived to have an indirect bearing on the environmental sector, indicating that it has societal relevance.

The distinction between research on the environment and research on sustainable development is less clear. That both terms are used implies that there is a perceived difference between them, but the descriptions of research funded by the councils often make no clear distinction between the two. Various kinds of environmental research are often used as synonymous with research for “ecologically sustainable development”, which in turn is seen as a prerequisite for sustainable development.

In its official documents, Mistra links strategic environmental research to sustainable development. It also defines strategic enviro-

⁷ Björn-Ola Linnér, The landscape of environmental research funding after the reorganisation of the Swedish research councils. See volume 2.

onmental research as long-term research oriented towards solving important environmental problems. This research should be guided by a vision of an environmentally sounder society.

5.3.2 The new councils

The landscape of Swedish research funding was fundamentally re-organized in 2000. All the governmental research councils then in existence were merged into three councils. Of these, Formas especially was given responsibility for environmental issues and was to support sustainable development research. However, the Swedish Research Council also takes on a large share of environmentally related research through one of its sub-councils.

The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas)

The role of Formas is primarily to fund research of importance for sustainable development within the areas of environment, agricultural sciences and spatial planning.

Formas has also been given responsibility for coordinating research with relevant funding agencies in the areas of climate, forestry, food and environmental toxicology. An informal working group, consisting of officials from Formas, the Environmental Protection Agency and Mistra, has recently embarked on this task by compiling data on the research funded in the various sectors.

Formas supports initiatives from individual researchers as well as research programmes initiated by the Council.⁸ It funds both basic research and applied research of relevance to society. The current Formas research strategy programme was to a large extent coloured by the five programme areas that were inherited from the former councils.

The 15 environmental objectives established by the Swedish Parliament in April 1999 are important for the definition of Formas's role in achieving sustainable development. These objectives are considered to be benchmarks for all environment-related development in Sweden. Intended to be coherent and uniform, they define what the state of the natural environment, farmland, forests, lakes, seas and the atmosphere should be in 20 years' time. The goals include clean air, good-quality groundwater, flourishing lakes and streams, thriving wetlands, a balanced marine environment, flourishing

⁸ Of these, 60–70 per cent are estimated to be researcher-initiated and 30–40 per cent initiated by the Council.

coastal areas and archipelagos, zero eutrophication, natural acidification only, sustainable forests, a varied agricultural landscape, a magnificent mountain landscape, a good built environment, a non-toxic environment, a safe radiation environment, a protective ozone layer and reduced climate impact.

Of the 746 ongoing Formas projects, 275 have the indicator *environment* (“*miljö*”) in their title or programme description, but only 58 *sustainable* (“*hållbar*”). In 2002, Formas funded about 16 per cent of the applications received.

In Formas’s 16-page presentation of its research strategy for 2002-2005, interdisciplinary, cross-disciplinary and transverse research are each mentioned once. The strategy also highlights the role of the natural sciences for sustainability science. “Research and the management of environmental issues often have a natural science emphasis. Many serious problems demand natural science knowledge and technological solutions.” A similar central role is not given to the social sciences or humanities. Nevertheless, the strategy also states that social science ought to assume a greater role, since the environmental problems of today and tomorrow are multidimensional and the consequences of complex relationships within society.

Future research areas mentioned include conflicts of interest within the environmental arena, such as distribution of environmental costs and benefits, and decision-making power and lifestyles. The strategy also poses the question of how radical societal changes can be initiated and carried out within the democratic order. In addition, the Formas strategy calls for greater participation of Swedish researchers in the international development of environmental theory.

Work has recently started on a new strategy programme for Formas for the years 2005 to 2008.

The Swedish Research Council

In the year 2000, the Swedish Research Council was given a national responsibility for developing Sweden’s basic research so that it attains “a strong international position”. The Swedish Research Council does not have any particular responsibility with regard to sustainable development or environmental research. If projects with this focus receive funding it is because they are regarded as relevant and meeting the defined research standards.

The Swedish Research Council, then, has a national responsibility to develop basic research. According to the Council, this task is carried out mainly by funding “the best research projects, which are initiated not by the Council but by researchers themselves at universities and colleges”.

Although the Swedish Research Council does not have an explicit responsibility for environmental research, 216 of its projects used “environment” in their presentations.⁹ Of these, 16 were in medicine, 8 in educational science, 12 in humanities and social sciences and 182 in natural sciences and engineering.

The policy documents do not specify clearly where the lines should be drawn between the Swedish Research Council and For-
mas as regards natural science research with a focus on environmental issues. It is the government’s intention that the two councils should cooperate.

The Foundation for Strategic Environmental Research (Mistra)

One important aim of the Foundation for Strategic Environmental Research (Mistra), according to the government, was to fill the gaps in Swedish environmental research that had been highlighted by two inquiries carried out in the early 1990s. These inquiries drew attention to three shortcomings in Swedish environmental research: it was not interdisciplinary, it was fragmented into small projects, and there was an imbalance between identification- and effect-oriented research and problem-solving research.

Before the reorganization of the public research funding structure in Sweden, Mistra developed its policy document for 1998 to 2002. It was intended to address Mistra’s priorities in relation to the rapidly changing research agenda. It therefore related Mistra to the agendas of other funding bodies, especially that of the Environmental Protection Agency. The policy document also discussed the role of research for the environmental field and the different research strategies, which include effect-oriented (problem-oriented) research and solution-oriented research.

Strategic research is defined as research that identifies problems and presents solutions to industry, governments and individuals. Effect-oriented research is not excluded from Mistra’s research field, but it is no longer considered sufficient. In the strategy, strong emphasis is placed on the usefulness of research activities: “effect- and solution-oriented strategic environmental research is only worthwhile when the results are being used”. The 1999 guideline to researchers characterizes effect-oriented research as research that defines and “dimensions” environmental problems, and solution-oriented research as research aimed at finding solutions. According

⁹ Defined as having a bearing on the relationship between nature, society/culture and modes of production.

to Mistra's strategy document, in which the Foundation defines its position in the research funding landscape, the aim of solution-oriented research is interpreted as being to generate knowledge for technological development that is necessary for solving environmental problems.

The document argues that when solutions are the main target, the emphasis is shifted from research of an almost exclusively technical and natural scientific character towards a combination – or preferably a synthesis – between natural sciences, technology, social sciences and humanities research.

The Swedish Environmental Protection Agency¹⁰

The Swedish Environmental Protection Agency is a central environmental authority under the Swedish Government. Its tasks include coordinating and serving as a driving force for environmental efforts, nationally and internationally. The Agency distributes a maximum of SEK 100 million per year for environmental research. Most of the funding, SEK 83 million, is used primarily to finance research that supports the work of the Agency. Thus the research funded is almost exclusively of an applied character. Social science research relating to environmental issues has focused on policy instruments. Such research has mainly been financed by the Environmental Protection Agency, which has been the principal customer for its results.

A special body appointed by the Swedish Government, the Environmental Research Council, is responsible for making decisions on the award of funding to projects. It is supported by a research secretariat at the Environmental Protection Agency. In its mission statement, the Environmental Research Council states that its activities have the aim of supporting the Environmental Protection Agency's work to promote sustainable development, with a focus on the ecological dimension. This is equivalent to the 15 environmental quality objectives adopted by Parliament, which serve as a guideline for the Environmental Protection Agency's sustainable development efforts.

5.3.3 EU environmental research programmes

During the last decade, Swedish researchers have been quite successful in becoming partners in EU programmes. In the 5th Framework Programme launched in 1998, under the thematic activity

¹⁰ In Swedish: *Naturvårdsverket*.

“Energy, Environment and Sustainable Development” (EESD) environmental issues were broadened to include sustainable development. In all, there are 310 projects within the EESD activity with at least one Swedish participant.

Up to now, Mistra has encouraged its applicants and programme directors to also apply for funding from the EU. Several programmes have received funding for projects which are part of or complementary to a Mistra programme. Mistra’s programmes and project organizations are in many ways similar to the EU programme structure. Both research bodies encourage multidisciplinary projects that have an applied focus. As mentioned earlier, a Mistra programme is led by a coordinator, who in most cases is an active researcher within the programme. Similarly, EU projects are organized with a coordinator whose task it is to keep the projects on track by means of budgets and reports. Both programmes have the goal of increasing the transfer of knowledge to society and to move the research base towards its applications.

The Sixth Framework Programme (FP6), running from 2002 to 2006, will concentrate on the seven priority areas of research that have been identified. In particular, three new instruments for allocating Community support have been introduced into the Framework Programme in order to help integrate European research:

- Support for the networking of centres of excellence in different countries.
- Support for integrated projects, involving a critical mass of scientific and industrial partners, and directed towards significant products, processes or service applications.
- Participation by the Union in specific science and technology cooperation programmes set up jointly by certain governments or national research organizations.

Significant resources will also be earmarked for coordination and the reciprocal opening up of national programmes.

The situation in FP6, with 13 new countries, will lead to greater competition and tougher selection of projects seeking support. As a rule there should be a minimum of six participants in an integrated EU project. It is expected that larger networks and centres of excellence may involve several hundreds of researchers. The Community contribution may range from several million to several tens of millions of euros. The duration of an EU project varies between 24 and 48 months. Most projects have a duration of 36 months.

5.4 Universities – the research-performing side¹¹

The success of the Mistra mode of operation is dependent to a high degree on how well the universities as research organizations can match the intentions of the Foundation. Some of the concerns about the Mistra model, such as the long planning period, the interdisciplinary research approach and the problem-solving focus, are generated by a mismatch between the ambitions of the Foundation and how the university research enterprise works. When considering its future strategy, the Mistra Board faces the question whether the Foundation should adjust its intentions or whether the universities could be persuaded to better satisfy this customer's special requirements. This is not a simple question. For several reasons, the universities have become hard pressed financially. Faced with this situation, their principal desire is to secure more discretionary funds, rather than temporary grants from external sources.

Universities are always short of funds, but they are particularly so at the present time. Universities are in some ways like anthills – each researcher tries to drag food to the heap and acts partly on his or her own, partly in communication with other researchers, but certainly with little coordination or leadership – and the total funding of university research is not under the control of the universities. Each researcher who obtains a grant adds to the total and the work generated by the grant makes claims on shared resources. Because a researcher who secures a grant tends to see it as his or her money, attempts by the universities to reserve a portion of the funds for joint use are resisted. Researchers are inclined to lock up the funds awarded in staff appointments, which are not easily reversed when the money dries up. The result is that universities have more staff than funds and become chronically underfunded and dependent on a continuous inflow of research grants. Joint resources needed for infrastructure maintenance and long-term university development are neglected. None of these tendencies are unique to Sweden or to this particular point in time. But major shifts in university funding during the 1990s have made them alarmingly acute.

There has been rapid change in the university research funding structure over the past ten years (figure 7).¹² From a situation where block grants to the university system accounted for nearly 60 per

¹¹ Part 5.4 is based on a report by Olle Edqvist, commissioned by the evaluation committee. See volume 2.

¹² Source: *Finansiering av svensk grundforskning*. The Swedish Research Council 1992.

cent of the total, they are now below 50 per cent. New sources of income have been added and have expanded over time. Mistra and the other research foundations that were created in 1994–5 now contribute some 6 per cent of total university funding, and private foundations have increased their contributions to 10 per cent.¹³ This extra money has given the universities new possibilities and the resources have been used to expand the system – but mainly the budgets of researchers and not those of deans and vice-chancellors.

SEK m.

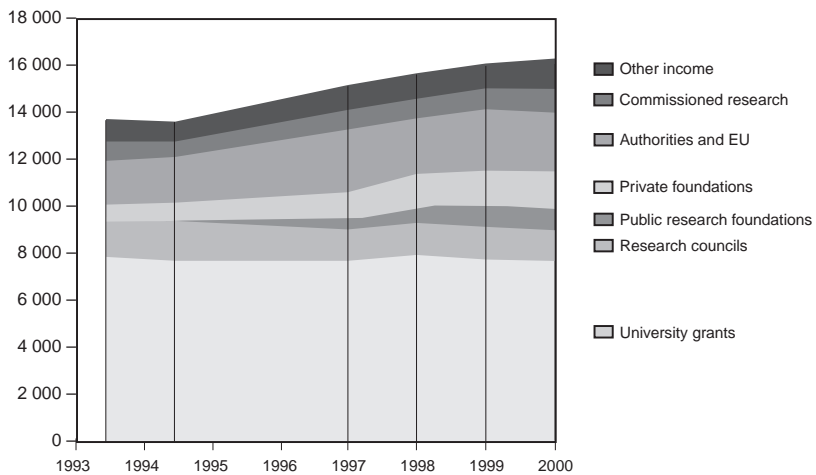


Figure 7. Swedish university research income 1993/94–2000 in constant (1994) SEK.

Source: Statistics Sweden.

The government requires that all research income to a university bears its share of total university research costs, including costs for shared resources, equipment, computers etc. This is resisted by most funding bodies as it is seen as a way of siphoning off resources given to specific research purposes to other non-specific ones not covered by the statutes or intentions of the funder. And the increase in university overheads has been rapid – from 3 to 13 to 45 per cent or more in just a decade.¹⁴ This change has put the funding system – and the dialogue between funders and universities – under severe strain.

¹³ *Pressinformation från SCB*, 2003-01-30, nr 2003:026.

¹⁴ An added difficulty is that the government has left the system to negotiate this without any clear specifications as to what “full coverage of costs” really entails and what should reasonably be included for different categories of funders and users of the university research system.

5.4.1 The rapid restructuring of university research funding

During the past decade there have been shifts between different government allocations. Funding to support industrial development, which made up 27 per cent of the total in 1990, had fallen to less than half of that by 2001, or just 12.5 per cent.¹⁵ The research foundations and industrial funding have only partly compensated for the decrease in government funding.

The new funding sources have placed new requirements on the universities. The research foundations have generously funded centres of research that link researchers in different departments, and even sometimes in different faculties and universities, into new groups or constellations. The new money has certainly allowed new research to be initiated and ongoing research to be expanded and continued, but again the resources have not been evenly spread. Researchers who are left outside this increase have suffered, at least in comparison with their more fortunate colleagues.

5.4.2 The pressure for regional development

A third aspect has been the rapid regional expansion of the university system, primarily for the purposes of higher education, but also for research. The government requires university teachers to have research experience, and this puts the research system under very strong pressure to expand at a regional level in order to meet teaching needs. The new universities and the regional higher education colleges are all demanding resources for local research. This has contributed to a reduction of the amount available for the traditional research universities.

5.4.3 The challenges ahead

One evident challenge for the university research organization is that the tendency to overexpand must somehow be reined in and regulated, and the shifting balance of total resources must be a concern for the government.

A much more serious challenge to the universities is to adjust the incentive system to the new funding opportunities. The primary incentive system for university researchers is based on research performance as judged by peers – not as it is perceived by funding organizations, industry or other sections of society. It is mainly the number of published research papers in refereed journals and the

¹⁵ *OECD Science, Technology and Industry Outlook*, OECD 2002, Table 20.

number of successful postgraduate students that determine whether a researcher will secure a university chair and a reputation within academia.

A second consequence of using the universities to meet the research needs of society is the resultant dependence on untrained researchers. The main research manpower resource of the universities is PhD students. They have many advantages, such as curiosity and boldness, but they are of course not yet experienced researchers and this limits what can be expected of them, in terms of both the scope and the type of research they can perform. Consequently, tasks that are comprehensive and difficult, and require large teams and cross-disciplinary work over extended periods, are hard to organize in the Swedish university system. ■

Members of the evaluation committee

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Secretary

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In considering the future management of its idea generation processes, and fostering innovative interdisciplinary thinking, the evaluation committee suggests that Mistra look at the model provided by the National Center for Ecological Analysis and Synthesis (NCEAS)¹⁶ that was established in Santa Barbara, California, by the US National Science Foundation. The committee understands that NCEAS is regarded as successful in generating high-quality interdisciplinary projects in the field of sustainable development. The following is a description of how an institute modelled on this Center might operate.

Although the institute would not carry out research programmes, or have laboratories, it would generate research output in the form of synthesis and publications. It would be sited close to a university with a good library, to facilitate easy access to the published literature and other documents. It would be designed to have a permanent staff just large enough to provide leadership, handle the complex logistical functions required to maintain a functioning organization, and work with the scientists who would spend varying periods of time at the institute. The director would be a distinguished environmental scientist and would provide intellectual leadership and represent the institute to the broader scientific, managerial and political community.

The institute would also carry out a variety of activities. These would include:

- Short-term workshops designed to bring together people from various disciplines to focus on particular topics, identify possible new research areas, assess their potential, and suggest where and by whom they might be implemented.
- Working groups that would interact together for longer periods to produce major analytical or synthetic documents on important environmental issues.

¹⁶ <http://www.nceas.ucsb.edu>

- Giving space and logistical support to individual investigators and industrialists, who might spend part or all of a sabbatical term at the institute working on problems appropriate to the overall goals of the institute. These individuals would apply to the institute for admission even if they had independent funding. The institute might develop a programme to supplement the support of individuals for whom outside funding covered only part of their anticipated expenses. A programme might be developed for researchers from management agencies and industry to spend time at the institute to work with researchers from other institutions.

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Boëthius, Olle. Evaluation of Mistra. Findings and recommendations from Swedish industry.

Edqvist, Olle. Swedish research policies.

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Gerdes, Stina. Research and Development in Sweden.

Högberg, Peter. An analysis of scientific assessments of Mistra's research programmes.

Hörnell, Erik. A questionnaire to the Mistra programmes.

Linnér, Björn-Ola. The landscape of environmental research funding after the reorganisation of the Swedish research councils.

Palo, Thomas. A comparison between EU framework programmes and Mistra.

Westberg, Jan. The views of programme committee chairmen of Mistra's research programmes of policy relevance.

Westberg, Jan. The views of programme committee members from industry about industrial applications of Mistra's research.

MISTRA

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