RESEARCH NETWORK PROGRAMMES EVALUATION FOR THE AUSTRIAN SCIENCE FUND (FWF)

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Foreword

The project team would like to extend its sincere thanks to all of the staff of the FWF for their enormous help with the research and writing of this report. At FWF we would like to thank especially Dr. Rudolf Novak for being an indispensable source of information, reacting to all of our inquiries in the greatest detail and with admirable patience, and assisting in contacting of interview partners. We would also like to thank Gerit Oberraufner for her valuable assistance in providing all reports and background material. We would also like to thank Andreas Schibany from Joanneum Research for providing us with survey data from the review carried out by the International Consortium.

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Executive Summary

This report has been prepared by PREST at the University of Manchester and by the Institute of Systems Innovation of the Fraunhofer Institute at Karlsruhe in response to a request from the Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung) for a study to examine its two network programmes, the FSP and the SFB.

The terms of reference and our proposal identified two major elements to the study, (1) a review and analysis of the Programmes, and (2) the presentation of a set of recommendations for future action by FWF to make changes to these programmes, and where possible, guidance on how such changes could be introduced, monitored and on their likely impacts upon the programmes themselves and upon the FWF.

The research and the writing of this report were carried out during the first half of 2004. The work was carried out by a team of 7 people all of them specialist in the field of science and technology policy evaluation. The sources of data used in the study took the form of a literature review, a large interview programme, an extensive documentary review and analysis of project records and reports, an international comparison of comparator programmes and a sub-contracted bibliometrics study on publication data provided to the study team by the FWF.

This Executive Summary deals firstly with the major findings and recommendations about the future of the two network programmes. It then reports on how specific changes might be made to the design, implementation and operation of the programme.

Major Findings and Overall Recommendations

The network programmes of the Austrian Science Foundation are an important cornerstone of the Austrian basic science funding activities. In general, they are succeessful in delivering the impacts expected by the FWF. They provide added value, but the forms of added value vary between two network types. We believe that there is sufficient evidence that the combination of the two forms of networks seems appropriate in fulfilling two slightly different tasks. While the SFB combine skills in order to build up critical mass at one place or centred around one place, the FSP seek for complementary capabilities across country.

For both networks, however, the immediate network effects are cooperation learning, the creation of new combinations in research content and the setting up of new research visions, - especially as for interdisciplinary tasks – as well as the common development of methods and common usage of infrastructure. These effects are very substantially realised for *both* programmes.

In addition – and most importantly – the quality of the participants as well as the excellence of the work they do within the networks is high and substantially higher than the average of Austrian scientific research. The improvement over time has been impressive compared to the totality of Austrian researchers.

Judged from peer review analyses and many interviews, the networks that are built up in a bottom up process can be assessed as being very topical, the tasks carried out are challenging and complex. Thus the networks contribute largely to the FWF mission statement and have become an indispensable means of FWF funding strategy.

In light of this overall performance and compared to other countries, the relative weight of the network programmes appears to be low, maybe even too low, given that the institutional funding in Austria has a greater weight than in most other countries.

Especially if thematic programming becomes more important in Austria, provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks. Moreover, the international comparison shows that the variety of schemes as for basic research cooperation is not at the high end.

The question of the value and relevance of thematic programmes to the FWF Mission cannot be solved in the context of this evaluation. However, the conclusion from the analysis of the structures and dynamics of the research networks which we can draw is that as a general rule of thumb the networks should remain largely bottom up, as this maximises the likelihood of excellent teams and research plans.

There is of course no reason why networks should not apply for funds in designated areas, especially as there might be thematic lines in the future. And there is also no reason why thematic programmes should not call for specific networks within their own realm. But to limit network programmes to designated areas would be highly problematic.

If the political will is to concentrate the scarce resources for scientific research in Austria via thematic areas full scale, it would be crucial that thematic areas are decided upon with the participation of the scientists themselves and by taking into consideration the potential of the Austrian science system to provide for critical mass in these areas. The Swiss network schemes provide for such inter-active definition of thematic areas even in network funding. In any case, lowering the quality and coherence criteria of the funding schemes for the sake of fitting into top-down designated areas should be avoided.

The network structures that have been built under the umbrella of these programmes are diverse. Thus the design of the programmes has stood the test of time rather well, as it enabled this variety with considerable success. However, it will certainly be a challenge for the FWF to ensure such diversity in the future. In effect, the separation of the two programmes already takes account not only of different location principles but also of different understandings and models of cooperation as regards coherence, pre-existing cooperation, expectation of cooperation effects, and risk involved etc. The importance of these different principles is likely to be even truer with the introduction of a new University Law that will act to concentrate networks in one location as cornerstones of university strategies, while networks that are spread across different locations will remain endeavours in their own right.

It appears that SFB have contributed to the research profiles of universities much more strongly than the FSP, and this difference will most likely continue to rise. Thus the location principle, although it is somewhat blurred, continues to play a major role. As long as excellence is kept up and added value can be proven, different variations of network structures should remain possible in the future. Whether this is done in one programme in combination with flexible guidelines and close coaching of peers and applicants, or with distinct programme lines or even programmes is of secondary importance.

As regards the management of the programme, the overall impression is that the FWF management is a very good one; in fact the application and evaluation procedure and the interaction with the network participants can be rated excellent. Some minor improvements are recommended though, especially as regards feedback procedures or a potential additional questionnaire to be used in evaluations.

To exploit the potential benefits of the networks further, a number of programme design and performance changes are proposed. Most importantly, the high potential that lies in the network as regards the training of young researchers could be exploited much more. Although the networks already offer some opportunities in this direction as universities do indeed utilise the networks to give young academic talent mid-term perspectives, they do not have systematic training programmes and this should certainly be considered in the future.

The networks are still too national, and further opening up both as regards attraction of scientists and as regards inclusion of foreign institutes will be crucial in the future. Austrian scientists in general are, according to our bibliometric data, working extensively within international science. As in all European countries, the legal framework conditions under which network programmes operate need to take full account of this if the gains from networking and collaboration on which the SFB and the FSP are based are to be realized fully. The efforts undertaken by the FWF in the context of ERA-NET and the DACH scheme are very important steps in the right direction.

As regards involvement of university leadership, the interviews revealed a small number of cases in which the leaders of the universities triggered the emergence of a network very actively and while these initiatives can be very beneficial, there is a risk that such commitments can, in certain cases, lead to commitments of scientists and sub-projects that do not really fit the overall requirements.

Until recently, the backing of the universities had been very diverse, and in some cases the universities had not lived up their commitments. This will change with the university law which enables the universities to become strategic players. For those SFB which can find a fit with such strategies, this will be a major improvement; the FSP by contrast, which have a smaller interest from the universities than for the SFB, might not fit the strategy quite so well and we feel that problems of matching might arise. It will be critical to make universities live up their commitment in each case, however. The FWF should ensure therefore that universities are aware of the fact that a strong commitment to a SFB means realising a number of positive cooperation and concentration effects. However, given limited budgets to set up SFBs as a means of University strategy goes at the expense of other future oriented activities and less degrees of freedom in strategic planning. It seems the more necessary that the planning of SFB application is done with strong integration of university leaders and that this integration is stressed in the evaluation procedure.

Finally, and also concerning the perception of the network programmes, the visibility of the networks has been very diverse, both as regards the scientific visibility and the visibility to the broader public. A better profiling of the networks themselves should be demanded in the future.

Findings and Recommendations on Detailed Changes

The selection of strictly international peers based on FWF lists should be continued. The attempts made to cover the most important disciplines of a network should be even strengthened.

The reduction of budgets for subprojects that are funded is in some cases rather considerable. In deciding whether to cut across the whole range of subprojects or whether to reject subprojects altogether, it seems more appropriate to do the latter. By cutting across the board, good projects may experience problems, and by not rejecting sub-projects on the edge of excellence the overall quality and cohesion of the networks are reduced.

Ideally, initial information on the applicants on the basis of the disciplinary spread (not the identity) of the peers could serve as a check as the applicants could comment and ask for some disciplinary adjustment. In addition, the selection of peers should try even more to find not only a collection of experts for the various disciplines, but should actively look for those experts that might have similar interdisciplinary experience.

The two stage process of project application ensures high quality networks are delivered and avoids the high costs involved in preparing and submitting research proposals. The proposal system could be altered to allow for more precise information to be given to researchers about the quality of their proposals; changes might also be made to systematize the selection and changing of peers within the review cycle for projects.

A danger of the network programmes seems to be rather paradoxically their high rate of success and good reputation. Both from interviews and from the analysis of the rejected networks, it seems that many scientists and sub-projects are attracted by this scheme that hope to have better chances for funding within a network than on their own. This requires the FWF to maintain the high levels of quality control within the application process.

In many networks there are too little explicit provisions for network integration and co-operations to be found that hinder the full exploitation of the cooperation effects. Especially the effective build-up of interdisciplinarity in networks needs strong provision for international cooperation.

For the SFBs, one of the major problems of those cases which failed or had severe problems has been lack of coherence and internal cooperation. Pre-existing co-operation thus certainly helps the success of a network – but at the same time a strong requirement to show pre-existing cooperation for an application would certainly limit the possibility to create new combinations through network funding. Our peer review analysis suggests that a reporting of cooperation should be broader, more systematic and mandatory in the reports.

The FWF should ensure that there is a sound relation between strong leadership on the one hand, which is essential and needs to be checked through peer review and FWF briefing within a network, and broad commitment and responsibility on the other hand. In general, both too strong a network core and too broad a responsibility hamper the sound evolution of the networks. The importance of management aspects in the networks is crucial for both scientific outputs and for efficiency purposes.

Care should be taken to ensure the right balance between interdisciplinarity and size: e.g. if SFB type research is very big and very dispersed it should, in general, not be too interdisciplinary as this overtaxes the coordination and integration capcities of participants.

There should be stronger and clearer requirement in proposals for networks to demonstrate their cooperation plan and to explain how interaction will be provided for (structural provisions), cooperation structures, and routine interviews. This is especially important in those cases where there is less coherence as networks are highly dispersed but still have added value in cooperating. A reporting system on all aspects of cooperation on a regular – e.g. yearly – basis could be developed, although the danger of over over-steering should be avoided.

1. Aims and Structure of the Evaluation

1.1 Introduction

This is a report of the evaluation of two programmes in the category research networks of the Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung) and has been carried out by PREST of the University of Manchester in the United Kingdom and Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe, Germany. The two funding programmes are the Joint Research Programmes (FSPs) and the Special Research Programmes (SFBs).

This first chapter of the report outlines the structure of the whole report and the aims of the review, specifying in concrete terms the main research questions, the reasons why they have been asked and their relative importance.

1.2 The Aims of the Evaluation

According to the tender, the evaluation of the FWP and the SFB should fulfil two main purposes: (1) a review and analysis of the Programmes, and (2) the presentation of a set of recommendations for future action by FWF to make changes to these programmes, and where possible, guidance on how such changes could be introduced, monitored and their likely impacts upon the programmes themselves and upon the FWF.

According to the tender and the discussion of major issues with the FWF, the review and analysis of the Programmes address the following *four major themes*:

- what is the *role of the programmes* within the overall Austrian Research system and the relevance of the programme goals within the *current context*
- are the *stated goals met*, i.e.
  - what are the *structural characteristics* of the funded network
  - what are the *outputs* and *impacts* from activities funded by the programme and how do they *match the goals* outlined;
- how is the programme *designed* and *implemented* and what are the *effects of the* design and implementation upon programme operation and the fulfilment of programme goals.
- what are current challenges for the FWF network programmes and how could they be tackled;

The findings and recommendations thus address:

- basic issues of the soundness of the programme concept and a discussion of future options of the network funding in light of the changing context the FWF operates, and
- and issues of fine tuning and improvements in the implementation.

1.3 The Structure of this report

This report is in 8 chapters with appendices and is prefaced with a short executive summary of findings which appears at the front. The second chapter outlines the principle research concept and the methodologies used to tackle the research questions such as the interview programme, a documentary review, a sub-contracted bibliometrics review, and a quantitative analysis based data from the FWF and from the networks.

Chapter 3 gives a literature survey to provide a framework for the review of network funding of research in Austria by the FWF. The framework gives theoretical benefit and cost considerations, discusses the challenges of evaluating network programmes and presents a categorisation of network programmes in Austria.

Chapter 4 is a contextualisation of the programme, outlining the FWF context (4.1) and giving a general understanding of the phenomenology of the programmes, of the environment and of the basic role the programme has in Austria (4.2). It also lists major future challenges that have been identified in the context of this evaluation and which are discussed in the last but final chapter of the report (4.3).

Chapter 5 contains the analysis of the structures that have evolved within the programmes and analysis of major features such as size, participation, location, interdisciplinarity, density of the network etc. All this analysis is done in a comparative way for both programmes.

Chapter 6 examined the performance of the two programmes against their stated goals, examining their outputs in terms of their scientific quality and quantity, their networking and collaboration activities, their interdiscipli-narity and their specific educational and capacity building effects. This section also addresses the extent to which the programmes give added value, above and beyond what might be possible through other methods.

Chapter 7 examines the implementation and procedures used under which the FWF operate and manage the two network programmes which are the focus of this review. This entails application and evaluation, especially as regards the role of evaluation in affecting the composition, and direction of work carried out. The findings also cover the major non-scientific management, administration and monitoring practices which affect the programmes, chiefly from the point of view of the FWF but also arising from the fact that the networks fund research staff working in host institutions which are mainly universities in the Austrian system.

Chapter 8 provides an overall analytical summary of the findings from the performance review of the programmes in three parts. The first part sets out and discusses the *major challenges* the network programme faces. The second part contains recommendations as for fine-tuning of the programmes regarding funding principles and implementations based on the findings of the analysis of structures, performance and implementation and in light of new requirements. A third part gives a final overall assessment.

In addition, a full scale international comparison of network research programmes has been conducted in four countries which is fully documented in Appendix 1 of this report and itself contains a short summary of the major issues. Throughout the main text of the report there will be occasionally separated boxes or insertions that give some insights form this international comparison. More background material is provided in a couple of further appendices.

Appendix 1:	An International Comparison Research programmes for the promotion of scientific networks in selected countries
Appendix 2:	A Bibliography
Appendix 3:	FWF Evaluation Guidelines for Reviewers
Appendix 4:	Structural Data of the FWF Network
Appendix 5	The List of Data Sources Used in the Research, including the lists of interviewees
Appendix 6:	Analysis of the Data Collection in the Consortium Review of FWF

2. Methodology

2.1 *Introduction*

Research evaluation is carried out normally to provide a range of judgements for research funders on programme quality, research outputs and impacts, programme operation, programme design and the fit and relationship of the programme with its organisational contexts, including mission and place within national and international contexts. In other words, the range of judgements required from research evaluation is normally very broad and correspondingly a large number of methods need to be brought to bear to gather the relevant evidence on which base analysis and from which to put forward recommendations. Research of this kind is often best thought of as case study research, and this has been the approach taken here.

The study team began from the premise that this research project requires an awareness and understanding of contexts and historical developments as the Austrian research system as the FSP and the SFB are embedded in a national research system which is itself connected to a world-wide research area. This complex institutional framework, or research landscape, can be highly sensitive with changes in one part of the framework having significant implications for other parts. Change is endemic in the research landscape, in terms of developments such as the European Research Area, the internationalisation of science and technology, the development of Mode 2 knowledge, and the growth of the third mission activities of the university sector. The study team considered that performance and the viability of the programmes should be considered in light of existing programme logic and frameworks but also within this larger and complex environment.

The evaluation was therefore sensitive to this larger dimension in which the funding of the research networks take place, and attempted to identify the implications of changes proposed on the wider context both as regards the goals and the rules of the programmes. When seeking information therefore about the different aspects of the performance of these two programmes, contextual information had to be gathered both on the performance of the programmes and upon the effects of possible changes to the way in which the programmes operate.

2.2 *Methodological Approach & Sources*

Our approach to methodology attempts to make full use of the data from within certain sources to illuminate and inform questions and issues raised by other forms of data, a technique known as triangulation and cross-referencing.

All methods that were applied are introduced in detail in those sections of the report in which they are applied for the first time in order to ease the reading both of this introduction and of the analytical part. Our use of different types of methods extends and sources extends to the following: a Literature Review, a Documentary Review, an Interview Programme, a specialist bibliometrics review, an international comparison study, and the analysis of a statistical database created for the Consortium Review. The details of these individual sections are given below.

Literature Review
This was a study of the literature of collaboration and networking to ground the overall analysis of the project and to provide a framework for the research itself, including the way in which other methods would be used. The framework also provided a structure for the recommendations of the report.

Documentary Review
(A) A documentary review was done on *all project proposals and reports* of all networks granted for funding since 1994 and a review of proposals of rejected proposals, also since 1994. This was a major basis to analyse structure (Chapter 5) and output (Chapter 6) of the programme and – partly – impact of evaluation (Chapter 7).

(B) A systematic review of all *evaluation reports and minutes*, both for the applied and the rejected networks since 1994 was conducted. This was a major source for the assessment for performance (Chapter 6) and – above all – the design and impact of the evaluation process itself (Chapter 7). It also was a source for the analysis of the reporting (Chapter 7.2) and gave a couple of important hints as regards adjustment in the design of the programme (Chapter 7 in general, Chapter 8).

The output based reviewed took the end of project reports containing information about programme impact and other documentation concerning programme design and programme procedures. It identified information relevant to other parts of the study, including the selection of interviewees, but it was also of use to the bibliometrics analysis. The output based review also collect information concerning the operation and procedures of the programmes and their noted effects.

Interview programme:
A broad interview programme was conducted to cover aspects of all research themes identified above. This delivered important input for all analytical chapters and for the recommendations. The interview phase included around 30 interviews of which around 16 were in person, with the rest being by telephone. Where interviewees were especially helpful or where there were issues which arose during the study, the same person was interviewed more than once.

The interviews will be carried out with the following groups Programme Managers/ FWF staff, Austrian experts, International Experts, Participants, Applicants and Non-applicants and Rejected Applicants to the two research programmes. Appendix 5 gives a detailed listing of all interviews. The number of people interviewed was 30, with 2 being interviewed more than once. This provided coverage of the categories of actor in the following way: Programme Managers, 5; Austrian Experts, 9; International Experts, 2; Participants, 16; Applicants - Non Applicants, 1; Rejected Applicants, 3.

Bibliometrics Study:
Part of the review which examines how far the impacts of the programmes meet expectations will directly address the question of added value through a review of publication activities of researchers involved in the networks. This bibliometrics review will be based on a method employed by PREST for previous bibliometrics studies. The method has been used to provide evidence of the net effect of programme funding on research.

The method involves three types of analysis: a) a review and assessment of the differential citation rates between the authors' project and non project publications; b) a review and assessment of the difference in citation rates between those papers published by the authors and those published by non-project authors (in this case also from Austria, but from no other countries) within the same journals; and c) a review and assessment of co-publication patterns from within the project. All the analysis is subject to the availability and the reliability of the data provided by the project interim and final reports under the two programmes.

The first two sections of the bibliometrics review was carried out under contract to PREST by Evidence Ltd, a bibliometrics company based in the United Kingdom with a strategic alliance with Thomson ISI, the world's leading provider of scientific information. The analysis that was to be carried out is intended to cover publications arising in two years, the first being 1996, the second being 2001, this providing opportunities to construct comparison groups and an inter-temporal comparison. The third section, on co-publication, will was undertaken by the project team itself to examine inter-disciplinarity. These third section tasks were also undertaken on the data of Austria as a whole and the results of the analysis are presented in Chapter 6 in which they play an integral part.

The bibliometrics analysis work carried out by Evidence Ltd. also included baseline comparisons between the Austrian publication activity and that achieved in a number of other important comparator countries of likely relevance to the FWF. These countries were: Switzerland, Sweden and Finland. As the budget for bibliometrics analysis was constrained, only two years' worth of data was allowable within the budget and this data was subsequently obtained. The data was also screened by Evidence to ensure that the database of records included publications from the humanities as these are normally poorly covered in the citation index. The specific steps taken by the bibliometrics company to prepare the data for analysis are listed in the separately in the bibliometrics report[1].

International Comparison
As the study involves an international comparative aspect, part of which will be carried through within the interviews themselves, a systematic analysis of four countries was conducted along the most important aspects of the evaluation. The result of this comparison is documented in the Appendix, the major lessons have been inserted at various parts of the study, most importantly within Chapter 9 (recommendations).

Special analysis of the Joanneum Database of the FWF systems evaluation/ Consortium Review
Data was made available from the systems evaluation undertaken by the Review of the International Consortium. The international consortium began its work in 2003 for the Austrian Federal Ministry of Traffic, Innovation and Technology (BMVIT). Some of the data from this evaluation, which was gathered by a survey undertaken by Joanneum Research, was used to effect comparisons between the networks projects of the FWF and the single projects[2]. The analysis of this data is presented tentatively by us for two reasons. Firstly, we were not responsible for collection, and are not fully aware of the limitations of the data. Secondly, and more particularly, because we were not

1 The Report by Evidence Ltd entitled: "Bibliometric Report FWF-funded research programmes, 1996 and 2001" June 2004 will be sent separately to the FWF. The report, as it is large and in .pdf format was not assimilable into this final report to the FWF.

2 The Consortium Review team and in particular Andreas Schibany from Joanneum Research are thanked most sincerely for their kind help in providing us with data with which we have been able to investigate a number of questions of special interest to this review.

able to standardize effectively the data presented on the single projects and the networks data in order to make possible comparisons of the highest reliability on questions of output. In regard to issues of the representation of women within the network and non network projects, our observations are more secure.

3. Theoretical Benefits of Collaboration Network Funding in Basic Science

3.1 Introduction

This chapter has presents a summary of the key areas of concern for policy making organisations that have responsibility for research networks. This review has been made of a large and varied literature on networking and collaboration. This summary provides the basis for an analytical framework to guide the review of the network programmes.

The literature review highlights a number of important issues, including the relevance of networks to the capacity of a research system, as well as in terms of what they are able to deliver in terms of publication outputs. Attention is also given to the internal dynamics of the research networks themselves, and the extent of variability within these internal structures and patterns of activity, and their implications for the quality of research outputs.

This analytical framework provides a basis for the empirical work of the review, which, as noted in the methodology chapter, is a broad and comprehensive approach, involving the interrogation of documents, the development of the interview programme, the analysis of network programme outputs, and analysis of other networking programmes in a set of comparator countries. The framework provides a way of considering the major questions raised by the invitation to tender and the proposal document, i.e. whether the networks should continue to be operated in their current fashion, or whether changes should be made to their operation. The framework also affords a basis for considering how any recommendations which emerge from the empirical programme of investigation can be implemented.

3.2 A Review of the Literature

This is a survey of the literature on collaborative and network funding for research. It has been carried out to provide a framework for the review of network funding of research in Austria by the FWF. The framework seeks to identify areas which may be key concerns for FWF research policy, and to identify steps by which these key concerns might be addressed.

The Scope of the Survey

The phenomenon of collaborative research and its support by research funders whether in basic or in applied science through the funding of networks has become an increasingly pressing issue for many, including those responsible for the design and operation of programmes, for funding applicants, for programme participants whether they be grantees or peers, and of course for funders and for citizens. This section of the report examines the literature on collaboration and networking and seeks to draw a distinction between the factors which have affected its growth and the substantive benefits and costs which are good reasons to support it. It seeks to provide both an assessment and a conceptual framework based on the published literature of the following major issues.

- the forms of collaboration and networking
- the contexts in which collaboration and networking occur;
- the value and justification of collaboration and networking;
- its relationship with other major forms of funding used by science support agencies within both the national and international science systems;
- the most suitable forms which the funding of networking and collaboration activity should take;
- the procedures for evaluating collaboration and networking activities.

After this discussion which is based on the literature, a conceptual model of collaboration and networking is presented with which to approach the issues raised. This will be followed by a characterisation of the two FWF programmes that are subject to this evaluation.

3.2.1 Value / benefit of scientific networks

The benefits of collaboration and network funding can be seen to exist at two fundamental levels: in terms of inputs to the scientific process and the development of capacity (assuming that additional money is spent for the networks), and in form, quantity and/or quality of outputs, most notably in forms of new knowledge and methodology. In addition to these direct benefits there is an instrumental one, i.e. *behavioural and structural effects* which describes a change in behaviour from isolated single projects to cooperation and opening of interfaces to other projects and disciplines and thus, on aggregate, to a structural change in the science system. Output justification is also held to include what Katz and Martin (1997) refer to as the "usual outputs in terms of socially useful outcomes." These justifications are applicable both to pure basic research and also to work undertaken to achieve some form of strategic goal. The presence of benefits from collaboration should not however obscure the issue that collaboration and networking activities involve a number of costs and these will be outlined at the end of this section.

The benefits which exist from collaboration and networking are broad in scope. Katz and Martin (1997) enumerate these benefits and costs, although they do not classify their justifications into input, output including *behavioural* and *structural* forms, which we suggest is a useful further distinction to make, although in some cases the distinction is not always clear. Based on their taxonomy of collaboration and networking benefits, we propose the following as comprising the major justifications for collaboration and network funding.

Combining Skills – Critical Mass

When researchers are working together in a group, there are likely to be a broader range of skills present than may exist within a single individual, or a single research group. The presence of such extra talents lead to a certain critical mass assuring a higher probability that a scientific problem can be solved, thus also contributing to a higher visibility of individual scientists as well as research locations and a clearer profiling of the latter. Additionally, it could be argued that when single projects are undertaken, a principal investigator may set a narrower remit for the work than might exist within a group and that this narrower remit may prevent a broader analysis and synthesis of the scientific issues.

There appears to be a tendency for research collaboration and networking to be more common in certain disciplines than in others and for certain scientific roles to engage in more collaboration than others. It is noted that in physics, collaboration as measured through co-publication is much more common in the case of experimenters than it is between theorists (Gordon, 1980; Meadows and O'Connor, 1971; Okubo et al. 1992). It is also noted that the expectations which collaborators and those seeking networking funding have will vary significantly, influencing what networks are formed, what purposes they serve, and what outputs they achieve.

Social Support

Working in groups is held to provide greater companionship and emotional support, a benefit that may be of more use to some researchers than others. There is little in the literature that examines this in any detail, although a number of scholars refer to this in passing.

Learning

A third benefit from collaborative work is that researchers learn from each other, not only at the level of disciplinary knowledge or knowledge from other disciplines, but in terms of methodology. Furthermore, in contrast to the transfer of codified knowledge which takes place in collaborations and networks, scientists working in groups are also more likely to acquire tacit knowledge Polanyi (1967; 1969). Increasing attention has also been paid to the development of capacity in research systems (Bozeman & Mangematin 2004), with the suggestion that more work in done to understand issue of life cycles of scientists studied by Stephan and Levin (1997). There is also strong evidence that the role of junior researchers is an important one in the transfer and distribution of tacit knowledge around the research system. It is contended that that while the knowledge transfer can occur within the range of activities supporting the diffusion of research findings such as conferences, it is substantially more effective through mobility of doctoral researchers (Mangematin and Robin, 2003). This form of benefit can be both an input and output of research collaboration, depending upon whether the learning which occurs is an explicit goal.

General Personal Learning

A related area to the above is that of general personal learning which equips researchers with skills that might be useful beyond the project on which they are currently working and indeed beyond their academic career. Many skills which can be acquired during a career in research can be subsequently used during a career in business and indeed in other professional activities. Whether research funders should consider it their responsibility is an important question for them to resolve. Again, these benefits can be anticipated or may arise to some degree accidentally. When these benefits are expected from the research collaboration, they can be defined as outputs.

Interdisciplinarity

Interdisciplinary research has not always been regarded as a serious form of research because the pre-eminence of the major institutions of science has depended upon strong disciplinary coherence. Nevertheless, interdisciplinary working can be a highly desirable form of research activity (Nissani, 1997) but enthusiasm for it is misplaced when it is regarded as simply an end in itself. At the level of outputs, it has been increasingly seen that collaboration and its support through network funding has a role to play in bringing together different academic disciplines to solve problems at a variety of levels, including research questions that are entirely pure in nature, but also to deal with more strategic and applied questions. Taxonomies of disciplinary interaction normally focus different degrees of interaction between areas of science, with the aim of identifying a hierarchy of closer relations between areas (Gibbons et al, 1994). In exceptional cases, such interaction leads to the development of new disciplines, but these take time to establish.

Interdisciplinarity can be seen both as an input to research and as the output of collaboration and networking activity. Conceived as an input, interdisciplinarity brings researchers together from a variety of fields in the expectation that to do so will make it easier to solve a problem, whether of an applied nature or at the pure basic level. Thought of as an output, interdisciplinarity is the result of collaboration in the form of a new set of concepts, theories or discourses whose applicability may well extend beyond the problem they were generated to solve.

Diffusion

It is also claimed that research collaborations and networks are more suitable mechanisms for the diffusion of scientific findings than smaller and single project working would allow. While it is clear than larger scale collaborations and networking do increase the number of academic staff working together, it is not necessarily clear that increasing the project size beyond a certain limit will help to diffuse research findings. Nevertheless, when technological systems such as web servers and bibliographic resources are established to diffuse research findings, increasing the scale of use increases the marginal efficiency of the service because there are negligible costs associated with extra use.

3.2.2 Costs of Scientific Networking

While there are strong arguments in favour of collaboration and networking, it should be noted that the difficulties of collaboration and networking are often significant. That there are costs involved in networking as a social activity is a well-known finding within the networking literature (Wasserman & Faust, 1994), but it is not always appreciated in practice that the larger the network, the more nodes any one node much remain connected with to ensure that the whole network retains a certain level of connectedness (what is termed network density).

Management costs

At the level of the management of scientific work, the costs for collaboration networks can be higher for a number of reasons. Firstly, collaboration may require increasing levels of travel and other forms of movement, perhaps of equipment or research results so that they can be shared across space. It has been made progressively easier to do this as information and communication technologies have proliferated, many of them established to facilitate collaboration, see for example the invention of the World Wide Web by the British scientist, Tim Berners-Lee. The use of the web for the sharing of results and the use also of video conferencing although not yet widely adopted may reduce the costs of collaboration.

Rise of bureaucracy
A further argument against collaboration and networking is that the management of such work necessarily involves the creation of bureaucracy to facilitate coordination. The creation of rules to guide conduct is not by itself problematic. However, what appears more likely to give rise to problems of coordination is the appearance of inconsistency when different organisations reward participants in different ways. Very usually, networking funding in research systems is paid for through one part of a dual support system. Under these systems, the costs of specific research projects are met by research councils, but, at the same time, research personnel remain employees of universities or research institutes whose mission involves the provision of teaching as well as the pursuit of research. Matching the goals of universities and research funders as well as dealing with the variation in reward systems between the host institutions that participate within a project can lead to extra costs (Katz and Martin, 1997). However, the failure to understand the relationship between funding for research from general university funds and from research councils could also be costly.

Preparation and planning costs
It is also argued that the specification and preparation of research funding bids which involve multiple individuals and organizations can take longer to carry out, and is therefore more costly than work which is planned for single individuals or small groups. While this case is outlined by Katz and Martin (1997), it is not necessarily a fair comparison to assume that because collaboration and networking involve more individuals than single research grants, single research grants are better value for money. In fact, because collaboration and networking may involve areas of science that are newer, more difficult and more challenging, their outputs may be of far more value. Indeed, the value of papers involving collaboration and networking in terms of their citation impacts and value to the scientific field generally is thought greater, see for example a long line of studies (Crane, 1972; Goffman and Warren, 1980; Diamond, 1985) and especially if it involves international collaboration (Narin and Whitlow, 1990). More recent work on the biotechnology sector in Israel (Amalya and Oliver, 2004), which is a highly multidisciplinary area involving much interaction with industrial science, confirms the importance of scale and collaboration in generating scientific outputs.

3.2.3 Assessing Networks and Network Programmes

As other forms of funding programmes, all programmes have to be measured against their stated goals, and ideally these goals are assessed in light of the current context of the country or region in which the programme is running. The evaluation of network programmes is a task that is a little more complicated and has always been controversial. In comparison to single project programmes, network programmes have an added benefit – or added instrumental dimensions – which are *behavioural* and *structural*. Thus, the evaluation of such programmes – no matter what the specific task of such an evaluation may be – is to be contextualised in a three-dimensional space with the following potential evaluation questions:

- *Input*: What (additional) funding has gone into the programmes and what capacities have been built up? What is the relative funding of participants?
- *Output*: What is the quantity and quality of the work coming out of the networks? This would include, in an ideal world, the assessment of the value of new combinations (methods, new contents) the concrete manifestations of which need not to be of higher quality as regards output in refereed journals. By the same token, quantity of research might be misleading as the research on new combinations needs more time and investment to materialise, the added value may be a new research venue rather than new concrete research results in the short and mid-term.
- *Behavioural and structural*: What networks have evolved, how has cooperation come to life, what synergies have been realised, how have internal structures and research profiles at universities changed and how have internal and external (including international) interfaces opened up?

To evaluate benefits at these three levels, and thus to evaluate the effects of network programmes, data on all three levels is needed. The input dimension is fairly straightforward, albeit it is not easy to assess if the money spend on network programmes has been spend in addition or if it has crowded out budgets for single project programmes or other kind s of funding.

As regards the output of network programmes the most important indicators are scientific publications. Some very specific studies are now appearing that comment upon the quality of outputs of these interdisciplinary research programmes compared with those of a monodisciplinary character (Rinia, et al 2001). This study of the Netherlands physics employs data which is now ten years out of date, but the conclusions drawn from it are that interdisciplinarity is valued as just as important as disciplinary research. Specifically, the authors found that i) in terms of peer review, there is no bias against interdisciplinarity; ii) that simplistic bibliometric indicators show some bias against interdisciplinarity, but that iii) more sophisticated methods do not. The nature of the bibliometric comparisons is however very important, with the normalization of the papers against the relevant journals in which they appear being vital to effect a fair comparison. Unless interdisciplinary research under network programmes is compared with interdisciplinary research that is undertaken outside network programmes, a true like for like comparison will not be obtained.

As for the *behavioural and structural changes*, evaluation tasks are even more complicated. Here one needs to depict collaboration behaviour and structures. Given that there is data available on cooperation behaviour, i.e. on bi-lateral and multi-lateral scientific contacts, the level and the dynamic of the cooperation within networks (network density) can be ascertained. In an evaluation of network programmes, one needs to concentrate on partial networks, i.e. the networks built upon scientific contacts rather than including total network analysis (Pappi 1987)[3]. If evaluations are interested in the role of a central player in networks, they sometimes analyse so-called ego-centred network structures (cf. Fisher 1977, Craven/Wellman 1973, Kaufmann et al. 1989). Finally, three forms of social networks are differentiated: (1) exchange networks, (2) information networks, (3) sympathy networks. In the context of research networks exchange (multiplicity of interactions, which range from networks of friends through neighbourly aid and up to recording professional relationships. For the field of science and technology policy evaluation, exchange and information networks are especially important.

While almost every author who has written an overview of the characteristics of social networks has utilized a different systematic approach, the most significant network features can, however, be considered to include the following (cf. Hall/Wellman 1985, 28): (1) size or scope of the network; (2) density; (3) extent to which a network member is directly connected with others; (4) demarcation (share of all bonds of network members which are contained within the network); (5) availability (average number of attachments which are necessary to connect the network members as a couple); (6) homogeneity (extent to which the network members possess similar personal characteristics); (7) cliques (network areas in which all members are directly connected); (8) clusters (network areas with high density, but less stringently defined connection criteria than for cliques); (9) components (network areas with which all members are directly or indirectly connected).[4]

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3 Network studies do not only record the existing relationships, more interesting are often the potentially possible, factually non-existent relationships ('structural holes') (Knoke/Kulinski 1982: 12). Relational analyses must also be differentiated, in which the kind of transaction as well as density, cliques and clusters of the total network are investigated, and positional analyses, in which the relationship of the actors to each other is examined, for example, questions about the structural equivalence and alterations in stable relationships in formal organisations (Kaufmann et al. 1989: 15ff.; Pappi 1987: 18ff.).

4 There are additional charactersitics of the relationships within networks, however, in the context of this evaluation we lack the data to engage in an analysis of individual relationships within networks.

What does this mean for the evaluation of modern research and technology policy initiatives? Network analysis requires detailed data about the actors belonging to the network (e.g. their institutional background, resources) and the kind of relationships between these actors. Usually, the "measurement" of the network takes place once, but it is also possible to repeat the survey in order to investigate changes within the network structure. Network analysis is a quantitative approach using highly formalized questions; the data gathered, however, should be complemented by some qualitative insights through personal interviews.

Thus, an assessment must be made about the quality and quantity of data at hand for a network analysis. Second, a decision must be taken whether to examine total networks or ego-centered networks and what type of network is the object of the study (partial network or totality of the relationships). Third, the research questions of an evaluation must be checked against the quality of data and against the possible network characteristics that can be analysed.

In the context of this evaluation, we will be able to utilise a limited set of network analysis tools. We have to rely on data drawn from network reports on the cooperation between sub-projects, giving all institutional details but without any indication about the quality of these bilateral relationships. This data will be analysed along the major research question: what kinds of networks have evolved (how big are they, how broad they are – how many different scientific disciplines do they cover) and how dense is the network (i.e. how many bilateral co-operations in relation to the maximum possible number of bilateral combinations are present).

4. Nature and Context of FWF Network Programmes

4.1 The FWF Context

The Austrian Science Fund (FWF) is the main research funding organisation in Austria supporting basic research. Its role qua research council involves the disbursement of research funds to the country's scientific community through three main schemes of support, its single projects, and its two network projects, and through a welter of small schemes to support individual scien-tists, including attempts to extend scientific career opportunities to women. This traditional mission sees the FWF operating as a Mode 1 institution in the terminology of *The New Production of Knowledge (Gibbons et al, 1994),* concerning itself exclusively with the promotion of basic science, the support of disciplines and their development, and the attempt to ensure that Austrian science is conterminous with the world science.

This mission was established by the Research Promotion Act in 1967 whose rules restrict the role of the Funds to the allocation of basic research rather than to either basic oriented basic or strategic applied research, the two categories which are normally considered together as comprising strategic research. The promotion of applied research falls to a separate body, the FFF, the Austrian Industrial Research Promotion Fund. Consequently, the mandate for research funding of two foremost bodies of the Austrian research system reflects a linear view of the research process that predominated during the 1950s, 1960s and early 1970s.

During the past year, the FWF, indicating a willingness to develop and broaden its role, has announced the creation of a Translational Programme to support attempts to transfer basic research findings towards suitable areas of application. The Translational Programme, under which no grant allocations have yet been made, is to a large extent modelled on the comparatively long running Transferbereiche of the German research system which were first used in 1996. Both programmes provide support to develop and apply research developed nationally within the basic pure or basic applied funding mechanisms. Funding is allocated in both schemes for up to 3 years duration for research at the pre-competitive stage. In Germany, the transfer units seek to find ways of applying research which is developed within the Collaborative Research Centres (Sonderforschungsbereiche (SFB)), and the Translational Programmes in Austria are intended to have a similar relationship with the SFB programmes.

The large number of smaller programmes consists of grants and prizes that to some extent commemorate Austria's major scientific achievements over the last century and a culture of academic and intellectual aspiration. However, while the Universities of Vienna, Innsbruck and Graz have been at one time the home to 9 Nobel Laureates, the country's more recent performance on this scale of achievement has not been so strong, with Austrian failing to figure in the list of countries receiving the prize in the last 15 years. Comparing Austria with a number of countries of similar size, between 1901 and 2002, all have achieved more Nobel Prizes, with Switzerland winning 22, Sweden 18, Denmark 8 and the Netherlands 9.

4.2 Aims, Concepts and Characteristics of FWF Network Programmes

4.2.1 Conceptualisation and Features of the Network Programmes

Before analysing the two network programmes, we introduce our own short conceptual characterization. While the introductory chapters have given potential benefits and evaluative concepts, this chapter carries out a characterisation and categorisation of the networks. This should help to understand the range of possible forms which scientific networks could take and assists in understanding the potential benefits and outreach of networks as well as potential alternatives to the existing networks funded by the FWF. The dimensions are partly derived from the literature review and partly from identifying programme goals and eligibility criteria.

Table 4_1 summarises – in a very simplistic form – the main dimensions of the characteristics of scientific networks and assigns the network programmes accordingly. The more application oriented network programme Kplus – a science-driven network programme connecting science and industry[5] – is included in order to highlight the differences already existing between other schemes and the similarities of the FSP and SFB programme.

[5] See See: J. Edler et. al. (2004): Assessment „Zukunft der Kompetenzzentrenprogramme (K plus und K ind/net) und Zukunft der Kompetenzzentren" Final report to the Federal Ministry for Transport, Innovation and Technology (BMVIT) and the Federal Ministry of Economy and Labor; Kalrsuhe/Wien; there you find a characerisataion of "science-driven" and the more industry-driven network programme Kind that is deliberately not included in this overview here.

Table 4_1: Research category and research form

	SFB	FSP	Kplus
Types of entities collaborating			
teams within institutes	X	X	X
institutes			
universities			
other institutions conducting research	(X)	(X)	(X)
individuals / teams within companies			X
Number of collaborators			
bi-lateral			
multilateral small (up to 8 teams)	(X)	X	
multilateral big (above 8 teams)	X	(X)	X
Coherence of the Research Activities			
opportunity structure to enable cooperation within a certain scientific area			
common vision and goals			
common vision, goals, research programme and working plan	X	X	X
Intensity of Cooperation			
ad hoc bi-lateral exchange of results			
concrete cooperation between individual teams and subprojects	X	X	X
interaction of all network members to contribute to a common task with clear division of labour	(X)	(X)	(X)
Duration / Sustainability			
short term, ad hoc			
mid term (up to 7 years)		X	X
mid to long term	X		
open ended			
Nature of collaboration			
clearly defined research design with limited risk attached	X	X	X
explorative and risky	(X)	(X)	(X)
Purpose of collaboration:			
exchange of results enriching each other's work		X	X
complementing each other's work with input from one being crucial for work of the other	X	(X)	X
common development of methods	X	X	X
common usage of infrastructure and equipment	X	(X)	X
Stage of scientific activity			
pure basic: excellent new knowledge	X	X	
basic oriented: excellent new knowledge with strategic goals			X
applied / translational: "useful" knowledge			(X)
Disciplinary reach			
mono-disciplinary			
multi/inter/trans-disciplinary	X	X	X
Geographical spread of network nodes			
located at one major host	X		
located in one city	(X)		X*
located in hosts that are *regionally* spread		(X)	
located in hosts that are *nationally* spread		X	
located in hosts that are *internationally* spread			

* one location principle, however, participants may come from all over the country

This overview demonstrates that the differences between the FSP and the SFB schemes are minor when mapped against the possible types of scientific networks. They differ in size and in the location principle. In addition, it shows that there are many possible combinations and types of networks that are not covered by the three major science-driven Austrian network programmes.

Research networking is a long running aspect of the research landscape in Austria; the FSP programme was established in 1972, six years after the research projects (the Einzelprojekten), and is the second oldest research programme of the FWF operational today. This mirrors a trend in both Germany and Switzerland whose older networking programmes were established in 1967 and in 1974 respectively. Austria's SFB programme is much more recent and was established in 1993.

Considering the *specific scientific aims* of the networks, there is no thematic direction given to any of the networks or to the single grants which together comprise the main forms of funding mechanism. It has been noted, however, that the research carried out under the network programmes maps closely onto research themes identified as important to Austria by the BMBWK. The use of thematic priority setting within network programmes in the comparator countries studied (Germany, Finland, Switzerland and Denmark) is widespread, and none of these countries has all its network programmes operating in an entirely bottom-up / response mode fashion.

In Germany the SFB and the Research Units, which operate for 12 and 6 years respectively, are predominantly response mode, while the Schwerpunkte and the Research Centres are thematic. In Finland, Centres of Excellence have thematic guidance while the research programmes have a mixture with the scientific direction chosen being the result of an interaction between top down and response mode approaches. In Denmark, the Centres of Excellence are top down. In Switzerland, the National Research Programmes, which operate for between 4 and 5 years are both thematic and response mode with the priorities set by the Swiss National Government chosen from priorities raised as important by academics. The Swiss National Centres of Competence, which operate for between 10 and 12 years, also operates a hybrid priority setting system, with thematic and response mode aspects.

The *specific functional aims* of the FSP and SFB are to encourage interaction between scientists and to carry out interdisciplinary research on complex and challenging research areas that will achieve international visibility and international excellence for Austrian science. These are complemented by a range of dissemination outputs such as public engagement at the level of research use and the training of young scientists.

The *specific functional aims* differ however in respect of the level of interdisciplinarity involved in collaboration and networking. Within the FSP, a multidisciplinary research approach is taken that requires less of an attempt at disciplinary integration. Within the SFB however, the single-site principle is observed and this is the clearest means of distinguishing between the two forms of network. Such an approach (for the SFBs) is meant to ensure a more coherent type of research project in which a higher level of interdisciplinary working is achieved.

The *types of actors involved in network* programmes in Austria are usually universities, although other research organisations do take part. One SFB has been run through the Vienna Institute of Demography. Predominantly, though, the members of networks are university departments.

The *location principle* for networks used varies therefore according the specific functional aims chosen for the networks. The FSP projects are normally multi-site and are seen to be constituted by a collection of sub-projects rather than a single integrated arrangement of sub-units or components. They are therefore distributed networks that are based on similar logic to the networks of excellence now receiving support under the European Research Area. FSP projects tend to be multi-site in form, with parts of the network being allowed in principle to come from anywhere in Austria, subject of course to the research meeting strong scientific criteria. SFB projects have normally required the co-location of the scientific resources of the network to provide for greater integration. Depending upon the extent of collaborative activities and the skill with which this aspect of the network is managed, more major sites or locations might be successfully integrated within the SFB.

The *project leadership principle* varies between networks. In respect of application, the procedure is very similar for both types of networks, as networks are normally led by a coordinator who is responsible for the bid to the FWF for funds. Projects nearly always comprise a number of sub-projects, the number of which varies considerably between networks, although not all sub-projects will last for the entire length of the main project.

In respect of the *duration of networks funding*, recognising the greater burden of interdisciplinary and transdisciplinary development required within the SFBs, the funding period of the networks is accordingly set at 10 years, subject to the outcome of a two stage reviewing process that can see projects altered significantly or stopped altogether should major problems be detected. The FSPs by contrast have a life-span set at 6 years. This shorter lifespan reflects the belief that the work of an FSP requires less integration and interdisciplinary development than the SFBs.

The *local / geographical linkages* established by the projects also differ markedly. Recognizing that the SFB is meant to make a distinct contribution at to the area in which it is located, the FWF carries expectations that SFBs will receive some further funding support from regional and local government bodies, and the university itself. By contrast, the FSPs do not have such "deep roots" and do not make such a local impact, although their research may have regional dimensions to it.

4.2.2 Funding Priorities and Relationship with Other Major Schemes

The majority of FWF funding is through three types of support grants, the scientific projects or Einzelprojekten / Forschungsprojekte which receive around 72% of total funding with a further 18% allocated to the two network programmes, the Forschungsschwerpunkte (FSP) and the Spezialforschungsbereiche (SFB), with the remaining 10% of the support spread across 15 smaller types of projects. These figures are based on three years' worth of data for the period 2001-2003.

In comparison with Switzerland, the amounts spent on networking and collaborative projects as a proportion of the overall budget of the research funding agency in Austria is almost the same with around 18% of grant allocations going to the two major network programmes. Within the close comparator group, Denmark is alone in not having its National Research Foundation fund single project grants. Within the Austrian networks themselves, during the period 1998-2003, 81% of funding was allocated to the SFB programme projects with the remaining 19% allocated to FSP projects. The SFB have become the dominant network project mechanism in Austria over the last decade, increasing their level of importance and becoming the dominant research network form for FWF funding.

Funding Across the Disciplines

The funding allocation by the FWF as a whole varies significantly across the disciplines. In areas such as social science and human and social sciences, the proportion of funding is less, while in areas such as natural science, the humanities and theology, the proportion is much higher. It is likely that the relatively low level of funding by FWF to social science and human and social sciences results from the availability of comparator funding schemes for these areas in the form of the Austrian Central Bank's Jubilaeumsfonds.

4.2.2.1 Participation of International Scientists in Networks

International participation is a problematic issue for network programmes – not only in basic science – in all European countries. In general, there are legal constraints to the financing of foreign scientistis working abroad, while it is less problematic to fund foreign scientist within the countries of the network programme. Moreover, initiatives towards a more flexible approach as regards financing of foreign institutes is often subject to politically debate. As for the FWF network programmes, there are attempts underway to enable a more flexible cross-border financing scheme within the so-called DACH tripartite agreement with Germany and Switzerland – soon to be enlarged with the Netherlands. In addition, the FWF is engaged in a series of initiatives within the European ERA-NET scheme – which aims at the opening up and coordination of national programmes via collaboration of funding agencies and ministerial departments. As of today, the major leverage as for internationality of the network is to check international connections and integration of the scientists submitting a network for funding in the evaluation and the internationality of the peers reviewing the networks.

4.3 Changes in the Context - New Challenges

This last section is meant to deliver a short discussion on those issues that emerge in the context of the Austrian FWF as new challenges. These issues expand - respectively concretise - somewhat the major themes that have been put to the evaluation team (see Chapter 1). After the analysis on structures and performance has been presented, the analytical and conceptual discussion in Chapter 8 (especially 8.1) will complete the discussion of these more future-oriented issues, without which recommendations on fine-tuning of the network programmes would be rather fruitless.

The Changing Relationship between Networks and Universities

Austria traditionally has a high level of funding from government and a particularly high level of general university funding (GUF) or core-funding that is not targeted to specific research tasks or outcomes. Research council funding or projects and programmes funding (P&P) is generally smaller in such countries. However, there has been a strong tendency for the funding of university research to become far more targeted in research years (Campbell, 2003) with a concomitant decline in the amount of GUF and an increase in the P&P funding.

Due to university reform, a process that has still properly to take effect, universities will in the future be more autonomous, taking responsibility for the development of research strategies, and with control over their costs. It is likely that university strategies will increasingly have to work with and take account of funding from the FWF. How they will do this is difficult currently to judge. Universities are to become more responsible for the use of their resources, including both teaching and research resources. It is likely that universities in the Austrian system will seek to develop strategies which maximize the value from external research funding both in terms of the research payoffs and in terms of the impact on teaching.

Crossroads I: After University Reorganisation – What Long-term Structural Effects Are Envisaged?

Related to the question of university strategies is the future of the networks that are funded. As the SFB programme, which has grown considerably larger than the FSP programme, has started 11 years ago, the funding for a considerable number of networks will end in the years to come. While the first decade has been a phase of constructing and consolidating the new scheme, the FWF is now faced with the questions of the long term structural effects intended. According to the FWF guidelines, the networks, especially the SFB, shall build up autonomous centres of research within universities. To do so, a critical mass of scientists and infrastructure and equipment has often been built up, effective structure and fruitful cooperations have emerged that might function beyond the immediate financing of the FWF network programmes. The question how the universities and the FWF deal with these structures in the long run is an important one. Even if one takes the position that scientists should anticipate their future cooperation activities without SFB funding, it is clear that with a growing number of finishing SFB the responsibility of universities and FWF will grow.

Crossroads II: A Streamlining of Schemes – Merger of Programmes?

The research system of Austria is a small one, and the FWF Consortium Review 2004 recommends streamlining the network funding, reducing it to a single scheme. However, it should be a premise of this study that it is – ex ante – far from clear what the adequate nature of the network programmes is. The question is whether the potential advantages (efficiency gains, less complexity, more flexibility etc.) outweigh the potential disadvantages. What these disadvantages may be depends of course on the final concept of a merged programme. It may mean a loss of flexibility, as one of the two principles (multi-location, single location) might be abandoned. Or it may mean an increased complication as many different structures might be possible under one programme. If that is the case, the guidelines would have to be adjusted and differentiated in order to come to a match of the envisaged structural network characteristics (e.g. geographical spread, interdisciplinarity) and the envisaged research agenda and working plan (e.g. internal coherence). It is our view that to argue for a merger for the sake of simplicity would not be helpful.

Crossroads III: Research – Users – Society and the Challenge of Thematic Programming

The Report of the Consortium on the performance of the FFF and the FWF has introduced a discussion of the way in which research outputs are conceived, and has proposed that there should be some further re-examination also of the relationship between the FWF and Austrian society. A number of models of interaction between science and society can be considered for guidance, some of which focus upon the interaction between institutions (for example the Triple Helix Model), and some of which take a more abstract view of the research process, its outputs and the relation to users (Stokes' Pasteur's Quadrant).

The need to reconsider the question of the relationship between Austrian science and the use which Austrian society makes of the science it produces has been raised by the FWF Consortium Review 2004. The contribution which Austrian science has made to the Austrian economy has hitherto been seen in terms of a traditional market failure paradigm. Under this analysis, scientific knowledge is considered to have properties that make it difficult to generate commercially, leaving a major role for the state to intervene to support science. This argument has also been used to support other forms of support to research closer to market application.

This argument retains great credibility but there is a growing awareness that science is not and has never been hermetically sealed from society, but rather exists in ever closer relation with it. Consequently, new forms of explanation for the governance of science are current, most of which focus upon the social processes involved in knowledge generation and transfer. Scientists and science organisations are now considering whether their survival in a Mode 1 paradigm remains possible or even intellectually sustainable.

In any case, the FWF is confronted with the challenge that there seems to be a pressure articulated by the Consortium review but not confined to it, that basic research funding organisations like the FWF should more directly contribute to societal and economic benefit, what is referred to by the Consortium Review as the Pasteur's Quadrant. The question thus arises what the position of network funding is in this discussion. Could it be seen as a major instrument to include elements of top down, thematic oriented programming? Could network funding accelerate the successful implementation of research areas within the FWF as larger teams would be working towards in designated areas? If so, how could the network programme structures be consolidated within the definition of scientific areas? Or would the limited size of the Austrian system also limit the possibilities of network programmes and thus reduce the benefit of those programmes?

The International Context – and Internationality of Networks
Basic science has always been international. We find large scale facilities and large scale cooperative research projects throughout the 20th century. However, there are developments that render international dimension of research ever more important. Basic science continues to specialise and thus demands both for interdisciplinary cooperation between those specialised units increase, especially in times of accelerating global accumulation of knowledge.

One specific and still somewhat open issue is the question of new funding schemes organized on the European level. The heated discussions on the form a European Research Council clearly demonstrate that no matter how it happens, some new, European-wide scheme will eventually emerge. Even if the governance of this scheme may allow for excellent national teams to apply for funds, it is clear that an enlarged market for basic research funds will lead to an intensified competition and an even greater demand for cooperation within the whole new "internal market" for basic research and – in very general terms – even more mutual openness of research systems.

Against this background, the FWF consortium review of 2004 assesses the internationality of the FWF system as having further room for improvement, particularly as regards the development of strategy (FWF Consortium Review, page 85). The review also recommends that the FWF adopt new procedures to increase the extent to which Austrian research is connected with the international research system, although a number of positive signs are present, such as the planned participation in ERA-NET[6]. The process of internationalisation is, as the Consortium Review notes, a fast moving one, and the need to have strategy in place to take account of these developments, which carry benefits as well as risks, is especially important for small countries such as Austria (page 109.)

The international dimension of research has certainly many aspects to it, most importantly exchange of knowledge, mobility of researchers both inward and outward and trans-border cooperation. The network programme concept could therefore play a specific role in this development in many aspects. To mention only the most obvious, network programmes may contribute more effectively to international competitiveness, and thus better prepare Austrian teams for international cooperation. They may furthermore raise the visibility and attractiveness of Austrian research locations and thereby increase the attractiveness for international scientists to come to Austria. More directly,

6 ERA-NET is a scheme set up by the European Commission to improve the cooperation and coordination of national research policies and funding schemes.

collaborative networks may integrate international research teams in their collaborative endeavours - as international teams might fill important gaps. In sum, it seems that basic science network funding has a significant potential to contribute to the challenge of internationalisation. The question therefore is, to what extent the networks already do contribute to this, and what could be done in order to make them perform better in this direction.

5. Funded Structures and Patterns of Participation, Collaboration and Integration

This section lays open the structure and embeddedness of the networks that are funded within the network programmes of the FWF. It analyses the funding patterns, the structures of the networks that have been funded in terms of size, location and participation patterns, disciplinary coverage and interdisciplinarity as well as patterns of cooperation within the networks. It then analyses the relation between these various structural characteristics in order to come to a more informed phenomenology of the networks.

Summary: The main findings

The analysis of structures in the FWF network programmes resulted in the following main findings:

- The two programmes are attractive for the Austrian science system, and the attractiveness has increased in the last couple of years for both programmes alike. The acceptance rates for the networks are about 50%, dropping considerably in the last 3 years in both programmes.
- The form of the networks is considerably shaped by the ex ante evaluation (also Chapter 7), which rejects a considerable number of sub-projects and, on average, cuts the budgets by almost 30% in both programmes.
- The size of the networks varies considerably; there are SFB networks that are smaller than some of the big FSP networks.
- The representation of senior scientists (professors) is slightly higher in the SFB networks than in the FSP networks, thus there are more junior project leaders in FSP networks.
- The average funding of a FSP sub-project per annum is slightly higher than for the SFB sub-projects. In comparison to German SFBs, the funding per sub-project and year is moderate.
- The official one-location principle of the SFB is softened, as 17 out of 20 SFB have sub-projects from at least two host organisations, on average, almost 30 % of the sub-projects are done outside the university that leads the SFB. 11 SFB are spread across at least two cities. Regional embeddedness of SFB – i.e. formal backing or financing by the regional or municipal government – is weaker than was hoped for by the FWF. However, while this wide geographical spread normally works well, too big a geographical spread contains the risk of cooperation deficiencies, especially as for SFB settings.
- Despite of a number of activities to improve the sitation, internationality (especially cross-border funding) could be further improved in both network programmes.

- The networks are most attractive for natural science teams, more than half of the networks are natural science, and the acceptance rate in natural science is far above the acceptance rate in other areas.
- Interdisciplinarity of the networks is – across the board – considerable, but differs a lot between individual networks in both programmes. FSP networks are – relative to their size - more interdisciplinary than SFB networks. Natural science networks are less interdisciplinary than non natural science networks.
- Too much interdisciplinarity might be dangerous, especially for SFB. Those SFB that cover a broad range of sub-disciplines without one or two clearly dominating lead disciplines have, in general, encountered severe problems.
- Size has its limits: Big network projects are both less interdisciplinarity (relative to their size) and show a lower level of interaction among their sub-disciplines.
- Internal coherence in general increases during the lifetime of networks. On average, FSP networks report considerably less internal cooperation than SFB networks, but there are examples of extremely high internal cooperation. Those SFB that are geographically spread across different cities show less internal cooperation than those that are located at one city. Pre-existing cooperation as well as a sound and strong leadership are beneficial to the development of coherence over time.
- The level of interdisciplinarity is neither a trigger for nor a hindrance to cooperation.

5.1 The Data Source and Methodology

As explained in Chapter 2, to characterise and to analyse the structure and the performance of networks of the SFB and FSP programmes we relied heavily on primary documents produced by the networks themselves. For *all granted FSP since 1994* and for *all granted SFB* we obtained and analysed the original proposals, the interim report(s), final report (if available) and all evaluation documents (mainly minutes of hearings). In addition to these documents, FWF provided the evaluation team with official FWF lists of participation. This was especially useful in those cases in which participation lists were not given within the regular proposals and reports.[7] Table 5_1 shows the number of reports and reviews available for all SFB and FSP. Table A5-1 and A5-2 in the Appendix A5 give a detailed overview of documentary sources differentiated for individual networks.

[7] In all cases in which we had both data given by the network and data given by FWF we combined these lists to get the comprehensive picture.

Table 5_1: Available and analysed FWF-Documents for funded networks

	SFB	FSP
Number of funded networks	20	14
Proposals		
Initial proposals	20	14
1st interim proposals	17	12
2nd interim proposals	10	not applicable
Reports		
1st interim report	17	12
2nd interim report	11	7
3rd Final report	3	6
Reviews		
Initial review	20	14
1st interim review	17	12
2nd interim review[8]	10	not applicable
final review	3	6

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

This collection of documents was systematically scanned for qualitative and quantitative information and this was then transferred into two databases, one for the FSP and one for the SFB.

We identified various *structural variables* such as:

- number of subprojects,
- scientific disciplines represented within the subprojects9,
- participating scientists, differentiated for their role, title, and gender,
- participating institutes and hosts (mainly universities),
- project leader activities,10
- and budgets asked for and budget granted.

As regards *output*, we identified the number of scientific qualifications finalised within the networks (habilitations, doctorates, diplomas), external presentations and conference activities, various kinds of written output

8 For three early SFB there has been an additional 3rd interim report.

9 On the basis of the categorisation of scientific disciplines as used by Statistics Austria.

10 Mainly looking for concentration of leaderships by identifying multiple leaderships of subprojects by scientists.

(refereed articles, other articles, books etc.) as well as the scope and scale of external and internal cooperation. This identification also was the basis for the bibliometric analysis.[11] External cooperation was identified via conference activities, invitations of external scientists etc. The data on external collaboration, however, was very inconsistent and systematic arguments are hard to derive from these data. As regards *internal cooperation* we systematically analysed the co-operation to other sub-projects which each individual sub-project *explicitly* indicated within the network interim and final reports (see below, Chapter 6).

This self-description of research approaches, research teams and research activities in proposals and reports was combined with the qualitative assessments of external evaluators. All peer review evaluations at various stages in the application and re-application process were systematically analysed. In aggregating the perspective of the scientific peers across the board of funded networks, the scientific performance and standing as well as the structural characteristics of the networks could be assessed, and conclusions as regards development over time could be drawn.

The combination of self-description and evaluation enabled intensive analysis of participation structures, research activities and cooperation and, last but not least, performance. Through a two step aggregation process and various calculations of adjusted and normalised averages it was possible to analyse the programmes at subproject, network and programme level. This also enabled a comparison of structures and performance of SFB and FSP networks. Next to the analysis of funded networks, a *rejection analysis* was conducted in order to assess the evaluation procedure (coherence over time and between networks/ programmes/ disciplines), and the reason for failure. Thus, for all *rejected proposals* since 1994 the evaluation team analysed systematically the original reviews and hearing minutes.

The analysis on the basis of all this primary data is – in our view – the most comprehensive and reliable means to assess systematically the structure and output of the networks. The alternative to this approach – a large scale survey done to ask for all output and collaboration information – was not feasible, not only because the Austrian scientists had been surveyed twice within the last couple of years concerning information on FWF. The major reason not to have such a survey is the apparent problem to recapitulate ex post collaboration structures and outputs in a systematic and meaningful way. A second – theoretical – alternative would have been to use the results of a consistent and compulsory monitoring of all output and networking activity transferred into

11 See Chapter 6.

a central activity, output and cooperation database. However, no provision for such a close activity monitoring has been foreseen by the FWF, for legitimate reasons such as over-steering and over-control of the funded activities and networks.

Of course the approach to analyse given primary documents is at the same time problematic. The proposals and reports are not of the same quality and lack a uniform structure. The (informal) guidelines given to the networks have apparently changed over the last decade, and the compliance with those guidelines is very diverse. Especially, individual scientists put somewhat different effort into the documentation of their research plans, achievements and activities. Thus the quantity and quality of the information is not uniform.

However, this problem is not as severe as it appears on first sight, as we assess the *programme* performance, i.e. we analyse the data on an aggregated level. The basic tendencies, the overall structure and the major averages can be defined rather well with this approach. Moreover, across the board of all networks at least the structural data is remarkably consistent, and where crucial data is missing, the FWF participation lists and other sources of information (e.g. homepages of the networks) could in many instances fill the gaps. In addition, in calculating averages across the programmes, account was taken of the fact that the years that are covered by the reports in many cases differ from the overall duration. Accordingly, whenever indicators were calculated regarding effectiveness (i.e. output per time period) and efficiency (output per input), *reported* years and only *the respective share of the budget* within the reported years were considered. Networks for which the necessary information to calculate indicators was not available were excluded from the calculation. Therefore, in many cases we have calculated indicators on the basis of less than 20 (SFB) and 14 (FSP) networks, trading a less representative picture of the whole programme for a far more accurate understanding of the way in which the networks had functioned which was closer to "real" averages.

5.2 *The Structures of the FWF Networks*

5.2.1 Basic Data: Funding Patterns

The major structural data for the two programmes within the period since 1994 is given in Table 5_2. Within this decade 20 SFB have been funded with an overall budget of more than € 105 m (as of May 2004). In these 20 SFB almost 247 individual projects were executed by approximately 2060 participants. [12] Within the same period 1993-2004, 14 FSP have been granted with a total amount of slightly above € 32 m, funding 108 projects and somewhat above 700 participants. This means, complementing the FSP programme in 1993, the SFB programme very soon became by far more important in terms of budget and participants.

Table 5_2: Structural data of network funding 1994-2004

	SFB	FSP
Budget granted total since 1994	105.848.509	32.264.416
Number of granted networks	20	14
Number of granted subprojects[13]	247	108
total participants[14]	2057	726

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

The Figure 5_1 shows the starting dates and duration (granted years, not "envisaged" years) of the SFB. It demonstrates that the granting of SFBs was rather continuous over time. The figure also shows that a couple of SFB did not receive funding for the full maximum period of 10 years. SFB 8 and SFB 12 were terminated after an interim peer review evaluation, SFB 10 did not apply for final funding period in reaction to review requirements and lack of internal coherence.

Figure 5_2 depicts the starting date and duration of the FSP. Again, as regards the *granted* FSP there is a good deal of continuity without any major breaks over time. Only one FSP (FSP 71) within the period considered was stopped after the interim evaluation.

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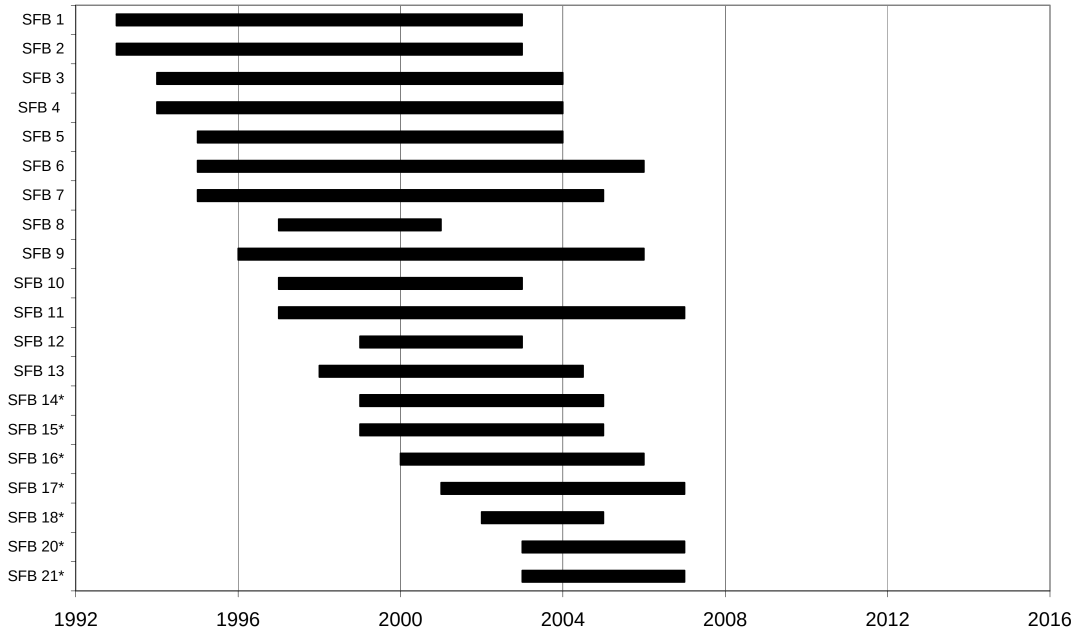
12 These 247 subprojects are only those that have been granted. It is clear that in many SFBs single projects are excluded from funding in the ex ante peer review evaluation, those have not been taken into account here. However, there are many subprojects both in SFB and FSP networks (see Chapter 7.1) that have been stopped during the life time of the networks in interim evaluations, this reduction of subproject over time have not been accounted for in the quantitative analysis of structural data.

13 Again, this number includes all those subprojects that have been granted initially, i.e. also those that have been terminated in the first or second interim evaluation, but not those that have been rejected in the ex ante peer review (see below).

14 The basis for the patrticipation numbers are two sources, the official FWF lists and the lists of the reports. Thus the numbers represent the maximum participation numbers of the networks representing all individuals ever to be part of the networks. Double counting has been systematically avoided. The overwhelming majority of the participants listed here are scientific personnel, however, as not in all lists the function of the individuals was given, it could not be clarified in each case if a participant was scientific or not.

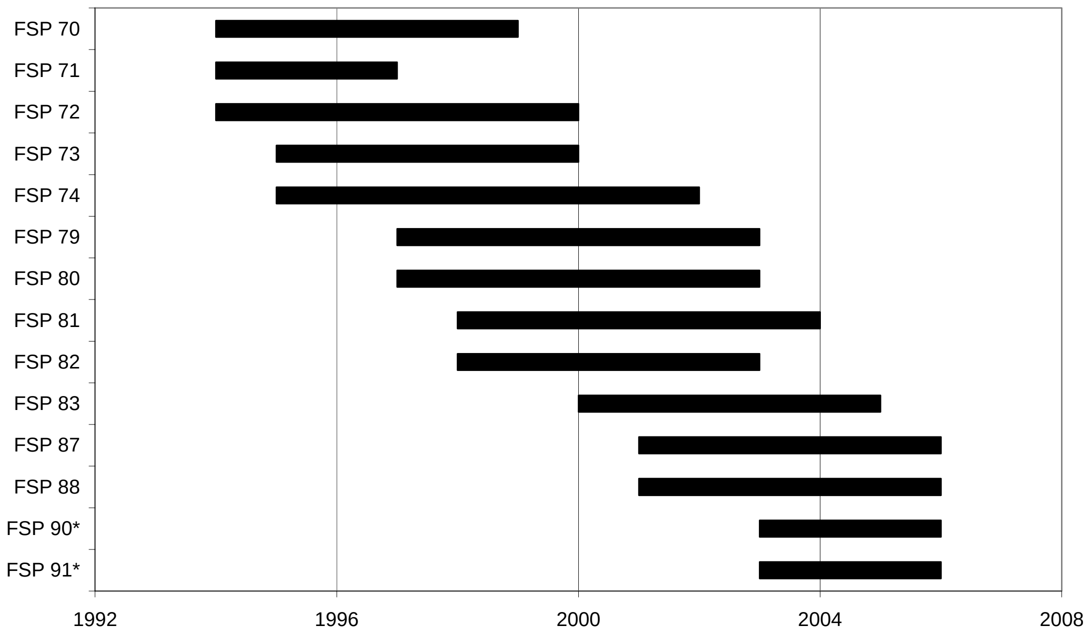
Figure 5_1: The duration of granted SFB



*SFB 14 - SFB21: period of granted funding (as of June 2004); light: purley natural sciences networks

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Figure 5_2: The duration of granted FSP



*FSP 90, 91: basis for duration: period of granted funding (as of June 2004); light: purley natural sciences networks

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Application and Rejections Structures

The demonstration of the interest in the SFB and FSP programme is complete when all proposals, including the rejected ones, are considered. As Table 5_3 shows within the last 10 years 37 SFB networks and 28 FSP networks have been applied for. With 20 SFB and 14 FSP funded this means an acceptance rate of 54% (SFB) and 50% (FSP). This is the more true, as rejections here are mainly rejections at the concept stage, i.e. those that did not reach the hearing of a full proposal but were rejected based on a first, sound concept that was evaluated in written form by external peers. The acceptance rate in the hearing stage is thus above 90%, which is – e.g. in comparison to the German acceptance rate of 60% to 80% extremely high. Thus, in Austria even more than in Germany, the real yardstick to acceptance is in the pre-hearing, i.e. the concept stage.

Table 5_3: Number of accepted and rejected SFB and FSP 1993-2004

	SFB		**FSP**	
	accepted*	**rejected****	**accepted***	**rejected****
1993	2	0	0	0
1994	3	3	3	1
1995	2	0	2	0
1996	1	0	0	0
1997	4	2	2	0
1998	1	1	2	1
1999	2	0	0	0
2000	2	1	1	1
2001	1	2	2	3
2002	0	0	0	6
2003	2	7	2	2
2004	0	1	0	0
total	**20**	**17**	**14**	**14**
acceptance rate	**54%**		**50%**	

* Start date of network, ** final rejection date

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Interestingly, the acceptance rate has markedly dropped in the last couple of years. Before 2003, the acceptance rate for the SFB was even 66% (18 out of 27 proposals accepted), as in 2003 7 out of 9 SFB were rejected. Similarly, the acceptance rate for the FSP was 66% before 2002 (12 out of 18 proposals accepted), while in 2002 and 2003 8 out of 10 proposals have been rejected. However, as according to the FWF there are no budgetary reasons for this high rejection rate in the recent past[15], it is fair to say that in the last couple of years the demand for getting funds for networked activities has gone up, however, the majority of proposals failed to meet the standards of quality and coherence asked for by the FWF.

In addition to the rejection of complete networks, the peer review process also leads to the reduction of network funds and the number of subprojects within the networks (see Table 5_4). The funding rate (budgets) of the networks shall be defined as the budget share granted to the funded networks out of the original budget the granted networks asked for.[16] On average, more than one third of the budget asked for is cut, the funding rate for the FSP is 63 per cent and for the SFB it is 61 per cent. These cuts are a combination of partly reducing funds for granted subprojects and rejecting entire subprojects altogether. In both programmes on average 15 per cent of the proposed subprojects within the networks are rejected. A rough calculation shows that on the level of sub-projects the acceptance rate – as percentage of granted subprojects out of all subprojects applied for in a programme – is around 46 % for the SFB (instead of 54 % for networks) and 43 % for the FSP (instead of 50% for the networks).

Table 5_4: Structural data of network funding 1994-2004: rejection data

	SFB	FSP
Number of granted networks	20	14
Number of rejected networks	17	14
Number of granted subprojects[17]	247	108
Number of applied subprojects[18] in granted networks	293	129
Granted subprojects per network	12,35	7,71
Rejected (in ex ante evaluations) subprojects per granted network	2,3	1,4
Funding rate budget (for the granted networks)	61,22%	63,35%

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

15 This is in clear contrast to other network funding programmes as, e.g. German SFB, where the limited budgets eliminate proposed networks that have stood the test of peer review (see Appendix 1).

16 Meaning that the budgets asked for in the networks that were entirely rejected are not taken into account here.

17 This number includes all those subprojects that have been granted initially, i.e. also those that have been terminated in the first or second interim evaluation.

18 This number includes all those subprojects that have been granted initially, i.e. also those that have been terminated in the first or second interim evaluation.

The Size and Relative Costs of SFB and FSP Networks

The comparison of this structural data[19] on first sight confirms common expectations concerning the network programmes: the SFB networks are larger, comprising slightly more than an average of 102 participants as compared to 52 within the FSP.

Table 5_5: Size and funding data for SFB and FSP 1994-2004

	SFB	FSP
Subprojects / network	12,35	7,71
Participants / subproject	8,33	6,72
Budget granted total since 1994	105.848.509	32.264.416
Budget grant / network	5.292.425	2.304.601
Budget grant / subproject	428.536	298.911
Budget grant / subproject / granted year[20]	58.147	65.514
budget grant / granted year / participants	6.982	9.653

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

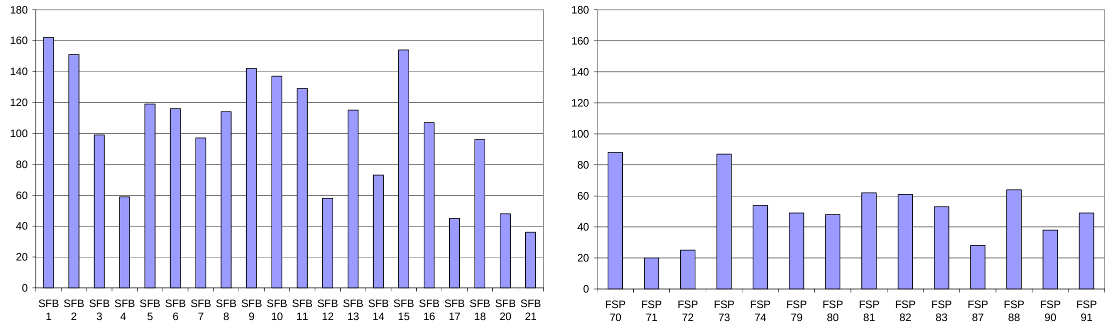
Figure 5_3 shows the size of all granted SFB and FSP networks and demonstrates that the average size of both SFB and FSP varies considerably. For the SFB the range varies between giants such as SFB 1 or SFB 15 with more than 150 participants and rather small networks such as SFB 17 and 21 with around 40 participants.[21] The relative range is similar for FSP, varying between about 80 participants (FSP 70, 73) and only 20 (FSP 71). There are no clear tendencies over time as regards the overall participation of the networks, the only possible trend might be a reduction of SFB size in the most recent past (SFB 17, 20, 21).

19 For the basis of the number of participants see footnote 13. For the number of subprojets within the networks we have included all sub-projects ever granted in the various networks, including those that started late or that were terminated before the network as finished. Thus the total number in many cases exceeds the number at any given time.

20 For this indicator we took into account the years for which the grants given were allocated to each individual network (granted years). For all output related data we have taken as basis the years that were covered by the reports (reported years).

21 The number of participants includes all participants mentioned during the various reports and on the FWF lists provided, thus the number is comprehensive and in fact an aggregation, it is higher than at any given time within the duration. Double counting was avoided.

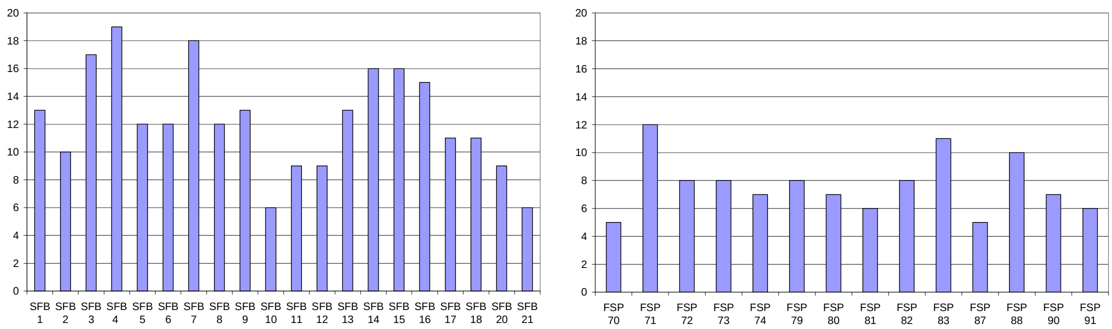
Figure 5_3: Size of SFB and FSP networks: number of participants[22]



Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

These differences between the two programmes are also reflected in the average number of projects,[23] with 12 subprojects per SFB network as compared to slightly less than 8 for the average FSP network (Figure 5_4). Here the differences are bigger with the SFB, ranging from above 15 projects (five SFB) to only 6 (two SFB). The tendency for smaller SFB networks starting with SFB 14 seems obvious. The FSP range is much smaller; there is a critical size of at least 5 subprojects (2 networks) and a maximum of slightly above 10 subprojects for three FSP. Thus, there are a number of FSP that are both larger as regards overall participants and number of subprojects.

Figure 5_4: Size of SFB and FSP networks: number of sub-projects[24]



Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Not only are the FSP networks smaller than the SFB networks, the same is true for the individual subprojects within the networks, with an average size of 6,7 participants compared to 8,3 participants in an average SFB subproject (Table 5_5).

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22 See footnote above for the data base regarding number of participants.

23 For the database see footnote 18.

24 For the database see footnote 18.

The size of the SFB networks offers a wide range of cooperation possibilities, but at the same time puts a great burden on efforts to define and implement coherent research visions and strategies and to keep up communication and cooperation across the network. In this perspective, the higher costs of cooperation for the FSP based on the need to communicate across distances is somewhat balanced by the smaller number of subprojects and participants.

This size structure has to be kept in mind when the funding of the two programmes is compared (see Table 5_5 above). Given the size of SFB networks and subprojects, it is obvious that the SFB networks consume more funds than FSP network (€ 5.3 m per SFB network as compared to € 2.3 m) and individual projects get more budget in SFB than in FSP. However, on average the SFB run considerably longer than the FSP.[25] Thus, for a meaningful comparison one has to calculate the average budget for a *subproject per year.* This shows that on average the FSP subprojects receive €65.514 which is over € 7.000 more than SFB subprojects, albeit SFB subprojects have more participants (on average 1,5 participants more).

International comparison: size
The size of the different programmes differs widely, i.e. the Finish CoE vary from staff between 20 and 200 (http://www.research.fi/ huippuyk_en.html), the German CRC show a size between 7 and 28 single projects (on the average 15,6 single projects per CRC) and the NCCR show between 8 and 20 project leaders (on the average 13,5 project leader per centre). From an evaluation study in the field of competence centres, however, we know that there is a threshold if fruitful communication and cooperation is intended: centres which had more than 100 single researchers as members (and therefore a rather complex organisational structure) had serious difficulties to assure the motivation of the members.

As will be shown below, the fact that FSP contain natural science networks – with their oftentimes expensive infrastructure and equipment – is not the reason for the larger relative funds of FSP. It appears that FWF funding reflects higher transaction costs of co-operation across distances.

In international comparison, the funding p.a. for a subproject seems to be slightly smaller in Austria than, e.g. in Germany, where average grant per single project in a SFB (Sonderforschungsbereich) is 77.300 EUR p.a. (WR

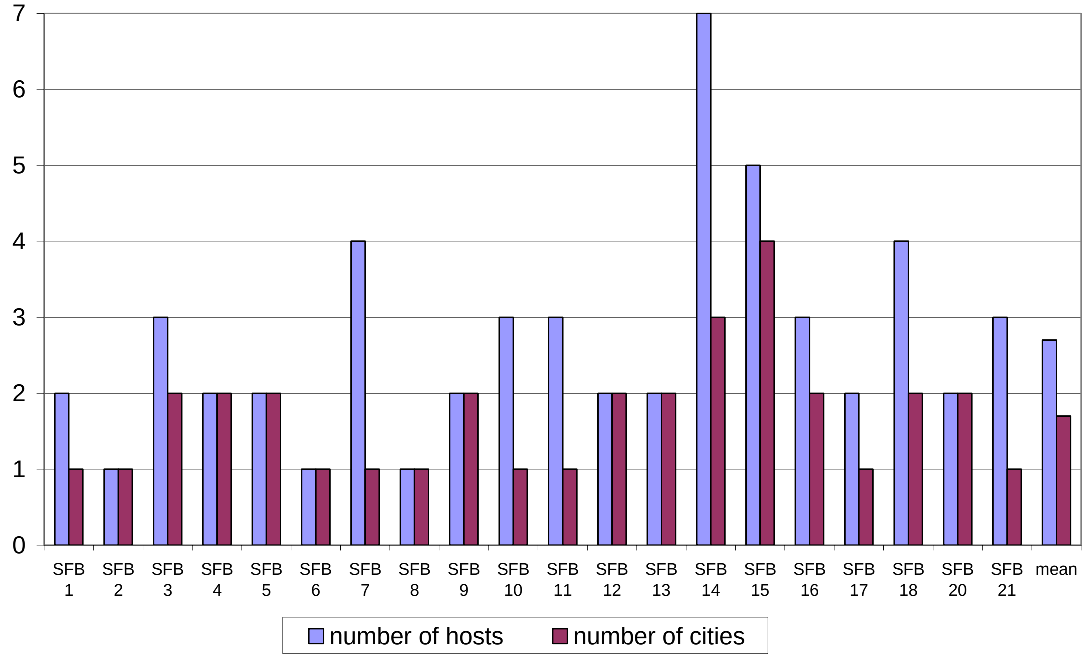
25 The average duration of a network for which funding was granted and that has been the basis for our calculations (based on funding decisions until May 2004) has been 7.3 years for the SFB and 5 years for the FSP. This is considerably lower than the maximum duration of 10 (SFB) and 7 (FSP) years as some of the networks did not run full time (for various reasons, see below) and for the latest ones only the period for which funding has already been granted is considered.

2002, p. 11), within the priority programmes (Schwerpunktprogramme) every single project received around 91.000, in research units (Forschergruppen) 109.000 EUR (WR 2002, p. 20).

Geographical and Institutional Spread

Next to the average duration, the major difference between the SFB and the FSP is the location principle. Altogether, there are 24 different organisations hosting sub-projects in the SFBs, five of which are non-universities, and – according to the reports given – two are from abroad (universities Munich and Heidelberg).[26]

Figure 5_5: Number of different host organisations and cities involved in SFB



Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Originally – and still in principle – the SFB are located in one host organisation (university) or at least in one city to provide for a concentration of critical mass. However, an analysis for the SFB based on the official lists provided by the FWF has shown that the strict single host SFB is the exception rather than the rule (Table A4_4 in Appendix 4). On average, the 12,3 sub-project per network are spread across 2,7 hosts, only three SFB are concentrated at one single university, seven SFB spread across two hosts and five across 3 host organisations, and four SFB have even four or more host orga-

26 Appendix 4 gives a location matrix of the SFB (A4_4) and the FSP (Table A4_5) networks showing the participation of all organisations and the spread of networks across locations.

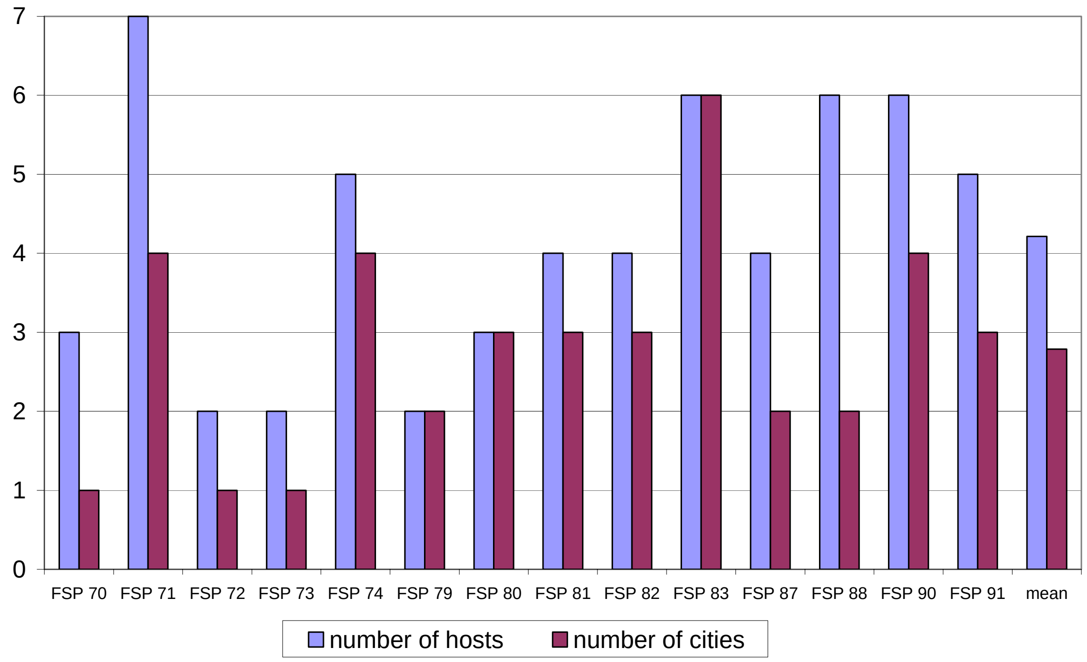
nisations involved. An analysis of sub-project locations shows that already in SFB on average 71% of all sub-projects are located at the host university of the leading institute. In other words, almost one third of all sub-projects are located at some other host organisation. Compared to the German SFB with a share of slightly above 80%, this spread is rather high. More importantly even, as this is the criteria of distinction to the FSP, is the spread across different host cities (see Figure 5_5). Only a minority of nine SFB is located in one city, 11 out of 20 SFB are spread across at least two cities, one SFB connects three cities, one SFB even four cities, the average across the SFB is 1,7 cities.

Although as regards performance the number of hosts and cities does not seem to make a big difference (see Chapter 6), for the management of the SFB in general it is clear that having different universities as host of one network means enhanced coordination problems as well as a potential reduction of university backing. While the complementarity of networks might be enhanced through pooling experts from different universities, the sense of belonging, attribution and responsibility as regards the network diminishes. From the interviews conducted and from the peer review analysis it appears that the spread of sub-projects across universities is problematic if there is not a clear concentration of sub-projects with one host which identifies its own profiling with the SFB. The alternative is to have the university leadership of all involved university make a formal commitment to the SFB and to the backing of individual sub-projects even if they play a minor role in the SFB.

By definition, the situation of the FSP is different. The major idea of FSP is to connect different locations and thus different host institutions (above institute level) that participate. There are 26 host organisations involved, 11 of which are non University. Thus, the FSP is more open to non-university institutions, to a large degree due to non university hospitals. Figure 5_6 shows the number of different hosts and different locations (meaning: cities). On average each FSP connects 4,2 different hosts and 2,7 different cities. Given the smaller size of the FSP networks (7,7 sub-projects) the formal prerequisite of being multi-location is largely met. Over time, there even seems to be a tendency for broader FSPs. The international outreach of the FSP is also rather weak, 3 out of 26 host organisations are international (Cologne, Munich, Singapore), and those only represent one single project each. The evaluation analysis of the FSP shows that international contacts in general have been rather weak in the FSP, although a positive development can has been conceded for a number of FSPs.

Unfortunately we do not have sound data on the participation of international scientists within the Austrian institutions. However, although the international connection of network participants is rated high in the peer reviews and a lot of international collaboration exists, the low number of five foreign host institutions that are reported in the reports of the 34 network to have their own subprojects can be regarded as rather low. This is confirmed by most of the interviewees who demand a stronger possibility to engage foreign institutes in their networks.

Figure 5_6: Number of different host organisations and cities involved in FSP



Regional Embeddedness

For networks to function properly and to result in regional spillovers and structural effects in their universities the regional and institutional embeddedness of networks is crucial. The original expectation in the SFB programme had been that the regions should in principle co-fund the SFB networks as added value for the region is obvious. However, the analysis of the geographical spread as well as our interviews indicate that this has not materialised as a general principle, although there are cases, in which the regional governments formally back and financially support the SFB (for example in SFBs in Graz / Styria or Innsbruck/ Tyrol). As in Austria the institutional funding of the universities is fully provided by the federal government and not the states (as, e.g. in Germany), the incentive for regional governments has been rather low, and the spill over effects to the region have not been graded that high. For FSP, which are smaller and spread more broadly, the regional embeddedness is both harder to realise, less effective – and less important.

Participation Structure

Next to the size and the institutional representation of networks, one can identify the composition of the networks in terms of the status of the participants. Table 5_6 shows again a remarkable uniformity in the pattern between FSP and SFB projects, with one significant difference. While the relative number of doctors and senior students per subproject is comparable between FSP and SFB[27], the number of subprojects in which no Professor is involved is considerable higher in the FSP, as there are 0,77 professors per subprojects in FSP compared to 0,91 in the SFB. The demand for excellence – as demonstrated by project leaders that are already professors – is apparently slightly higher in SFB than in FSP.[28] Compared with the single projects, the number of scientists with habilitations is significantly higher in FSP and SFB networks (see Appendix 6)

Table 5_6: Structure of participation in FWF networks[29]

	Prof.	Dr	Ma/Dipl*	other**	"none"***
FSP	127	373	312	27	271
FSP averages	5,93	17,14	14,71	1,50	11,71
FSP participant/subproject	0,77	2,22	1,91	0,19	1,52
SFB	224	528	439	54	641
SFB averages	11,2	26,4	21,95	2,7	32,05
SFB participant/subproject	0,91	2,14	1,78	0,22	2,60

* Magister / Diploma student, ** Mainly assistants (especially biomedicine)

*** Title not to be identified with lists given[30]

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Women in FWF networks

Gender mainstreaming is high on the agenda in Austrian science policy and administration. Table 5_7 shows that the representation of women is especially low in the natural sciences networks, while it is above 40% of all participants[31] in non natural science[32] SFBs. It can, however, not clearly be defined

[27] This is also comfirmed by the analysis of the data by the International Consortium analysing the FWF, see Appendix 6, where we find

[28] There is, however, an inconsistency in the data as for the SFB 33 % and for the FSP 24 % of the participants in the various lists no title was given, simply names. This results is confirmed by the analysis done for the FWF systems evaluation (see Appendix 6), that shows a higher participation rate of habilitated scientists in SFB as compared to FSP and a higher.

[29] For an explanation of the data sources here see footnote 13.

[30] These are participants for which only names but no title was given in the FWF lists or in the reports. See also footnote 13.

[31] This includes the sum of both the network report lists and the FWF lists provided and thus also non-scientific staff.

how big the share of women in all scientists really is. Within the research community there was almost consensus on the assessment that FWF network funding could not be a means to alleviate the problem of too few women being active in scientific activities. Thus, gender does not really play an important role in the evaluation process and in the interim reports of the networks.

Table: 5_7: Structure of participation in FWF networks

	SFB	FSP	SFB		FSP	
			natural sci.	non natural sci	natural sci.	non natural sci
share of women	32,9	27,7	25,5	40,9	25,8	31,3

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

5.2.2 Disciplinary distribution

How are the disciplines covered in the FWF network programmes?[33] First of all, there is a clear bias towards natural science networks. More than half (18 out of the 34) of the granted networks are natural science networks,[34] three networks contain a considerable part of natural science activities, combined with social science (1) and biomedicine (2) (see Table 5_8), others contain minor parts of natural science subprojects. Some kind of opportunity structure that enables co-operation seems to be of major importance for natural sciences in particular. Next to natural science, the two scientific areas that are most represented in the FWF networks are biomedicine (5) and humanities (4) while agriculture/forestry/ veterinary medicine and especially the technical sciences are only represented in one network each, and social science has only 2 networks.

The bias towards natural science is bigger in the FSP programme, in which even 11 out of 14 networks are purely (9) or partly (2) natural science networks. Natural science is the only area in which more FSP where applied for than SFB. In humanities and biomedicine the FSP are slightly more attractive, in social sciences the FSP are apparently not attractive at all.

32 For the definition of the disciplines see the next chapter below.

33 The basis for the assignment of a discipline or sub-discipline has been the scientific index of Statistic Austria. All subprojects have been assigned one or several four digit scientific categories of that index based on their title, institute and short descpriptions, the assignemt of the scientific disciplines (2 digit level) or areas (1 dgit level) for the whole network has been done as a result of a qualitative aggregation of these sub-projects, taking into account also the discipline of the co-ordinator and the leading institute.

34 This means that all or almost all the sub-projects are within the area of natural science as indicated in the science index of Statistics Austra.

The demand for networks in general, i.e. the *overall application* activities (Table 5_9), show that the bias towards natural science is indeed slightly smaller. The *acceptance rates* differ somewhat between the scientific areas, neglecting the one network in Agri/For/Vet.Med the acceptance rate is highest in natural science networks (62%). It is especially low in technical sciences (20%) and social sciences (29 %) and medium in humanities and biomedicine. In other words, the share of granted natural science networks out of all granted networks is 53 % (18 out of 34), while the share of all applied networks is 45 % (29 out of 65).

Table 5_8: Scientific distribution of SFB and FSP networks: level of scientific areas

Discipline	total			SFB			FSP		
	all	granted	*rejected*	all	granted	rejected	all	granted	rejected.
Humanities	**10**	**4**	6	**6**	**3**	3	**4**	**1**	3
Biomedicine	**10**	**5**	5	**7**	**4**	3	**3**	**1**	2
Agric., For., Vet. Med.*	**1**	**1**		**1**	**1**				
Natural Sciences	**29**	**18**	11	**14**	**9**	5	**15**	**9**	6
Social Sci.	**7**	**2**	5	**6**	**2**	4	**1**		1
Technical Sci.	**5**	**1**	4	**2**		2	**3**	**1**	2
Nat. Sci. *and* Biomedicine	**2**	**2**		**1**	**1**		**1**	**1**	
Nat. Sci. *and* Social Sci..	**1**	**1**					**1**	**1**	
Sum	**65**	**34**	31	**37**	**20**	17	**28**	**14**	14

* Agriculture, Forestry and Veterinary Medicine;
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Table 5_9: Acceptance rate of SFB and FSP: level of scientific areas*

Discipline	all	SFB	FSP
Humanities	40 %	50 %	25 %
Biomedicine	50 %	57 %	33 %
Agriculture, Forestry, Veterinary Medicine	100 %	100 %	
Natural Sciences	62 %	64 %	60 %
Social Sciences	29 %	33 %	0 %
Technical Sciences	20 %	0 %	33 %

* The networks with a clear inter-disciplinary approach on the level of areas (3 networks, see table above) are excluded here.
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

As regards the bias towards natural sciences, two preliminary observations from these evaluations contribute to an explanation here: First, the nature of co-operation seems to be different, as in natural science the results tend to be complementary in the sense that a result of one subproject needed as input for another one. In other sciences, e.g. in humanities, very often the exchange of results is used for inter-disciplinary discourse that might lead to focused interpretations, to new common insights or – in the long run – to new paradigms or even sub-disciplines. However, there is in many cases no immediate need for the input of other subprojects in order to advance with one's own disciplinary research. Thus, the extra effort to co-operate, especially across distances, does apparently not pay off that much. This is especially true for social sciences that have shown such a limited interest in FSP so far. A second explanation for the natural science bias could be that there is ample room for economies of scale in sharing expensive equipment and infrastructure.

Table 5_10: Structural and funding data for the networks, differentiated for natural science and non natural science

	SFB		FSP	
	natural sci.	**non natural sci**	**natural sci.**	**non natural sci**
number of networks	9	11	9	5
Subprojects / network	13,22	11,64	8,11	7,00
Participants / subproject	8,98	7,72	6,62	6,94
Budget granted total since 1994	52.893.903,48	52.954.605,31	21.114.988,19	11.149.427,85
Budget grant / network	5.877.100,39	4.814.055,03	2.346.109,80	2.229.885,57
Budget grant / subproject	444.486,58	413.707,85	289.246,41	318.555,08
Budget grant / subproject / granted year[35]	54.339,87	61.262,33	64.502,70	65.587,96
Budget grant / granted year / participant[36]	6.049	7.937	9.749	9.447

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

However, how different are natural science networks? Is the bias towards natural science networks also reflected in different funding and participation patterns? The following table differentiates the data given above between natural science networks and non natural science networks. If the economies

35 For this indicator we took into account the years for which the grants given were allocated to each individual network (granted years). For all output related data we have taken as basis the years that were covered by the reports (reported years).

36 See footnote above. In addition, this indicator includes all participants that are mentioned and thus somehow both in the report lists and the FWF lists, including non-scientists, no matter how strong their involvement actually is.

of scale argument concerning expensive equipment were true, the expectation would be that the funding per network would be higher than in other areas.

Natural science networks have on average more subprojects, and the greater size leads to higher budgets per network. However, natural science networks do not spend more money per subproject or participant, to the contrary, for the SFB the ratio budget per participant is smaller in natural science. Thus, natural science networks provide for larger cooperation structures, and in those cases in which large infrastructure is provided this infrastructure is shared by many participants and subprojects.

5.2.3 Interdisciplinarity of the networks

A major requirement of the funding of scientific networks since the early 1990s – not only in Austria – has been interdisciplinarity. On the level of major scientific categories (1 digit level) both types of FWF networks are not particularly inter-disciplinary, i.e. only three out of 34 network contain a critical mass of subprojects from two different major categories and define themselves as representing two major disciplines. As seen above, all of those contain natural scientists. However, the picture changes of course when differentiating disciplines further. To differentiate, we follow the categorisation of Statistics Austria and distinguish between 1-digit *areas* (major disciplines as depicted in Table 5_2), 2 digit *disciplines* and 4 digit *sub-disciplines*. 2 digit disciplines are those commonly used to group sciences. For example the 1 digit area natural science (category 1) is differentiated into the 2 digit disciplines mathematics/ informatics (11), physics/mechanics/ astronomy (12), chemistry (13), biology/ botany/ zoology (14), geology/ mineralogy (15), meteorology (16), hydrology/ hydrography (17) geography (18) and finally "other natural sciences" (19). The 4 digit disciplines are all *sub-disciplines* of, e.g. mathematics (11) such as ADV, EDV (1101), algebra (1102), analysis (1103) etc.. For each of the subprojects of all networks we have tried to attribute the discipline or disciplines on a 4 digit level they represent.[37]

On that basis we can define for each network:

- the number of projects
- the names and numbers of different 2 digit disciplines and 4 digit sub-disciplines
- an index of interdisciplinarity scope (IIS) , both for the 2 digit and the 4 digit level. This is a quantitative indicator of interdisciplinarity defined as

[37] In some cases this was explicitely given in the various sources, in some cases weh ad to attribute.

the number of different 2 (4) digit disciplines divided by the number of subprojects, thus taking into account the size of networks. The higher this measure, the broader the disciplinary scope of a network (without taking account of the relative weight of individual disciplines within the SFB).

- an indicator of concentration of disciplines (the gini-coefficient). This takes into account "quality" of interdisciplinarity, i.e. the relative weight of individual disciplines within a network. Ranging from 0 to 1, the higher the gini-coefficient, the higher the concentration (the weight of the individual disciplines). A gini coefficient of 0 would mean that all sub-disciplines are mentioned equally often across the network, a gini-coefficient of 1 would mean that the network consists of only one discipline.[38]

Table 5_11 compares the mean values of all networks and differentiates both between SFB and of FSP networks and between natural science and non natural science networks.[39] The following observations can be derived:

- Across the board, there is a considerable level of interdisciplinarity – albeit there is no comparable data for other network programmes available. Across all networks the ratio between number of different disciplines (2 digit level) to the number of projects is 4:10 (IIS2=0,4). On the level of 4 digit disciplines the ratio is almost 10:10 (IIS4=0,97), meaning that on average in 10 subproject there are 10 different sub-disciplines represented.
- There is a marked difference between natural science networks and non natural science networks. As seen above, natural science networks are, on average, slightly bigger than non natural science networks. At the same time, they are clearly less interdisciplinary on the 2 digit level (the IIS 2 is 0,32 compared to 0,48 for the non natural science networks). This means the co-operation between, e.g. chemistry and physics, is less common in the SFB than the cooperation between different disciplines within the humanities or the social sciences. However, at the level of sub-disciplines (4 digit) the difference is much smaller. Apparently, natural scientists are less likely to engage in co-operation with scientists of other natural science areas, but within one discipline (such as physics or chemistry) they are almost as likely as scientists from other areas to co-operate with partners from neighbouring sub-disciplines.

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38 For methodological reasons the gini-coefficient could only be calculated for the 4 digit level, as the number of different disciplines in the network is too low at the 2 digit level.

39 The Figures A4_1 to A4_6 in Appendix 4 show these indicators of interdisciplinarity IIS, gini-coefficient and a composite indicator for all SFB and FSP networks. This composite indicator has been used to calculate relations between output data and interdisciplinarity (below).

- There is a high variance within the SFB programme between the single SFB networks and within the FSP programme between the FSP regarding interdisciplinarity (see Appendix 4, Figures A4_1 to A4_6). Across the board, the FSP networks have a broader scope (IIS 2 and 4) of interdisciplinarity than the SFB networks, i.e. in the FSP networks the number of sub-disciplines represented is, in relation to the size of the networks, higher than in the SFB networks.
- Thus, by far the highest scope of interdisciplinarity can be found in non natural science FSP networks. Apparently, cross-distance networking is no obstacle for demanding co-operation, to the contrary, the FSP scheme seems to allow for or even encourage daring cooperation constellations in natural sciences. This also means that institutes that are multi-disciplinary by nature are more inclined to engage in long-distance cooperations.
- The concentration of interdisciplinary work (measured by the gini coefficient) does not differ much between the various groups of networks considered, both as regards the mean and the variation. However, there is one marked exception confirming the greater interdisciplinarity of FSP networks: the SFB networks in the natural sciences are more concentrated, they seem to focus more on one or two major sub-disciplines (gini 0,4) while the sub-disciplines are more equally weighed within the FSP natural science networks.
- There is no systematic relation between the scope of inter-disciplinarity and the number of hosts or the geographical spread of networks.[40]

In addition, the individual networks have been characterised as for their interdisciplinarity. The Tables A4_5 and A4_6 in Appendix 4 depict the interdisciplinarity values for the individual SFB and FSP. The following paragraph is simply to demonstrate the variety of interdisciplinarity that is funded by the FWF programmes. It is obvious that the SFB differ considerably as regards interdisciplinarity. The variety at the level of 2 digit disciplines ranges from 7 different disciplines (SFB 18) down to only 1 (SFB 15) 2 digit discipline. For the sake of illustration two somewhat extreme SFB can be looked at. SFB 15 is a rare example of a network that brings together many different subprojects (16) within only one 2 digit discipline (physics/ mechanics/ astronomy). Even within this discipline, the range of sub-disciplines is modest, as there are only 7 different 4 digit disciplines represented in this network of 15 subproject. SFB 15, thus, has the lowest scope of interdisciplinary of all networks. In addition to the low variety of sub-disciplines, SFB 15 is – in comparative terms – also rather concentrated (gini 0,44 against an average of 0,35 in all SFB), meaning that a few sub-disciplines have a rather strong weight in the network.

[40] As a result of a correlation analysis.

Table 5_11: Interdisciplinary scope of SFB and FSP networks – averages

	No. of sub-projects	No. of different 2 digit discipl.	IIS 2*	No of different 4 digit discipl.	IIS 4*	gini***	density[41]
all networks							
all	10,41	3,82	0,40	9,53	0,97	0,33	0,28**
SFB	12,3	4,35	0,37	10,7	0,90	0,35	0,33**
FSP	7,71	3,07	0,44	7,86	1,07	0,30	0,21**
natural sciences							
all	10,67	3,11	0,32	9,22	0,91	0,34	0,29**
SFB.	13,22	3,44	0,27	10,67	0,83	0,40	0,29**
FSP	8,11	2,78	0,37	7,78	0,99	0,29	0,30**
non natural sciences							
all	10,13	4,63	0,48	9,88	1,04	0,32	0,26**
SFB.	11,55	5,09	0,45	10,73	0,97	0,31	0,36**
FSP	7,00	3,60	0,55	8,00	1,21	0,34	0,14**

* IIS = Index of interdisciplinary scope, calculated as number of different discipline (at 2 digit or 4 digit level) represented by the subprojects of the network divided by number of subprojects.

** Mean out of those for which data is available.

*** Gini coefficient, concentration measure, the higher gini, the more concentrated the distribution of sub-discilines is. Gini has been defined on the level of 4 digits only.

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

In contrast, SFB 8 had the broadest scope (highest IIS2 and IIS 4), with its 12 subprojects it combines 7 different 2 digit disciplines and 16 different 4 digit disciplines. At the same time, this SFB had a low concentration (gini of 0.28), this means that despite the large number of sub-disciplines we do not see a dominance of 1 or 2 leading sub-disciplines with a series of peripheral ones, but rather a set of sub-disciplines with a considerable weight. The pre-conditions for coherence and cooperation within such a broad network appear enormous. This might be one explanation for the problems this SFB faced as it was terminated after an interim evaluation. Similarly, SFB 10 and SFB 12, both terminated (12) or stopped by the responsible scientists (10), have a very low gini coefficient (0.13 and 0.10) in combination with a broad range of disciplines (high IIS). Thus, there are clear indication that over-ambition as regards inter-disciplinarity – i.e. a combination of broad scope and distributed relative weight – put a high burden on the effectiveness and functioning of networks.

As regards the FSP the variety of interdisciplinarity across the different networks is even bigger. At the two digit level, the scope ranges from 7 disciplines (FSP 71) to only 1 (FSP 82 and 83). FSP 82 (Dynamic Genome , U.

41 The concept of density will be explained and discussed below. It describes the intensity of relations within a network as the share of all existing bilateral cooperations out of all possible cooperations in a network.

Vienna) is an example for an extremely focused FSP, with only four different sub-disciplines within 8 sub-projects, and at the same time a concentration of sub-disciplines is – compared to other networks. On the other extreme, FSP 70 (Digital Image Processing, TU Vienna) combines 5 different disciplines and 10 sub-disciplines with only five sub-projects, and the concentration is remarkably low. Similarly, FSP 74 (Genetic Modification of Cells and Animals for Investigation and Treatment of Diseases, U. Graz) has both a large variety of sub-disciplines the relative weight of which is rather equally distributed (low gini).

Is there any significant relation between size of a project on the one hand and interdisciplinarity? First of all, it is straightforward that there is a positive correlation between the number of subprojects and the number of different 4 digit and 2 digit disciplines represented. However, the relative variety as defined with the IIS decreases with the size of projects. This means, in relative terms small projects are more interdisciplinary than big ones. Thus, regarding interdisciplinarity there is a trade of between the absolute number of disciplines (increasing with the number of subprojects) and the variety within the whole network (declining with the number of subprojects). In other words, as for interdisciplinarity big is not necessarily beautiful, it might be more effective to have two small scale networks than one large one.

Moreover, there is no systematic relation between the scope of sub-disciplines within a network and the concentration of the sub-disciplines. This means that to increase the variety of sub-disciplines within a given network does not systematically mean less concentration of sub-disciplines

The attitudes of network participants towards inter-disciplinarity is somewhat mixed, but matches the quantitative analysis and is also in line with the characteristics of the three networks that have been terminated (see above). For most participants inter-disciplinarity means an opening up of their own discipline to neighbouring sub-disciplines within the same scientific area 81 digit) and even discipline (2 digit). Too broad interdisciplinarity is regarded as a problem of mutual understanding imposing high transaction cost of cooperation. If a broader inter-disciplinarity is regarded as sensible the participants of the network programmes suggest to have one clear lead discipline or sub-discipline and in order to make the cooperation function and to avoid too many sub-disciplines with the same weight in a network.

For the design and management of the FWF network programmes follows that interdisciplinarity means different things in different disciplines. The bottom up approach taken by the FWF that leaves the level of interdisciplinarity largely to the networks themselves and does not insist on a particularly broad definition of interdisciplinarity appears to be adequate. However, more does not mean better, as we have seen that those networks that have been stopped (SFB) are those that combine a high variety in with a low concentration (similar weight of several sub-disciplines).

5.3 Cooperation Analysis

The added value of networks derives from pooling resources and internal cooperation. In fact, internal coherence and cooperation is one of the major criteria for funding and is checked regularly by the peer reviews. This chapter analyses the intensity of cooperation within networks and asks for the relation between the intensity of internal cooperation and other variables such as size, inter-disciplinarity and geographical spread of networks. Chapter 6 will relate intensity of cooperation to the performance of the networks.

Method Applied

As discussed in the survey of literature, collaboration activities between researchers acting within networks can be subject to various forms of sociometric techniques including social network analysis. Social network analysis, or network analysis as it is normally referred to, offers mathematical tools of varying degrees of sophistication that make possible the assessment of levels of interaction between so-called "nodes" (in our case sub-projects) within a defined group. As noted in the literature, their application can be to individual elements of the network or to the entire network itself.

The use of network analysis methods in this study is simple in scope and has been carried out to assess the extent to which interaction takes place at the level of the individual sub-projects within a network, and the relationship between interaction and the size, geographical spread and interdisciplinarity as well as project quality (Chapter 6), of networks. The focus therefore is upon projects considered as the network with individual sub-projects considered as nodes of the network.

For each project the bi-lateral cooperations between the sub-projects given in the reports were systematically transferred into a so-call incident matrix and the network densities of each project were then calculated. This *network (or co-operation) density* indicates the share of bi-lateral co-operations out of all possible bi-lateral co-operations, and thus it is an indicator for the intensity of cooperation.[42] For example, a network of 10 projects could, in theory, have a

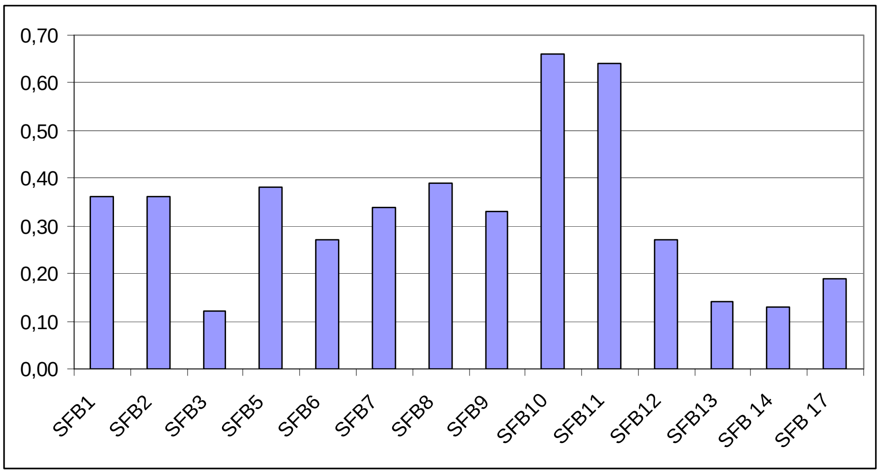
[42] As a basis, this approach treats each bi-lateral cooperation reported equally.

maximum of 36 bi-lateral co-operations[43], and if the subprojects indicate 18 the share is 50%. In addition to the network analysis qualitative judgements and interview results fed into this analysis.

Intensity of Cooperation (Network Density)

Across all SFB where sufficient data is available (N=14), the reported co-operation density – i.e. the share of reported bilateral cooperation out of all possible cooperations – is 33%. Figure 5_7 depicts the cooperation density of the SFB networks, showing that two SFBs (10 and 11) indicate an exceptionally high cooperation intensity, while out of those for which data was given in the reports three SFB (3, 14, 3) indicate values below 15%. A clear pattern over time (starting date of SFB) cannot be seen, however, it appears that until SFB 11 the intensity has risen only to decline again for the later SFB again.

Figure 5_7: Network density of SFB



Source: Calculations ISI – PREST 2004, based on project reports[44]

The cooperation density of FSP networks is significantly lower across the board. On average the cooperation density is 25% for the 12 FSP for which data is available (compared to 33% for the SFB). This confirms the intuition that cooperation across distances is less likely and more costly.

However, there are three FSP that indicate intensity of and above 50% (FSP 70, FSP 81, FSP 90). This high level of interaction in FSP demonstrates that

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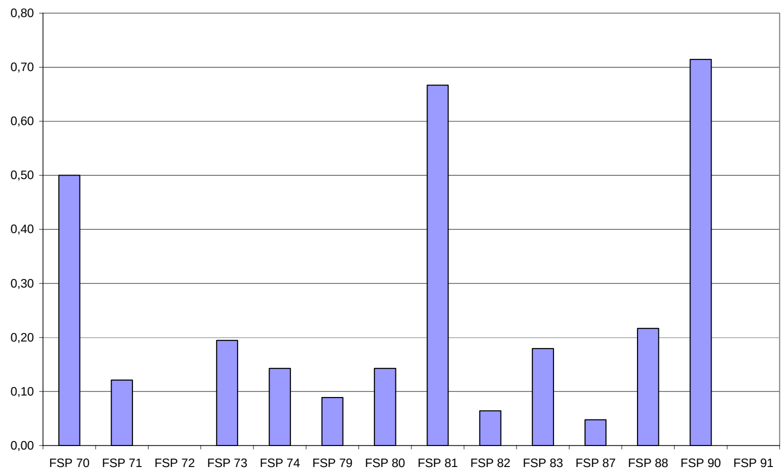
43 Project 1 as a management project is not counted. Thus 9 projects remain. Project 1 could have a maximum of 8 co-operations, project 2 7 co-operations (as the cooperation with project 2 is already indicated by project 2), project 4 6 co-operations and so on. The sum of all possible bi-lateral co-operations would be 36.

44 Where no number is given the network did not report internal cooperations within its sub-project reports.

geographical distance is no principle obstacle to extensive cooperation. Unfortunately, the low number of FSP for which cooperation data exists does not allow for a statistical correlation analysis to see if there is a relation between cooperation activities and number of different host organisations or cities involved. However, it can be seen that cooperation density is not linked to the number of hosts or cities. For example, FSP 70 has a high level of cooperation across six different hosts, while there are other FSP with markedly lower internal cooperation activity albeit connecting only two or three different hosts. Similarly, FSP 90 is a network connecting four different cities and still the cooperation activity is extremely high. On the other hand, while the level of cooperation is much lower with FSP representing only one or two cities.

Figure 5_8: Network density of FSP



Source: Calculations ISI-PREST 2004, based on project reports45

As we have seen above, the nature of natural science networks differs in many respects from networks in other scientific areas. This is also true for the level of interaction within SFB and FSP, albeit with different consequences. Our data on the basis of a self-description in the regular reports to the FWF suggests that the intensity of interaction within the natural science *SFB* is considerably lower than for networks from other scientific areas (see Table 5_5 above). However, all three FSP with a very high reported cooperation activity are in the natural science (especially mathematics, physics)

The *qualitative judgement* of the *peer reviews* for the FSP suggests that internal coherence has increased for the majority of networks. There were no signs of "alibi"-cooperation to be presented in interim reports in order to impress the

[45] Where no number is given the network did not report internal cooperations within ist sub-project reports-

peers, although there are cases that are criticised not to fulfil their cooperation potential. For many FSPs and SFB alike this cooperation intensity over time development has not started from scratch, but a number of networks could build upon an existing nucleus of co-operation between network members. For the SFBs, one of the major problems of those cases which failed or had severe problems has been lack of coherence and internal cooperation. Pre-existing co-operation thus certainly helps the success of a network – but at the same time a strong requirement to show pre-existing cooperation for an application would certainly limit the possibility to create new combinations through network funding. The peer review suggests that a reporting of cooperation should be broader, more systematic and mandatory in the reports.

The peer review analysis and many interviews also suggest that intensity and scope of interaction is biggest in cases where there is a sound relation between a clear leadership and a spread of responsibility and commitment across the network. While the latter is a matter of network identity as a whole and as such obvious, the former seems to be a requirement often underestimated but stressed several times in the peer reviews. The importance of nuclei in cooperative structures has also been found in previous studies.[46]

The Relation of Density and Size, Geographical Spread and Interdisciplinarity
What is the relation between size and the density of the FWF funded networks? This analysis took the form of a bivariate correlation of the number of sub-projects (nodes) with the measure of collaboration to test if larger networks had lower levels of collaboration. The answer is straightforward. There is a statistically significant negative correlation between the extent of collaboration and the size of the network (see Table 5_12). When the network is larger, there is a tendency for the level of interaction within the network as a whole to be lower.

The reason for this seems clear: the number of cooperation partners must be easily comprehensible in order to make co-operation work. This might slightly differ with disciplines, but the basic finding is true across all disciplines. As with the scope of interdisciplinarity, big is not beautiful again. And for FSP it seems that it is not the variety of hosts and locations, but the size of the networks that influences the level of internal networking and cooperation.

[46] See, for example, Balthasar et. al. 1997 who have also shown this for networks in EU programmes.

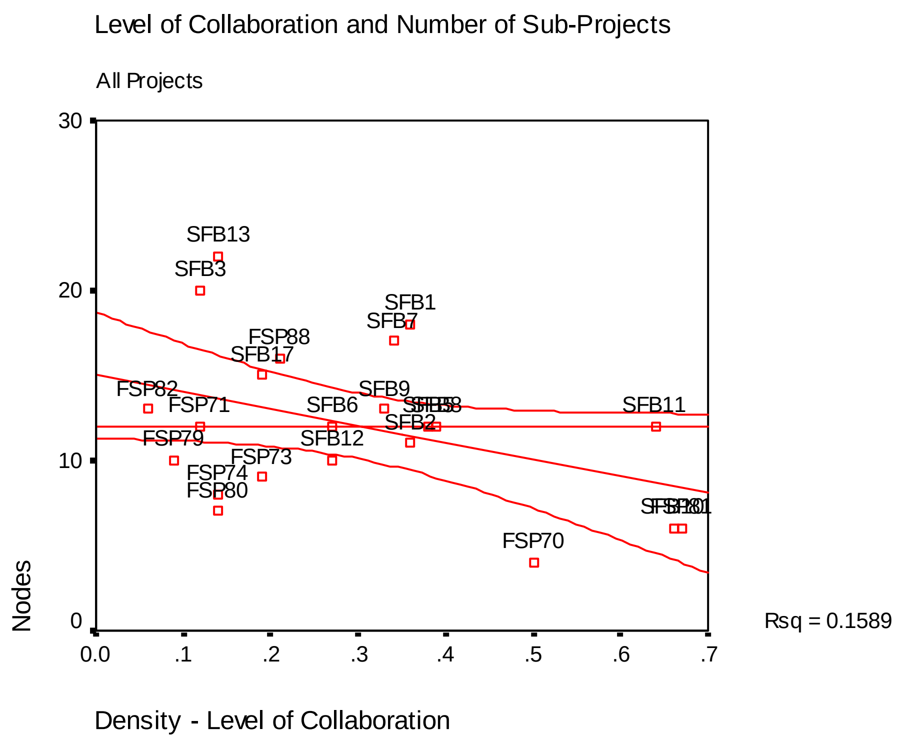
Table 5_12: Network size and the extent of collaboration

		Density	Nodes**
Density	Pearson Correlation	1	-.399(*)
	Sig. (1-tailed)	.	.033
	N	22	22
Nodes**	Pearson Correlation	-.399(*)	1
	Sig. (1-tailed)	.033	.
	N	22	22

*Correlation is significant at the 0.05 level (1-tailed); **nodes = subprojects
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

The graph shown below displays the relationship; however, it should be noted that this relationship is not especially strong with an R^2 value of only 0.16.

Figure 5_9: Level of collaboration and number of sub-projects



Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Does the *geographical spread* of networks make a difference as regards cooperation intensity, as transaction costs rise with the number of hosts and cities involved? A statistical analysis shows that it does make a difference for the SFB, not for the FSP. The larger the *geographical* spread of SFB networks, the lower the network density. The same is not true for the number of host organisations. This means that for the very large and very ambitious SFB geographical spread leads to a loss of co-operation and networking.

This finding is confirmed by comments of various peer reviews and interviews. Although there are cases of excellent performance of SFB with multi-location and even different cities, it appears that in order to organise close cooperation, the number of locations that are represented in a SFB via its sub-project should not exceed a certain limit. In addition, from all the interviews and from the peer reviews it is obvious that good cooperation has to do with a good management provided by a strong leadership within the network.

Finally, what is the relation between *interdisciplinarity* and the cooperation intensity (network density) within the networks funded by FWF? There are three competing hypotheses:

(1) the more disciplinary variety, the higher the level of interaction as the pooling of different disciplines in a network obviously follows an impulse to do something together that could not be done without this network;
(2) the closer the subprojects, the lower the transaction costs of co-operation and the higher the level of interaction
(3) there is no correlation between interdisciplinarity and density, meaning that for the level of interaction it does not make a difference if sub-projects are from different disciplines.

The answer from the statistical analysis is clearly hypothesis 3: there is neither a positive nor a negative correlation between interdisciplinarity and network density, i.e. interdisciplinarity does not induce more cooperation nor does it hinder cooperation within networks.

6. Performance of the Networks

Summary: The Main Findings

The analysis of the performance in the FWF network programmes resulted in the following main findings:

- There is a general consensus among all experts in Austria that the networks in general produce good scientific results and have an important networking and collaboration function in Austria. This assessment is – by and large – confirmed by the peer review analysis of all networks.
- The major benefit of the networks lies in
  - their longer term perspective (both as for research content and research staff),
  - the establishment of new interfaces and scientific cooperation,
  - cooperation and management learning,
  - profiling of the host universities (for the SFB) and
  - internal and external quality control
- The visibility of the networks in Austria can be considered as rather moderate beyond the inner circles of the disciplines involved.
- On the basis of various bibliometric and survey based calculations it appears that the quality of the sub-projects within networks is higher than the quality of the average single FWF projects. This is not only a selection bias effect, as also the improvements between 1996 and 2001 have been stronger within the networks than outside.
- Between the two schemes, there are mixed signals as regards the quality and quantity of output. The FSP can certainly not be regarded as second best compared to the SFB.
- SFB and FSP participants publishing scientific papers in general work only part-time within the networks. This is especially true for medical sciences. However, the quality of the work produced within the networks is higher than outside.
- The quantity of international collaboration of FWF authors who have been supported by networks has risen significantly over the period of the analysis. Between 1996 and 2001, the number of papers with only Austrian addresses on the papers has fallen from 57% of papers to 45% of papers. In terms of the collaboration with European co-authors in the period
- A high level of cooperation within the networks is likely to produce good results. The network show a rather strong internal quality control and peer review, as the more interaction there is in the networks, the more likely the results are near the average of all networks. However, against the background that the average of network performance is already above the

average of Austrian scientists, the networks that perform significantly above or below this network average show somewhat lower level of cooperation.

- The level of interdisciplinarity and the level of cooperation in networks have no statistically significant effect on the quality of the output (albeit there are indications that both have a slight positive effect). There is, however, a positive relation between geographical spread of the networks and quality, geographical distance of network does not hamper excellence.
- A higher level of interdisciplinarity and a higher level of internal cooperation spur the quantity of the scientific output.[47]
- In many networks there are too little explicit provisions for network integration and co-operations to be found that hinder the full exploitation of the cooperation effects. Especially the effective build-up of interdisciplinarity in networks needs strong provision for international cooperation.
- Training is rated as high priority of participants and university leaders alike and for those who participate, conditions and scope of learning effects seem to be better than in single projects. However, training is not considered systematically enough in network programmes and thus only poorly reflected in the reporting of the networks.

6.1 The data source and methodology

This chapter gives account of the benefit and performance of the FWF funded networks and related output to certain characteristics of the networks. Benefit and performance of the networks can be measured along the dimensions outlined in Chapter 3 of this report, i.e. effects on *input* (more money spent) *output* (money spend leads to better or more output), and *behavioural and structural effects* (mainly to learn how to cooperate and manage cooperation projects, interdisciplinary opening, profiling of universities).[48]

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[47] As the output could not be measured as for its interdisciplinary content, higher output rates could also indicate competition between sub-projects from different sub-disciplines rather than integration.

[48] So-called Input Additionality (an increase of own spending triggered by the public funds received) is structurally not to be expected as the funds of the universities are limited and no private companies are involved. A shift in resources from other areas towards the areas of the networks could be considered as input additionality forom the perspective of the participants and their disciplines, not, however, from the perspectrive of the whole university. The only case where networks show input additionality is when they are able to attract further money to the university from other sources. This happens, but as additional funds are not easy to get in basic science (as compared to the applied sciences and the European Framework Programme) the scope for this is limited.

To ascertain effects of increased and improved output as well as of changed behaviour of scientists, this chapter draws again on various sources, such as the interviews, the peer review analysis and the documentary analysis. We are aware that an assessment of the performance of the basic science networks funded by the FWF is challenging. First of all, it is generally not straightforward to assess results and effectiveness of basic science. Most commonly used are *publications* as output of scientific work and the analysis of the relative value of these publications through detecting output that has been judged by external reviewers (referred articles) and an analysis of the citation of the output as a measure of relevance and excellence. Such a bibliometric analysis is provided here in Chapter 6.3 and 6.5. There methodological introductions are given. However, we have, in addition, used *quantitative data* derived from the *primary documents* of the networks and, above all, *qualitative data* from interviews.

As regards the document data, we counted and differentiated all output data that was documented in the interim (and where available final) reports. In many cases this was given in explicit lists that could be counted and categorised. The quality of the data is of course dependent on the quality of these reports, but as the interim and final reports should be documents convincing the external peers of the quality and quantity of the work, most networks have put considerable effort in this reporting. As with most data source used in evaluations, the coherence, uniformity and the completeness of the data is not ideal. However, across the board of 34 networks these inconsistencies level out to a large degree. Only those networks were included in the analysis that did report about all relevant variables needed of a specific calculation. Finally, we inserted all qualitative input that gave an indication about the added performance value of the funded networks. Unfortunately, there is no comparative data other than that we have produced ourselves, i.e. between types of networks and between sciences, thus an assessment of the relative productivity vis-à-vis other funding schemes cannot be provided.

6.2 *Overall qualitative assessments of performance and benefit of the networks*

Before presenting the detailed analysis of various performance dimensions and how they relate to other network characteristics, a very general assessment on the overall benefit and performance of the networks on the basis of the peer review analysis and the expert interviews (non-participants) shall be given. There is a general consensus that overall the performance of the networks funded by the FWF is good to excellent– both for the FSP and the SFB.

One yardstick are the ratings given by the peers in the interim evaluations. In the interim and final evaluations almost all networks have performed very well, in the terminology of the assessment even "excellent" (above 80% in the rating system). There are a couple of extremely good performances, where almost for all criteria the rating is 100% or near to 100% was given for the whole network. There are a few cases of failure, in which the whole network was criticised as low performing, two SFB and one FSP have been stopped for various reasons, among them quality, coherence and commitment. One SFB has not applied for the last funding period as it struggled with internal problems of coherence and commitment and did not feel ready to comply to all requests done by the reviewers that had given this SFB a chance to continue.

We have conducted a cross-cutting analysis for those 20 interim peer reviews that rated the SFB networks with percentage rating.[49] The mean value for the 10 different evaluation criteria[50] was 88,3 %, with the three highest rated criteria topicality (91,7%), international contacts (90%) and scientific quality of the team and slightly lower ratings for working plan (85%), internal coherence (86,6) and innovative approaches (86,8%). There are only two SFB where we find values below the threshold to excellence in any of the criteria[51] .The minutes of the interim evaluation confirm this overall good assessment.

It comes as no surprise that participants of networks praise this scheme as enhancing the possibilities of doing cooperative research on a *long term* secure basis that enhances not only the individual standing but also the opening up of disciplinary borders and – for the SFB – the *profiling* of the host universities. Unanimously the participants stress the importance of real cooperation and cooperation learning that, ideally, can be extended beyond the funding period of the networks. One further indication for this is the fact that next to existing networks and after the funding of networks has finished further cooperation structures are sought and established, both nationally (e.g. in form of Kplus centres, re-grouping or application of FSP teams in the SFB scheme, see Chapter 8.2) and in a few cases also internationally.

Moreover, the network funding allows for projects that are not only long term but large scale. For scientists able to participate in a SFB means to increase the

[49] For the FSP this was not possible as only 5 interim reviews used such a percentage rating.

[50] These evaluation criteria are scientific progress/quality of results (only interim), publication activity (only interim), topicality, innovative theoretical methodological approaches, scientific potential of the research team, competitiveness, internal coherence, working plan, international contacts.

[51] One of the two SFB that have been stopped is not included in this analysis, it can be assumed that this SFB has shown poor ratings, too.

weight of his or her discipline in the university and – ideally – to set in motion a virtuous circle of increased visibility, attractiveness and future funding, including international cooperation schemes. The interviews indicate that the attraction of international funding as complementary budgets, more important in theb FSP programme than in the SFB programme which contributes much more to profiling of host universities. Within the networks the participants regards all provisions that enable or enforce cooperation as fruitful to their work. Especially, the in-built quality control is a major argument, both as regards the external review process and as regards the social control within the networks. Some interviewees even argue that all groups that are internationally successful and recognised have been funded by the network programmes.

Similarly, the interviews with experts outside the networks – and even with rejected applicants and participants of SFB that have not been funded until the end of the 10 years period, support this overall good judgement. Especially those that could not finalise their SFB have, to be sure, some criticism as regards the implementation, such as allowing for too broad geographical spread or interdisciplinarity; however, in principle they fully acknowledge the virtue of this scheme

One overall benefit of the network is supposed to be visibility in Austria. However, from the FSP peer review no judgment on visibility in Austria is possible; it plays no role in the peer review for this type of network. If something is said it is rather negative, the peers judge visibility efforts as rather unsatisfactory. As the FSP represent basic science (and not applied science better to be presented to a wider audience) which is spread across various hosts, this is not surprising. Still, there seems to be ample room for improvement to demonstrate the identity and benefit of FSP to a wider audience.

In the SFB peer review this is slightly different as there are some cases in which it is clearly stated that the funded structure is a real beacon (Leuchtturm), often with international outreach. However, the overall visibility of the SFBs, e.g. as stronghold of the universities vis-à-vis the environment of the university is rather low – as, for example, demonstrated in the weak representation of the networks in the university homepages(see Chapter 5.2b).

Judged by the visiting scientists per year to each of the networks, the SFB networks seem to be slightly more attractive, as they attract 6 international researchers per year as compared to 3,5 in the average FSP.[52] Although we have no clear proof, it seems that a network with a clear focal university producing itself as a concentrated power house in a certain scientific field is more attractive than an excellent but dispersed network. While the bundling of resources nation-wide is not counter-productive to the productivity of network, it is certainly not a major means to attract foreign scientists.

A major aspect of international visibility is the international peer review process itself, as many interviewees have stressed that the peers have been an important transmission belt to scientific communities outside Austria.

6.3 *Scientific output of the networks*

6.3.1 Analysis based on reported data

The quantitative analysis of performance is based on output counts. As we do not have comprehensive data for all networks, absolute numbers would be misleading. To make meaningful statements about the output of the funded network, the output intensity was ascertained by calculating the absolute number *per reported period* (years covered by the reports of the networks) and *per network, subproject or participants*. Although we concede that comparison of scientific productivity is always a very sensitive matter, these intensities enable some comparison at least between the two programmes. Moreover, as with the structure of the networks in Chapter 4 we again differentiate between natural science and non natural science networks. A further breakdown as regards disciplines is not sensible on the basis of the data at hand.

Table 6_1: Output of SFB and FSP per *network* and year

	SFB		FSP	
	n*		n*	
refereed articles	10	33,47	7	22,37
books	10	5,59	8	2,53
written publ.**	14	37,07	12	52,76

* number of networks for which data was available in reports
** including all written output no matter if a refereed journal, other journal or book.
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

52 For this category no clear definition can be given as the reports apparently counted all kinds of visits as visiting scientists, be it for a lecture or a research stay. However, no systematic difference between the reporting of the FSP and the SFB was shown.

On average, the FSP are somewhat more productive than the SFBs. Although the absolute numbers are higher with the SFB networks (Table 6_1), the output intensities for the FSP are higher as regards both the yearly output per subprojects (Table 6_2) and per participant (including non-scientific participants, Table 6_3).

Table 6_2: Refereed articles per *subproject* per year

	SFB				FSP			
	n*	all	nat sci	non nat sci	n*	all	nat sci	no nat sci
refereed articles	10	2,88	2,78	3,05	7	2,94	3,22	1,23

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Table 6_3: Output per *participant* per year

	SFB				FSP			
	n*	all	nat sci	non nat sci	n*	all	nat sci	non nat sci
written publication	14	0,38	0,39	0,36	9	0,51	0,55	0,45
referred journals	10	0,28	0,29	0,27	7	0,38	0,47	0,09
books	11	0,06	0,05	0,07	8	0,05	0,04	0,07

* number of networks for which all data was available in reports.

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

As FSP are slightly more productive, the budget spent for each publication (Table 6_4) is lower for the FSP than for the SFB. Furthermore, an analysis between natural science networks and non natural science networks shows that the output intensity is somewhat higher for the natural science networks than for the non natural science networks.

Table 6_4: The relative cost of output of the FWF networks*

	SFB		FSP	
	n*		n*	
budget/ written publications	14	16.534	9	14.185
budget/ referenced journals	10	22.538	7	17.335

* number of networks for which in all categories necessary data was provided in the reports.

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

6.3.2 The Scientific Quality: Results of a Bibliometrics Analysis

6.3.2.1 Introduction

The Bibliometric Analysis was specified in the invitation to tender as an essential means with which to assess certain important aspects of the performance of the FWF network programmes. The analysis was scoped by the study team and carried out by a specialist bibliometrics company based in the United Kingdom. This company, named Evidence Ltd, is located in Leeds and is identified in the tender document and the appendices. Evidence Ltd is a highly respected bibliometrics company which has access to the databases of scientific publication and citation information held by the Institute of Scientific Information (the ISI) of Philadelphia in the United States.

Bibliometrics research uses information compiled from academic texts, principally journal articles, to construct measures that can be used to assess a number of important dimensions of academic work. It can be used to create measures of quality, to estimate how research is carried out and what level of collaboration is taking place to produce the research. Measures of quality principally involve consideration of the citation of the academic journal article or papers, making an inference that the higher the level of citations received by a paper, the higher its quality. The journal in which an article appears can also give some insight into the quality of the article. Where measures of quality are made, this is often for the purposes of comparison. When comparisons are made, it is very important to ensure that the appropriate comparison is made. Levels of collaboration can be assessed at a number of levels: in terms of the number of collaborators co-authoring the paper; the number of countries involved in the writing of the paper, which is given by the number of addresses on the paper; the number of academic or other institutions involved. Comparison across scientific areas is also possible by use of the appropriate rebasing methods that take into account variations between subject areas and the entire citation rate for a particular field.

In line with the invitation to tender, the aims of the bibliometric analysis were to assess the quality of the research carried out by the FWF under its two network funding programmes and to make an assessment of whether this work was of high scientific quality, was good value and represented a sensible use of FWF time and resources. Such assessment necessarily involves comparisons of Austrian work with other scientific output at a number of levels: from the same scientists operating outside the programme; with other scientists operating in Austria not funded by the programme; with other comparable scientific work published in the same journals in which the FWF output appears; with the work of other countries publishing in the same journal in which the FWF output appears.

So far as a true comparison is concerned, this is never possible as a true counterfactuals cannot be found in real social and institutional situations; however, by finding cases that wherever possible achieve a like for like comparison, a informed and meaningful view of the additional benefit of FWF funded programmes can be obtained.

6.3.2.2 Specific Aims

In more detail, the bibliometrics company was asked to obtain the following information from the ISI citation index databases and to carry out an analysis into the following issues which were identified in the proposal:

- To compare the quality of publications from scientists funded under FWF programmes with others from Austria and from around the world;
- To compare the quality of publications from scientists funded by FWF with the quality of their publications which are not funded by the FWF;
- To compare publication quality of Austrian science with other world benchmarks;
- To examine the level of collaboration between Austrian scientists with scientists from other countries (world benchmarking);

In addition, it was decided also to obtain data from more than one year both to obtain a larger and more statistically reliable data set and to investigate changes over time in the performance of Austrian research and in relation to comparisons.

6.3.2.3 Methods Employed

The bibliometrics contractor was presented with a detailed specification outlining the aims of the research. In order to ensure that the citation data obtained from the Institute of Scientific Information was sufficient in quantity to make valuable comparisons, it was decided that the bibliometrics contractor be sent as full a database of the publications from the FWF's network projects as could be obtained in order to pre-test this against the Institute Of Scientific Information database. This data was then obtained from the FWF. When this was done, the years for which reliable citation data could be found was determined to be 1996 and 2001. The selection of more years would have of course increased the reliability of the analysis and provided more evidence of trends. However, the budget for bibliometrics analysis was constrained and only two years' worth of data was allowable within the budget and this data was subsequently obtained. Increasing the number of years of data would also increase disproportionately the amount of other data and the amount of time required for the bibliometrics company to analyse the data.

The data was also screened to ensure that the database of records included publications from the humanities as these are normally poorly covered in the citation index. The specific steps taken by the bibliometrics company to prepare the data for analysis are listed in the separate bibliometrics report. In general terms however, this preparation involved the following steps.

- The database of papers from the FWF was collated and the author names were obtained. This list of names was checked to identify synonyms so that a reliable set of author names could be obtained for the comparison with papers written outside the project. This checking was carried out using author home address where available for cross referencing.
- The data set of papers written by authors in the FWF programmes and outside the FWF programmes was obtained from the Institute Of Scientific Information.
- It should be noted that this data set uses the more complete Institute of Scientific Information data set rather than the smaller Science Citation Index. The value of the larger data set is that the Institute of Scientific Information databases are larger and carry more journals, including more of the journals in which specifically European authors are likely to publish.

From the data obtained, a series of comparisons was then prepared as follows to address the aims of the study. These measures form the structure of the report of the bibliometrics company.

- FWF citation measures for main science areas
- Citation measures for projects by type
- Comparison of the authors work within the projects with their work outside
- Comparison of authors work with Austria as a whole
- Collaboration by FWF authors
- Performance by Project
- Performance by Project Leader

The analysis by the bibliometric company generates data about each publication in the following forms:

- Observed citations
- Expected citations
- The citation ratio
- The impact
- The rebased impact

Before analysing and interpreting the data, the definitions of the major terms is provided. The ***observed citations*** are the numbers of citations from the paper in question, while the ***expected citations*** is the number of citations expected for a paper in the journal in question in that year. This expected citations measure is taken as the mean number of citations for the set of papers in the journal in which a paper appears.

The ***citation ratio*** compares the paper with the average by dividing the observed citations by the expected. A measure of greater than 1 indicates that the paper is cited more than the average. The data presented by the bibliometrics company gives for each paper the citation ratio.

From this number the performance of individual authors, the projects under which the papers are written can be calculated. No measure of the extent to which an individual publication differs from the mean for a journal is used in this analysis and the result would have involved extensive further calculation. The index of individual paper quality is therefore measured by the citation ratio.

The bibliometrics company also makes use of a concept of ***impact*** which is calculated by dividing the number of citations of a paper by the total number of citations in a particular field. The field in question can be arbitrarily defined as the papers in a specific field, the papers authored by FWF funded researchers, the papers authored in all Austria. Finally, the ***rebased impact*** corrects or adjusts the impact measure for scientific field by multiplying by a factor that takes into account the world average for the respective disciplinary category.

The measure of quality used for comparing publication outputs is one suggested by the bibliometrics company and involves comparison of the papers which score above the average for a particular journal and the papers which score below as regards citation. This measure is therefore to a large degree time independent and provides therefore an indicator which is independent of the length of time a particular project has been operational, giving a reliable indication of the quality of the project. The number of publications by contrast is a time sensitive indicator, and for this reason we would not consider using the absolute level of outputs of two programmes which had been operating for different lengths of time against each other without taking into account the length of the network project itself.

The bibliometric comparisons between Austrian science both from FWF funded research and for the whole of Austria were made with a select group of countries requested by the FWF itself as specifically relevant to the case of

Austria. These countries were Switzerland, The Netherlands, Sweden, and Finland.

It should be noted that the bibliometric comparisons we have obtained have focused on differences in quality between work carried out under the FWF programmes and with other comparators. However, when the question of value for money is concerned, it is appropriate that the quantity or volume of publications is considered as well as the quality of those publications. As the cost of obtaining comparative data on the volume as well as the quality of publications was thought to be too high, information explicitly about quality rather than quantity data has been put together. Nevertheless, some data on the quantity of research is provided in the bibliometrics analysis report and this is available for the FWF itself to carry out further comparative work within its own internal evaluation processes if it should wish to do so.

In the following sections, the results of the analysis are given. In addition to the analysis carried out by the bibliometrics researchers, the study team integrated the results of the bibliometrics on project and sub-project performance at the project level for an analysis of the networking and collaboration behaviour of scientists operating under the programmes. This analysis is given in the networking and collaboration study below.

6.3.2.4 Results

FWF Funding and International Impact Comparisons

The results of the analysis which compares the FWF publications with those from world averages (the rebased impact measure) suggest that the performance of scientists who are funded under the FWF is very good[53]. There are however variations between disciplinary areas, and variations over time. It is notable that in mathematics, variations over time are large, although there is an improvement of a significant level between 1996 and 2001. It is also the case that with both FSP and SFB considered together (aggregated) it is medicine and natural science that have the highest rebased impact.

Considered separately, those FSPs which are involving medicine and biosciences are the best performing groups with a significant advantage over other disciplinary areas funded by the FWF. The lowest performing area in terms of world comparisons of the FSPs is mathematics where the performance is below world levels. In all other areas however, the FSPs performance is in excess of world levels. Owing to the fact that our data set

[53] Rebased impact is the standardized impact figure for a particular discipline, allowing comparisons between countries and disciplines.

was not sufficiently large (because of cost limitation reasons) no papers were collected from the Institute of Scientific Information on management studies and environmental science. This is regrettable as these are areas in which interdisciplinary working is important.

Table 6_5: Austria (all papers): average impact of publications in 1996 and 2001 by disciplinary category

Austria (all papers): average impact of publications in 1996 and 2001 by disciplinary category				
	1996		2001	
	Impact	Rebased Impact	Impact	Rebased Impact
Medicine	15.58	0.96	2.78	1.02
Biological Sciences	15.33	0.99	3.27	1.21
Environmental Science	7.63	0.81	1.60	1.26
Mathematics	4.59	1.12	0.54	1.00
Physical Sciences	10.47	1.08	2.41	1.24
Engineering	8.27	1.30	1.52	1.39
Business and Management Studies	3.96	0.77	0.48	0.90

Source: Bibliometrics Research by Evidence Ltd., 2004

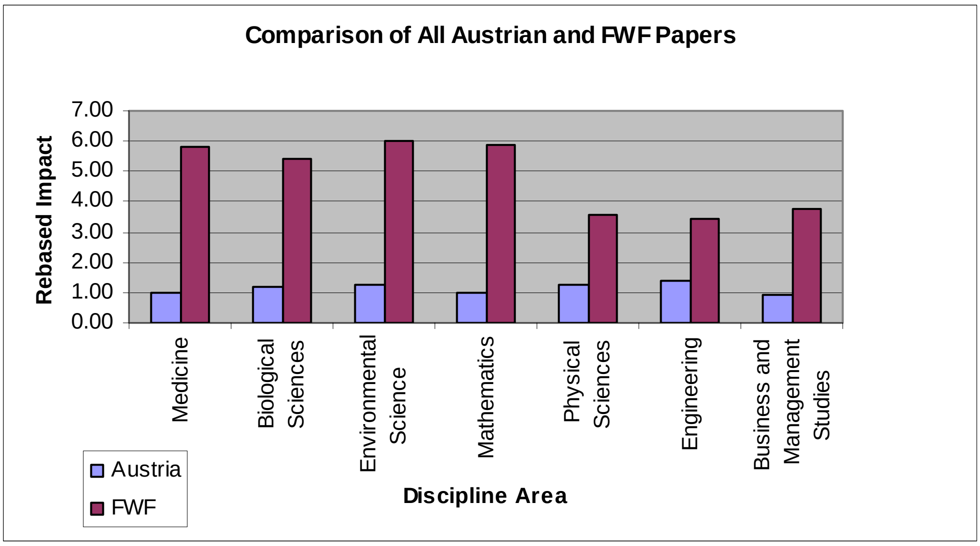
Table 6_6: Impact of papers published in FWF network programmes in each disciplinary category

Impact of papers published in FWF network programmes in each disciplinary category				
	1996		2001	
	Impact	Rebased Impact	Impact	Rebased Impact
Medicine	41.45	2.59	15.81	5.79
Biological Sciences	34.75	2.25	14.63	5.4
Environmental Science	no data	no data	7.63	6.01
Mathematics	1.67	0.41	3.19	5.91
Physical Sciences	19.98	2.05	6.96	3.59
Engineering	15.69	2.47	3.73	3.42
Business and Management Studies	no data	no data	2	3.77
No assigned	28.69	---	18.65	----

Source: Bibliometrics Research by Evidence Ltd., 2004

Considering the SFBs separately, it is clear that here too the disciplines of medicine and biosciences are important, with the papers produced under these kinds of projects being amongst the most high scoring. Environmental sciences are also important though with the papers from the year 2001 being very highly rated in terms of citations and rebased impact score. It is unfortunate however that there were no papers submitted from the 1996 period and so comparisons between these two periods cannot be made for environmental science SFBs.

Figure 6_1: Differences between FWF and all Austrian papers, 1996 & 2001

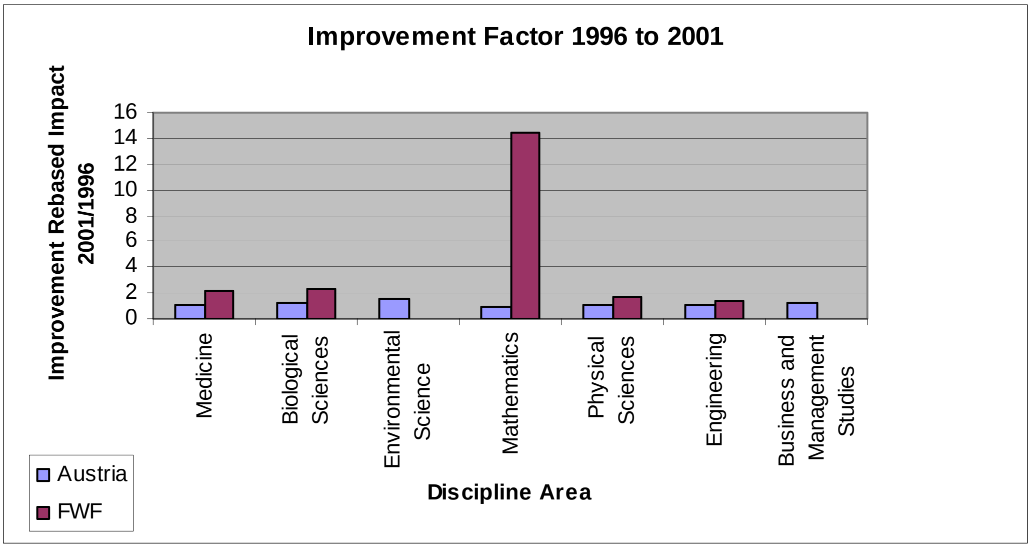


Source: Bibliometrics Research by Evidence Ltd., 2004

When comparisons are made with the rest of Austria, the performance of the FWF network programmes (both FSP projects and SFB projects) is good with rebased impact scores for all disciplinary areas being higher for the FWF than for the whole of Austria, see Figure 6_1: Differences between FWF and all Austrian . When the comparisons are made between the rates of improvement of FWF published papers from the network projects with those published in the whole of Austria, on the limited basis of the two years of data we have, the FWF papers have improved more than the average for the whole of Austria. The following table identifies the rate of improvement in the projects. Improvement figures shows on the Y axis of the figure below are calculated by dividing performance figure for rebased citation impact for year t_{+1} by the figure for year t.

An analysis was carried out by the bibliometrics company using the expected and actual impacts separating out the FSPs from the SFBs. This analysis has shown that the FSPs have generally higher citation counts than the SFBs, but the analysis also shows that the SFBs do include some papers with very high citation counts that exceed the best of the FSP project outputs. Whether this second feature of the data is a systematic feature representing a general tendency for SFBs to achieve some very high citation counts is difficult to determine. It is our view and also that of the bibliometrics company that this very high citation count may not be present in other years. Consequently, the results of the analysis of the proportion of papers with observed and expected citation rates appears to us to indicate that the FSP projects are generally producing papers with a greater citation impact. While the number of papers in the sample is low, and there could be no difference, the available evidence suggests that the rate of improvement over time between 1996 and 2001 is higher for the FSP than for the SFB. As the following Table 6_7 shows, the level of improvement does vary between the SFBs and the FSPs over the period, with the data showing that more of the disciplines make an improvement in their publication impact under the FSPs over the period from 1996 to 2001 than for the SFBs.

Figure 6_2: Rate of improvement by discipline, 1996 to 2001 for Austria and for FWF network programmes



Source: Bibliometrics Research by Evidence Ltd., 2004

Table 6_7: Improvement in impact of papers published between 1996 and 2001 for FSP and SFB separately.

	SFB	FSP
Discipline Area	Improvement Factor	Improvement Factor
Medicine	1.52	2.09
Biological Sciences	2.05	1.80
Environmental Science	no data	no data
Mathematics	17.00	no data
Physical Sciences	1.70	2.10
Engineering	1.35	5.60
Business and Management Studies	no data	no data

Source: Bibliometrics Research by Evidence Ltd., 2004 analysis by PREST/ISI

FWF Authors and their Publications within and outside the Programmes

This limited comparison examines the rebased impacts by discipline for the papers of FWF authors arising from the network projects and their papers arising outside (i.e. not attributed) to the FWF network projects. This method has been used elsewhere to establish if the papers produced under programmes are substantially better or substantially worse than the papers produced by the same authors outside. Again, where there are no true counterfactuals possible to make a comparison, considered in the aggregate, these measures constitute a useful indicator of the extent to which programmes represent excellence and momentum in research trajectory. The comparisons made here are in some cases tentative because of the very small number of papers available, both within the outputs of the FWF funded schemes and within the papers produced outside. Nevertheless, a number of observations can be made.

Generally, FWF authors work is of a higher quality in their network projects than in activities outside the networks (financed by institutional funding or other grant schemes).[54] In medicine and biosciences this difference is indeed substantial. In other disciplinary areas, the data that we now have is not so clear and, as we will note later, further work on bibliometrics is advised to investigate these issues more carefully.

Table 6_8: FWF Authors outside programmes

FWF Authors Outside FWF Programmes				
	1996		2001	
	Impact	Rebased Impact	Impact	Rebased Impact
Medicine	13.09	0.82	6.24	2.29
Biological Sciences	17.58	1.14	6.80	2.51
Environmental Science	6.89	0.73	5.64	4.44
Mathematics	4.96	1.21	1.91	3.54
Physical Sciences	29.25	3.02	5.90	3.04
Engineering	25.89	4.08	3.31	3.04
Business and Management Studies	1.80	0.35	2.40	4.53

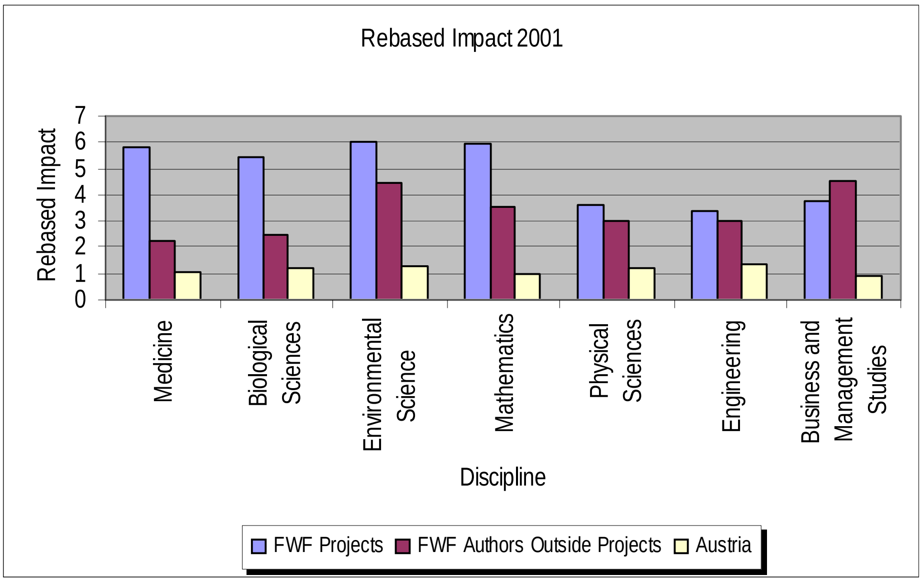
Source: Bibliometrics Research by Evidence Ltd., 2004

In physical sciences for example, the data shows that in 1996 the work of programme authors was better outside the programmes than their work inside, whereas in the period 2001, the reverse is true, i.e. their work

54 The comparison carried out here distinguishes between the rebased impact of papers under networks, papers by the same authors outside networks, including Research Projects or, for example, EU funding, and papers authored by Austria as a whole.

published within the programmes was better than their work published outside. Also, in 2001, in the Business and Management science area, based on a very small sample of publications, the work of authors within the projects is not considered as good as their work outside.

Figure 6_3: Rebased impact 2001, FWF authors (network) projects, FWF authors outside (network) projects and Austria (total)



Source: Bibliometrics Research by Evidence Ltd., 2004

An overall comparison shown below (Figure 6_3) indicates well the importance of the FWF network projects in delivering excellence for Austrian scientific research. In nearly all areas, it is the publications from FWF funded research that attain the highest level of rebased impact and are above the level achieved by FWF authors outside network projects and above Austrian in total.

Perspective of Interview Results on Scientific Knowledge

Interview records generally confirm the view that the Austrian research is of an internationally high quality, with one estimate being that around 1/3 of the networks produce research of the highest international quality. Interviews also suggest that the research itself is in the areas of most scientific interest and in areas which will attract the world's top scientists. There is little evidence that the science which is done by the networks is second rate. While we do not have direct comparative data of Einzelprogramme, such comparative data that we have suggests that many of FWF network programmes are of the highest international quality.

While it was generally thought that the quality and reputation of the networks was high and that this did attract good scientists back to Austria, the more experienced scientists were not always as familiar with the Austrian system as they could be and could be difficult to fit back into the research system. The most senior ones could be very difficult to integrate back into the system.

There was strong support for collaborative work with the FWF arguing that networking significantly enhanced the development of disciplines and the solving of major scientific problems.

Comparison of Austrian Science with World Benchmarks

The international comparisons of the Austrian papers produced with papers produced in other science systems shows that papers from Switzerland and from the Netherlands are rated higher than those from Austria, while Austria is performing better than either Sweden or Finland. Switzerland's performance is very strong, and a number of reasons have been advanced to explain this, including the presence of large research facilities in the physical sciences (CERN) and in biosciences and pharmaceuticals which tap more effectively into international networks of academics and industrial laboratories of multinational companies. While this may show up in country data, it is very possible that such indicators do not represent the true strength of native Swiss science.

In 1996, a number of areas of science in Austria were lower than the world average. This group included medicine, biosciences, environmental sciences and business and management studies. Austrian science has since improved from 1996 to 2001, although one area remains behind the world averages. This area is business and management studies. Mathematics appears to be equal to the world average on the 2001 comparison but it has improved its position.

The rates at which Austrian science has improved over this period are comparable with those achieved in other countries, although Switzerland has achieved markedly higher level of improvements.

Comparison of Collaboration in Austrian Science with World Benchmarks

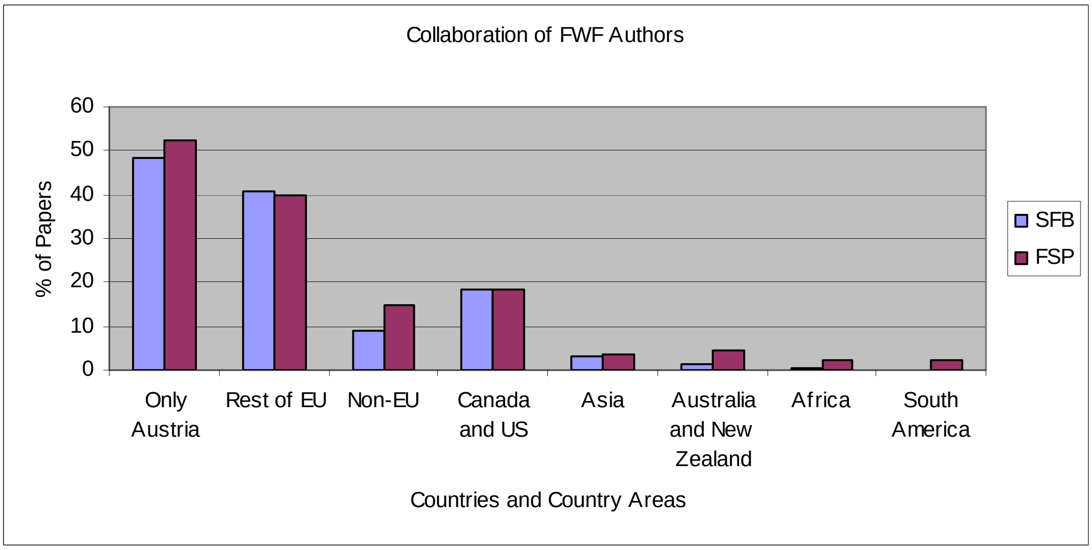
An analysis of the addresses appearing on the papers published under the network programmes of the FWF has been carried out to establish the extent to which Austrian scientists have been involved in research collaboration internationally. Collaboration is often regarded as beneficial for the research process, (see the literature review) and the aim of this study has been to establish what levels of collaboration are occurring that involve Austrian scientists funded by the FWF only, (see Evidence Report, section 8).

The results of the analysis of collaboration shows that between 1996 and 2001, the number of addresses on each paper produced under the FWF funded research networks rose from 2.7 to 3.4, indicating that the level of collaboration has increased. The bibliometrics report gives a detailed frequency count of the number of collaborators and the frequency within the data set. This shows that there was one paper with 41 addresses, but the commonest value is 2.

The country profile of papers produced under the FWF networks by country of first address shows that most common first country is Austria and the second most common is Germany with the United States third most common, although the numbers of papers with Germany and with the United States as first address are a very small proportion of the overall papers. The UK, France and Italy are the other countries with which collaboration is common.

The number of papers written by FWF authors in the network programmes with collaborators from anywhere in the world has increased over the period from 1996 to 2001. This is shown by the fact that the number of papers with only Austrian addresses has fallen from 57% to 45%. This is a substantial fall in the number of papers during this period. The greater increase in cooperation is with scientists in European countries rather than increases with the rest of the world.

Figure 6_4: International cooperation of FWF authors, by project type



Source: Bibliometrics Research by Evidence Ltd., 2004

The levels of collaboration are very similar for both the FSP and for the SFB programme authored papers; however, there appears to be a slight tendency for the FSP programme authored papers to be co-authored with a higher proportion of countries outside the European Union area. In this respect therefore, while both programmes involve collaboration beyond national boundaries, the FSP are more truly international. This tendency may however derive from the balance of subjects and further analysis of the papers could be carried out to examine this is more detail.

Rates of Publication for FWF Authors: Inside and Outside the Programmes
A small analysis has been carried out on the productivity of FWF funded authors within and outside the FWF funded programmes. The data presented in the following table indicates for 1996 and for 2001 those disciplinary areas where such comparisons can be made. It is clear that FWF network project funded authors publish more outside their association with the FWF projects than they do within. This means that in general, scientists participating in a SFB or FSP do so only part time and next to many other activities. However, as we have noted earlier, this work, which is published outside the FWF networks, does not have the same quality, overall as the work produced within the networks.

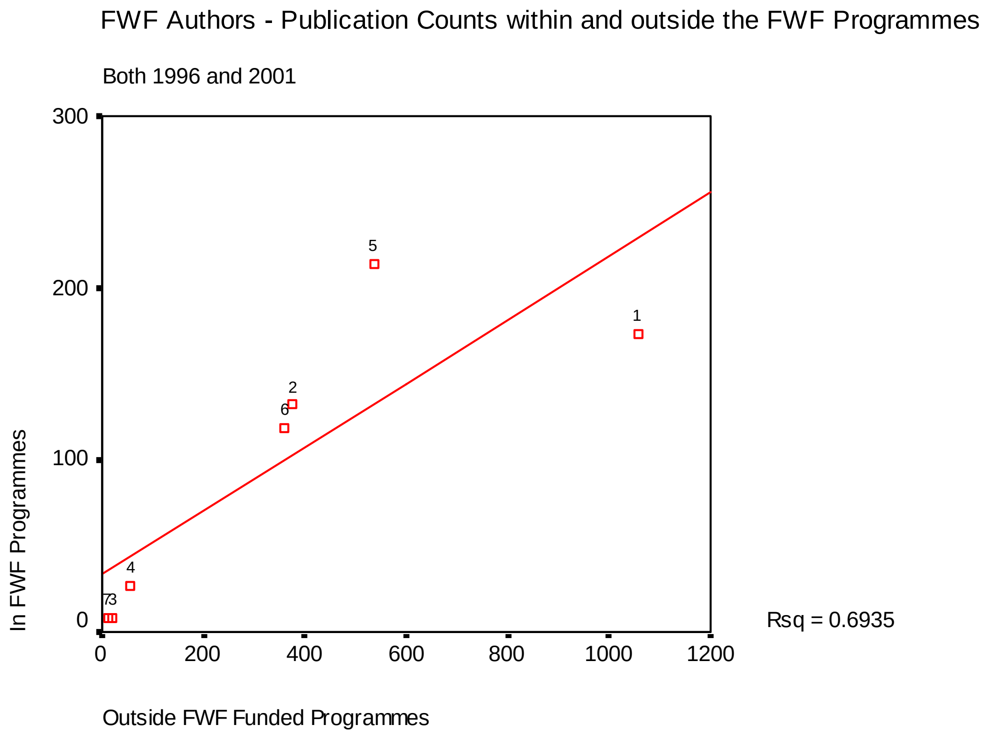
Table 6_9: FWF authors' productivity – inside network projects and outside

FWF Authors Productivity			
		Both Years	
Discipline	Case Label	In FWF Programmes	Outside FWF Funded Programmes
Medicine	1	173	1057
Biological Sciences	2	132	375
Environmental Science	3	8	20
Mathematics	4	27	57
Physical Sciences	5	214	536
Engineering	6	119	361
Business and Management Studies	7	8	10

Source: Bibliometrics Research by Evidence Ltd., 2004

The differentiation as for disciplines can be visualised. This scatter plot below shows well the different disciplines vary in the extent to which publication by academics outside matches publication within the FWF networks. demonstrating the different relative weight the networks have for the scientists involved.

Figure 6_5: Author publication counts within and outside the FWF Programme, both years combined



Source: Bibliometrics Research by Evidence Ltd., 2004

Medicine (discipline 1) is far below the trend, meaning that for scientists in medicines the work within their networks is – in quantitative terms – less important than for the average network scientist. In contrast, disciplines 2, 5 and 6 (Biological Sciences, Physical Sciences and Engineering) are ones where the extent of publication within the FWF projects is higher than the trend. For scientists within those three disciplines, the activity within the networks is more important and has more weight than for scientists from other areas.

Finally, on the basis of the FWF analysis by the international consortium (Appendix 6) a comparison with the Einzelprojekten has been carried out in relation to the scientific quality of the results. In relation to peer-reviewed papers per sub-project, the analysis of variance shows that the subprojects in networks do achieve higher numbers of papers in the peer-reviewed journals than the single projects. When the number of papers submitted to ISI journals are considered, the differences remain. Similarly, the projects within networks receive higher number of scientific awards than single projects, (for details see Appendix 6). These findings, albeit to be interpreted with caution, confirm our conclusion that the quality of the sub-projects within networks is higher than the quality of the average single FWF projects.

6.4 Training and international attractiveness

A further aspect of performance is the human training and exchange dimension as the training of young scientists is one requirement for the funding of FWF networks. From all interim and final project reports the number of degrees, PhDs and habilitations were collected and intensities calculated. In addition, the FWF systems analysis data was used. First of all, the training dimension is equally represented in both networks. Given that the FSP are smaller, the intensity of training is again slightly higher for the FSP than for the SFB. As with publications, we find no indication that the greater geographical spread leads to any disadvantages.

Second, the data in Appendix 6 (systems analysis) indicates that the relative number of people working on their habilitation is higher in the network subprojects than in the single projects of the FWF. Still, the number does not appear to be that high: while on average there are 5,9 professors per FSP network and 11,2 professors for the SFB networks (see Chapter 5 above) the reports indicate less than one finished habilitation per network per year.

In the judgement of the peer reviews the training dimension is not considered systematically. For the FSP the overall judgement is that those young scientists that are involved have very good conditions and show considerable improvements. A few FSP have been the base for international careers. There are almost no sound observation regarding the training of women especially. For the SFB the picture is a little unclear. In many networks there are too few young project leaders, few upcoming "hot shots" for whom an SFB project does not simply mean resources for funding, but gives the possibility to gain experiences in the management of complex research cooperation, an ability that becomes increasingly important.[55] In addition, albeit conceding that networks are a prime opportunity for universities to train PhD students, peers criticize that there should be even more PhD in FWF funded networks. On the other hand there are networks that fully satisfy peers regarding the representation of students and PhDs. In any case, a more systematic training commitment, plan and demonstration of its effects is asked for.

[55] The peers, however, are not unanimous about the role of young scientists within the networks, as a minority of peers feel that young scientists should gain experience in single projects before they engage in network projects, assuming that the sole responsibility in a single project has a greater benefit to their scientiic career.

Table 6_10: The human and training dimension of network performance

	SFB				FSP			
	N*	avg.** years	No***	No / network /year	N*	avg.** years	No***	No / network/ year
PhD	18	5,6	576	5,7	10	5	290	5,8
Diploma/Masters	19	5,2	648	6,6	11	4,6	318	6,3
Habilitations	8	7,1	40	0,7	6	6	20	0,6

* number of networks for which data was available,** average duration that was covered by the reports of the SFB/FSP networks that were included in the analysis, ***no. of output
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

The interviews conducted in the networks show a strong strong role of networks as regards scientific training. A significant number of interviewees both relatively young and with more experience argued that membership of networks had been instrumental in helping younger scientists become more knowledgeable about the research system in Austria in an important number of ways. They stated that membership of networks was important in developing their academic knowledge of the area in which they worked. Collaboration also gave considerable visibility to their work.

They also argued that membership of networks provided them with insight into the funding and administrative systems in which they will increasingly play an important role. This insight and knowledge of funding systems is not to be underrated, and is an important element in the educational experience of scientists, the progress of whose work often depends upon their knowing how to obtain and retain funding. The networks also give younger researchers management and cooperation experience of large scale projects.

For the universities the network programmes are a central means to enhance the possibilities to employ young scientists and to do so in a mid term to long term perspective. However, it appears that the conditions to do so are not flexible enough and that in many cases the networks are not a real springboard for the young scientists as Universities often do not live up to the expectations that were raised in the application phase. Many interviewees complained that the FWF scheme does not provide for special training programmes within the networks funded, as it is possible with the "Nachwuchsgruppen" that are integral part of the SFBs in Germany. However, it seems to be a common feature that excellence networks do not consider adequately the importance of formal training programmes and groups within their structures, as even where the formal possibility is there, the German SFBs have – at least until the late 1990s – only 3% of all SFB had such a group (WR 1998).

***Excursus: International Comparison – Training*[56]**

All programmes emphasize the importance of training. The promotion of young scientist can take place in different forms: (1) it may be one of the main objectives and thus integral part of the general research activities, (2) it may be executed in form of particular (sub-) programmes, (3) there may be a special obligation to integrate the research results into training courses at universities. The first way of promoting young scientists seems to be most common in Switzerland: Not only that training is mentioned as one of the main objectives of the NCCR, related to the total number of 2465 persons involved in the centers 1185 (= 48%) belong to the group of younger scientists (diploma students, master students, doctoral students, postdocs), additionally senior scientists (838), management staff (51) and „other staff" (391) can be found (Guide 2004, p. 7).

Overall there are no sufficient data available to what extent single projects are led by young scientists. According to the claim of excellence, however, it seems to be that the projects are mainly led by senior scientists.

In Germany the focus is on particular programmes: the most important instruments of the DFG to promote young scientists are the Independent Junior Research Groups and (International) Research Training Groups.

Example: German Training Programmes
Independent Junior Research Groups can get funding for a maximum of five years. During this time, the position as project leader as well as the positions of staff can be financed. In addition, based on the extent of the research project, funds are also available for consumables, equipment and travel. Researchers may not apply directly to the DFG for funding for an independent junior research group. As a rule, CRCs and Research Units will publish their announcements for independent junior research groups on their websites, in national newspapers or in specialist journals (http://www.dfg.de/).

Research Training Groups are university training programmes established for a specific time period to support young researchers in their pursuit of a doctorate. These groups provide these doctoral students with the opportunity to work within a coordinated research programme run by a number of university teachers. Doctoral students are incorporated into the research work being done at the participating institutions. The study programme aims to complement and extend the doctoral students' individual specialisations and to provide a structure for cooperation. An interdisciplinary focus of the research and study programme is desired. (http://www.dfg.de).

[56] The references to this part can be found in the international comparison in Appendix 1.

In Finland the strategy paper from 1997 emphasizes that „graduate schools and other high-level researcher training form an integral part of a creative research environment [...]. It is important that the best researchers participate in various ways in both graduate and post-graduate university teaching, to convey the latest research results to university courses as fast as possible" (Academy 2000, p. 8). Additionally one of the four selection criteria groups is related to training. Concrete criteria are (1) general potential for researcher training, (2) involvement in the work of graduate schools, (3) practical arrangements for researcher training, (4) success of supervisors in researcher training, (5) numbers of graduate students and supervisors (ratio), (6) need for researchers and experts in the unit's field (Academy 2000, p. 35)[57].

6.5 The Relation of Networking, Interdisciplinarity and Output

6.5.1 Assumptions and Methods Applied

Chapter 5 has shown the intensity of interaction and the scope and scale of interdisciplinary work and has already produced some lessons as regards the nature of the FWF funded networks. However, networks are not mainly set up for the sake of cooperation itself but to advance scientific knowledge by increasing the range of scientific questions which can be addressed, and by combining capabilities to improve the levels and quantity of research performance. The purpose of the analysis carried out here is that the networks funded by the FWF require interdisciplinarity and intensive cooperation on the assumption that both increases quality and quantity of scientific results. The question then is, what is the relation between interdisciplinarity and intensity of cooperation on the one hand and output on the other?

To answer this question, the attempt has been made here to assess whether the level of interaction taking place within networks is correlated with other important measures of network performance. In this analysis we focus upon the quality – and to some extent quantity of the publication outputs of the entire network - rather than other sorts of output.

Our major assumption in this analysis of the relationship between quality and collaboration is that scientific interaction is affected by two important processes. These two processes are:

a) The disciplinary combination process, giving rise to "new combinations" of results and findings with potential to make major changes to scientific thought and practice;

[57] In Germany, we can obseve just the opposite discussion, i.e. a better distinction between excellence in research and excellence in training. Professors or even younger scientists who are excellent in research shall be released from training activities.

b) The second is a peer review process which operates throughout the research process within academic knowledge production. We might refer to this second process as a "social quality check".

In respect of the first, the more scientific interaction, both ex ante and within the process of the network, the more likely it is to have a mutual stimulation and productivity of scientific programmes between different sub-disciplines. As in most FWF networks cooperation is largely interdisciplinary (see above), this is likely to be an important influence. This can lead to major break-throughs, to creativity gains and new methodological achievements that may have a very positive effect on scientific quality. However, the potential of "new combinations" in terms of major scientific advancements is accompanied by the greater risk of failure. In addition, in times of increasing specialisation of scientific research, scientific quality is measured in terms of rather narrow disciplinary standards. Thus a lower degree of interaction, in which the simple exchange of results and ideas prevails, may have a better effect on scientific quality (measured by excellent publications). Thus, in terms of mutual fertilization between individual sub-projects there are two somewhat contradicting effects of strong inter-disciplinary interaction: new combinations as *potential scientific advancement* on the one hand against the *greater risk of failure* of new combinations and the potential *loss of disciplinary specialisation* on the other hand.

The second influence is that interaction within a network constitutes a check upon or moderation of scientific quality: in effect the more collaboration taking place within a network, the more strongly does a form of peer review operate. The higher the degree of collaboration the more powerful is the peer review process operating through social control and therefore the more likely that scientific quality will be representative of overall scientific quality.

Conversely, we can assume that in networks where there is little cooperation, peer review is not working strongly, and therefore under these conditions, we would expect the publication quality of outputs to be different from the overall level, i.e. both lower and higher in quality. The overall level we have here assumed to be the overall level of projects in the project set, which comprises the projects funded by the FWF for networking and which includes the top scientists in the Austrian system.

Our Test

The network densities (as measure of cooperation within the networks, see Chapter 5) were related to a publication output taken from the bibliometrics analysis from two years, 1996 and 2001. Those projects which produced outputs in the literature in these two years were included in the analysis. The measure of quality involved here is one which compares the papers which score above the average for a particular journal and the papers which score below as regards citation as noted earlier in this section on bibliometrics methodology.

For each project, its scientific outputs were assessed to provide a measure using chi-square of deviation of quality from average level of quality based on the entire data set of papers from all projects. This method is identified by Langley (1971) and it measures the extent not of quality but of the deviation from the average quality level. In this respect, very high quality and very low quality outputs will score similarly in terms of their deviation from the expected value. The final column in the table indicates whether the project achieved more publications above their respective averages than below.

6.5.2 Quantitative Results

Network Density and Quality

A statistical calculation relating network density and scientific quality was carried out and this shows evidence of a possible internal peer review effect. When collaboration is high (enabling internal peer review), scientific quality is more likely to be close to the average value for the whole data set, which is – as we have seen above – significantly higher than the performance of Ausrian scientists in general. When collaboration is low, the quality of the work which is done by the network is likely to be either less than expected or greater than expected (see Appendix 4).[58] The less the level of cooperation, the more likely the networks scientific output will vary from the – already high performing – average (see also Appendix 4, Figure A4_7).

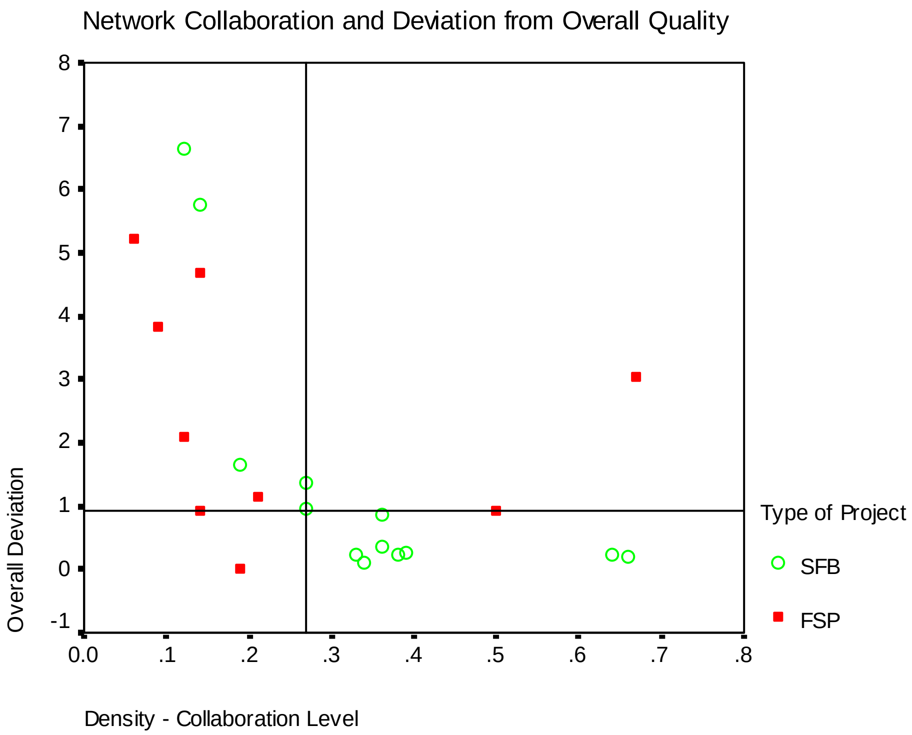
Seen visually, the following figure indicates well the relationship between increasing levels of network density (internal cooperation) and deviation of quality from the expected (the higher the deviation the better or the worse the projects perform compared to the average).

Our results do not undermine the importance of collaboration; rather they point to the effect of a peer review process operating within the context of collaboration. The comprehensive analysis of this study has shown that the FWF networks produce excellent results (new combination, creativity) and indeed is generally associated with higher levels of scientific quality realize many positive effects of collaboration (as laid out in Chapter 3.2). Thus, the fact that some networks produce above average although they do not

[58] There statistical details and related figures are given, tables A4_6 and A4_7 and related text).

cooperate intensively should not lead to the conclusion that cooperation is not important, in fact the *sum* of cooperation effects are the justification for the networks to be funded within the FSP and SFB schemes. Rather, this result indicates that for the monitoring and assessment of collaboration and performance all these aspects must be taken into consideration.

Figure 6_6: Network density and deviation of project score from average



Source: Data from Evidence Ltd, 2004, and from PREST /ISI

A further interpretation of this result is tricky and ambiguous. First, one has to stress that the average of the networks are higher than Austrian science average, thus networks pay off. Second, the fact that networks reporting more frequent collaboration do not result in extremely good output performance may also been caused by the fact that those networks produce what is sought for in the networks, i.e. intedisiplinary research and new research venues (methodologically and/or as regards new research fields). Thus for them a high output score within the short time range of our data set and analyses is less likely than for those areas in which more specialised and less disciplinary work is done. However, in consequence, for those networks collaborating significantly less than the average, a strong collaboration and output monitoring is needed. In some cases it could mean that the level of collaboration is poorly reported, in other cases it could mean that only a low level of collaboration is needed to achieve added network value, still in other cases it could mean that collaboration is not really important for the sub-projects, in which case the network funding – meant to finance collaboration costs – would be questionable. The peer review analysis below shows that the FWF evaluation schemes take account of the importance of internal cooperation, the monitoring of which, however, might be improved to better understand the ollaboration effects and to make scientists reflect upon their collaboration activities within networks (see below).

Nature of cooperation, interdisciplinarity and output
Until now we have seen that intensity of cooperation affects the likelihood of producing medium, good or excellent results. Here the attempt is made to find more concrete relation between the intensity and nature of cooperation on the one hand and the quality and quantity of scientific output on the other hand. To do so, some statistical tests have been tried using the structural, the bibliometric and the reported output data.

As concerns the *quality* of the scientific work, we have compared the mean value as regards the indicators for interdisciplinarity and network density between those network that perform "above" and those that perform "below" in the bibliometric analysis (see above).[59]

Table 6_11: Quality of output vis-à-vis interdisciplinarity and networking

Quality of output (bibliom.)*	No. of networks	No. subproj.	No 2 digit	No. of cities	IIS 2	No 4 digit	IIS 4	gini	density
Above	8 (3 FSP)	11,00	3,13	2,4	0,30	9,25	0,87	0,33	0,40
Below	11 (2 FSP)	11,55	3,91	1,6	0,35	10,36	0,89	0,36	0,32

*Above = out of all papers produced in the two years (1996 and 2001) there are more papers above the average citation score than papers that are below the average citation score.
Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Table 6_11 shows the results. It appears that while the size of the networks (number of subprojects) seems to make no difference as regards the likelihood of producing excellent results, those networks that perform ***above*** average tend to have:

- *lower number of sub-disciplines and lower scope of interdisciplinarity (2 digit)*
- *higher density (more interaction)*
- *lower concentration* (lower gini-coefficient, meaning more relative weight of the variety of sub-disciplines involved)
- *higher number of cities* involved.

[59] Simple mean comparison, tested with T-Test (only those 19 networks for which data was available and which had at least 5 SCI-publications).

However, the only relation that is statistically significant is the relation between geographical spread and excellence. This means that interdisciplinarity does not spur excellence, at least not in the short term. This is in line with the mechanism that in general specialised activities better fit the publication routines and journals available, need more time to produce excellent results and are, in principle, more likely to also produce failures (more risky). In addition, it pays off to cooperate – in statistical terms at least it does not affect excellence negatively. Finally, as regards the relation of geographical spread of the network and output, it appears that for all networks (SFB and FSP) there is a *positive correlation* between the number of *cities* (not the number of hosts) and the quality of the output.[60] Thus, if networks take the effort to cooperate across distances they do so in order to combine and produce real excellence. Cross-distance cooperation is thus not detrimental to scientific quality.

As regards the *quantity* of scientific output the results are more significant. Quantity has been measured as *publication intensity*, taking into account different sizes and different duration of the networks (see Chapter 6.2 above)

Table 6_12 shows the results of a mean comparison between those networks which have a publication intensity above the average and those that have an intensity below average of all networks.

Table 6_12: Output intensity vis-à-vis interdisciplinarity and networking

No. ref. articles/ subproj. / year	No. of networks	No. of subproj.	No 2 digit*	IIS 2**	No 4 digit**	IIS 4	gini	density**
Above	8 (3 FSP)	9,50	2,38	0,28	6,75	0,78	0,35	0,44
Below	11 (2 FSP)	9,27	4,09	0,46	9,18	1,02	0,31	0,26

* significant at the level of 5%, ** significant at the level of 10%.

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

It appears that those networks that perform ***above*** average as regards publication intensity tend to have[61]:

- *lower number of sub-disciplines and lower scope of interdisciplinarity (both at the 2 digit (IIS2) and the 4 digit (IIS4) level)*
- *higher density (more interaction)*

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[60] An additional Pearson correlation resulted in a coefficient of 0,46 with a level of 5% of significance.

[61] The geographical spread makes no difference here and is not included in table here.

- *higher concentration* (higher gini-coefficient, meaning more relative weight of the variety of sub-disciplines involved)

Both the scope of interdisciplinarity and the density of the network (interaction) are significant. This means that intensive cooperation leads to a higher output, in other words investing in cooperative activities within the networks does pay off in terms of quantity of scientific output. Similarly, interdisciplinarity of the work does not demand a tribute in the form of less output.[62] However, as the output could not be measured as for its interdisciplinary content, higher output rates could also indicate competition between sub-projects from different sub-disciplines rather than integration.

6.5.3 Qualitative Assessments of Collaboration Benefits

The very positive comments of participants of networks as regards cooperation and its benefit have been stated already in Chapter 6.2. A number of interviewees noted the existence of significant difficulties with establishing coordination within the programmes. This was said to be especially true of the FSPs. It was also noted that the funding of networking activities was not always given sufficient weight either by the FWF itself or by those running the projects themselves. It was also noted from the interviews that the quality of work in interdisciplinary research fields is difficult to establish; unless that is the fields themselves pre-exist. Further resources for collaboration activities would be sensible, and there should be less emphasis upon equipment spending within budgets and more on ensuring that researchers are able to engage with each other at conferences, seminars or other ad hoc academic interactions.

In one area, surface chemistry, the academics interviewed suggested that their field had always been an interdisciplinary one. However, it should be noted that many interdisciplinary fields and transdisciplinary discourses especially within the humanities take many years to develop, and certainly cannot be developed within 6 or even 10 years. It was also noted that often expectations for interdisciplinary work can be high, and that lack of immediate progress can often lead to disappointment. Even when researchers are co-located, effort is still needed to establish collaboration, which underlines the importance of collaboration strategies for projects under both SFB and FSP and also

62 It must remain open if we also see an artificial effect due to the different routines to report about cooperation that might correlate with the routines to report about output. However, as the cooperation activities are measured at the level of subprojects and thus the reporting is not dependent on a small number of leading figures of the networks this effect should be marginal and should level given the size of the networks.

underlines the commitment of the host institutions to the research projects and sub-projects.

7. Implementation and Management

Summary: The main findings

- The implementation and management of the networks by the FWF is carried out with a high level of commitment to the scientific community of Austria and is done to a very high standard which exceeds in many cases the standards attained elsewhere in the world.
- The application, review and evaluation processes for networks are clear and transparent to those who use them. For this reason, they are held in high regard by those involved as researchers and as peers from the international scientific world. There is clear evidence that the procedures are efficient and effective in delivering networks of high scientific quality to support the mission of the FWF.
- The two stage process of project application ensures high quality networks are delivered and avoids the high costs involved in preparing and submitting research proposals.
- The proposal system could be altered to allow for more precise information to be given to researchers about the quality of their proposals; changes might also be made to systematize the selection and changing of peers within the review cycle for projects.
- The selection of strictly international peers based on FWF lists should be continued.
- The attempts made to cover the most important disciplines of a network should be even strengthened.
- Ideally, initial information on the applicants on the basis of the disciplinary spread (not the identity) of the peers could serve as a check as the applicants could comment and ask for some disciplinary adjustment. In addition, the selection of peers should try even more to find not only a collection of experts for the various disciplines, but should actively look for those experts that might have similar interdisciplinary experience.

7.1 Application and Evaluation Procedure

The basis for the following chapter is the qualitative analysis of *all* written reviews and *all* hearing minutes of all proposals (including the rejected ones) and of all interim – and where available final – reports as well as the various interviews conducted. This broad database allows both for aggregated assessments and for the consideration of peculiarities. As we have conducted a deep analysis here, in contrast to other parts of this report we have inserted specific recommendations immediately in the text only to summarise them in our final chapter, Chapter 8.2.

7.1.1 Design

One of the central means for governance of a funding scheme for research is the evaluation process. The evaluation of the FWF network programmes can be divided into two parts: The ex ante evaluation decides *if* the received proposals are funded, under *what conditions* they are funded and to *what degree* they are funded. The *interim and ex-post evaluations* of running projects judge the performance of the networks against the funding criteria of the funding schemes and decides about prolongation of the funding and new conditions to be met.[63]

The FWF has outlined the evaluation procedure very clearly in the application and the evaluation guidelines easily available in the FWF homepage. The evaluation process is very similar between the two schemes SFB and FSP, in fact the description of the evaluation procedure is identical except for the enumeration of the programme objectives and funding criteria in the guidelines for the peers.

Figure 7_1 shows this procedure. It is a two-step peer review approach. In a first step the applicants need to hand in a short and sound concept. This concept needs to demonstrate

- the basic rationale for the inter-disciplinarity and *long-term* research,
- the scientific progress to be expected
- the meaning for the scientific community at large.

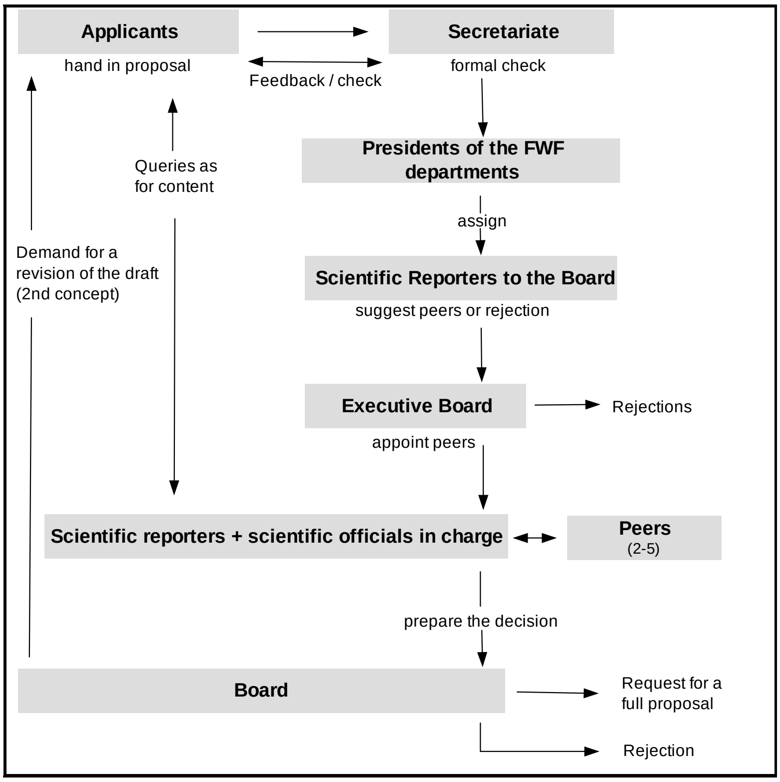
This concept also needs to contain an abstract of the individual projects, a time-frame, the expected costs and complementary funding sources as well as the standing of the scientists involved.

After a formal check by the FWF secretariat the scientific reporter(s) of the FWF, senior scientists not employed by the FWF suggest(s) to the executive board to assign international evaluators for the project or to reject it. If the executive board has decided positively, 2-5 international (non-Austrian) peers are selected and judge – anonymously – the proposal against the criteria of the programme (SFB or FSP). At this stage, special emphasis is put on *importance*, *quality*, *comprehensiveness* and *qualification* of the team. Again this evaluative emphasis is identical for both programmes. The final decision regarding rejection of the proposal or the request to hand in a full proposal is taken by the board of the FWF on the basis of a judgement of the peers

[63] The basis for this section is information of the FWF given in the official documentation (Homepage) as well as interviews with FWF officials, programme applicants and other experts.

summarised and presented by the scientific reporters. The board may also, as it has done a couple of times in the past, ask the applicants for a second concept rather than reject it or allow for a costly full proposal.

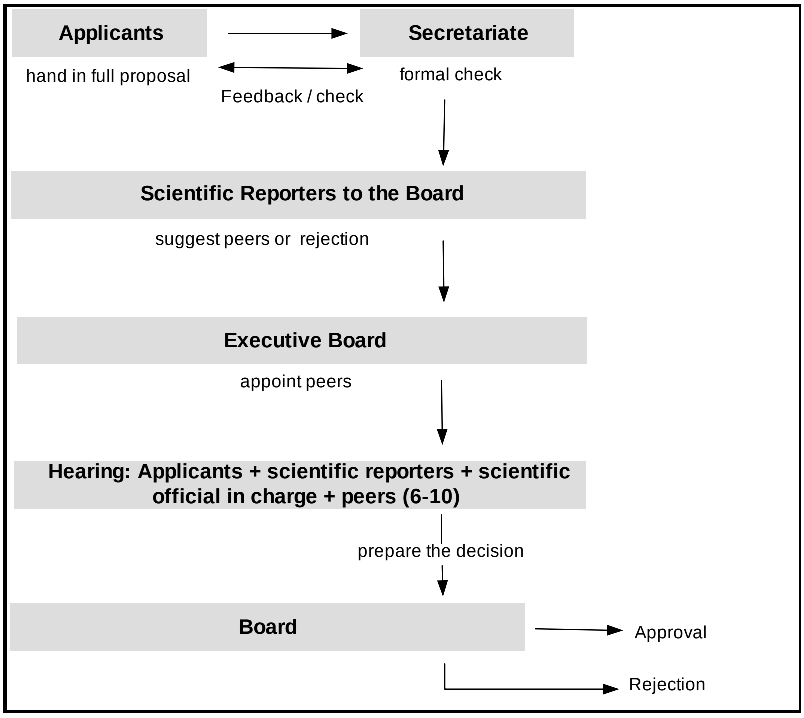
Figure 7_1: The evaluation process: pre-proposal



Source: FWF, translation FhG-ISI 2004

Once the secretariat has done the formal check of full proposals, the evaluation of the full proposal is done by 6 to 10 international (i.e. non-Austrian) peers that are proposed by the scientific reporter and appointed by the executive board. In contrast to the written and anonymous review of the first stage, the second stage is an open hearing to which applicants (i.e. all leaders of sub-projects of a proposed network, all peers, the scientific reporter(s) and a scientific FWF official in charge) participate (see Figure 7_2). The basis for the decision of the board of the FWF is a minute of the hearing including comments to the individual sub-projects. These minutes are drafted by a FWF official and agreed upon by all peers and the scientific reporters.

Figure 7_2: The evaluation process: main proposal



Source: FWF, translation FhG-ISI 2004

For both stages the number of peers is dependent on the scientific diversity of the proposals. The peer reviewers are given guidelines both for the pre-proposal and the full proposal stage. Despite the conceptual differences of both programmes these guidelines are extremely similar. Guided by the rationales and criteria of the programmes, in both programme in the pre-proposal stage the peers are asked to make judgements as to whether:

- the network is feasible,
- its research programme needs modifications,
- the applicants are qualified enough and
- the network mode is appropriate and needed for the added value envisaged.

In the main evaluation of the full proposal the peers are requested to judge the proposed network along *scientific* (e.g. excellence), *structural* (e.g. multi-disciplinary, synergies, coherence, team) and *institutional* (e.g. capabilities of location) criteria. In addition, they need to assess the individual projects, as regards both its "own scientific merits" and its fit with the ensemble of all sub-project and the overriding aims.

The basic evaluation guidelines for both programmes are almost identical. While the full text is given in Appendix 3, in the following we highlight the differences between the two programmes. In addition to the FSP guidelines, in the scientific part the peers for SFB are asked to carefully check the appropriateness of the network against the criteria and aims of the SFB (for the FSP this is in essence equally true, the SFB is simply a stronger confirmation). In the structural part the SFB peers are asked to assess if additional funding sources would be available for the proposed network and if the organisational demands for a SFB are met by the organisational and governance structure of the network. As regards the institutional location of the networks, the importance of the infrastructure is stressed slightly more for the SFB, regardless of the multi-location principle of the FSP.

Next to the ex ante evaluation, both networks have interim and final evaluation. For the FSP the interim evaluation is after the third year, for the SFB the interim evaluations are generally after the third and the seventh year. The basic guidelines are the same as in the ex ante evaluation, however, in the interim evaluations the networks are of course judged against their work plans and against the recommendations given in the ex ante evaluation.

Excurse: International Comparison: Two Stage Procedures
As far as detailed information is available nearly all programmes we looked at dispose of a two-stage-application-procedure, i.e. in the first step a short proposal / research intent is written, if this is positively evaluated a full proposal is submitted in the second step. This procedure is well established and helps to save a lot of time and efforts for the applicants as well as for the research funding organisations. Generally the research funding organisations play a very important role as they are in close contact with the applicants / researchers at least during the ex ante-selection stage where they help to assess the chances of a proposal.

Two stage procedure: German CRC

Before submitting a proposal there is usually an informal consulting dialogue with a small group of scientific representatives and members of the DFG. Since 2001 the results of these dialogues are discussed within the Senate, in a comparative matter. They now have the character of a pre-selection. This procedure was introduced because there has been increasing criticism due to the large number of rejected CRC proposals. However, the dialogues are expected to be further an opportunity where constructive criticism takes place (WR 2002, S. 12f.).

If a new CRC shall be established there is a two days on-site-visit where beside the reviewers also two so-called „Berichterstatter" from the Senate committee and representatives of the university participate. Additionally representatives from the federal state, the state itself and the Science Council are invited. The decision itself is made by the approval committee to which members of the Senate committee and representatives of the federal state and the states belong. The decision is based upon the protocol of the visit and information from the reviewers (WR 2002, S. 13, 34). As there were more positively evaluated CRC proposals than resources, the DFG changed the procedure: now a ranking is made based on the number of Yes/No-votes in order to ease the selection (WR 2002, S.15).

Two-stage procedure:eSwiss NCCR (National Centres of Competence in Research, Natinoale Forschungsschwerpunkte) programm

The evaluation of contents of the pre-proposals is preceded by a formal check by the NCCR Programme Office. For this check, the SNF shall designate an evaluation committee that shall be composed of some 15 foreign experts as well as members of the National Research Council[64]. The committee shall meet once at the head office of the SNF and evaluate each pre-proposal. The supporting documents submitted and the written reports by two members of the committee in each case shall assist in this task. After the individual check, the committee divides the pre-proposals into three categories (A = chances of success good, B: doubtful, C: slight). Already at this stage a first joint meeting shall take place between the Home Institution (Rector's Office), GWF (Group for Science and Research) / Federal Office for Education and Science (FOER) and SNF at which structural aspects are to be discussed. GWF/FOER are not responsible for the evaluation of the content. All those whose pre-proposal have been admitted for evaluation can submit a NCCR proposal which again is evaluated by an international expert committee. Each committee shall be chaired by a member of the National Research Council. The SNF shall pass on the NCCR proposals recommended for implementation to the GWF-GSR for evaluation with regard to research and higher education policies.

[64] For the Call 2003/2004 11 experts of the Evaluation Committee stem from Germany, 2 from the Netherlands, one from Austria, UK, Canada and Denmark. Three of the reviewers are women. For pre-proposals from specific subject areas the SNF used additional written assessments by experts who were not members of the Committee (http://www.snf.ch/en/rep/nat/ nat_ccr_eva. asp).

7.1.2 Assessment of the Evaluation Procedure

The evaluation of the application procedure and peer review process is based on two major sources. First, all evaluation reports both of the accepted and the rejected proposals have been analysed. Second, in the interviews with applicants (again both successful and rejected) the experience with the evaluation has been asked for.

Quality of the Evaluation Procedure

Overall, the FWF network evaluation procedure can be judged as being of high quality. It is transparent, follows clearly defined criteria, separates decision making from evaluation and takes advantage of the international dimension of science – thus providing quality check at international level and promoting its own scheme and network internationally. In addition, efforts are made to avoid systematically a clash of interests, scientific reporters, board members and peers are excluded if any potential conflict of interest becomes apparent.[65]

Moreover, it is reliable in the sense that there is a remarkable consistency over time regardless of the scope of changes in the peer team evaluating one specific network. This points towards clear, consistent guidelines and assistance given by the FWF. At the same time there are many examples that the peers do not judge the networks in an overly mechanistic way. There are many examples for flexibility of the peer reviews, where the peers have taken positively into account that changes in context conditions or internal team structures have led to changes in the network programme. This positive overall judgement is not only based on the review analysis, but also acknowledged by all interviews conducted in this study.

Nevertheless, there are issues of critique and leverage for improvements. The following paragraphs thus concentrate on aspects that still can be improved or discusses various options for the future.

The Two-stage Procedure in the Application Phase

The *two-stage procedure* applied by the FWF serves as a cost-efficient quality and appropriateness check. All in all, this function is served very well. Since 1994 only two applying networks that have taken the effort to draft a full proposal (one SFB, one FSP) have been rejected. The rejection takes place in

[65] For large FSP with broad representation of universities this can occasionally lead to structural problems, as many board members represent the university system ex officio. Should this automatic representation of university staff is changed, the problem would be eased as members of the board would be elected ad persona and not in their function as university rectors.

the concept phase, in some cases[66] on the basis of a second, re-drafted concept. Thus, the major issues like topicality, excellence, originality, coherence and added value are judged in this pre-proposal stage. If an applying team is requested to draft a full proposal, it can be sure that in principle they are about to design something promising. In addition, the concept is much shorter than the full proposal and does not involve so much administrative preparation; this quality check is highly efficient as it saves time and money for the full proposal writing.

The analysis of the proposals and the interviews show that for the full proposals the written comments of the 2 to 5 peers are extremely helpful. Although the written comments are of different quality, in general the peers take a great effort to give detailed and comprehensive comments that serve as recommendations for the full proposal and give hints as regards the scientific direction and relevance as well as the potential teaming. Moreover, they often put it into the international scientific context, providing the FWF and the applicants with a sound judgement of international relevance and competitiveness and with hints as to improve the standing of the envisaged networks. In the interviews there were a few critical comments regarding the first proposal stage as the written, anonymous pre-proposal evaluation does not allow for feedback and explanation and as the verdict of a few peers that have no opportunity to discuss with the applicants decides about the research activities of a large team of scientists.

Assessment and Recommendation:
The high standards of the two step procedure with external, international experts is – in the international comparison (see Appendix 2) – remarkable. In most cases discussed in the international comparison, the pre-proposal is checked and assessed by internal staff of the funding organisation.

For reasons of efficiency written evaluations at the first stage are sensible. But even more important this efficiency argument is the fact that the quality and differentiation of the recommendations based on the written reviews seems to be much better than recommendations given in a hearing. The analysis produces the impression that the hearing minutes in the full proposal stage are much more consensual and less differentiated than the aggregate of the 2 to 5 written comments of the pre-proposal stage.[67] Thus, there is a trade off between lack of feedback (as complaint by applicants that have been rejected)

66 Five SFB proposals and three FSP proposals that have been asked to re-write their concept (but not a full proposal) for a second written evaluation

67 The trade off between the advantage of a hearing and the advantages of the prospoals is dealt with below).

and the lack of possibilities to explain one's case on the one hand and the quality and usefulness of the feedback of written comments on the other hand.

This trade off is solved in the Swiss NCCR (National Centres of Competence in Research, Nationale Forschungsschwerpunkte), where there is a combination of written procedures (by two foreign experts) and a hearing even in the first tage (see box above).

Benefits and Pitfalls of the FWF Hearing Process
The praise of the written review process as an important source for quality improvement of the applied networks points towards the more principle question which type of peer review would be the most efficient and effective. All interviewees praised the hearing in the second stage as an indispensable means of feedback with the international experts. In light of the application rate in the second, hearing-based stage this assessment is not surprising. Certainly the possibility to clarify and focus the envisaged research programme and to present the network as a team struggling for common funding is important in the whole process of the emergence of the networks. This is the more true as the written comments on the concept have already given differentiated input for the envisaged network activities.

However, the analysis of all hearing minutes since 1994 shows that the minutes of the hearing are formulated very consensually. In contrast to conflicting views in the written reviews the discussion of the peers during and after the hearing is summarised without giving dissenting views. Moreover, there is no real weight given to individual aspects of the recommendations and issues criticised. The lack of clarification and feedback once the hearing minutes and review reports are sent to the applicants is seen as a problem by many participants. Some applicants feel left alone with a very concise report on the hearing and often feel to lack interpretation of the result. Possible as it may be to discuss the minutes with the scientific reporter or even with individual peers *ex post*, this is the exception rather than the rule. Some applicants interviewed were not entirely clear in how far this is accepted or even wanted and backed off.

Assessment and Recommendation: the combination of written review on the one hand and the hearing on the other hand is able to join detailed, differentiated input to the applicants (first stage) with direct, personal feedback (second stage). It is *efficient* as it saves costs for rejected applications. This combination should be conserved.

However, the hearing could be made *more effective* through some minor adjustments. First of all, some applicants, successful ones and rejected ones, argued that they would have liked to have more time within the hearing to explain their case, and more intensive feedback. Thus, the hearing should be organised even more interactively and the applicants should be ready to answer further questions regarding the team (cooperation history etc.), their individual projects and the overall fit of the bundle of projects. Second, after the reception of the written reviews (first stage) and after the completion of the hearing (second stage) better possibilities for feedback loops should be foreseen in order to make it easier for the successful applicants to apply to the recommendations given in the hearing minutes. This feedback could be moderated by the scientific reporter of the FWF or – provided the peers agree – take place in direct, bi-lateral contacts afterward. This additional feedback loop should, however, be limited to the successful applicants as scientists interviewed feared that a general feedback would produce additional pressure on the peers making functioning as a peer less attractive. In addition, it should be made mandatory that all relevant people should be present in the hearing, i.e. not only individual project leaders but also the leadership of the universities that are committed in order to demonstrate backing and to be ready to answer critical questions of the Peers. As the backing of the university will become more important in the future, such a participation, both in the ex ante and the interim evaluation should be made obligatory and be a part of the Peer`s judgement.

Finally, the hearing minutes should weigh the individual critical aspects and contain dissenting views in order to ease the decision process in the board and – even more important – to ease the adjustment process for the applicants. It is clear that each adjustment process, especially regarding the composition of the team and the formulation of long term visions – triggers a trade off consideration in the applicant team between the present and future transaction costs of adjusting and the importance of this adjustment for the success of the project and further funding. Thus very clear signals are needed.

Selection of Peers

The FWF provides for a flexible number of peers in both stages in order to take the disciplinary spread into consideration. Thus, in very interdisciplinary and heterogeneous networks up to 10 peers are invited to judge applications. As all peers are non-Austrian and as the applicants can name individuals that they do not want to be Peers, conflicts of interests are scarce.

Thus, the basic feedback of applicants to the FWF network programmes has been that the peers selected for peer review have been of very high quality and have given sound judgements and most valuable feedback. Beyond the principle question of having more possibilities for feedback with the peers, the overall judgement was very positive.

However, there is an in-built dilemma in the evaluation process of interdisciplinary networks aiming at new combinations and the establishment of new research fields. By definition there are no experts that could judge the real merit of such new combination. The more daring a network becomes, the more difficult it is to select appropriate peers. For example, one member of a very inter-disciplinary network argued that in the ex-ante and the interim evaluations the coverage of disciplines was unfortunate with one key discipline not represented in the peer panel. A further dilemma that is only partly checked by the ex ante identification of scientists that should not act as peers is the problem that the peer review process is mis-used in the context of a clash of scientific paradigms. One of the interviewees judged the negative aspects of the evaluation of his proposal as based on entirely different ontological and epistemic views of the majority of the international peers representing a different school of thought.

The selection of peers needs, moreover, to find a sound balance between continuity of peers to judge the development over time and a change of peers to induce fresh perspectives. For 22 SFB evaluations, the peer names for interim evaluations are available. Altogether 143 peers have been appointed out of which 66 have been new compared to the previous evaluation. The overall renewal rate of 46% could be judged as a good balance, however, it ranges from 0% (two cases) to more than 75% (four cases), both appearing a bit extreme to strike the balance needed. In any case, there is a very strong consistency of the assessment over time for one specific network that is not strictly related to the consistency of the peer team.

Finally, the question has been raised regarding the possible payment of peers for their duties. The interviewees conducted show mixed results, and so does the international discussion (below), although there seems to be a tendency in the direction of payment.

Excurse: International Discussion – Payment of Peers

As far as public research funding organisations like DFG but also ministries are concerned, the reviewers work honorary in Germany. But with the increasing number of evaluations which take place for example in the context of performance-based university funding the honorary principle is object of serious discussions. The main reason is that it is becoming more and more difficult to find and motivate qualified reviewers and that due to the work overload of the reviewers the evaluation processes take too much time. Foundations which offer a certain amount of payment can show much faster evaluation processes. A further argument to pay some expense allowance *or royalties is that more influence can be exerted to accelerate the evaluation processes. Additionally it was mentioned that only those recommendations for which one had to pay at least a certain amount of money are realized afterwards. Finally, if policy-makers stress performance-based funding, it should be recognized that reviewing is a performance and should thus be paid or at least rewarded in the internal allocation mechanisms. Arguments against the honorary principle are: reviews are part of the duties of professors; reviews are already now quite expensive and would become unaffordable; false incentives; it is difficult to define a suitable payment especially if the impression of corruptibility shall be avoided; danger that some scientists specialize on reviews and neglect own research; payments does not help to solve the main problem, scarcity of time; problem of science policy if some agencies pay and some do not.*

Recommendation: The selection of strictly international peers based on FWF lists should be continued. The attempts made to cover the most important disciplines of a network should be even strengthened. Ideally, initial information on the applicants on the basis of the disciplinary spread (not the identity) of the peers could serve as a check as the applicants could comment and ask for some disciplinary adjustment. In addition, the selection of peers should try even more to find not only a collection of experts for the various disciplines, but should actively look for those experts that might have similar interdisciplinary experience. This is, of course, an extremely hard task given the uniqueness of the individual disciplinary constellations.

As regards the danger of inserting paradigm clashes into the review process one could think of providing for some space in the proposal forms in which such potential clashes could be mentioned. This would point the scientific reporter of the FWF to the potential problem, and, if the problem is indeed existing, could induce him to select the peers from different scientific paradigms in order to check for reviews based on scientific interests. As regards the renewal of peers over time, the FWF attempts to strike a sound balance between renewal and consistency and should continue to do so, avoiding both extremes.

Coverage of Aspects and Evaluation System in the Review Process

The peers are given clear guidelines as to the leading questions they have to address when judging the applications. These guidelines reflect, of course, the programme guidelines. The quality and scope of the written reviews is very different. Some written reviews have very broad and detailed comments on almost all criteria of the programme while others are rather sketchy without evaluating in any real detail the individual sub-projects. On aggregate for most applications the major issues are covered. The minutes of the hearings are rather short and highlight the major results of the peer discussion.

Most criteria of the programmes are covered in both stages, most importantly the scientific excellence (competitiveness), topicality, working plan, the internal coherence and the adequacy and quality of the team. Especially in the last years the reviewers always have detailed comments on the coherence (overall goal, fit of single project into overall rationale, co-operation history) and the network team, arguing for changes in topics as well as the team itself (see below).

However, there are again and again certain gaps in the peer review documents, both in the written reviews (including the rejected networks)[68] and in the final hearing. The reason for this seems to be that many peers do not consistently use the questionnaire given to them in order to check for each of the criteria in the programme.[69] In addition, the evaluators differ in the importance they attach to the various aspects of the programmes, reflecting – maybe – the importance the peers think these aspects should have in the programme. For example, the *training* aspect or the *backing of the host universities* and institutes are severely under-represented in some of the evaluations. Similarly, the representation of women in the network is neglected in some cases. From the analysis of the evaluation it appears that this is a consequence of a bad reporting of the networks rather than reflecting that evaluators would not be interested in this dimension. Further aspects only mentioned occasionally are the choice of scientific fields, the networking with Austrian scientists outside the network, the visibility in the broader audience, the level of international contacts, the commitment of the regions and municipalities and – interestingly – the future of the SFB networks. Sometimes this under-representation of aspects changes over time if they are explicitly highlighted in the network reports.

Next to these inconsistencies regarding the coverage there are various systems of evaluations to be found in the review documents across the last decade. Both in the ex-ante evaluation and in the interim reports there is a mixture of networks and sub-projects that are formally rated using some sort of scaling and those that are simply judged in qualitative terms. The scaling mechanisms differ in the degree of differentiation, ranging from a 3 category scale (A, B, C; in the early SFB, FSP) to a 0-100 % scale.

68 We have analysed all reviews of rejected networks as regard the coverage of aspects and the reasoning for not funding.

69 This is based on the fact that the final evaluation reports did not always contain the questionnaires filled in by the peers, this being, in fact, more common for the FSPs than for the SFB.

However, there has been a clear tendency to use formal scaling in the last couple of years. At the network level since 2000 almost all SFB and FSP networks have been evaluated with the % rating. As regards the subprojects, the tendency is less clear. In the FSP even in some more recent evaluations, the single subprojects have not been rated with a formal scale, in the SFB the latest seven evaluations used formal % ratings. Overall, there is a trends towards more uniformity and formality in using the rating system (1 to 100%).

Recommendations: The review process should ensure that the the guiding questionnaire is actually used and filled in and thus complements more open text that is produced. For the hearings the questionnaire could be used ex post as a kind of check list. It should guarantee that all criteria in the programme guidelines are looked at and commented, and if proposals fail to be conclusive on certain dimensions this should be noted and counted as a negative.

Check for Quality and Coherence
The use of scaling can be an important assistance in thinking about each and every aspect, comparing the relative quality of the various criteria within one network and communication between the peers. The scaling, however, entails some risk as it suggest a degree of objectivity and formality that might back-fire especially if it should be – in case once the budgets for successful funds exceed the FWF network budget – used to select between networks. This is especially true as the scaling might differ between disciplines. Therefore, scaling should be systematically used but always only as a complement to qualitative assessments.

A stronger uniformity of the guidelines for the evaluators should also lead to a greater uniformity of the review reports, although it seems that the FWF is working already towards this goal. This would be especially important once the networks should be selected on a more comparative basis if budgets to be granted exceed budgets available for the networks.

Within the last 10 years the peer review has recommended to fund 20 out of 34 SFB proposals and 14 out of 28 FSP proposals. As seen in Chapter 4, in addition to the simple "go – no go"- decision the peer's verdict has two further concrete consequences: First, they adjust the budgets to what- in their judgement – is needed in order to fulfil the task envisaged. On average, almost 40% of the budget asked for is cut. This indicates how important the criteria of cost-benefit ratio and added value are for the peers in the FWF procedures. These cuts have, one way or the other, effects on the team of the individual projects that are cut, as they need to reduce not only infrastructure, but also personnel costs. Moreover, the peers have stopped three networks (two SFB and one FSP). This practice of stopping whole networks during their lifetime is most common in the Nordic countries. Most interim evaluations there use the instrument of well prepared -site-visits to assess the quality and achievements made by the centres.

Second, the peers reject single sub-projects altogether, on average for both programmes roughly 15 % of the sub-projects are rejected. These rejections are done on the basis of two considerations: check for quality and check for coherence. Each sub-project must meet the excellence criteria of the FWF, the peers are asked to judge each project as if it was a single project within the FWF scheme. Moreover, the sub-projects must be complementary to the whole network; they must have a function in the overall research strategy and have interfaces with other projects. In some cases these two principles may contradict each other, as individual sub-projects might fit very well in the research programme but not meet the normal FWF quality standards. The trade off-considerations in these cases cannot be judged, as we are not able to judge the quality and coherence ex post. In our interviews there have been a few voices assuming that it is easier to get a single project funded within the network schemes as the quality standard for individual sub-projects would not be equally high as in single FWF projects for reasons of network coherence. There is an acceptance rate of about 45% for the sub-project within the network schemes (SFB roughly 46%, FSP roughly 43%)[70]. This is somewhat lower than the overall acceptance rate of FWF projects (single ones and sub-projects within the network programmes) which is 49,6%**.**

However, the quality check is not finished with the ex ante evaluation, i.e. sub-projects that might have got a chance for the reason of coherence and added value of the network are judged with high standards in the interim evaluations. In 34 interim evaluations in the SFB programme 54 individual projects have been stopped, and 6 interim evaluations of the FSP programme have led to the termination of 8 subprojects. In sum, in the SFB programme 35% and in the FSP programme 22 % of all sub-projects initially applied for in the granted networks are rejected or terminated (see Table 7_1). Moreover, there is an internal quality check within the networks, the social dynamic tends to function as a further selection mechanism. Thus, a final, sound judgement if this quality check within the network programmes on the level of sub-projects functions better or worse as compared to the single projects cannot be made here, from the analysis of the evaluation documents over time

70 These figures have been calculated on the basis of the average number of applied sub-project in granted networks that was taken as a prioxy for the overall average of all applying networks.

and from the majority of interviews conducted it is fair to say that there are strong indication that quality control works.

Table 7_1: Rejection data FWF network programmes 1994 - 2004

	SFB	FSP
Acceptance rate of network	54%	50%
Number of applied subprojects[71] in granted networks	293	129
Number of granted subprojects[72]	247	108
Rejected subprojects in ex ante evaluations	46	21
Granted subprojects per network	12,35	7,71
Rejected (in ex ante evaluations) subprojects per granted network	2,3	1,4
Approval rate subprojects (for the granted networks), ex ante eval.	84%	85%
Rejection of running sub-projects in interim evaluations (in brackets number of interim evaluations considered here)	57 (34)	8 (6)
Total of rejected / stopped subprojects (ex ante and interim evaluation)	103	29
Percentage of sub-projects rejected or stopped out of all subprojects	35%	22%

Source: FWF, network reports. Compilation and calculation: Fraunhofer-ISI 2004

Excurse: International comparisons – Meaning of Evaluation

Evaluations play a crucial role in all programmes. First of all, all programmes are based on competition, i.e. an ex ante selection is carried out. Usually after three or four years, midterm and. interim evaluations take place. Also ex post evaluations are made, but due to the average age of the programmes, they are not as frequent as the other two evaluation forms. In all evaluations, international peers play an important role, except from Germany where mainly national peers are involved[73]. One reason for this pattern is that the applications and scientific reports are usually written in German which makes the successful selection of foreign peers difficult.

Example: German CRC

One improvement reflecting the huge amount of evaluation efforts due to the increased number of CRC proposals was the prolongation of the promotion periods from 3 to 4 years. Expectations are a better continuity of research, more chances for risk projects, a more profound basis for decisions on proposals and the reduction of the number of evaluations (WR 2002, p 16).

71 This number includes all those subprojects that have been granted initially, i.e. also those that have been terminated in the first or second interim evaluation.

72 This number includes all those subprojects that have been granted initially, i.e. also those that have been terminated in the first or second interim evaluation.

73 In 2001 the share of foreign reviewers was around 3,3% (AK FTI-Politk 2001)

7.1.3 Effects of the Peer Reviews on the Network Performance

The peer review process does not only select, but shapes the network, both as regards form (team, cooperation structure) and as regards the content. Indeed, individual peers take strong efforts to coach the networks in order to assist in team-building and the formulation of coherent research strategies.[74] Thus, peer review has particularly strong effects on the networks. The interim evaluations show that the compliance with the recommendation of the peers is considerable, even if in some cases non-compliance is heavily criticised.[75] Although compliance is expected, the FWF does not connect further funding too closely with compliance to the recommendations made in interim evaluations, as it has made rather bad experiences with a strict conditioning.

Above we have seen the interference of the peers with the team building process through rejecting or stopping sub-projects and through cutting funds. In addition, the interference with the team building process also includes recommendations to take on board further research teams in order to strengthen coherence or to fill a scientific gap that needs to be filled in the perspective of the reviewers. The team building recommendations are strongly connected to the content, as in many cases for the rejected and in all cases of amended sub-projects the justification is scientific coherence and critical mass in a specific field.

What effects does the interference with the team building effort have? Again, there is no simple or uniform answer. Across the board the networks take the recommendation of the peers rather seriously. The interim evaluations show in the majority of cases that the peers are content with the way their recommendation has been taken up. The analysis of evaluation reports over time and the interviews show many examples in both networks in which the elimination of a number of sub-projects both in the ex ante-evaluation and the interim evaluation has shown very positive effects on the scientific development of the networks. For example, in one FSP 4 out of 10 sub-projects in the ex ante evaluation and one further in the interim evaluation were rejected or stopped. The overall development of this network has been excellent. Similarly, one team applying for an SFB has been requested to re-draft the proposal and to severely change the team. The second concept and the full proposal were then rated excellent and the SFB was granted, with a

74 The hearing minutes of interim proposals show in some cases even a sort of pride that a certain network has succeeded in its teaming effort over time with the assistance of the peers.

75 Non-compliance seems to be a problem for the interim evaluation of FSP and the last interim evaluation of the SFB, as after these last interim evaluations the networks seem to loose fear of consequences of non-compliance.

special praise for the interdisciplinary networking and teaming achieved. The leaders and initiators of networks actually rely on the peers as they function as a quality check for the whole network and its sub-projects and welcome a strict rejection of individual sub-project ion the basis of quality and coherence.[76] In some other examples, the peers for a SFB network recommended enlargement of the network with a team from another city, accepting the location split to the benefit of an enlarged and focused research effort.

On the other hand the interference in the team building effort can also become problematic. The applying consortium is the result of a negotiation and trust building effort between individual teams from different institutes and in most cases different universities. This social process is even one of the merits of the network programme in its own right as even rejected proposals have some kind of social effect. While the rejection of individual teams – to our knowledge from evaluation reports and interviews – has not produced problems as regards the team coherence, the request to take on board additional sub-projects and distinguished scientists has had detrimental effects in a few cases.

Example of a FWF SFB
In one SFB the enlargement of the team led to a reduction of the social coherence as the newcomers did not identify themselves with the overall thrust of the network and did not adjust their research programmes to the peculiarities of the network. At the same time, the initial core team from one university had to open itself to new lines of research and vision building for the network that was not in line with their initial idea of the network. What complicated matters was the fact that enlargement meant also to have an additional host university, which did not identify with a SFB network that did not have any weight for the university. Thus, the overall backing of the network was reduced. In addition, the peers had linked their team building recommendations with the request for more daring, more radical approach for the network including a disciplinary enlargement. This vision was then operationalized by the network, but apparently could not be shared in all consequence by all members. Albeit the network showed some excellent output and new interdisciplinary contacts, it did not succeed in fulfilling its new research programme.

Assessment and recommendation: The analysis of the evaluation reports showed that there are two rationales for peers: *judges* and *supporters*. In the scientific community of Austria the evaluation is regarded as an explicit merit for both reasons, they give a test of quality and insert ideas as to how improve the projects. The intensity of assistance both as regards structure and content is of course dependent on the individual peer and assistance should in principle

[76] One interviewee even welcomed the peer review as some kind of external judge stopping “free riding” on their networks.

not be limited, as it has definitely shown positive effects in many cases. However, the FWF should highlight to the peers that they need to take into account the specific contexts of the networks in any case and that they need to double check the effects of their recommendations – both ex ante and in interim evaluations – not only on the scientific coherence but also on the social coherence and on the internal dynamics as regards the backing of universities. Especially in cases where the peers take a strong stand in content or team recommendations the feedback process should, as already mentioned, be improved.

7.2 *Implementation issues*

7.2.1 Proposals, Monitoring and Reporting

Quality of the Proposals and Interim Reports as Basis for Evaluation

The quality of the proposals varies quite significantly, with some proposals being well drafted, showing complete lists of participants and activities foreseen, cooperation structures outlined. However, even networks that have been funded have been heavily criticised for having proposals that were written without the care needed.

The formal check of by FWF secretariat should be stricter as regards the coherence and comprehensiveness of the proposals. From our own analysis and from the peer review statement it is clear not only that the quality of reports is very diverse, but also that in some cases not all funding criteria (e.g. training aspects, gender mainstreaming) are dealt with in appropriate detail. In some cases the provision taken to build up cooperation and internal exchanges are weakly demonstrated. The formal check should be more than an eligibility check but should assess if all programme criteria are dealt with in appropriate details (without – of course – judging the appropriateness of the content).

There should be a uniform structure of the proposals and the interim report in order to ensure that all aspects of the programmes are covered in the necessary detail. Evidence from the peer review analysis shows that a clear network structure, working plan and central aim contribute to the possibility of peers to judge the SFB and to control it in the interim evaluation. Emphasis is given especially to the training aspects of the networks and the need to demonstrate the support of universities and institutes should be included more systematically, as the former will be increasingly become a source of legitimating of network funding and the latter will be a major success criteria for networks.

It might be considered to demand a commitment report in the interim reports making it obligatory to demonstrate the scope and intensity of the university backing and giving the networks leverage in their internal discussion with the host organisations. This would ease the judgement of the peers in this respect. Peers criticise the written interim reports and proposals as partly not written well. The quality check needs to be improved. Clear presentation of network structures and cooperation activities, initially and in the interim reports, cooperation monitoring and proof of structural provisions for cooperation. The reviewers acknowledge that changes of emphasis are necessary in a dynamic field, yet point out several times that they should be better documented in the reports (what was proposed initially, which were the previous goals and expectations and what and why were they changed). Such documentations would help reviewers to better evaluate the achievements

Costs of Re-drafting and Re-application

In some cases, especially when re-drafting of the concept is demanded, the application procedure is rather costly for the applicants. They can get some application financing but given the quality and quantity asked for in the evaluations this does not really cover all costs.

International Comparison Data

It is normal for research funding agencies themselves to be responsible for the monitoring of the programmes through a process of annual reporting. In the Finnish case given below, the responsibility for monitoring goes to a special board. This system keeps the work of the project under relatively permanent scrutiny of individuals with the status of international level scientists.

Example: The Finnish CoE Programme

An interesting characteristic for the monitoring of a CoE is the existence of a so-called Scientific Advisory Board (SAB) that consists of 2-5 international top level experts. This board is nominated by the Academy and has the main task of supporting, strengthening and monitoring the scientific work of the CoE. Additionally these boards may proactively propose improvements. The SABs meet annually at the CoE, also other actors like observers from the host organisation, the Academy and potential further financiers can join the meetings. After three years the SABs deliver statements of the CoE based on a detailed report written by the Centre (Malkamäki et al. 2001, p.37).

7.3 Management of the FWF

Administrative Support of FWF

On the whole, the response of interviewees about the level of help which they received from the FWF was strongly positive. The unbureaucratic behaviour of the FWF staff is praised by many in their relation with participants in the network projects. The help received from FWF was found to be most satisfactory and respondents had to be pressed to give evidence of any kind of problems that they might have encountered. However, most respondents did not report any problems with the administrative support they had received from the FWF. The FWF is also noted to be politically as well as scientifically neutral, the monitoring is not too burdensome, the duration of administrative procedures is regarded as adequate and widely accepted and the supportive role in day-to-day management is widely recognised.

However, some criticism was raised as regards the manpower responsible for the network programmes. In their view, the broad responsibility of these FWF staff should be enhanced and they should be more pro-active in the influencing of the network programmes (not in the integration into the political process as the neutrality is regarded as a key asset). The normally good personal relationships between the FWF and FWF-referee generally ensure that insights into the report/ examination processes can be given. However, a more influential role for the FWF was suggested by some.

International comparisons reveal problems in research council and support organisations, as well as considerable good practice. Research managing organisations in Germany as well as in Switzerland locate responsibility for networked programmes in specific departments. Furthermore, it is noted that departmental cultures of evaluation can vary considerably within governments which gives rise to inconsistencies.

In Switzerland, the committee in charge of the evaluation of the SNF has criticized the operation of the NCCR's selection procedure because it did not meet expectations with regard to professionalism and scientific independence (SNF-Evaluation, p. 9f.). Problems were also noted in department IV of the SNF where also the NCCR are administrated. Here it was claimed that the scientific level and the quality of the evaluation processes are seen as not reaching the level of the other departments (SNF-Evaluation, p. 16).

As this review was mainly focused upon the scientific credibility of the networks, the respondents were mostly concerned to focus upon this area and not upon what to them might appear to be secondary considerations.

Nevertheless, we regard the issue of design and implementation of the report as of considerable importance, even if the issues often appear of only secondary importance to the academic staff we interviewed.

Financial Support of the Networks

One of the biggest problems for the universities is the lack of overheads paid by the FWF network funding. This represents a limitation to the attractiveness of the networks as a successful application of a network first of all means additional binding of overhead resources for these activities and a reduced degree of freedom for the university leadership and those faculties that are not involved in the network funding. With a payment of overhead the immediate justification for and legitimation of networks will increase. Most interviewees suggest that in order to maximise the integration effects the overhead should be paid to the university as such and used for the general institutional funding rather than added to the budget of the network or the institute that leads it.

Financial Management of the Networks

There is no clear picture as regards the possibility to use FWF network funds as leverage for other funding sources. Some interviewees complain about the limited possibilities to use the network funds as additional funding to existing sources. In the early years of the SFB, for example, the FWF wanted the recipients of network money to concentrate on the network projects and thus not to be engaged in too many other funding schemes in parallel. On the other hand, some scientists regard this as no major problem and argue that the FWF network funding should be high enough in order to avoid the necessity to raise additional funds as a growing number of project funding sources putting additional demands on the networks increases the likelihood of loosing focus.

The new system in which the networks are funded via the administration of the universities raises concerns with network leaders that there will be too much rigidity. The future funding scheme should thus provide for more flexibility even in the new system, mainly as regards ad hoc resources for integrative activities and activities related to the improvement of the training dimension. Networks are living entities, and they cannot be designed ex ante in all of the integrative and training aspects that might emerge during the course of the activities. It goes without saying that the spending of such a small share of global budget must also be subject to financial controlling and auditing ex post.

Funding for Sub-projects
A further issue of concern for the participants in networks is the rather low funding per sub-projects within the networks. Participants argue that network projects are funded less well than single projects, while the transaction costs of networking should even lead to higher budgets per sub-project.

Budgetary Control Systems Within the Networks
Finally, there were some comments received from one source suggest that it may not be possible to switch money about internally within projects very easily once the overall budget of the project has been agreed. If for example there is a demand that more networking activities take place, it might be that there is not enough flexibility within the rules of the projects to permit changes of emphasis and strategy. This might be seen to be a problem of the FSP, whereas the SFB appear to have far greater flexibility within their re-allocation and movement of funds around the networks; however, problems have been also reported about SFB budgetary control, which is considered to be too tight and restrictive. This may be a university ~ project relationship management problem, and should be addressed within this context, a context which is likely to grow in importance with university reform.

Administration
The administrative coaching of the network is an important task of the FWF. While universities appear to interact well with the FWF systems, there are some instances of where more could have been done to ensure that the university operated procedures which harmonized with those of FWF.

Development of the Network Model
A number of interviewees commented on the FSP and observed that its history has been characterised by a number of changes and adjustments as regards their shape and design. Apparently, for a couple of years now the FSP scheme is regarded as stable and well established calling for ambitious research cooperation and by some regarded as a "success model".

8. Future Challenges, Major Findings and Recommendations

This section discusses the major challenges the FWF programmes face in the immediate future and gives recommendations based on the overall findings of the evaluations (8.1). In doing so, Chapter 8.1 reflects the major challenges discussed above in Chapter 4.3. Chapter 8.2 will then give more concrete and fine-tuned recommendations as for the concepts and implementation of the programmes. Section 8 will close with an overall assessment of the FWF network programme (8.3). In this section, major recommendations are printed in bold and italics

8.1 Discussion and Recommendations as for Future Challenges

The Changing Relationship Between Networks and Universities

From the perspective of universities, the embeddedness of networks depends on their strategic value and personal commitments. In principle, the strategic value of networks, especially as for SFB, seems obvious. The interviews indicate that university leadership in general regard FSP as being less important for the strategic development and profiling of the universities.[77]

Conceptually as well as in the perspective of the vast majority of interviewees, the strategic value derives from a couple of clear benefits of the networks: a large number of scientific sub-projects are evaluated externally, intra-university departmentalisation is broken, critical mass and stronger scientific profiles can be built up, the national and international visibility and attractiveness of the university increases, scientists are trained to cooperate and manage complex projects, often reaching beyond the limits of the university itself. Of course, the additional funds coming in are an important argument, but the problem for the time being is that there is no overhead paid for the universities, which limits the financial effect considerably. Thus, the non-monetary effects of the networks are rated extremely high by the interviewees and are at least equally important.

Regarding the institutional backing of the universities for the SFB, the peer reviews and the interviews show a clear picture: institutional backing is crucial for a sound and sustainable working of networks, especially as regards structural changes within the universities and the motivation of researchers to engage in SFB projects with a medium to long term perspective. In a number

77 This is also reflected in the poor reporting of the networks on the integration into the universities (see Chapter 7).

of cases the peers have strongly criticized that the universities have not lived up to their commitment as regards longer term positions.[78] For example, in deciding about new scientific contracts at the universities the SFB needs have often not been taken into consideration adequately from the perspective of peers. Interviews, not only with participants of SFB but also with external experts, support this assessment. The problem seems to be that the commitment given by the universities is not legally binding, and the problem facing the networks and the FWF is that until there now there has been no means of demanding support in any major form from the universities when it has been needed.

This unfortunate situation, which exists for a number of SFBs, is largely due to a lack of willingness and responsibility on behalf of the universities for strategy building. The Austrian universities had until recently only a modest strategic research planning and did not have the financial and administrative freedom to build up coherent strategies. All interviewees in universities – both within existing networks and within the leadership of universities – agree that this situation has changed and will continue to change under the new University Law. The universities will become more autonomous corporate institutions with more responsibility for the leadership of the university and less collective decision-making, thus enabling stronger focussing of resources. The new "Leistungsverträge" (performance based funding contracts) will make it increasingly necessary to stress performance that can be proven by publications and externally reviewed achievements.

The network programmes provide such mechanisms as strong external review process is organised by the FWF which increases the likelihood of good performance as compared with work done within the normal institutional funding framework. In addition, universities more and more realise the potential learning effect of the networks (cooperation, management) and the better framework they provide for training of young scientists in general (see Chapter 6). In all interviews with officials from universities it became obvious that external funds, external quality control, cooperation learning and training are the features which will make the

78 A simple indication for the lack of integration within the universities and the importance attached to them might be that only a minority of FSP and SFB have homepages that are clearly connected to the homepage of the leading institute or even the university. In most cases the homepages are connected via the personnel homepage of the network leader. In addition, next to the short homepages provided by the FWF for the networks, the homepages of the networks themselves are in many cases very abridged and do not give account of the on-going activities. This is in contrast to many German examples where SFB (Sonderforschungsbereiche) are signposted very explicitly. The lack of good homepages is also a pitfall as international visibility is reduced.

network approach in both forms of the FWF increasingly important in the future. For the SFB there is more to it, as they will become an increasingly important tool for the strategic targeting of areas within universities

The experience from interviews and peer review analysis suggests that all of these effects are up to now dependent on the personal commitment of responsible personnel in the leadership of the university, as formal commitments are poorly implemented. Moreover, it seems obvious that the backing and support for SFB networks rises with the concentration of the network in the leading university. The more dispersed a SFB is, the more problematic the support becomes.

However, two major considerations for the future of the networks as regards university strategies have to be made. First, a stronger strategic orientation and planning of universities does not necessarily and automatically mean that all SFB are supported. The interviews have shown that strategic planning may also mean that new proposals of SFBs or even running SFBs do not match the priorities of universities. For example, if a commitment to a SFB were to produce - or has already produced – long term investments in instrumentation or personnel in areas that are not regarded as crucial for the future research profile of the university, the support of that SFB may be neglected. It must be clear for universities and the FWF that a strong commitment to a SFB means realising the positive secondary effects (cooperation learning, profiling, external quality control) for a university at the expense of other future oriented activities and less degrees of freedom in strategic planning. It seems the more necessary that the planning of SFB application is done with strong integration of university leaders and is stressed in the evaluation procedure. Second, the interviews showed a couple of cases in which the leaders of the universities triggered the emergence of a network very actively. These impulses can be very positive; but they can, however, also lead to commitments of scientists and sub-projects that do not really match the overall requirements of the network project. While an impulse and strong signals for support are very beneficial for networks, there is some danger that in the future they might be misunderstood as a strategic means to be imposed on the scientists of a university. The very high rejection rates in the last 2-3 years may be a first indication of an increased instrumental purpose of SFB and – to a lower degree – FSP.

The Austrian university system now appears to have a greater likelihood of strategic and more profiled research planning. Here, the networks can play an important leveraging role. In order to do so, the commitment of universities to the FWF funded networks needs to be much stronger, formalised and de-personalised. It should be made mandatory that the heads of university or the

vice rectors for research are present at network hearings. All this should contribute to secure framework conditions, clear commitments for positions and held promises for infrastructure investment needed by the long-lasting structures. At the same time the university administration should support this rationalisation of financing as a service to their networks and not as a means of control. The times of "anything goes" (quote of an expert) in terms of flexibility might be gone, some sort of global budgets should, however, remain for the networks and especially for their leaders in order to – for example – organise cooperation structures beyond bi-lateral cooperations.

FWF will have to pay overhead, this is not only the expectation of almost all experts in the field, it is simply rational to enable transparent cost structures – pushing scientist into a more systematic controlling culture and clearing away a severe obstacle for networks from the perspective of universities.

The FWF needs to do everything to stop networks being reduced to strategic tools neglecting the high standards needed for excellence and cooperation. Especially with a raising attractiveness of the networks a strong and professional evaluation culture needs to be kept, including strict judgements in interim evaluations leading to the stop of networks if necessary. By the same token, university leaders should enable or give incentives, but they should not try to push scientists into cooperative structures. The evaluation has shown that cooperation has many requirements, such as complementary sub-projects and converging long term strategic research visions in interdisciplinary settings. To impose this means producing high risk for failure.

Crossroads I: The Time After – What Long-term Structural Effects Are Envisaged?

There are no uniform ideas as for the future of the networks once funding ends, and this – of course – needs to be the case as each network has its own specific opportunities, long term investments and research horizons. Therefore, there are many different futures. In the peer review analysis not much is said about this dimension. The cases that are discussed are mainly those in which the peers suggest that the application potential of the network should be realized in specific network structures such as Kplus. Indeed, four SFB and one FSP have been the nucleus for the industry-science cooperation centre Kplus, or they at least provide a central transmission belt to the university, with personnel overlaps.[79] Thus the basic science scheme SFB has

[79] These five networks are SFB 1, (Graz, Kplus AB), SFB 5 (Vienna, BMT,), SFB 9 (Graz, ECHEM), SFB 13 (Linz, SCCH), and FSP 80 (Graz, ACV)) Source: Technologie Impulse Gesellschaft TIG, Vienna).

led to a cooperation nucleus that was ready to further open to the industry world. In these cases the long term benefit of these SFB – and thus of the whole scheme – has been a two-step approach to complex cooperation, combining basic science funding with strategic and oriented science activities. It is also possible that networks re-group and re-apply for the funding scheme, in some cases FSPs have been nuclei for SFB. Of course there are also cases in which the network dissolves and – if at all – individual co-operations remain.

The general lack of long term visions for the SFB and FSP networks may not simply be interpreted as a sign of ignorance but also reflects the basic rational of many participants that SFB are an opportunity to establish new links and explore new co-operations, but are not perceived as a nucleus for long lasting structures. However, given that the financing of SFB network has started 11 years ago, the question of what to do after the funding has finished has become manifest only lately and will become more important. The cessation of these networks could mean a break in the research profiling of the universities or at least the realization of sunk costs as for hardware investments, and the build up of competences and infrastructure. Apparently it is not clear to all of the community what really is expected from networks that are approaching their ending and how exactly the principles for re-application are to be interpreted.

Recommendations are not straightforward here. What seems more important than an attempt to formulate a limited set of alternatives is that cooperation structures do have effects lasting beyond the duration of the funding. In that sense part of the network funding should be seen as an investment in long lasting structural and cultural changes, ranging from common large scale equipment to better interfaces between institutes and a more open cooperation culture. Thus, the cooperation schemes beyond bilateral project cooperation, such as symposia, conferences, seminars etc. should be strengthened during the lifetime of networks. The reporting routines should support this development by introducing a mandatory section on all aspects of cooperation in the networks. Most of all, the final interim evaluation should ask for a clear statement of the participants and the scientists as well as the university leaders that will become strategic players in the future. The funding decision should not be made fully dependent on those statements, but it should take into consideration not only if the money is needed to finalize a certain project, but also if the money can still be regarded as seed money for further cooperation activities. The fact that the Kplus scheme seems to be an attractive option for the SFB participants shows that within the networks oriented research is already done. This is already confirmed by the peer review analysis and some interviews. Thus, during the final stage of the

networks a slight change in the relative weight of application orientation might help the orientation towards future cooperations. Similarly, as interviews have reported cases in which SFB have – partly – developed into international schemes, the possibilities for further opening up the schemes towards international cooperation should be proven more systematically.

Crossroads II: A Streamlining of Schemes – Merger of Programmes?
In line with the FWF Consortium Review 2004, the evidence we have from our interviews is that many scientists and experts do not argue that the two schemes be retained, but that that they should be merged for reasons of streamlining and simplifying the FWF funding schemes. A majority of the experts interviewed have the feeling that essentially Austria does not need two network programmes, and for many these two programmes seem already too similar to be separated. They cannot see a real difference between the programmes. Indeed, the structural and the performance analysis have shown that in some dimensions the differences are rather small. Some FSP are big enough and concentrated enough to qualify for a SFB. Many SFB are spread across different locations or even different cities, this spread is bigger than – for example – in Germany, and those spread SFB do perform very well. On the other hand, the FSP – often regarded as being less scientifically ambitious – show equally good results as the SFB, they are even more interdisciplinary (relatively speaking). The analysis of rejected networks has shown that the demands for coherence are almost equally applied for the FSP as for the SFB.

Also in terms of international comparison there is a clear tendency that the clear distinction between single location or multiple locations seems to disappear. Due to the increasing complexity and differentiation of modern science and thus the need for research institutions and universities to specialise, differentiate and build up a particular competence profile, co-operation between different partners becomes more and more important. “Different” means not only different disciplines, but also different locations because it seems to be unlikely that a university would possess, at the same location, all the high quality researchers across the relevant disciplines. If quality is the main criterion, the need to integrate partners from other locations becomes apparent.

However, almost all interviewees also indicate that a merged programme would still need different lines. Why is there a view that only one uniform programme might be problematic? And would it lead to more effectiveness and efficiency if the programmes would be merged into one programme with different lines? The analysis shows that the quest for different lines results from the experience that there are still distinct differences between the cooperation in both programme – and the evaluation has demonstrated this -

although the guidelines for both programmes are almost identically except for the location (one location, autonomous research for SFB) and the duration (10 vs. 6 years). All other criteria are the same already.

The differences can be summarised as follows: The cooperation intensity with FSP is significantly smaller – the same is true for SFB that are spread across different cities. The nature of the cooperation is somewhat different as with FSP the exchange of ideas and results seems to be more important than the actual cooperation between distinct sub-projects. This certainly means a different form of cohesion within these networks. At the same time, FSP are equally or even more inter-disciplinary, and they enable the selection of those partners nationwide that fit best the common needs. They do not seek critical mass at one distinct place but complementary mass across the whole country. This also means a different kind of cooperation learning and entails different management tasks. Moreover, as seen above, a spread of subprojects to different universities in different cities means – of necessity– a lower integration into the university strategy process and lower commitment. This gives FSP networks less backing, but also – it appears – more freedom to experiment in the future.

Moreover, with the new University law the differences between SFB-type networking and FSP-type networking will most likely *increase*. The SFB will become cornerstones of university research strategies and thus the bottom up process of finding SFB teams might be complemented by strategic profiling. In that perspective there will be limits as regards the number of universities involved and the number of geographical locations for future SFB. The FSP might, in that scenario, increase in its importance as a means of doing meaningful, cross-distance cooperation with well chosen cooperation partners and thus to contribute to the build up of nation-wide excellence structures.

Against this background and as both programmes have shown good to excellent results in providing opportunities for two different kinds of networks, a new programme should still enable scientists in Austria to cooperate either way. Two basic lines of funding should be kept up, no matter if this is in one programme or if the programme remain distinct. The FWF should continue to provide for the following types of action, and even profile this distinction:

> ***(1) SFB-type interaction with clear commitments of the major host university, an integration into the university long term strategy and the attempt for structural changes within the university to enable a future for cooperation structure beyond the funded period. The single-location principle could be softened (see also international comparison – location***

principle below), but not given up taking into account the importance of strong leadership and commitment.

(2) FSP type interaction with more flexibility, less commitment and coherence but well proven cooperation gains across distances.

In any case it should be made explicit that there are flexible possibilities for networking in basic science in Austria and that these are reflected in the programme descriptions, guidelines and evaluation process. For example, multi-location networking with a number of universities carrying a similar weight would not be able to demand the same level of commitment from universities, the same level of internal coherence and cooperation or the same structural effects on universities. But if the added value of cooperation – that can take different facets as we have seen - is well demonstrated and given proven excellence, there seems to be no reason not to fund such networks simply because they do not stand the coherence and commitment tests of SFB.

There is a second line of argumentation for differentiation in the network programme(s) that adds to the complexity. There are a number of further demands for possible new directions networks could take (see also Table 4_1 in Chapter 4). For example, new distinctions of programmes between somewhat more *application oriented* and strictly *basic research* network, or between *more exploratory, daring and risky research (maybe even conducted by less senior researchers)* and research with a clear overall aim and a *little risk of failure,* conducted by teams of experienced senior researchers most likely with pre-existing cooperations could be envisaged.

We cannot propose to decide for one of the possible combinations here. However, we suggest that FWF thinks about making the network programmes more flexible and allow for different types of cooperation gains – but at the same time should avoid becoming too complicated. These are only suggestions for further thoughts, no clear-cut recommendations ready to be implemented. But from international comparison – see below – we know that other countries have a greater variety of programmes. This is not only due to size, but to differentiated perspectives on networking. The main priority here needs to be excellence and external quality check. A third decisive variable, however, should be the added value of cooperation, and within this context, applicants should be allowed some discretion over how they address each of these criteria. Why not allow for more risky, daring research in these networks if quality of scientists is proven and external peers see realistic chances of improving methods and maybe contribute to breakthroughs? Why not allow for more explicit and direct application orientation, within the limits of university type activities and without extending networks to some

sort of Kplus-centres? If the FWF did allow for these varieties, it would be the challenge for applicants to make a convincing case for a certain combination. To do so, strong interaction with FWF staff and reporters should help in framing networks in such a way that cooperation gains are maximised. All this would certainly not simplify matters, as guidelines would have to be re-drafted and peers carefully briefed as to the peculiarities of the various applications. Most importantly, the interim evaluations should very carefully check if the network that has been created, functions the way it claimed to do and if it does not, strong remedial action should be taken. More flexibility must not mean anything goes. Again, we do not argue for more schemes, but we argue for the possibilities of more differentiation for those networks that are eligible for funding. It seems that the FSP-type networking might – as a rule –become slightly more daring, more risk-taking, while SFB-type networking as a long term investment by universities will become university excellence centres.

Excurse: International Comparison – Multiplicity of Programmes

All countries we looked at have different kinds of programmes for the promotion of scientific networks, each with a certain main issue, typically either promoting scientific excellence (in form of a Centre of Excellence) or solving a certain problem of national relevance (different kinds of Research or Priority Programmes).

Maybe due to its size, the portfolio of the German Research Foundation (DFG) shows a wide range of so-called "co-ordinated programmes". At the moment there exist 9 different programmes, two of them exclusively dedicated to promote science (and innovation) in the New Federal States. One of the most interesting developments during the last years is that the most prominent programme Collaborative Research Centres (CRC) was complemented by three different sub-programmes:

- *Transregional Collaborative Research Centres (since 1999),*
- *Transfer Units (since 1996),*
- *Cultural Studies Research Centers (since 1997).*

Transregios are seen as a suitable possibility to promote cross-regional and cross-federal cooperations without loosing the objective of establishing clear research profiles. Transregios offer an opportunity especially to those universities which are small or excellent in their (narrow) science field but do not reach the necesseary critical mass. Through Transregios, the establishment of a reserach profile is possible at two, three or even four different locations. Additionally there is chance to achieve a particularly high scientific quality through the possibility of free choice of partners (WR 20202, S. 42/43).

Transfer Units build on successful basic research projects funded within the scope of CRCs. Their purpose is to ensure that scientific research findings are transferred without delay into industry and other applied environments for practical testing. Funding is restricted to the pre-competitive area, extending at most to prototypal results (http://www.dfg.de/en/).

Cultural Studies Research Centres have to meet certain thematic and structural criteria, i.e. the research must be cross-disciplinary and international in terms of thematic focus and cooperation and must encourage advancing young researchers by offering special study programmes.

With regard to the political steering of the overall programme portfolio it is worth to mention that Switzerland stopped one programme and integrated it into a further due to evaluation results. Concretely: The promotion of the Swiss Priority Programmes, launched in 1991, was stopped in 2003 due to their weakness with regard to the sustainability of the envisaged priorities or respectively their integration into the Swiss university landscape (Selbstevaluation SNF, S.4).

There is no hint that an unproductive competition between different programmes exists. However, every research funding organisation has of course a defined (scarce) budget. Thus, in the German case, it could be observed that more CRC were positively evaluated than resources were available which may damage the reputation of the DFG evaluation procedures.

Excursus: International Comparison – Location Principle
The different programmes show distinct patterns with regard to their location. Generally those programmes which aim to establish Centers of Excellence (e.g. the Danish and Finnish CoE-Programmes, the German Collaborative Research Centres) are located at a host institution, usually a university. The following advantages of the location principle can be mentioned:

- *Identification with the host institution / university,*
- *search for cooperation partners at the same location, but outside the own discipline,*
- *incentive to integrate non-university R&D institutions and therefore,*
- *promotion of regional research landscapes,*
- *building of discernable competence centres,*
- *promotion of competition between the different R&D institutions,*
- *public relations and increase of the attractiveness of the location for young researchers (WR 2002, S. 39).*

However, the clear distinction between single location or multiple locations seems to disappear: even if the core is located at one university, there may be also partners from *outside, for example in the Swiss NCCR which are a mixture between Competence Centres and Competence Networks having a clear focus at a host institution (usually a university), but integrating a certain number of other institutions at other locations.*

This development is not only true for small countries (but there in particular), but also for large ones like Germany.

***Example: German Research Programmes**:*
For the Collaborative Research Centers which in the past strongly relied on the location principle it is now accepted that scientists from other R&D institutions – located at the same place or even from other places – can participate in a CRC (WR 2002, S. 6)[80].
Additionally, in 1999 a new subform of CRC was established, so-called Transregional Collaborative Research Centres. They are seen as a suitable possibility to promote cross-regional and cross-federal cooperations without loosing the objective of establishing clear research profiles. Transregios offer an opportunity especially to those universities which are small or excellent in their (narrow) science field but do not reach the necessary critical mass. Through Transregios, the establishment of a research profile is possible at two, three or even four different locations. Additionally there is chance to achieve a particularly high scientific quality through the possibility of free choice of partners (WR 20202, S. 42/43).
Finally, in the past the Research Units served to locally concentrated collaboration and thus structural objectives within the participating institutions. Meanwhile the „location principle" is no longer a funding requirement.

Crossroads III: Research – Users – Society and the challenge of thematic programming
The general debate about the pros- and cons of thematic programmes cannot be discussed or even solved in the context of this evaluation. The basic argument is that even basic science funding should be driven by some kind of societal benefit (Pasteur's quadrant), especially as small countries will less and less be able to spread their resources into the full range of scientific areas. Opponents of thematic priorities argue that while in principle a re-definition of the merit of basic funding could be discussed, the definition of scientific areas cannot be done properly and would have a number of detrimental

80 An investigation of the German Science Council (Wissenschaftsrat = WR) from 2002 found out that 82% of all single projects are conducted at the speaker's university, 8,7% belong to another university and 9,3% to another R&D institution (WR 2002, S. 23).

effects in the long run.[81] It is the personal opinion of the evaluators that *in general* for the FWF some sort of thematic prioritising should be done in the future, but this should be organised in a way that takes into account the Austrian scientific profiles and the dynamics of the Austrian science system rather than orient itself along internationally set themes. This could, for example, be organised in an interactive fashion in order to bring together societal needs politically defined and the interests and capacities of the science system.

What, however, would be the role of network programmes in thematic programming? There are certainly some special aspects of thematic programming as regards the network schemes. The results of this evaluation suggests that network funding pays off as regards cooperation effects, (future) profiling of universities and scientific output and thus should not be reduced, neither in absolute nor in relative terms. In contrast, given the net value of the networks and comparing the share of the budget Austria spends on network programmes with other countries, the relative share should even be increased in Austria.

However, assuming that the network programmes will remain important or become even more important, would there be *enough critical mass* within the Austrian science system to provide for excellent networks in *selected and designated* areas? As this evaluation has shown for networks to function properly a couple of important prerequisites have to be met. Most of all, there must be a number of excellent subprojects that fit an overall thematic framework of the networks. The high rejection rate of the last 3-4 years already indicates how hard it has become to form suitable teams and programmes. As a lowering of quality criteria for the networks should be out of the question, to find a critical mass of teams for a thematic programme would be the major challenge.

Finally, interdisciplinary networks are sources of new research venues, of exploratory combinations. These effects cannot be achieved if networks are limited to thematic areas, there must be ample space for new combinations in all scientific areas. Truly interdisciplinary and daring networks might be in a worse position in thematic programming.

81 The resaons for this in the perspective of the opponents are: the risk of imitation of themes that are en vogue elsewhere and thus the structural neglectance of unique country propositions; the short terminism of industry and politics as regards the definition of research prioirties that runs counter the mid term and long term effects of sound basic science; the societal problem of letting whole areas of research – and thus locations – suffer from a structural neglectance of scientific areas in the funding schemes.

Thematic programming in network programmes can be done, as the international comparison below and in Appendix 1 indicate. But in most cases network programmes are bottom up and sometimes the applications are checked with the political and societal priorities set.

If thematic programmes will become a cornerstone of FWF activity in the future, the weight of the networks might be reduced as many teams might not fit into the designated areas. Thus, even an addition to the FWF budget for thematic programmes, as is demanded by many experts, might lead to a reduction of the relative weight of networks within the FWF funding. This to happen is certainly not the message of this evaluation.

Thus we put forward three recommendations:

(1) The conclusion from the analysis of the structures and dynamics of networks is that as a general rule of thumb the networks should remain largely bottom up, as this maximises the likelihood of excellent teams and research plans.

(2) There is of course no reason why networks should not apply for funds in designated areas, indeed given that theremight be thematic lines in the future a premium in the evaluation could be given to those networks that fit these lines. And there is also no reason why thematic programmes should not call for specific networks within their own realm. But to limit network programmes to designated areas would be highly problematic.

(3) If the political will is to concentrate the scarce resources for scientific research in Austria via thematic areas full scale, it would be crucial that thematic areas are decided upon with the participation of the scientists themselves and in taking into consideration the potential of the Austrian science system to provide for critical mass in these areas. The Swiss network schemes provide for such inter-active definition of top down areas even in network funding. In any case, lowering the quality and coherence criteria of the funding schemes for the sake of fitting into top down designated areas should be avoided.

Excursus: International Comparison – Top-down vs. Bottom-up

Generally at least three types of network oriented programmes can be differentiated: (1) Centres of Excellence programmes, (2) programmes in order to solve particular problems of national importance (societal or politically motivated), (3) programmes for building (national) networks and concentrating resources. The problem solving oriented programmes are usually characterized by a top-down-principle or at least a certain influence of policy makers in defining the relevant topics. Centers of excellence, however, are mainly based on the bottom-up-principle. Table 8_1 gives an overview on the different principles:

Table 8_1: Top-down / bottom-up selection principles

Programme	Top down- / Bottom-up Selection
NRP (CH)	Topics are chosen by the Swiss Federal Government, but the selection of topics is bottom-up
NCCR (CH)	The scientists are in principle free to choose their research topics, but the ex ante selection of the proposals is is made also with regard to the national research policy
SSP (CH)	Topics and budgets are decided upon by Parliament.
CRC (D)	complete bottom-up principle
Transregio (D)	complete bottom-up principle
Research Units (D)	complete bottom-up principle
Priority Programmes (D)	Once the Senate has established the programme, the DFG announces a call for proposals, i.e. within a defined framework the scientists are free to choose their topic, research plan as well as methods.
DFG Research Centres (D)	The DFG annually announces one or two topics for which universities are invited to submit project drafts. German and international experts select approximately three of the most promising concepts in a pre-selection phase. The DFG then invites these universities to submit their proposals and to present their project to an international review team in a two-day competitive review.
Research Programmes (FI)	Initiatives for Research Programmes usually come from researchers, additionally the following paths of emergence are mentioned: (1) concerns arising from science, (2) internal development needs, (3) societal importance
CoE (DK)	The calls for proposals follow particular research areas, for example in 1996 bioinformatics, demography, geosciences, chemistry, mathematics, man-machine-interaction, plant biology. These areas are seen as international key areas where Danish research is expected to be competitive (Malkamäki et al. 2001, p. 29).

Table 8_1 shows that in several cases there is no clear distinction between bottom-up or top-down-procedures, but a mixture, for example the German Priority

Programmes, the DFG Research Centres, the Danish Centres of Excellence and the Swiss NRP and NCCR.

> *Example: Swiss NRP*
> The selection of topics is bottom-up. Interested persons / institutions can submit proposals on new research programmes to the responsible Federal Office for Education and Science (FOER). After examination by the FOER the Bundesrat decides on the application of the Federal Departement of Home Affairs (DHA) periodically about the topics and funds of one up to three new NRP. Afterwards the FOER commissiones the SNF with the implementation. After the approval by the DHA a new NRP is announced. The single research proposals related to the NRP are subject of the standard evaluation procedure of the SNF.

The International Context – and Internationality of Networks

There are two aspects of internationality in the FWF networks. First, there is the requirement of non-Austrian peers for the evaluations. This is a very pronounced feature of internationality, matched only by Nordic countries (see below). This is made easier through the presence of a big neighbouring country with the same mother tongue; however, the range of countries from which international peers are invited is in fact enormous. This has two kinds of positive effects, first, international benchmarks and consultations are given in the judgements, and second, the international visibility of the emerging networks is increases as a secondary effect.

The simple recommendation here is that the FWF should maintain this strong reliance on international peers.

The second dimension is the involvement of international scientists in the networks, both as scientists inside Austria, at participating Austrian institutes, and through the involvement of foreign institutes. This second dimension is poorly developed. Only very few foreign institutes and universities are formally engaged, and the number of foreign scientists within the networks – albeit poorly documented – seems low. The reasons for this is not the reluctance of the FWF to engage in more international activities, but the existing legal framework that inhibits a stronger cross-border financing and a general reluctance across Europe to open up national schemes. The DACH scheme with Switzerland and Germany which is about to be amended by the Dutch institution, and various activities within the ERA-NET programme of the EU[82] are important steps in this direction.

[82] ERA-NET is a scheme by the European COmmission supporting the cooperation and coordination of national research policy and funding schemes.

Both from the interviews and from the developments across Europe, it can be concluded that international opening up will become a major requirement for the Austrian funds.In some scientific areas it appears that cooperation with foreign institutes close to the Austrian border would be easier and make more sense than the exclusive cooperation with Austrian partners. In addition, most likely international funding schemes for basic research will become more important in the future (ERA, European Research Council). Even if in principle there will be no formal requirement to cooperate internationally when applying for European funds, it is clear that the readiness and capability to do so increases the competitiveness of Austrian research teams on an international level. The learning of cooperation in the national network programmes is an important aspect in order to make young Austrian scientists fit for international funding schemes in the future.

The recommendation here is that improved systems for financing of foreign scientists within Austrian science should be developed. The attempts to internationalise the FWF schemes should be further supported and intensified and – more important – in the long run legal requirements and national policy rationales all over Europe will have to be adjusted. The DACH memorandum with the Swiss and the German partner institutions (DACH) needs, however, to be made to work and fully exploited as soon as possible.. The enlargement with the Netherlands would send a signalfor future coordination – on the basis of principle reciprocity – between basic research foundations of different countries. The possibilities to complement research teams with adequate teams would be optimised. However, as with national SFB, too broad a spread would certainly endanger coherence and cooperation effects. A maximisation of international teams in SFB-type networks would be problematic, while in FSP schemes there is in principle not such a limit to international cooperation.

Second, the networks should even more be understood as training centres for international cooperation in the future schemes to come. The learning of cooperation in the national network programmes is already an important way of ensuring that young Austrian scientists are prepared for international cooperation, and this should be exploited better.

Excurse: International Comparison: the International Dimension
Two dimensions as for internationality are particularly evident in the international comparisons we have done. First, the use of international evaluators is a typical pattern in small countries, especially the Nordic one.Peers are usually involved in the ex ante selection as well as in monitoring and ex post evaluation activities, i.e. the whole evaluation system is based on foreign experts. In contrast, the German evaluation system, particularly the ex ante selection of proposals, is strongly based on

national evaluators, a pattern which has been strongly criticized during the system evaluation of the DFG (Internationale Kommission 1999).

Second, especially smaller countries are interested in an involvement of foreign researchers in their networks at home. In the Swiss NCCR, for example, the share of foreign scientists is rather high: concerning the senior scientists, there are more Non-Swiss scientists (456) than Swiss scientists (402). This ratio is even more distinct with regard to doctoral students (282 Swiss vs. 467 Non-Swiss) and postdocs (90 Swiss vs. 264 Non-Swiss) (Guide 2004, p. 7).

Example: Swiss NCCR
In the context of the Swiss NCCR networking is not only seen at the national but also at the international level: „High international networking is an objective which is assessed high in the evaluation process. A NCCR disposes of a network of decentrally acting research groups. There is no reason why these groups should be limited to Switzerland" (Selbstevaluation SNF, S. 131). However, as far as the 14 current NCCR are concerned, there is no foreign participation.

Other programmes such as the co-ordinated programmes in Germany emphasize that they support and encourage international collaboration, but there is no reliable data available on to what extent foreign researchers are already integrated into the national research networks.

8.2 Structural, Output and Management Issues

This part of the Chapter 8 outlines the important findings of our review in three areas dealt with in Chapters 5, 6 and 7. These findings are generally concerned with how best the programmes can be improved within existing frameworks, and the findings therefore constitute a range of suggestions on how best to fine tune the programmes. In relation to Chapter 5, we give our summary findings on the questions of the network structures which have developed under the programmes. In relation to Chapter 6, we give our findings in relation to the performance of the networks, reporting on how well the programmes met their goals, and the extent to which added value was produced by the programmes. In relation to Chapter 7, we report our findings of our review of the implementation and operational aspects of the programmes and the key role of the FWF.

Findings from Structural Analysis
Firstly, our findings on the question of network structures and the way in which the scientific networks supported under the programmes have developed and operated in structural terms are as follows:

The two programmes are attractive for the Austrian science system, and the attractiveness has increased in the last couple of years for both programmes alike with acceptance rate for the networks are about 50%, dropping considerably in the last 3 years in both programmes. The networks are shaped and influenced significantly by the ex ante evaluation (also Chapter 7), which rejects a considerable number of sub-projects and, on average, cuts the budgets by almost 30% in both programmes.

Networks vary considerably, there are SFB networks that are smaller than some of the big FSP networks, and the representation of senior scientists (professors) is slightly higher in the SFB networks than in the FSP networks, thus there are more junior project leaders in FSP networks. The official one-location principle of the SFB is softened, as 17 out of 20 SFB have sub-projects with at least two host organisations, on average, almost 30 % of the sub-projects are done outside the university that leads the SFB. 11 SFB are spread across at least two cities. Regional embeddedness of SFB – i.e. formal backing or financing by the regional or municipal government – is weaker than was hoped for by the FWF initially. While this type of geographical distribution works very often, too big a geographical spread contains the risk of cooperation deficiencies especially as for SFB settings.

In terms of funding, the average funding of a FSP sub-project per annum is slightly higher than for the SFB sub-projects. In comparison to German SFB the funding per sub-project and year is moderate.

The networks are most attractive for natural science teams, more than half of the networks are natural science, and the acceptance rate in natural science is far above the acceptance rate in other areas. The interdisciplinarity of the networks is – across the board – considerable, but differs a lot between individual networks in both programmes. FSP networks are – relative to their size - more interdisciplinary than SFB networks. Natural science networks are less interdisciplinary than non natural science networks.

We conclude that too much interdisciplinarity might be dangerous, especially for SFB. Those SFB that cover a broad range of sub-disciplines without one or two clearly dominating lead disciplines have, in general, encountered severe problems within their lifetime.

Size has its limits: Big network projects are both less interdisciplinary (relative to their size) and show a lower level of interaction among their sub-disciplines. The level of interdisciplinarity is however neither a trigger for nor a hindrance to cooperation.

Internal coherence in general increases during the lifetime of networks. On average, FSP networks report considerably less internal cooperation than SFB networks, but there are examples of extremely high internal cooperation in FSP as well. Those SFB that are geographically spread across different cities show less internal cooperation than those that are located at one city. Pre-existing cooperation as well as a sound and strong leadership are beneficial to the development of coherence over time.

Findings from Performance Evaluation Analysis
Our findings from our performance evalation of the networks which come from Chapter 6 comprise the following:

There is a general consensus among all experts in Austria that the networks in general produce good scientific results and have an important networking and collaboration function in Austria. This assessment is – by and large – confirmed by the peer review analysis of all networks. The major benefit of the networks lies in their longer term perspective (both as for research content and research staff), the establishment of new interfaces and scientific cooperation, cooperation and management learning, profiling of the host universities (for the SFB) and internal and external quality control.

The visibility of the networks in Austria can be considered as rather moderate beyond the inner circles of the disciplines involved. However, on the basis of various bibliometric and survey-based calculations it appears that the quality of the sub-projects within networks is higher than the quality of the average single FWF projects. This is not only a selection bias effect, as also the improvements between 1996 and 2001 have been stronger within the networks than outside.

Differences between the two schemes in terms of quality and quantity of output show that FSP can certainly *not* be regarded as second best compared to the SFB. SFB and FSP participants publishing scientific papers in general work only part-time within the networks. This is especially true for medical sciences. However, the quality of the work produced within the networks is higher than outside.

Training is rated as a high priority of participants and university leaders alike and for those who participate, conditions and scope of learning effects seem to be better than in single projects. However, training is not considered systematically enough in network programmes and thus only poorly reflected in the reporting of the networks.

Research network performance is a function of collaboration and cooperation activities operating under the strong influence of a peer review process which is effected very largely by the research networks themselves. The research networks of the FWF reflect these influences with highly collaborative networks achieving consistent research quality. The level of interdisciplinarity and the level of cooperation in networks have no statistically significant effect on the *quality* of the output (albeit there are indications that both have a slight positive effect). There, however, are clear indications that geographical distance of network does not hamper excellence.

Recommendations

(1) In many networks there are too little explicit provisions for network integration and co-operations to be found that hinder the full exploitation of the cooperation effects. Especially the effective build-up of interdisciplinarity in networks needs strong provision for internal cooperation.

(2) For the SFBs, one of the major problems of those cases which failed or had severe problems has been lack of coherence and internal cooperation. Pre-existing co-operation thus certainly helps the success of a network – but at the same time a strong requirement to show pre-existing cooperation for an application would certainly reduce limit the chances of creating new combinations through network funding.

(3) A reporting system on all aspects and effects of cooperation on a yearly basis could be developed, although the danger of over over-steering should be avoided. In addition: there should be clear provisions for cooperation, cooperation plan and explanation of how interaction will be provided for (structural provisions), cooperation structures, routine interviews: really welcomed plans of presence of key people in the SFB areas, regular seminars for example. This is especially important in those cases where there is less coherence as networks are very dispersed but still have added value in cooperating.

(4) The FWF should ensure that universities are aware of the fact that a strong commitment to a network means realising the positive secondary effects for a university at the expense of other future oriented activities and less degrees of freedom in strategic planning. It seems the more necessary that the planning of SFB applications in particular is done with strong integration of university leaders and that this is stressed in the evaluation procedure. Second, the interviews showed a couple of cases in which the leaders of the universities triggered the emergence of a network very actively. These impulses can be very beneficial, they can, however, also lead to commitments of scientists and sub-projects that do not really fit the overall requirements. While an impulse and strong signals for support are very beneficial for networks, they should not be misunderstood as a strategic means to be imposed on the scientists of a university.

(5) The FWF should further ensure a sound and strong leadership (to be checked through peer review and FWF briefing) within the networks. This should, hower, not lead to networks that are too focused to the leading institutes, the responsibility still needs to be laid on many shouldersin order to realise network effects. Thus, strong leadership should be combined with broad commitment.

(6) Care should be taken to ensure the right balance between interdisciplinarity and size: e.g. if SFB type research it is very big and very dispersed it cannot be too interdisciplinary. The clear focal theme of the network should sit at a mid point, not too focused but not too broad.

(7) The management aspects in the networks are crucial for both scientific outputs and for efficiency purposes. Management of the network should be given high priority in the evaluation process.

Findings from Review of Implementation and Operation
As regards the implementation and management of the networks, which are reported in detail in Chapter 7, we offer the following findings.

The implementation and management of the networks by the FWF is carried out with a high level of commitment to the scientific community of Austria and is done to a very high standard which exceeds in many cases the standards attained elsewhere in the world. The application, review and evaluation processes for networks are clear and transparent to those who use them. For this reason, they are held in high regard by those involved as researchers and as peers from the international scientific world. There is clear evidence that the procedures are efficient and effective in delivering networks of high scientific quality to support the mission of the FWF.

Our recomendations are as follows:

(1) The selection of strictly international peers based on FWF lists should be continued. The attempts made to cover the most important disciplines of a network should even be strengthened.

(2) Ideally, initial information on the applicants on the basis of the disciplinary spread (not the identity) of the peers could serve as a check as the applicants could comment and ask for some disciplinary adjustment. In addition, the selection of peers should try even more to find not only a collection of experts for the various disciplines, but should actively look for those experts that might have similar interdisciplinary experience.

(3) The cuts of budgets for subprojects that are funded are in some cases rather considerable. In deciding whether to cut across the board of subprojects or whether reject subprojects altogether it seems more appropriate to do the latter. By cutting across the board, good projects might run into problems, and by not rejecting sub-projects on the edge of excellence the overall quality and cohesion of the networks are reduced.

(4) Paradoxically, a danger of the network programmes seems to be their high rate of success and good reputation. Both from interviews and from the analysis of the rejected networks, it seems that many scientists and sub-projects are attracted by this scheme that hope to have better chances for funding within a network than on their own. This requires the FWF to maintain the high levels of quality control within the application process.

(5) The two stage process of project application ensures high quality networks are delivered and avoids the high costs involved in preparing and submitting research proposals. The proposal system could be adjusted to allow more precise feedback information to be given to researchers about the quality of their proposals.

8.3 Overall Assessment

The network programmes of the Austrian Science Foundation are an important cornerstone of the Austrian basic science activities. Overall, they provide for the cooperation effects which are desired by the FWF. The added value provided through these combinations has many facets that differ to some degree between the two network types. The combination of the two forms of networks seems appropriate in fulfilling two slightly different tasks. While the SFB combine skills in order to build up critical mass at one place or centred around one place, the FSP seek for complementary capabilities across the whole country. For both networks, however, the immediate network effects are cooperation learning, the creation of new combinations in research content and the setting up of new research visions, - especially as for interdisciplinary tasks – as well as the common development of methods and common usage of infrastructure. These effects are very substantially realised for *both* programmes.

In addition – and most importantly – the quality of the participants as well as the excellence of the work they do within the networks is high and – judged not only by experts but also by the bibliometric analysis –seems to be higher than the average of Austrian scientific research. Especially the improvement over time has been impressive compared to the totality of Austrian researchers. Judged from peer reviews and many interviews, the networks that built up in a bottom up process can be assessed as being very topical, the tasks carried out are challenging and complex. Thus the networks contribute largely to the FWF mission statement and have become an indispensable means of FWF funding strategy.

In light of this overall performance and compared to other countries, the relative weight of the network programmes appears to be low, maybe even too low, given that the institutional funding in Austria has a greater weight than in most other countries. Especially if thematic programming becomes more important in Austria, provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks. Moreover, the international comparison shows that the variety of schemes as for basic research cooperation is not at the high end.

Still, the network structures that have been built under the umbrella of these programmes are very diverse. Thus the design of the programme has stood the test of time rather well, as it enabled this variety with considerable success. However, it is certainly a challenge for the FWF to take account of this diversity in the future. In effect, the principle separation of two programmes already takes account not only of a different location principle but also of different understandings of cooperations as regards coherence, pre-existing cooperation, expectation to cooperation effects, risk involved etc. This is likely to be even truer with the introduction of the new University Law as the networks concentrated in one location will become stronger cornerstones of university strategies, while networks that are spread across different locations will remain endeavours in their own right. It appears that SFB have contributed to the research profiles of universities much more strongly than the FSP, and this difference will most likely continue to rise. Thus the location principle, although it is somewhat blurred, continues to play a major role. As long as excellence is kept up and added value can be proven, different variations of network structures should remain possible in the future. Whether this is done in one programme in combination with flexible guidelines and close coaching of peers and applicants, or with distinct programme lines or even programmes is of secondary importance.

However, there are also some drawbacks regarding the network programme design and performance. Most importantly, the high potential that lies in the network as regards the training of young researchers could be exploited much more. Although the networks already offer some opportunities in this direction as universities do indeed utilise the networks to give young academic talent mid-term perspectives, they do not have systematic training programmes and these certainly should be considered in the future. Secondly, the networks are much too national, opening up both as regards attraction of scientists and as regards inclusion of foreign institutes will be crucial in the future. Thirdly, up to now, the backing of the universities had been very diverse, and in some cases the universities had not lived up to their commitments. This will change with the university law which enables the universities to become strategic players. For the SFB which can find a fit with such strategies, this will be a major improvement; for FSP that have a smaller interest from the universities and for the SFB that might not fit the strategy, we fear that new problems might emerge. It will be critical to make universities live up their commitment in each case, however. Finally, and also concerning the perception of the network programmes, the visibility of the networks has been very diverse, both as regards the scientific visibility and the visibility to the broader public. A better profiling of the networks themselves should be demanded in the future.

As regards the management of the programme the overall impression is that the FWF management is a very good one, in fact the application and evaluation procedure and the interaction with the network participants can be rated excellent. Minor improvements are needed though, especially as regards feedback procedures or a potential additional questionnaire to be used in evaluations. In addition, the cutting of budgets in network applications seems rather high, and should be rethought as it may be better to reject more sub-projects altogether than to limit the functionality of all sub-projects. Furthermore, a better reporting especially as regards the cooperation and integration activities should be asked for.

Appendix 1 - International Comparison

International Comparison Research programmes for the promotion of scientific networks in selected countries

Preface

In the following appendix we give a concentrated overview about network oriented programmes in basic science in selected countries: Germany, Switzerland and some Nordic states. We choose these countries for several reasons: except from Germany all countries are quite small and thus have to concentrate their resources and focus on particular strengths or (national) priorities. Germany was choosen as the authors are most familiar with this system and because several interview partners in Austria mentioned the different German priority and network programmes in describing the advantages and disadvantages of their own system.

For every country programme a short description is delivered including an introduction which discusses the funding system in respect of the most important funding bodies within each. For those programmes which seem to be most similar to the Austrian research programmes and / or which deliver the most interesting particularities, a more detailed analysis is given. Depending on the available information such an analysis discusses the following main issues:

- Objectives
- One location / multiple locations
- Size of consortia
- Relative Importance of networking compared to scientific excellence
- Measure to guarantee network integration
- Importance of interdisciplinarity
- Top down- / bottom-up selection
- Role of training and gender
- Funding
- Evaluation

The comparison is purely based on desk research using public available documents like internet homepages, annual reports, evaluation documents etc.

German Research Programmes

Introduction

„The **Deutsche Forschungsgemeinschaft** DFG (German Research Foundation) is the central, self-governing research organisation that promotes (primarily basic) research at universities and other publicly financed research institutions in Germany. The DFG serves **all branches** of science and the humanities by funding research projects and facilitating cooperation among researchers (http://www.dfg.de/en/index.html). The DFG

- serves as the **central public funding organisation** responsible for promoting research in Germany,
- fosters **scientific excellence** through competition,
- **advises** parliaments and public authorities on questions relating to science and research,
- encourages **international collaboration** in science and the humanities, and
- supports the advancement and education of **young researchers**“ (http://www.dfg.de/en/dfg_profile/dfg_in_brief/)

As the DFG can be seen as central public funding organisation - at least as basic science is concerned - we look at DFG programmes only. 7 main types of research programmes can be differentiated:

- **Individual Grants** Programme („Normalverfahren“) (Individual Grants / Research Grants, Sabbaticals, Short Courses and Summer Courses, Clinical Trials)
- **Coordinated Programmes** in order to promote (interdisciplinary) research collaboration
- Promoting **Young Researchers** (Research Fellowships, Staff Positions in DFG Projects, Fellowships in the Research Training Group Programme, Funding for One's Own Position, The Emmy Noether Programme: Research Fellowships Abroad and Independent Junior Research Groups, Independent Junior Research Groups in Collaborative Research Centres, The Heisenberg Programme, Scientific Networks)
- Scientific **Prizes** (The Gottfried Wilhelm Leibniz Programme, The Heinz Maier-Leibnitz Prize, The Communicator Award, The Eugen and Ilse Seibold Prize, The Albert Maucher Prize in Geoscience, The Bernd Rendel Prize)
- Funding scientific **instrumentation and infrastucture** (Scientific Instrumentation and Information Technology, Scientific Library Services and Information Systems, Central Research Facilities)
- **Scientific Contacts** (International Scientific Events in Germany, Mercator Programme, Roundtable Discussions and Colloquia, Conference Trips to

the Federal Republic of Germany, International Conference, Lecture and Information Trips)

- DFG **Project Groups** (Funding Initiatives and DFG Project Groups) (http://www.dfg.de/en/)

Under the heading „**Coordinated Programmes**“, the following funding schemes can be found:

- Collaborative Research Centres (since 1968) with the programme variations
  - Transregional Collaborative Research Centres (since 1999)
  - Transfer Units (since 1996)
  - Cultural Studies Research Centres (since 1997)
  - Independent Junior Research Groups

  ☐ All programmes support and encourage **international cooperation**.
- Research Units / Clinical Research Units
- Priority Programmes (since 1952)
- Humanities Research Centres (since 1996) / Innovation Colleges
- DFG Research Centres (since 2001)
- Research Training Groups (Graduiertenkollegs) (http://www.dfg.de/en/)

In 2002 **54,3%** of the total DFG budget was dedicated to Coordinated Programmes and 33,7% to Individual Grants Programmes. **28,1%** of the means were spent for Collaborative Research Centres (DFG 2002, S. 20).

Collaborative Research Centres (CRC), (Sonderforschungsbereiche, SFB)

Short Description

„Collaborative Research Centres are **long-term university research centres** in which scientists and researchers work together within a **cross-disciplinary** research programme. They concentrate the resources, knowledge and skills available at a university to enable comprehensive research projects to be carried out. The programme pursues the structural goal of **forming core research areas** at a university ("**location principle**")“. (http://www.dfg.de/en/ research_funding / coordinated _ programmes/collaborative_research_centres/programme_variations/index.html)

Some facts:

- Since 1967 the DFG promoted a total number of 593 CRC, referred to 1st July 2001 there were 284 CRC presently promoted.
- CRC have a clear focus in the field of bioscience (36% of all CRC in 2000, 40,5% in 2003).

- In 2000 every CRC received on the average 1,12 Mio. EUR p.a. nominal (WR 2002, S. 7f.).

Objectives

Overall Purposes are:

- To create **core research areas** at universities by establishing **temporary centres of excellence**;
- to promote **interdisciplinary cooperation**;
- to advance **young researchers** (http://www.dfg.de/en/research_funding / coordinated_programmes/collaborative_research_centres/in_brief/ index.html)

One location / Multiple locations

Recently the location principle, which is still valid, has been widely discussed. Scientists from other R&D institutions are now allowed to participate – located at the same location or even from other locations– in a CRC (WR 2002, S. 6). An investigation of the German Science Council (Wissenschaftsrat = WR) from 2002 found out that 82% of all single projects are conducted at the speaker's university, 8,7% belong to another university and 9,3% to another R&D institution (WR 2002, S. 23). The following advantages of the location principle are mentioned:

- Identification with the speaker's university
- Search for cooperation partners at the same location, but outside their own discipline,
- Incentive to integrate non-university R&D institutions and therefore
- Promotion of regional research landscapes
- Bilding of discernable competence centres
- Promotion of competition between the different R&D institutions
- Public relations and increase of the attractiveness of the location for young researchers (WR 2002, S. 39).

However, cross-regional cooperations are a common feature of modern science. Additionally the probable institutional change with even stronger differentiation, specialisation and profile building will – in the long run – counteract the location principle as universities will concentrate on few priorities (WR 2002, S. 42).

Size of consortia

The number of single projects varies **between 7 and 28**, and on the average there are **15,6** single projects per CRC. The average grant per single project is 77,3 TEUR p.a. (WR 2002, S. 7f.).

Relative Importance of Networking compared to scientific excellence

According to Wissenschaftsrat (2003, S. 2f.) the CRC serve primarily to **excellent research**. Further important functions are:

- supporting **intra- and interdisciplinary cooperations**, especially those which go beyond faculty borders;
- giving incentives to **concentrate ressources** (personal, financial, institutions) and building up a **profile** at research universities.

The WR assesses that the CRC work is primarily **confirming and consolidating**; however for the establishment of new capacities or for restucturing, other instruments like DFG research units or foundation professorships seem to be more appropriate (WR 2002, S. 46).

Measures to guarantee network integration
There are no explicit measures mentioned, but usually a lot of seminars, colloquia, symposia etc. take place in the context of a CRC.

Importance of Interdisciplinarity
Of course the importance of interdisciplinary work is mentioned (as it is in all coordinated programmes) but the aspect of excellence seems to be much more important.

Top down- / Bottom-up Selection
The scientists are free to choose their research topics, and therefore the process is an entirely bottom-up principle. Correspondingly there is no submission deadline for first proposals.

Role of Training and Gender
Training and the support of **young researchers** is an important overall objective of the DFG. It takes place in particular programmes but also within CRC, mainly through **Independent Junior Research Groups**. „Funding is given for a maximum of **five years**. During this time, the position as project leader as well as the positions of staff can be financed. In addition, based on the extent of the research project, funds are also available for consumables, equipment and travel. Researchers may not apply directly to the DFG for funding for an independent junior research group. As a rule, Collaborative Research Centres and Research Units will publish their announcements for independent junior research groups on their websites, in national newspapers or in specialist journals“ (http://www.dfg.de/en/research_careers / career_planning/
postdocs/postdoc_qualification_germany/junior_research_groups.html#nachwuchs).

There is no explicit hint to gender promotion in the official documents.

Funding
Every CRC can get staff funding (including the head of an Independent Junior Research Group), funding for scientific instrumentation, consumables, travel, publication allowance, funding for colloquia and visiting researchers. The funding duration is, as a rule, **up to 12 years**, one funding period runs for three or four years. The Universities (and other participating research

institutions) are required to provide appropriate basic resources, including personnel and infrastructure, for the duration of the funding.

Evaluation
Eligible for funding are primarily **research universities**; other research institutes may only be included in the proposal upon consent of the institution applying for funding. The proposal needs to be approved by the responsible state ministry / authority (DFG: FAQ, Internet).

The most important assessment criterion for the ex ante selection is **scientific merit and originality** of an ambitious, extensive and long-term research undertaking at an internationally competitive level (http://www.dfg.de/en/research_funding/ coordinated _programmes/collaborative_research_centres/in_brief/index.html).

Before submitting a proposal there is usual an informal consulting dialog with a small group of scientific representatives and members of the DFG. Since 2001 the results of these dialogues are discussed within the Senate, in a comparative matter. This consulting process now has the character of a pre-selection exercise, a procedure introduced because there has been increasing criticism due to the large number of rejected CRC proposals. However, the dialogues are expected to be a further an opportunity where constructive criticism takes place (WR 2002, S. 12f.).

If a new CRC are established there is a **two days on-site-visit** where, as well as the reviewers,[83] two so-called „Berichterstatter" from the Senate committee and representatives of the university participate. Additionally, representatives from the federal state, the state itself and the Science Council are invited. The decision itself is made by the approval committee to which members of the Senate committee and representatives of the federal state and the states belong. The decision is based upon the protocol of the visit and information from the reviewers. The most relevant selection criteria are **quality and originality of the research programme** and **plausibility of the financial need**. The approval committee also evaluates the embededdness within the stuctural planing of the university, the concept for the training of young researchers and the relevance and originality of the proposal compared to already promoted CRC (WR 2002, S. 13, 34). The reviewers' work is **honorary**. As there were more positively evaluated CRC proposals than resources, the DFG changed the procedure and now a ranking is made based on the number of Yes/No-votes in order to ease the selection (WR 2002, S.15). In order to increase the level of formality and thereby to improve the

83 In 2001 the share of foreign reviewers was around 3,3% (AK FTI-Politk 2001)

comparability of the peer votes from different science fields, the DFG introduced an evaluation sheet in 2001. However, the members of the Senate committee did not see it as very helpful (WR 2002, S. 13f.).

The **time to decision** on proposals shall be (less than) 18 months, some times ago it was around 24 months (WR 2002, S. 15). One improvement reflecting the huge amount of evaluation efforts due to the increased number of CRC proposals was the prolongation of the promotion periods **from 3 to 4 years**. Expectations are

- a better continuity of research,
- better chances for risk projects,
- better basis for decisions on proposals,
- reduction of the number of evaluations (WR 2002, S. 16).

Assessment

Critical points in the view of the German Science Council are:

- Large number of allowances and a simultaneous decline of resources: if the number of CRC will further increase, the WR fears that the **claim of excellence is threatened**.
- Without sufficient financial means a research university won't be able to establish a **real research priority** (WR 2002, S. 29).
- During the on-site-visits, the **success rate** lies between **60-80%** - a potential contradiction to the claim of excellence (WR 2002, S. 32).
- There are problems to **assess interdisciplinary proposals adequately**, only a good mix of reviewers and an active moderation taking into account the different evaluation cultures of different science fields may help to avoid injustice (WR 2002, S. 33).
- There is a tendency of **standardisation**, i.e. the number of single projects and total grants became more and more similar (WR 2002, S. 35). But low grants per single project increase the evaluation efforts and are therefore inefficient, additionally a lower number of single projects seems to improve cooperation, leads to better cohesion of the research programme and generally more effective research (WR 2002, S. 36).

The **recommendations** of the German Science Council with regard to the CRC are to:

- Improve the internal quality control
- Give a certain amount of free resources to the speakers of a CRC
- Offer the opportunity of central funds, for example in order to support measures to improve the internal cooperation
- Offer further education on project & cooperation management (WR 2002, S. 37).

Transregional Collaborative Research Centres (Transregios)

Short Description

„Transregional Collaborative Research Centres are CRCs based at **up to three separate locations**. The contributions made by cooperating partners must advance the joint research project by being **essential, complementary and synergetic** in nature. The programme's structural goal is to develop the **networking of cross-disciplinary research interests** and material resources“ (http://www.dfg.de/en/research_funding/ coordinated_programmes/collaborative_research_centres/programme_variations/index.html). Compared to priority programmes it is not sufficient that several scientists pursue similar scientific interests. The applicants are free to choose their partners (WR 2002, S. 17).

Transregios are seen as a suitable possibility to **promote cross-regional and cross-federal cooperations** without loosing the objective of establishing clear research profiles. Transregios offer an opportunity especially to those universities which are small or excellent in their (narrow) science field but do not reach the **necesseary critical mass**. Through Transregios, the establishment of a reserach profile is possible at two, three or even four different locations. Additionally there is chance to achieve a particularly high scientific quality through allowing the **free choice of partners** (WR 20202, S. 42/43).

Objectives

The programme's structural goal is to develop the **networking of cross-disciplinary research interests** and material resources (http://www.dfg.de/en/research_funding/ coordinated_programmes/collaborative_research_centres/programme_variations/index.html).

One location / Multiple locations

„Unlike the traditional form of a CRC a Transregio is characterized by **several,** usually two or three locations. One of the universities will act as head institution. A qualitatively and quantitatively **equal participation** of the locations is expected“ (Leaflet Transregio).

Size of consortia

„The number of projects and the overall budget depend on the specific circumstances of the collaboration in each case“ (Leaflet Transregio).

Relative Importance of Networking compared to scientific excellence

Even if Transregios are only a subcategory of CRC, networking is much more important than in CRC as the structural goal is to develop the **networking of cross-disciplinary research interests and material resources** and to create a local and transregional network. However, the criterion of scientific excellence is valid also for Transregios.

Importance of Interdisciplinarity
The importance of interdisciplinary is mentioned (as it is in all coordinated programmes) but the aspect of excellence seems to be much more important even here.

Top down- / Bottom-up Selection
The scientists are free to choose their research topics; this is again a completely **bottom-up or response mode funding** principle. Correspondingly there is no submission deadline for first proposals.

Role of Training and Gender
As within CRCs, the establishment of **Independent Junior Research Groups** is also possible within Transregios.

The document „Muster und Hinweise“ for an application contains one chapter which focuses on the aspect of Gender. The applicants shall answer questions like the share of female researchers within the participating institutions, the share of female researchers in the planned Transregio, potential measures planned in order to increase the share of female researchers within the Transregio.

Funding
In principle Transregios follow the usual guidelines of a CRC. The maximum duration of funding is **12 years**. Transregios may get staff funding (including the head of an Independent Junior Research Group), funding for scientific instrumentation, consumables, travel, publication allowance, funding for colloquia and visiting researchers (http://www.dfg.de/en/research_funding/coordinated_programmes/collaborative_research_centres/programme_variations/index.html).

Evaluation
See above, CRC

Transfer Units (Transferbereiche)

Short Description
„Transfer units serve to transfer the findings of basic research produced by a CRC into the realm of practical application by **promoting cooperation between research institutes and users**“ (business, industry, etc.). (http://www.dfg.de/en/ research_ funding/coordinated_programmes/collaborative_research_centres/programme_variations/index.html).

„Transfer Units build on successful basic research projects funded within the scope of Collaborative Research Centres. Their purpose is to ensure that scientific research findings are transferred without delay into industry and other applied environments for practical testing. Funding is restricted to the pre-competitive area, extending at most to prototypal results. Transfer Units can range in size from **one to six projects**, while funding may be provided for between **one and three years**[84] (http://www.dfg. de/en/research_funding/coordinated_programmes/collaborative_research_centres/programme_variations/transfer_units/index.html). In 2000 the DFG supported 19 Transfer Units with a total sum of 3,1 Mill. EUR (WR 2002, S. 16).

Cultural Studies Research Centres (Kulturwissenschaftliche Forschungskollegs)

Short Description

„The same principles apply to these centres as to the CRCs, with the exception that Cultural Studies Research Centres have to meet certain thematic and structural criteria. The research must be **cross-disciplinary** and **international in terms of thematic focus and cooperation** and must encourage advancing **young researchers** by offering special study programmes“ (http://www.dfg.de/en/ research_funding/ coordinated_programmes/collaborative_research_centres/ programme_variations/ index.html). Additionally it is expected that the centres contribute to overcome isolating disciplinary boundaries. Correspondingly the methodological reflection is very important (WR 2002, S. 17).

Research Units (Forschergruppen)

Short Description

„A Research Unit is made up of a team of researchers working together on a research project which, in terms of thematic focus, duration and finances, extends beyond the funding options available under the Individual Grants Programme or Priority Programme. Research Units provide the staff and material resources required for carrying out **intensive, medium-term cooperative projects** (generally **six years**). Research Units often contribute to **establishing new research directions**. Funding opportunities for Research

[84] According to the German Science Council the number of single projects within a transfer unit is not restricted (WR 2002, p .16).

Units are subject to the same principles as research grants“ (http://www.dfg.de/en/research_funding/coordinated_programmes/research_units / index.html).

In 2000 the DFG supported 118 research units with a total of 427 single projects, on the average there are 3,6 single projects per research unit. The total budget for research units was 47 Mill. EUR, i.e. on the average each research unit received 394.000 EUR and each single project 109.000 EUR. The rate of approval was 49,4% (WR 2002, S. 20).

Objectives
The main objective is to promote close, medium-term cooperation between several outstanding scientists in a special research project with the goal of achieving findings which extend beyond the scope of individual funding (http://www.dfg.de/en/research_funding/coordinated_programmes/research_units/forschergruppen_kompaktdarstellung. html).

One location / Multiple locations
In the past the Research Units served to **locally concentrated collaboration** and thus structural objectives within the participating institutions. Meanwhile the **„location principle“ is no more** a funding requirement.

Relative Importance of Networking compared to scientific excellence
The eligibility as well as the project requirements focus on scientific excellence (eligibility: **outstanding scientists** and academics, project level: scientific quality and originality of a research project at an international level), the excellence criterion seems to be much more important than networking.

Measures to guarantee network integration
The applicants can get funds in order to cover their cooperation costs that means that network integration plays a certain role.

Importance of Interdisciplinarity
Of course the importance of interdisciplinary work is mentioned (as it is in all coordinated programmes) but the aspect of excellence seems to be more important.

Top down- / Bottom-up Selection
The scientists are free to choose their research topics, it is a complete **bottom-up** principle. Correspondingly there is no submission deadline for first proposals.

Role of Training and Gender
It is possible to get funding for the head of an Independent Junior Research Group.

Funding
„As a rule, the funding duration is up to **six years.** The applicants can get staff funding (including the head of an Independent Junior Research Group), funding for scientific instrumentation, consumables, travel, miscellaneous costs, possibly also **cooperation costs**, use of information and communication technology as well as for particular structure-building measures" (http://www.dfg.de/en/research_funding/ coordinated_programmes/research_units/forschergruppen_kompaktdarstellung.html).

One of the most important characteristcs of Research Units is the **flexibility**: besides staff funding for research, the applicants can also get grants for cooperation costs, use of information and communication technology as well as for particular structure-building measures. The application is made by the participating scientists and not by the institution (WR 2002, S. 20).

Evaluation
For the first proposal there is no submission deadline, draft applications may be submitted at any time. Decisions on first-time funding for Research Units are generally made by the DFG's Senate at the beginning and middle of the year. (http://www.dfg.de/en/research_funding/coordinated_ programmes/research_units/ forschergruppen_kompaktdarstellung.html).

Priority Programmes (Schwerpunktprogramme)

Short Description
„A particular feature of the Priority Programme is the **nationwide cooperation** between its participating researchers. The DFG Senate may establish Priority Programmes when the coordinated support given to the area in question promises to produce particular scientific gain" (http://www.dfg.de/en/ research _funding/ coordinated_programmes/priority_programmes/index.html). The instrument was established in 1952.

In 2000 there were 1881 single projects belonging to 143 priority programmes, on the average every priority programme got 1,2 Mill. EUR funds, every single project 91.000 EUR. The total budget for the priority programmes was 170,9 Mill. EUR (WR 2002, p. 19f.).

Objectives
The main objective is „to **advance currently relevant fields** in science and the humanities by encouraging coordinated, interdisciplinary, national and international cooperation between outstanding researchers – **networking**" (www.dfg.de).

One location / Multiple locations

As one of the main objectives is networking, the basic principle of priority programmes is **multiple locations**.

Relative Importance of Networking compared to scientific excellence

A particular characteristic of this programme is the **cross-regional cooperation** of the participating scientists. International cooperations are possible too. The project requirements emphasise too the aspect of collaboration / networking. Selection criteria are:

- A currently relevant and/or innovative topic
- Innovation: New approaches and/or new methods which can be expected to lead to substantial advances in knowledge
- Synergy: Close cooperation between participants; coherent content
- Originality: Project stands out positively against existing programmes http://www.dfg.de/en/research_funding/coordinated_programmes/priority_programmes/priority_programme_in_brief.html

Measures to guarantee network integration

As described above, the selection criteria focus on the aspect of networking, additionally the project grants are usually accompanyied by **colloquia**.

Top down- / Bottom-up Selection

Once the Senate has established the programme, the DFG announces a call for proposals, i.e. **within a defined framework** the scientists are free to choose their topic, research plan as well as methods.

Funding

„As a rule, funding is available for **up to 30 individual projects**. Funding can be received for, as a rule, **six years“** (http://www.dfg.de/en/research_funding/ coordinated _programmes/priority_programmes/priority_programme_in_brief.html).

Evaluation

The particularity of the selection procedure is that the Senate of the DFG evaluates the proposals in a **comparative matter** and tries primarily to identify promising research fields where Germany is not yet established. After defining the research fields the single scientists may formulate their proposals according to specific deadlines. Priority programmes enable researchers to join cross-regional cooperations indepedently from the structural prerequisites of their home institution (WR 2002, S. 19).

Humanities Research Centres / Innovation Colleges (Geisteswissenschaftliche Zentren / Innovationskollegs)

Short Description

Humanities Research Centres as well as Innovation Colleges serve to the creation of **sustainable research structures** in the **New Federal States** (WR 2002, S. 21). „The Humanities Research Centres were established in response to a recommendation by the German Science Council and have been funded by the DFG since 1996. These centres aim to maintain existing humanities research focuses in eastern Germany and help set new research focuses with a clearly defined humanities-focused methodology and content. Humanities Research Centres have an **interdisciplinary, collaborative and project-oriented approach** with a cultural studies and international focus. Six Humanities Research Centres are currently being funded. The establishment of further centres is not planned at the moment“ (http://www.dfg.de/en/research_funding/ coordinated_programmes/ humanities_research_centres/index.html).

Centres are established for a specific time period and are institutionally **sponsored by the federal state in which they are located**. Core support is provided by the federal state or the group of participating states. Based on a review process, the DFG provides project-specific funds for the work carried out by these centres (http://www.dfg.de/en/research_funding/coordinated_programmes/ humanities_ research_centres/index.html).

DFG Research Centres (DFG-Forschungszentren)

Short Description

Since 2002 Research Centres are part of the DFG programme portfolio, in July 2003 the first three centres were established[85]. „DFG Research Centres are internationally visible **centres of excellence** at universities“ (http://www.dfg.de/en/research_ funding/coordinated_programmes/dfg_ research_centres/ index.html). Main objective is the **concentration of outstanding competence and ressources**. DFG Research Centres are an important element of the strategic and thematic planning of a research university and sharpen their profile. They are an important strategic funding instrument to concentrate scientific research competence in particularly innovative fields and create temporary, internationally visible research priorities at research universities. Thus, only research universities are eligible for funding.

[85] Ocean margins (University of Bremen), Funktional Nanostructures (University of Karlsruhe), Experimental Biomedicine (University of Würzburg).

DFG Research Centres enable the universities to establish **research priorities** on the basis of **existing structures**. The thematic focus must incorporate a **high degree of interdisciplinary cooperation**. Networking with other research institutions at the university location is encouraged. DFG Research Centres are open for cooperation with partners from industry **(**http://www.dfg.de/en/).

Apart from the **substantial amount of funds** one of the main particularities of the centres is that up to six professorships can be funded (WR 2002, S.21) which have to be overtaken afterwards by the university. In the view of the German Science Council (WR) this deliveres more **opportunities for restucturing** than CRCs (WR 2003, S. 6).

Funding
Funding may be provided for **up to six professorships** as well as associated **independent junior research groups** working within a DFG Research Centre. Following the start-up funding provided by the DFG, the host university commits itself to financing the professorships from its core budget. Appropriate personnel and material resources will also be made available. Funding for each DFG Research Centre averages approximately **5m EUR per annum**. Research Centres may receive funding for up to a **maximum of 12 years (**http://www.dfg.de/en/).

Evaluation
„The **DFG** annually **announces one or two topics** for which universities are invited to submit project drafts. German and international experts select approximately three of the most promising concepts in a **pre-selection phase**. The DFG then invites these universities to submit their proposals and to present their project to an international review team in a two-day competitive review. The DFG's Joint Committee decides on the establishment and funding of DFG Research Centres on the basis of the recommendations made by the review team“ (http://www.dfg.de/en/research_funding/ coordinated_programmes/dfg_research_centres/forschungszentren_kompakt darstel-lung.html).

(International) Research Training Groups ((Internationale) Graduiertenkollegs)

„Research Training Groups are university training programmes established for a specific time period to support young researchers in their pursuit of a doctorate. The Research Training Groups provide these doctoral students with the opportunity to work within a **coordinated research programme** run by a number of university teachers. Doctoral students are incorporated into the research work being done at the participating institutions. The study programme aims to complement and extend the doctoral students' individual specialisations and to provide a structure for cooperation. An interdisciplinary focus of the research and study programme is desired. **International** Research Training Groups provide opportunities for engaging in joint doctoral training between a group at a German university and a partner group at a foreign university“ (http://www.dfg.de/en/research_funding/coordinated_programmes / research_training_groups/index.html). Only universities and the federal state in which they are located may submit a joint application.

Project Requirements are:

- Research programme - high scientific quality and originality (interdisciplinary approach desired) at an international level
- Study programme - of direct relevance to the research programme, including innovative teaching and supervision elements, which should clearly extend beyond the courses (doctoral student colloquia) usually offered in doctoral programmes
- Visiting professor programmes - integrated into the study programme, internationalisation of the training http://www.dfg. de / en/research_funding/coordinated_programmes/research_ training_groups/gk_ kompaktdarstellung.html

„Type and Extent of Funding: Grants and fellowships for doctoral students, postdocs, applicants holding a Fachhochschule (university of applied sciences) degree or a Bachelor's degree. Funds for visiting professors, research students, travel, workshops, smaller equipment, consumables, coordination, miscellaneous. The funding duration is per funding period 4.5 years; the maximum funding duration is 9 years“ (http://www.dfg. de / en/research_funding/coordinated_programmes/research_ training_groups/gk_ kompaktdarstellung.html).

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Swiss Research Programmes

Introduction

Article 64 of the Swiss Constitution obliges the **Confederation** to **promote scientific research**. In carrying out this task the Confederation

- supports **free basic research** by financing the Swiss National Science Foundation and scientific academies as so-called National institutions promoting science;
- commissions the Swiss National Science Foundation to carry out **program research** in areas where structural weaknesses in the scientific system call for a concentrated approach or where economic and social requirements demand specific scientific results: National Centres of Competence in Research; National Research Programmes (NRP);
- grants funds to **independent research institutions** outside the university sphere; the federal administration finances numerous research proposals through **mandates and commissions**;
- supports **international co-operation** in research by the public and private sectors in international research programmes (European Union Framework Program for Research and Technological Development; European Co-operation in the field of Scientific and Technical Research COST) and international research organizations;
- manages and finances the **Commission for Technology and Innovation** (CTI) as an agency for the promotion of research of economic interest (http://www. bbw.admin.ch/html/pages/forschung/forschf-e.html).

The **Swiss National Science Foundation** (SNF) was founded on 1st August **1952** by the scientific umbrella organisations of Switzerland. It operates according to the principal of **scientific independence** and is a **central player in publicly funded research promotion**. Its key tasks are to **provide financial support** for clearly defined **free research projects in all scientific disciplines** (inside and outside universities) and to **foster young scientific talent**. Over the years, additional tasks have been added to the SNF's remit, the range of promotion instruments and measures has become wider and more varied (http://www. snf.ch/en/por/his/his.asp).

The SNF has at its disposal a wide range of research promotion opportunities, which are **open in principle to all scientists working in Switzerland**, irrespective of nationality. The range of promotion opportunities includes:

- Project promotion
- Fostering of individual talent
- Publication grants
- Conference grants

- Promotion of international research co-operation
- Special programmes, divisional promotion initiatives (http://www. snf.ch/en/por/his/his.asp)

A distinction is drawn between promotion measures benefiting **independent free research** without a predefined theme and those benefiting **targeted research** on a predefined theme within the context of coordinated inter- or transdisciplinary research programmes (http://www.snf.ch/en/fop/fop.asp). With its interdisciplinary and problem-oriented research programmes, the SNF attempts to provide scientifically sound solutions to problems of social significance and to develop scientific centres of excellence for certain subject areas. The national and international research programmes are coordinated and **interdisciplinary** research efforts of **restricted duration** and with **clearly (and politically) defined aims and topics**. Co-operation with non-academic partners, the transfer of knowledge and know-how in training and in practice and the translation of research results into a form suitable for future users and interested members of the public are all important features. There are currently three different types of research programmes:

- National Research Programmes (NRP)
- Swiss Priority Programmes (SPP)
- National Centres of Competence in Research (NCCR) (http://www.snf.ch/en/ rep/nat/nat.asp, http://www.snf.ch/en/rep/rep.asp).

In the year 2002, the SNF awarded a total of CHF 368.5 million in grants for the promotion of research and for the fostering of young scientists. 71 % of the research grants are spent on salaries for the staff engaged on research projects. In 2001, around 4200 staff were employed on research projects funded by the SNF. 74% of the staff are under thirty-five, 39,5% are women (http://www.snf.ch/en/por/fac/ fac. asp). The national programmes have a **share of 20,3%** of the budget in 2002 (NRP = 7,1%, NCCR = 11,6%, SPP = 1,6%), in 2001 this share was 18,8%.

National Research Programmes NRP (Nationale Forschungsprogramme NFP)

Short Description

The National Research Programmes make scientifically sound contributions to solving **urgent problems of national importance**. The **topics are chosen by the Swiss Federal Government**. The examination of important contemporary problems generally requires an **interdisciplinary** approach to research and a combination of theoretical research and practical application. NRPs last **4 to 5**

years and are funded to the tune of 5 to 20 million Swiss francs. At the moment the following NRP exist:
NRP 56 - Language Diversity and Linguistic Competence in Switzerland
NRP 54 - Sustainable Development of the Built Environment
NRP 53 - Musculoskeletal Health - Chronic Pain
NRP 52 - Childhood, Youth & Intergenerational Relationships in a Changing Society
NRP 51 - Social Integration and Social Exclusion
NRP 50 - Endocrine Disruptors: Relevance to Humans, Animals and Ecosystems
NRP 49 - Antibiotic Resistance
NRP 48 - Landscapes and Habitats of the Alps
NRP 47 - Supramolecular Functional Materials
NRP 46 - Implants and Transplants
NRP 45 - Future Problems of the Welfare State
NRP 43 - Formation and Employment
NRP 42+ - Relations between Switzerland and South Africa
NRP 41 - Transport and Environment: Interactions Switzerland - Europe
NRP 40 - Violence in Daily Life and Organized Crime
NRP 40+ - "Right-wing Extremism - Causes and Counter-measures"
NRP 39 - Migration and Intercultural Relations
NRP 38 - Diseases of the Nervous System
NRP 38+ - Pathogenesis of Novel Forms of Infectious Diseases
NRP 37 - Somatic Gene Therapy
NRP 36 - Nano Sciences (http://www.snf.ch/en/rep/nat/nat_nrp.asp)[86].

Evaluation

The selection of topics is **bottom-up**. Interested persons / institutions can submit proposals on new research programmes to the responsible Federal Office for Education and Science (FOER). After examination by the FOER the Bundesrat decides on the application of the Federal Departement of Home Affairs (DHA) periodically about the topics and funds from one and up to three new NRP. Afterwards the FOER commissions the SNF to implement the project(s). After the approval by the DHA, a new NRP is announced. The single research proposals related to the NRP are subject of the standard evaluation procedure of the SNF[87].

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86 In other parts of the SNF Homepage five further NRPs are mentioned: NFP 42: Basics and possibilites of Swiss foreign policy, NFP 35: Women in right and society: ways to recognition, NFP 34: complementary medicine, NFP 33: Effectiviness of the education system, NFP 32: Age.

87 Usually the evaluation is made by at least two experts, on the average three which are invited by the responsible officials in charge. Only one third of the experts stem from Switzerland, two thirds from abroad (Selbstevaluation SNF, p. 9). The beneficiaries are

Assessment
Since the start of the programme in 1974 a total number of 50 NRP has been promoted. According to the SNF, an international expert commission assessed in 1994 that this programme is generally **useful and effective**, but that in the past there were **no systematic and detailed ex post analyses** concerning the real contribution to political problem solving. A further criticism was related to the **selection of topics** which is not made by the SNF and / or scientists but **by politicians** (Selbstevaluation SNF p.4). From the point of view of Economiesuisse, an economic association, the NRP are threatened by an increasing tendency to be monopolized by policymakers and consequently a certain loss of scientific quality. However, this association also insists that the economy should be integrated in future selection procedures in time (NZZ Nr. 119, 25. Mai 2001).

National Centres of Competence in Research NCCR (Nationale Forschungsschwerpunkte NFS)

Short Description
„National Centres of Competence in Research (NCCR) promote **long term research projects** in areas of **vital strategic importance** for the evolution of science in Switzerland, for the country's economy, and for Swiss society. Each Centre of Competence is **based in and managed from a university** or other renowned research institution („Leading House"). A **network** links the research groups from this **home institution** with other teams throughout Switzerland. The following aspects are decisive for the approval of a Centre of Competence: it must

- conduct research of **outstanding, internationally recognised quality**, and
- actively foster knowledge and technology **transfer**,
- **training**, and the promotion of **women** researchers.

A further aim of NCCR is to **globally restructure** and improve the organisation of Swiss research. Federal funding for NCCR is voted by Parliament, and completed by funding from the institutions themselves, and from third parties. Launched in 2001, in its end stage the programme should include **up to 20 NCCR**" (http://www.snf.ch/en/rep/nat/nat_ccr.asp). Public promotion will be up to **10 years**, 12 years at maximum. There is a first funding period which lasts four years. Afterwards the applicants have to write a proposal for further funding. The approval is dependent on an interim evaluation and this proposal.

At the moment **14 NCCRs** are promoted:

- Molecular Oncology - From Basic Research to Therapeutic Approaches

obliged to deliver a scientific and a financial interim report, when the project is finished an end report. Especially important are publications (Selbstevaluation SNF, p. 10).

- Interactive Multimodal Information Management
- Frontiers in Genetics - Genes, Chromosomes and Development
- Materials with Novel Electronic Properties
- Financial Valuation and Risk Management
- Molecular Life Sciences: Three Dimensional Structure, Folding and Instructions
- Nanoscale Science - Impact on Life Sciences, Sustainability, Information and Communication Technologies
- North-South: Research Partnerships for Mitigating Syndromes of Global Change
- Quantum Photonics
- Neural Plasticity and Repair
- Plant Survival in Natural and Agricultural Ecosystems
- Computer Aided and Image Guided Medical Interventions
- Mobile Information and Communication Systems
- Climate Variability, Predictability and Climate Risks (http://www.snf.ch/en/rep/nat/nat_ccr_pro.asp).

Objectives
„The objective of the NCCR is the **sustained strengthening** of Switzerland as a centre of research in strategically important fields. The programmes seek to promote research **projects of the highest quality** with a particular emphasis on **interdisciplinary approaches**, but also on new **innovative approaches** within the disciplines. At the time, the initiative seeks to stimulate a **concentration of forces** and an improved distribution of work among research institutions in Switzerland, as well as to promote **partnerships** in the academic and non-academic sector. In addition, the NCCRs are intended to become involved in the fields of the promotion of young investigaters, the transfer of knowledge and the advancement of women in research" (Programme Call 2003, p. 4). From the point of view of the SNF, the NCCR serve also as instrument to promote **risk research** as the project duration is rather long and the evaluation looks primarily at the general potential and development of the overall research programme and not at single projects (Selbstevaluation SNF, p. 3). The GWF (Group for Science and Research) sees the NCCR as most important incentive in the Swiss research landscape to create **networks** in order to reach critical mass and promote interdisciplinarity (GWF 2000, p. 12).

One location / Multiple locations
The NCCR are a mixture between Competence Centres and Competence Networks. While they have a clear focus at a host institution (usually a university), they integrate a certain number of other institutions at other locations (see table 1). Due to the network character, NCCR can be desribed as **multilocal**. It is important to mention that the share of foreign peronal is rather high: concerning the senior scientists, there are more Non-Swiss scientists (456) than Swiss scientists (402). This ratio is even more distinct with regard to doctoral students (282 Swiss vs. 467 Non-Swiss) and postdocs (90 Swiss vs. 264 Non-Swiss) (see Guide 2004, p. 7).

Size of consortia

The size of NCCRs varies between **eight and twenty project leaders** whereas on the average there are **13,5** project leader per centre. There is no relationship between thematic field (e.g. Life Sciences) and size (see table 1).

Table 1: Characteristics of the 14 Swiss NCCR

NCCR	Project leader	Project start	Budget
Molecular Oncology	20 (12 belong to the host institution)	May 2001	CHF 36'708'236 (SNF 20'200'000; own / third party means 16'508'236
Frontiers in Genetics	17 (11 belong to the host university)	July 2001	CHF 46'880'640 (SNF 18'520'000; own / third party means 28'360'640
Molecular Life Sciences	16 (5 belong to the host university, further 7 to the ETH at the same location)	May 2001	CHF 29'968'480 (SNF 14'400'000; own / third party means 15'558'480
Neural Plasticity and Repair	11 (5 belong to the host university, further 6 to institutions at the same location)	June 2001	CHF 72'135'643 (SNF 16'400'000; own / third party means 55'735'643
North-South	8 (2 belong to the host university)	July 2001	CHF 32'600'000 (SNF 14'500'000; own / third party means 18'100'000 (Direction for development and co-operation DEZA 14'500'000)
Plant Survival	14 (6 stem from the same location)	April 2001	CHF 24'976'471 (SNF 14'000'000; own / third party means 10'978'471
Climate	14 (5 belong to the host university)	April 2001	CHF 21'567'585 (SNF 11'100'000; own / third party means 10'467'585
Materials with Novel Electronic Properties	19 (7 belong to the host university)	July 2001	CHF 45'453'352 (SNF 19'100'000; own / third party means 26'353'352
Nanoscale Science	12 (8 belong to the host university)	June 2001	CHF 64'000'000 (SNF 19'200'000; own / third party means 44'800'000
Quantum Photonics	10 (5 stem from the same location)	July 2001	CHF 36'417'760 (SNF 18'900'000; own / third party means 17'667'760
Information Management	12 (4 belong to the host institution)	January 2002	CHF 31'620'000 (SNF 15'400'000; own / third party means 16'220'000
Medical Interventions	11 (4 stem from the same location)	July 2001	CHF 40'495'522 (SNF 17'000'000; own / third party means 23'495'522
Mobile IuK-Systeme	11 (7 belong to the host institution)	November 2001	CHF 31'452'190 (SNF 15'400'000, own / third party means 16'052'190
Financial Valuation and Risk Management	14 (5 belong to the host university)	November 2001	CHF 14'600'000 (SNF 10'700'000, own / third party means 3'900'000

The share of own / third party means is in some cases more than the share of public funding, quite often a 50% rate can be found.

Relative Importance of Networking compared to scientific excellence
Basesd on the existing documents it is quite difficult to give a clear answer on how important networking is compared to scientific excellence. However, as the NCCR serve to structure the Swiss research landscape, networks seem to play a rather important role as they may improve co-operation and thus avoid redundancies. Besides this scientific excellence is of course important: the NCCR were established in order to promote „scientific excellence in areas of major strategic importance for the future of Swiss research, economy and society" (Guide 2004).

It is important to mention that networking is not only seen at the national but also at the **international** level: High international networking is an objective which is assesed as important in the evaluation process. A NCCR disposes of a network of decentrally acting research groups. There is no reason why these groups should be limited to Switzerland (Selbstevaluation SNF, S. 131). However, as far as the 14 current NCCR are concerned, there is no foreign participation.

Importance of Interdisciplinarity
The large number (and diversity) of participating institutions shows that interdisciplinarity plays a crucial role. In order to submit a pre-proposal the applicants have to indicate in detail which disciplines will participate. Additionally, a sufficient thematic and disciplinary range is an important criterion in the selection process of pre-proposals.

Top down- / Bottom-up Selection
The scientists are in principle **free to choose their research topics**[88], but the ex ante selection of the proposals is not only based on scientific criteria but is made also with regard to the fit with the **national research policy**, whereas the Confederation definces the main lines and topics of research. Thus the selection procedure of a NCCR is characterised by bottom-up as well as top-down elements.

Role of Training and Gender
Training and Gender are seen as one of the three **main characteristics** of NCCR. One category in the proposal sheets serves to describe the aims and measures to promote young scientists and women, thus it has a certain relevance in the selection process. However, the typcial science-related criteria imply selection on the basis of the state of the art, but also international networking are mentioned also and on an earlier position (see table 2).

Looking at the total personal of the 14 NFS (Guide 2004, p. 7) it can be shown that female researchers have a total share of 29%, but related to the senior scientists only 15%. Women can be found especially frequent (> 50%) in the group of master students and „other staff". Two of the 14 NCCR leaders are women. However, this is a typical pattern all over Europe as the different Gender Studies show (European Commission 2001).

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[88] However, the NCCRs should be appropriately broad in terms of the themes and disciplines covered (http://www.snf.ch/en/cal/rep/rep_ccr.asp).

The Guide 2004 makes clear that training plays an important role: Related to the total number of 2465 pesons involved in the NCCR 1185 (= 48%) belong to the group of younger scientists (diploma students, master students, doctoral students, postdocs), additionally senior scientists (838), management staff (51) and „other staff" (391) can be found.

Funding
The funds of a NCCR stem from the Confederation as well as from the host institution and it is expected that the „Leading House" or main centre contributes seriously in terms of personal and material resources. As table 1 shows, this is true: the public funding is a substantial but not the unique important part of the overall budget of the NCCR. Within five out of fourteen NCCR the share of public means is more than 50% (in one case 73%), in the other nine centers this share is lower, in one case only 23%.

Evaluation
Based on the available documents it is only possible to describe the **ex ante-evaluation procedure**[89]. The selection of NRRC is made by competition. The particularity of the selection is that it is not only based on scientific merit (by SNF) but also by **criteria related to research policy** (by GWF). The reason is that the NCCR aims to strengthen strategically important research areas which are defined by policy. The evaluation is made by **international expert committees**.

The timeframe foresees about 9 months between submission of pre-proposals and detailed proposals, and until the eventual start around 6 months may then elapse.

„The evaluation of contents of the pre-proposals is preceeded by a **formal check** by the NCCR Programme Office. For this check, the SNF shall designate an **evaluation committee** that shall be composed of some **15 foreign experts** as well as members of the National Research Council[90]. The committee shall meet once at the head office of the SNF and evaluate each pre-prosal. The supporting documents submitted and the written reports by two members of the committee in each case shall assist in this task. After the individual check, the committee divides the pre-proposals into three categories (A = chances of success good, B: doubtful, C: slight). The following criteria shall be applied:

- Significance of the research topic for Switzerland as a research centre

89 As the instrument NCCR was established only in 2001 and the promtion takes about 10 years, no ex post evaluation took place. However, it is intended to publish output data (publications, knowledge and technology transfer) and data about structural effects in the Guide 2005, after three years running of NCCR (Guide 2004).

90 For the Call 2003/2004 11 experts of the Evaluation Committee stem from Germany, 2 from the Netherlands, one from Austria, UK, Canada and Denmark. Three of the reviewers are women. For pre-proposals from specific subject areas the SNF used additional written assessments by experts who were not members of the Committee (http://www.snf.ch/en/rep/nat/ nat_ccr_eva. asp).

- Originality, innovation potential and interdisciplinary nature
- Criticial mass and added value of the NCCR in comparison with the sum total of the individual projects
- Potential of the NCCR to attain a leading international role
- Plausibility of the goals / measures with respect to knowledge transfer, education / training and advancement of women
- Academic reputation of the NCCR director or of the deputy and leadership experience of the management team
- Academic reputation of the project leaders
- Suitability of the Home Institution (Guide 2004, p.9).

Already at this stage a first joint meeting shall take place between the Home Institution (Rector's Office), GWF (Group for Science and Research) / Federal Office for Education and Science (FOER) and SNF at which **structural aspects** are to be discussed. GWF/FOER are not responsible for the evaluation of the content. All those whose pre-proposal have been admitted for evaluation can submit a NCCR proposal which again is evaluated by an international expert committee. Each committee shall be chaired by a member of the National Research Council. The SNF shall pass on the NCCR proposals recommended for implementation to the **GWF**-GSR for evaluation with regard to **research and higher education policies**. The following criteria are mainly applied in this examination:

- Suport for the Leading House in the Home Institution's strategic planning
- Distribution of work and co-ordination in the higher education sector
- Incorporation into the regional and national overall distribution of leading houses in accordance with the goals of NCCR programme
- Agreement with the Federal Goverment's research policy goals
- Embodiment in Switzerland's international scientific co-operation agreements and co-operation endeavours on an institutional level" (Guide 2004, p. 9f.).

The pre-proposals and proposals shall contain the following statements (Programme Call 2003):

Table 2: Structure of (Pre-)Proposals

Pre-Proposal	Proposal
Summary	Summary
The scientific question formulated and its relevance and importance to society	The scientific question formulated and its relevance and importance to society
The general state of research and previous contributions on the topic by the participants in the NCCR	The general state of research and previous contributions on the topic by the participants in the NCCR
The research programme for the first four years and expected contribution to the state of research, the perspective for the following years	Research plan as a whole, the structure of NCCR for the first four years and expected contribution to the state of research, the perspective of the following years
	The research plans for the individual projects
International networking	International networking
The goals, measures in the field of education / training and the advancement of women, as well as knowledge transfer	The goals, measures in the field of knowledge transfer and co-operation parnters outside of the NCCR
	The goals, measures in the field of education / training and the advancement of women
Qualification of the Home Institution	
Organisation of the NCCR	The organisation structure and procedures
Budget of the first four years	The detailed budget of the first period of four years

The committee in charge of the evaluation of the SNF critisized the NCCR, especially the selection procedure, which did not meet expectations with regard to professionality and scientific independence (SNF-Evaluation, p. 9f.). Besides this there was some basic criticism concerning department IV of the SNF where also the NCCR are administrated: the scientific level and the quality of the evaluation processes are seen as not reaching the level of the other departments (SNF-Evaluation, p. 16).

Swiss Priority Programmes SPP (Schwerpunktprogramme SPP)

Short Description

The Swiss Priority Programmes, established in 1991, ensure that Swiss research keeps up with international developments and supports the **establishment of Centres and Networks of Competence at Swiss universities**. Priority Programmes are designed to cover research **areas of**

strategic importance. Their **topics** and budgets are **decided upon by Parliament**. The Programmes last for **8 to 10 years** and are funded to the tune of 60 to 110 million Swiss francs. Four SPPs were supported before this instrument was integrated into the promotion scheme National Centers of Competence in Research:

- SPP Switzerland: Towards the Future
- SPP Biotechnology
- SPP Information and Communication Structures
- SPP Environment (http://www.snf.ch/en/rep/nat/nat_pri.asp).

The promotion of SPP was stopped in 2003 due to their weakness with regard to the sustainability of the envisaged priorities or respectively their integration into the Swiss university landscape (Selbstevaluation SNF, S.4).

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Annex: Distribution of Grants and Fellowships 2002

Amount in 1000 CHF, according to instruments of funding

	2001	2002
Research Grants	238 736	248 455
Publication Grants	1 817	2 290
Personal Grants		64
SNF Professorships	28 187	15 419
Fellowships for Advanced Researchers	7 842	8 065
Fellowships for Prospective Researchers	16 445	14 939
Int. Research Co-operation and other Grants	6 071	11 531
National Research Programmes	7 485	26 707
Swiss Priority Programmes	4 215	5 936
National Centres of Competence in Research	57 696	43 893
Total	**368 494**	**377 298**

Source: http://www.snf.ch/en/por/fac/fac_gra.asp

Nordic Research Programmes

Besides the allocation of basic funds and different kinds of technology-oriented programmes like competence centers which serve primarily to improve the collaboration between science and industry, most of the Nordic states use the instrument of promoting Centers of Excellence to be internationally competitive. That is the reason why we restrict our description and analysis to two Nordic countries, Finland and Denmark.

Finland

Introduction

The Finnish S&T policy is formulated by the Science and Technology Policy Council and mainly implemented by the **Academy of Finland** and Tekes, whereby the Academy focuses on the support of basic research and Tekes on applied research. Additionally, the two agencies also **jointly implement programmes**. There exist several programmes, which address science-industry relations: Technology Programme, National Centres of Expertise Programme and Cluster Programmes. The *Centre of Excellence Programme*, the *Research Programme* and the *TULI programme* also seek to stimulate cooperation, but focus on the research system (StarMAP Country Report Finnland, p. 13).

The **Academy is the central planning and financing body for basic research**. The Academy has **four research councils**, which decide on research funding on the basis of mutual **competition** between applications for appropriations (http://www. minedu.fi/eopm/hep/ii/ 8_3.html). The main goals of the Academy are: (1) to promote scientific research, (2) to promote international scientific cooperation, and (3) to act as an expert body in matters concerning science and science policy (Report No. 68., 1994).

In 2002, the Academy's support for research at Finnish universities and research institutes amounted to **EUR 184 million**. This represents more than 13% of total government research funding (http://www.aka.fi/index.cfm?ChangeSet Now=3, StarMAP Country Report Finnland, p. 7). Some two thousand research professionals are working on research projects funded by the Academy (http://www. minedu. fi/eopm/hep/ii/8_3.html). About 80% of research funding goes to research at universities. Almost 10% is allocated to researchers' work abroad. (http:// www. minedu.fi/eopm/hep/ii/8_3.html). The key forms of research funding are:

- General research appropriations
- Research Programmes
- Centre of excellence programmes
- Research posts
- Appropriations to postdoctoral researchers
- Appropriations to senior scientists
- Other support (Pauli 2003)

Research Programmes

Short Description

Research programmes are a growing form of Academy funding and are also seen as one of their key instruments (http://www.research.fi/tk-ohj_en.html). They differ from other Academy-funded research in that they have a given problem to start with. Their aim is to **boost new, rising, or relapsed yet important areas of research or to answer a particular social need** (http://www.minedu.fi/eopm/hep/ii/ 8_3.html).

New programmes are being **launched annually**. Research programmes are scheduled to run for a set period of time, usually for **three or four years**. In general, **other funding bodies**, both Finnish and foreign, are also involved (http://www. research.fi/tk-ohj_en.html).

In **2002**, the Academy had **21 ongoing research programmes** (http://www. research. fi/tk-ohj_en.html). The ongoing research programmes are:

- Biological Functions, Life 2000 (2000-2003)
- Baltic Sea Research Programme, BIREME (2002-2005)
- Environmental, Societal and Health Effects of Genetically Modified Organisms, ESGEMO (2004-2007)
- Finnish Companies and the Challenges of Globalisation LIIKE (2001-2004)
- Future Electronics, TULE (2003-2006)
- Future Mechanical Engineering, TUKEVA (2000-2003)
- Health Promotion Research Programme, TERVE (2001-2004)
- Health Services Research, TERTTU (2003-2007)
- Industrial Design (2003-2006)
- Infrastructure Programme 2004
- Interaction across the Gulf of Bothnia (2000-2003)
- Life as Learning Research Programme, LEARN (2002-2006)
- Marginalisation, Inequality & Ethnic Relation in Finland, SYREENI (2000-2003)
- Microbes and Man Research Programme, MICMAN (2002-2006)
- Proactive Computing Research Programme, PROACT (2002-2005)
- Russia in Flux (2004-2007)
- Social Capital and Networks of Trust, SOCA (2004-2007)
- Space Research ANTARES (2001-2004)
- Sustainable Use of Natural Resources SUNARE (2001-2004)
- Systems Biology and Bioinformatics, SYSBIO (2004-2007)
- Wood Material Science Research Programme, WOODWISDOM (2003-2006)

Completed research programmes are:

- Ageing (2000-2002)
- Biodiversity, FIBRE (1997-2002)
- Electronic Materials and Microsystems, EMMA (1999-2002)
- Finnish Global Change Research Programme, FIGARE (1999-2002)
- Media Culture Research Programme, MEDIA (1999-2002)
- Process Technology, PROTEK (1999-2002)
- Structural Biology, RAKBIO (2000-2002)
- Ecological construction
- Genome Research Programme (1994-2000)
- Urban Studies (1998-2001)
- Mathematical Methods and Modelling in the Sciences, MaDaMe (2000-2003)
- Materials Research and Structures Research, MATRA (1994-2000)
- Molecular Epidemiology and Molecular Evolution (1997-1999)

- Restoration of Boreal Environments, RESTORE 2000
- Studies on Science and Science Policy
- Health and Other Welfare Differences between Population Groups (1998-2000)
- Russia and Eastern Europe (1995-2000)
- Telecommunication Electronics, Telectronics

Objectives

Research programmes have the objectives of

- raising the scientific standards of research within a certain field of research;
- promoting multidisciplinarity, interdisciplinarity (and where possible cross-disciplinarity) and international cooperation;
- creating and strengthening the knowledge base;
- creating and reinforcing of a scientific tradition of a new type
- promoting professional careers in research and the networking of researchers;
- intensifying researcher training and
- of supporting the establishment of creative research environments (http://www.aka.fi/index.asp).

One location / Multiple locations

The Research Programmes are quite open and free with regard to size as well as with regard to location. There are two main types of cooperation if different sites are involved:

- parties cooperate in the context of **ordinary project cooperation,**
- if funding is required for research at those different sites, the project shall submit an **application in the name of a consortium.**

In the first case funding applications shall be made for **independent projects**, with separate applications complete with appendices compiled for each project. The principles of project cooperation shall be briefly described in each project application. In the second case, the research plan shall include a general section that describes the work of the whole consortium. The general section of the application submitted by the researcher in charge shall include a description of each component project as well as of the division of labour within the consortium and the **value added that the cooperation is expected to generate**. Each project taking part in the consortium shall complete its own application form (www.aka.fi).

Size of consortia

A research programme is composed of a **number of interrelated research projects** focused on a defined subject area (http://www.research.fi/tk-ohj_en.html). The size varies and the applicants are widely free to choose the appropriate size of their network.

Relative Importance of Networking compared to scientific excellence
Generally scientific quality is the most important assessment criterion for evaluations done by the Academy. Accordingly the most important objective of this type of programme is seen in raising the scientific standards of research within a certain field of research.

Importance of Interdisciplinarity
The official documents and the website stress that **multi- and interdisciplinary approaches** will receive special emphasis in the future. One can interpret this statement in a way that in the past interdisciplinarity was not one of the most important criteria of the Research Programmes (http://www.minedu.fi/ eopm/hep/ii/ 8_3.html). However, inter- respectively multidisciplinarity is mentioned on the second place when describing the main objectives of the programme.

Top down- / Bottom-up Selection
Initiatives for research programmes usually come **from researchers**. In the Academy, they proceed from the research councils to the Board (http:// www.minedu.fi/ eopm/hep/ii/8_3.html). There are the following typical paths for research programmes to emerge:

- Research programmes may by motivated by **concerns arising from science and/or society in general**.
- Initiatives for a research programme may be prompted by **internal development needs** within a discipline or field of research or by needs to support a new, emerging field.
- An initiative may also arise from an issue or problem that is considered to be of **societal import** (http://www. aka.fi/index.asp).

Role of Training and Gender
The promotion of professional careers in research and the intensification of researcher training are mentioned as objectives of the Research Programmes, but other objectives like strengthening the knowledge base seem to be more important. The role of women and especially gender mainstreaming is not mentioned in the documents on the website.

Funding
In 1997, the Academy allocated some **20 per cent of its research appropriations** to research programmes, and the figure is expected to grow to 25 per cent in the near future. Programmes often have **other sources of funding** as well (http://www. minedu.fi/eopm/hep/ii/8_3.html).

Evaluation
Applications for research programmes are usually processed in two stages. Initially, researchers are requested to submit their **plans of intent**, which will be used to decide on a shortlist of projects going through to the second round

(done by the Academy). Those going through to the second round will then be requested to submit **full applications**. The applicant may be a consortium, a research team, or a researcher with a PhD. Application timetables for plans of intent will be adjusted to the Academy's general application times. The funding decisions will be made by the Academy of Finland (www.aka.fi).

The webpage offers a lot of useful information for applicants, for example detailed objectives and instructions for each research programme (to be found in the **research programme memorandum** for the programme concerned), information on research programmes open for application at each given time etc.

Centres of Excellence Programme

Short description

The centre of excellence programme is one of the Academy's most important forms of research funding for promoting the **development of creative research environments**. All centres of excellence in research represent the **cutting edge** of their respective field. The national strategy for centres of excellence in research has been **jointly developed with** the National Technology Agency (**Tekes**), which also contributes to the funding of centre of excellence programmes (http://www.aka.fi/). Centres of excellence substantially **reinforce and diversify the research activities** of universities and other research organizations (http://www.minedu.fi/eopm/hep/ii/8_3.html). The programme is open for all disciplines.

The Ministry nominated the first 12 centres of excellence for the period 1995-1996, but without earmarked funding; five more CoE were nominated for the period 1997-1999, the first 12 CoE continued (Malkamäki et al. 2001, p. 35)[91]. For the period 2000-2005 further **26 CoE** were nominated, also **umbrella organisations** can be supported since that period. These umbrella organisations „produce strategically important core facilities and expensive infrastructure shared by several research groups. Only such umbrella organisations that have at least one CoE operating under the „umbrella" are eligible to the core facility funding from the CoE Programme" (Malkamäki et al. 2001, p. 35).

At the moment, a total of **42 centres of excellence** are funded through two national centre of excellence programmes. The 26 centres of excellence and seven core facilities organisations involved in the first centre of excellence

91 Since 1997 the Academy has the primary responsibility for the CoE programme.

programme from 2000-2005, started their **second three-year term** in the beginning of 2003. It was decided to spend **EUR 30.3 million** on supporting this programme **in 2003-2005**. In 2004, resource negotiations for the years 2005-2007 will be conducted with the **16 new centres** of excellence involved in the second centre of excellence programme from 2002-2007 (http://www.aka.fi/). The funding decisions within the two programmes have been made for three years at a time. (http://www.research.fi/huippuyk_en.html). The number of centres of excellence active in 2000-2005 will be **at least 20** (http://www.minedu.fi/eopm/hep/ii/8_3. html).

Objectives

The objective of the CoE is to support the emergence of **creative and efficient research and training environments** and to **raise the quality** of Finnish research (http://www.aka.fi/index.cfm?ChangeSet Now=3, StarMAP Country Report Finland, p. 7). The centers shall create preconditions that will allow such high-level, creative and efficient research and researcher training giving rise to work of the **best international level** (http://www.minedu.fi/ eopm/hep/ii/8_3.html). „The objectives of the programme are to create the information base required for cultural, social and industrial development, and to create a solid **base for a national innovation system**" (Malkamäki et al. 2001, p. 35).

One location / Multiple locations

CoE can be organised at **different locations**, and there is a lot of freedom with regard to size as well as with regard to structure. However, the National Strategy from 1997 emphasizes the advantages related to close geographical proximity: „Experience has shown that the daily personal contacts between various research organizations [...] and those who actually use the results generate all kinds of fruitful interaction that even the best electronic communication cannot yield" (Academy 2000, p. 8). However, in this document also so-called cluster-type CoE are described, i.e. CoE which may include top researchers who do not belong to any group; top units and top researchers working on the same research subject or problem and who come together under a shared umbrella organisation, and may even include other groups and researchers of internationally high quality (Academy 2000, p. 23).

Size of consortia

The size of units depends on the particular field, it varies from the staff of **20 to almost 200** (http://www.research.fi/huippuyk_en.html). A unit selected as a centre of excellence is a **research unit or researcher training unit** which comprises **one or several high-standard research teams** with shared, clearly defined research goals, and which is at, or has good potential for reaching the **international forefront** in its field. Research teams working outside the universities may also be awarded centre of excellence status (http://www.aka.fi/).

Relative Importance of Networking compared to scientific excellence
Generally criteria related to (1) scientific merits and output are most important for the selection of a CoE. They are followed by criteria related to (2) significance and feasibility of the research and operating plan, (3) research environment and (4) success and potential in researcher training (Malkamäki et al. 2001, p. 35). However, the instrument of **umbrella organisations**, i.e. core facilities or infrastructure is an important tool for networking because sharing resources deliveres an excellent opportunity for fruitful collaboration[92].

Importance of Interdisciplinarity
As already mentioned above, scientific merits and output are most important for the selection of a CoE. Inter- or multidisciplinarity is not explicitly mentioned.

Top down- / Bottom-up Selection
The National Strategy 1997 suggests that „In addition to the best researchers we should also identify the research fields and subjects of national strategic importance for which internationally competitive research must be systematically generated in Finland" (Academy 2000, p. 24).

Role of Training and Gender
Training plays an important role, one of the four selection criteria groups are related to this aspect. Concrete criteria are (1) general potential for researcher training, (2) involvement in the work of graduate schools, (3) practical arrangements for researcher training, (4) success of supervisors in researcher training, (5) numbers of graduate students and supervisors (ratio), (6) need for researchers and experts in the unit's field (Academy 2000, p. 35).

The strategy paper from 1997 emphasizes that „graduate schools and other high-level researcher training form an integral part of a creative research environment [...]. It is important that the best researchers participate in various ways in both graduate and post-graduate university teaching, to convey the latest research results to university courses as fast as possible" (Academy 2000, p. 8).

The National Strategy 1997 shows that in 1996 on the average 42% of the academic personal in the 17 CoE were women, but only 19% of the senior staff (Academy 2000, p. 14).

Funding
The **Academy** of Finland is the **major source** of funding for the centres of excellence. The centres **require long-term funding from their backers**, the

[92] Due to budgetary reasons, this useful tool is no more foreseen in the CoE programme 2002-2007.

Academy and **other funding bodies**. Their share of Academy funding is about **20 per cent** (http://www.minedu.fi/eopm/hep/ii/8_3.html). The 2000-2005 centre of excellence programme is funded by the Academy with a total of 54.9 million euros. The 2002-2007 programme is funded with 16 million euros during the first three years. The programmes are also funded by the National Technology Agency **Tekes** (EUR 10.5 million and EUR 2.5 million respectively) as well as by the **host organisations**, i.e.universities and research institutes, which provide a significant share of the funding (http://www.research.fi/ huippuyk_en.html).

It is important to mention that the National Strategy recommends that „care should be taken that CoE do not become too dependent on outside allocated funding to be able to pursue their own research programmes, independent of the financers" (Academy 2000, p. 26).

Since 1995, the centres of excellence have been one of the **criteria for performance-based funding**, allocated to universities by the Ministry of Education (http://www.research.fi/huippuyk_en.html). The 2004 budget funding for universities includes a total of 13,8 million euros of performance-based funding, allocated on the basis of centres of excellence. This money is allocated to the university as part of the core funding, and the university may use it at its discretion (http://www.research.fi/huippuyk_en.html).

Evaluation

As typical for CoE the application procedure shows a **two step pattern**: „In the first step, there is an open call for outline plans. An outline plan (5-10 pages) contains a research and operating plan for the six-year CoE period, information on the present situation and future plans of researcher training, and a list of publications and other output of the unit during past five years. [...] The outline plans are handled by a national working group. Based on its proposal the Board of the Academy of Finland asks for full applications from the best applicant units. **International, external reviewers** evaluate the applicant units based on the full application and a site visit. The evaluation reports are discussed by the national working group. Based on it s proposal the Academy's Board nominates the CoEs for six years" (Malkamäki et al. 2001, p. 36).

An interesting characteristic for the monitoring of a CoE is the existence of a so-called **Scientific Advisory Board** (SAB) that consists of 2-5 international top level experts. This board is nominated by the Academy and has the main task of supporting, strengthening and monitoring the scientific work of the CoE. Additionally these boards may proactively propose improvements. The SABs meet annually at the CoE, also other actors like observers from the host organisation, the

Academy and potential further financiers can join the meetings. After three years the SABs deliver statements of the CoE based on a detailed report written by the Centre. After the six-year period international peers evaluate the CoE (Malkamäki et al. 2001, p.37). Thus international expert groups are involved at the ex ante as well as interim stages.

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Denmark

Introduction

The **Danish National Research Foundation** is committed to **funding unique research** within the basic sciences, life sciences, technical sciences, social sciences and the humanities. The aim is to identify and support groups of scientists who based on international evaluation are able to create **innovative and creative research environments of the highest international quality** (http://www.dg.dk/english_ objectives.html).

„The Danish National Research Foundation carries out its responsibilities as part of and in co-operation with the rest of the Danish research system. The Foundation works on an understanding of the total research system, and on the purpose served by the Danish research system within the Danish society. The Act that governs the Foundation stipulates that **basic research is the primary area** for its work. As in nearly all other European and North American countries, Denmark has a two-tier system for resource allocation to research. One tier of this system is the basic grants allocated by the different ministries according to the Danish State Budget to the institutions. The other tier comprises allocation from research councils, The Danish National Research Foundation, specific research programs, research and development funds in individual ministries." (http://www.dg.dk/english_objectives.html).

The activities of the Foundation will be carried out, primarily, with grants to an independent group of scientists to form a centre of excellence with a director of research. The Foundation does **not support individual projects** (http://www.dg.dk/ english_grants.html).

Centre of Excellence Programme

Short description

The Centers of Excellence programme **started in 1993/1994** with 23 CoE. The programme is open for all research areas. The responsible agency is the Danish National Research Foundation (Malkamäki et al. 2001, p. 29). The Foundation is at the moment financing a **total of 30 centres of excellence** ranging from science to arts with a total annual budget of about **250 mills DKK** (http://www.dg.dk/index_ english.html). In 2001 the Foundation established **9 new centres** covering a broad range of research topics within science, life sciences, technical sciences, and social sciences. A special call for proposals form the humanities and social sciences was undertaken after this, resulting in the beginning of 2002 in the establishment of **three new centres within the humanities** (http://www.dg.dk/index_english.html).

Current centres are:

- Søren Kierkegaard Research Centre (SKC), established 1994, average annual grant: 11 mill. DKK, location: University of Copenhagen, but Independent foundation, St. Kannikestræde 15, Copenhagen K.

- The Danish Epidemiology Science Centre (DESC), established 1994, average annual grant: 10 mill. DKK, location: Statens Serum Institut in cooperation with the University of Aarhus and the Copenhagen Hospital Corporation.
- Theoretical Astrophysics Center (TAC), established 1994, average annual grant: 8 mill. DKK, location: University of Copenhagen and University of Aarhus Aarhus.
- Center for Atomic Physics (ACAP), established 1994, average annual grant: 9 mill. DKK, location: University of Aarhus.
- Centre for Basic Research in Computer Science (BRICS), established 1994, average annual grant: 8 mill. DKK, location: University of Aarhus and University of Aalborg.
- Danish Lithosphere Centre (DLC), established 1994, average annual grant: 17 mill. DKK, location: The Geological Survey of Denmark and Greenland (GEUS) and University of Copenhagen.
- Danish Centre for Experimental Parasitology (CEP), established 1993, average annual grant: 10,6 mill. DKK, location: The Royal Veterinary and Agricultural University.
- The Copenhagen Muscle Research Centre (CMRC), established 1994, average annual grant: 17 mill. DKK, location: Rigshospitalet (and the Copenhagen Hospital Corporation).
- Center for Sensory-Motor Interaction (SMI), established 1994, average annual grant: 6 mill. DKK, location: Aalborg University.
- Centre for Sound Communication (CSC), established 1994, average annual grant: 6 mill. DKK, location: University of Southern Denmark, Odense.
- Centre for Crystallographic Studies (CSS), established 1994, average annual grant: 6 mill. DKK, location: University of Copenhagen.
- Copenhagen Polis Centre (CPC), established 1993, average annual grant: 2 mill. DKK, location: University of Copenhagen.
- Economic Policy Research Unit (EPRU), established 1993, average annual grant: 4 mill. DKK, location: University of Copenhagen.
- Centre for Solid Phase Organic Combinatorial Chemistry (SPOCC), established 1997, average annual grant: 4 mill. DKK, location: Carlsberg Research Centre.
- Center for Catalysis, established 1997, average annual grant: 6 mill. DKK, location: University of Aarhus.
- Center for Mathematical Physics and Stochastics (MaPhySto), established 1998, average annal grant: 6 mill. DKK, location: Aarhus University Aalborg University and the University of Copenhagen.
- Center for Molecular Plant Physiology (PlaCe), established 1998, average annual grant: 10 mill. DKK, location: The Royal Veterinary and Agricultural University.
- Center for Experimental BioInformatics (CEBI), established 1998, average annual grant: 7 mill. DKK, location: The University of Southern Denmark, Odense.

- Danish National Research Foundation: Center for Metal Structures in 4 Dimensions, established 2001, average annual grant: 7.4 mill. DKK, location: Risoe National Laboratory.
- Danish National Research Foundation: Center for Nucleic Acid (NAC), established 2001, average annual grant: 7 mill. DKK, location: University of Southern Denmark.
- Centre for Applied Microeconometrics (CAM), established 2001, average annual grant: 5.4 mill. DKK, location: University of Copenhagen.
- Danish National Research Foundation: Center for Biomembrane Physics (MEMPHYS), established 2001, average annual grant: 7 mill. DKK, location: University of Southern Denmark.
- Danish National Research Foundation: Center for Quantum Optics, established 2001, average annual grant: 6 mill., location: University of Aarhus.
- Danish National Research Foundation: The Water and Salt Research Center, established 2001, average annual grant 6,7 mill. DKK, location: University of Aarhus.
- Danish National Research Foundation: Quantum Protein Centre, established 2001, average annual grant 6,7 mill. DK, location: The Technical University of Denmark.
- Danish National Research Foundation: Center of Functionally IntegrativeNeuroscience, established 2001, average annual grant: 7.4 mill. DKK, location: University of Aarhus (and Århus Sygehus)
- Danish National Research Foundation: Wilhelm Johansen Center for Functional Genome Research, established 2001, average annual grant: 6 mill. DKK, location: University of Copenhagen.
- Danish National Research Foundation: Centre for the Study of the Cultural Heritage of Medieval Rituals, established 2002, average annual grant: 3.4 mill. DKK, location: University of Copenhagen.
- Danish National Research Foundation: Centre for Black Sea Studies, established 2002, average annual grant: 3.7 mill. DKK, location: University of Aarhus.
- Danish National Research Foundation: Centre for Subjectivity Research, established 2002, average annual grant: 3.8 mill. DKK, location: University of Copenhagen (http://www.dg.dk/sub_english_current_centres.html).

Objectives
The main aim of CoE is „to have research of international level to make a **contribution to global research**. Each centre should be among the **five or ten best in Europe** in it s subject“ (Malkamäki et al. 2001, p. 28). The overwhelming importance of international visibility and competitiveness is also emphasised in the selection criteria.

One location / Multiple locations

The centres are **located at an existing research institution**, at universities or other public research institutions and comprize a number of senior scientists and professors, post docs with temporary employment contracts, Ph.D. students and a number of international guests. Major investments in equipment are also a possibility (http:// www.dg.dk/english_grants.html). 7 out ouf the 30 existing CoE show more than one location but at maximum three.

Size of consortia

The size of the centres differs largeley (http://www.dg.dk/index_english. html).

Relative Importance of Networking compared to scientific excellence

Scientific excellence is much more important than networking.

Importance of Interdisciplinarity

A common feature of „especially the new centres is, however, a tendency to cross disciplinary boundaries - and often not only between related disciplines but also between natural sciences and technical sciences or between science and arts“ (http://www.dg.dk/index_english. html).

Top down- / Bottom-up Selection

The calls for proposals follow particular research areas, for example in 1996 bioinformatics, demography, geosciences, chemistry, mathematics, man-machine-interaction, plant biology. These areas are seen as international key areas where Danish research is expected to be competitive (Malkamäki et al. 2001, p. 29).

Role of Training and Gender

Training is seen as crucial issue especially as there is a growing need of qualified people who are capable to conduct excellent basic research and / or applied research as well. One of four selection criteria is explicitly dedicated to traning.

Funding

Substantial, adjustable grants for up to **5 years** allow centres of excellence to be created and depending on the outcome of regular international evaluation, support can be given for a **total of 10 years** (http://www.dg.dk/english_objectives.html).

Grants from the Foundation will be **overall grants** for an approved research activity and will therefore be based on a principle of **total funding**, which means that the grants cover salaries as well as equipment and operating costs. The Foundation encourages the research groups to apply for grants from other sources for the purpose of expanding the activities, in particular when participating in and establishing international co-operation (http://www.dg.dk/english_grants.html). The grants are allocated by the Board of the Foundation[93]. On the average the centres receive 7,6 mill. DK per annum, the range differs from 2 to 17 mill. DKK.

„The financing of each Centre is based on contract between the Head of the centre, the host institution and the Foundation. The co-financing by the institution is through facilities they provide“ (Malkamäki et al. 2001, p. 29). The Head of the centre, usually a university professor, decides how the resources are allocated.

Evaluation

„The Board of the Danish National Research Foundation applies scientific assessments from **international experts** in its decisions concerning applications for the funding of centres of excellence. The use of international competent experts ensures a supplement to the scientific competence of the Board and brings a more broad perspective into the decision process“. http://www.dg.dk/english_activities.html

„The Danish National Research Foundation calls for international scientific expertise when existing centres of excellence are to be evaluated. The evaluation is to be accomplished one year before the funding period of the relevant centre expires. The evaluation gives the Board of the Foundation, the researchers involved and institutions a valuable report on the performance of the centre and finally provides a basis for the Board's decision-making on the future of the centres“ http://www.dg.dk/english_activities.html.

The selection of the research groups is based on competition. The main selection criteria are (1) quality on international level, (2) visibility in the international research world, (3) the possibilities for impact in the Danish research system, (4) the potential for contribution to training new researchers (Malkamäki et al. 2001, p. 28).

Following the typcial pattern of large-scale research programmes, the application procedure is characterized by two main steps: plans of intents followed by full proposals. The detailed research plans are evaluated by foreign experts. The Board of the Foundation, consisting of nine independent members appointed by the Research Minister, makes the final decision (Malkamäki et al. 2001, p. 28f.).

93 The Danish National Research Foundation establishes its own framework for selection procedures and other work. The funds distributable by the Foundation correspond to 2% of the overall annual Danish public research budget (http://www.dg.dk/english_objectives.html).

After the first five-year-period midterm evaluations take plase, made by international peers. Based on their assessment it is possible to stop funding. This kind of evaluation consists of documentary analysis, answers to precise questions and centre visits. Additionally, the centres have to submit annual reports and members of the Foundation visit the centre twice a year. Thus there is a straightforward monitoring system, but an overall (strategic) evaluation of the whole programme did not yet take place (Malkamäki et al. 2001, p. 29f.).

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Appendix 3 - Guidelines for Reviewers

Objectives of the preliminary review process

All those wishing to apply for a Joint Research Project (JRP) must provide a draft proposal prior to submitting a comprehensive application proposal (this final proposal will be reviewed in the framework of a hearing). The draft is sent to independent experts who are asked to critically review the specific area of research and basic structural features of the planned JRP.

The preliminary consideration of the draft JRP proposal by the FWF is designed to enable us to assess:

- whether the planned JRP is feasible
- whether the proposed research program itself requires modification, or
- whether the participating scientists are sufficiently qualified (in an international context) to meet the high quality standards required to conduct a project like an JRP
- whether other forms of funded research (e.g., carrying out the proposed research as a set of individual projects or a research package, or submitting an application for a special research program) might be more appropriate to achieve the prospective applicant's desired scientific aims.

Based on the result of this prliminary evaluation, the board of the FWF decides

- whether a comprehensive application proposal should be prepared on the basis of the submitted draft
- whether the draft should be revised and modified before a definite proposal is prepared (a revised draft will be sent to reviewers again)
- whether the JRP-initiative should be cancelled

Appendix XXX: Guidelines for Reviewers (Full Proposal)[94], FSP-Programme[95]

Evaluators of Joint Research Programs in Austria are kindly requested to pay particular attention to the following aspects of the proposal. A final overall evaluation-form, as well as an evaluation form for the individual Projects is attached.

1. The Research Proposal as a Whole

A) The scientific[1] quality of the proposed program of research

- What is the relevance of the proposed program of research as whole to the current level of international research in the field?
  What significant additions to scientific knowledge may be expected from the research to be carried out within the framework of an FSP?
  Does the proposed FSP research program make sufficient allowance for foreseeable developments in its field of inquiry over the next five years?
- Ranked according to scientific criteria, would the proposed FSP be among the top 10 % of all ongoing or planned international research projects in this area known to you?
- Which research institutions are currently engaged in the most intensive research in the area of the proposed FSP? Where are the research groups located that are in the most direct competition with the proposed FSP?
- What would you estimate are the chances of the present research proposal in comparison to these competitors?
  How would you compare the scientific quality and potential of the proposed FSP research team to its international competitors?
- How would it be possible to improve the projects for success of the proposed FSP? Would it be possible to avoid areas overlapping with existing or planned research institutions or larger research projects?

B) Structural Aspects

- Has the proposed research program been conceived in such a way that accords sufficient weight to multidisciplinary approaches, synergetic effects and the question involved training future scientists?
- How would you evaluate the internal structural coherence of the proposed FSP? Does the proposed research represent a compact unit built upon a solid common foundation? Have the inter-connections, cooperation, and the interface between various parts of the research project been adequately defined?
- How would you evaluate the coherence of the proposed research team? How would you evaluate the existing forms of cooperation? To what extent has preliminary collective work been carried out and would this in your view be sufficient preparation to enable those involved to undertake a cooperative research effort on the scale of an FSP?

[1] When used in this paper, the terms "science", "scientific", etc. refer also to all fields of scholarly (e.g., history, the social sciences, etc.) inquiry, not merely to those which are normally described as being "sciences"

[94] Source: FWF – Homepage, "Application Procedures"

[95] For the very limited deviations to the SFB guidelines see Chapter 6 **XXX**.

- Have both the overall composition of the FSP-group (in terms of the specific qualifications of the respective individual group members, etc.) and the structure of the proposed group as a whole (in terms of the ratio between scientific and non-scientific personnel, etc.) been designed optimally to achieve the immendiate objectives of the proposed research? If not, which changes in the proposed group itself and/or the assignment(s) of its individual members should in your view be undertaken immediately? Which changes would be desirable to insure that the long-term goals of the FSP are achieved?

C) Location

- Is the existing technical and scientific infrastructure of the participating institutes capable of supporting the proposed FSP-based research adequately?

- Which changes and/or improvements should be considered? Which of these changes and/or improvements should be undertaken immediatley, which will be necessary - insofar as it is possible to judge - only in the middle-term, over the course of the proposed FSP´s existence?

- Would you favor initiating cooperation with research institutions beyond those foreseen in the FSP research proposal? If so, which one(s)?

- Is there a justifiable and reasonable relationship between the additional equipment, etc., requested for the proposed FSP and that already existing in the designated hosting institution(s)?

2. INDIVIDUAL PROJECTS OF THE FSP

- Is the given Project based on a clearly formulated and scientifically unexceptionable hypothesis? How would you evaluate the proposed research on its own scientific merits and its potential to lead to futher scientifc inquiry (its relationship to the overall conception of the FSP´s? research aims)?

- Is the proposed Component Research Project innovative and in keeping with the latest developments in the field?

- How would you evaluate the previous scientific achievment of the individuals involved in the Project (both principal investigator(s) of projects and prospective associate(s))?

- How would you evaluate the scientific competence of this (these) individual(s) to undertake this Project?

- How would you evaluate the chosen methodology?

- How would you evaluate the proposed plan of research?

- What is the relationship of the Project to the overall conception of the FSP research objectives? How important is it for the achievment of these objectives? Does the Project occupy a central and important position in the FSP as a whole, or is it of more marginal significance?

- How would you evaluate the planned forms of cooperation between the various Projects of the proposed FSP and the given one? Which Projects already cooperate closely with one another? Which cooperative relations ought in your view be extended or intesified?

  Are the forms of cooperation defined specifically enough? If not, which ought to be specified more concretely?

Appendix 4 – Structural Data

Structural Data of the FWF Network

Note: The source for all following figures has been – if not indicated otherwise – the reports and documents produced by the networks themselves and given to the evaluation team by the FWF. All calculation done by ISI and PREST.

Table A4_1: List of SFB networks

Number	**Title**	**Leading Institute** (source: FWF Homepage)
SFB 1	Biocatalysis	Intitut für Organische Chemie, TU Graz
SFB 2	Biological Communication Systems	Institut für Medizinische und Biochemie, Universität Innsbruck
SFB 3	Optimization and Control	Institut für Mathematik, Universität Graz
SFB 4	Moderne - Vienna and Central Europe around 1900	Institut für Geschichte, Universität Graz
SFB 5	Microvascular Injury and Repair	Institut für Gefäßbiologie und Thromboseforschung, Universität Wien
SFB 6	Regulatory Mechanisms of Cell Differentiation and Cell Growth	Institut für Medizinische Biochemie, Universität Wien
SFB 7	Biomembranes and Atherosclerosis	Institut für Molekularbiologie, Universität Graz
SFB 8	Restoration of Forst Ecosystems	Institut für Waldwachstumsforschung, BOKU Wien
SFB 9	Electroactive Materials	Institut für Chemische Technologie anorganischer Stoffe, Technische Universität Graz
SFB 10	Adaptive Information Systems and Modelling in Economics and Management Science	Institut für Tourismus und Freizeitwirtschaft, Wirtschaftsuniversität Wien
SFB 11	AURORA - Advanced Models, Applications and Software Systems for High Performance Computing	Institut für Softwarewissenschaft, Universität Wien
SFB 12	Coexistence and Cooperation of Rival Paradigms in Science	Institut für Philosophie, Universität Salzburg
SFB 13	Numerical and Symbolic Scientific Computing	Institut für Mathematik, Johannes Kepler Universität Linz
SFB 14	The Synchronization of Civilizations in the Eastern Mediterranean in the Second Millennium B.C.	Institut für Ägyptologie, Universität Wien
SFB 15	Control and Measurement of Quantum Systems	Institut für Theoretische Physik, Universität Innsbruck
SFB 16	Advanced Light Sources (ADLIS	Institut für Photonik, Technische Universität Wien
SFB 17	Modulators of RNA Fate and Function	Institut für Mikrobiologie und Genetik, Universität Wien
SFB 18	Molecular and immunological strategies for prevention, diagnosis and treatment of Type I allergies	Institut für Pathophysiologie, Universität Wien
SFB 20	International Tax Coordination	Institut für österreichisches und internationales Steuerrecht, Wirtschaftsuniversität Wien
SFB 21	Cell proliferation and cell death in tumors - molecular mechanisms underlying the interplay of proliferation and apoptosis	Institut für Anatomie, Histologie und Embryologie, Universität Innsbruck

Table A4_2: List of FSP networks

Number	**Title**	**Leading Institute** (source: FWF Homepage)
FSP 72	Two-dimensional Protein Crystals	Zentrum für Ultrastrukturforschung, BOKU Wien
FSP 73	Stellar Astrophysics	Institut für Astronomie, Universität Wien
FSP 74	Genetic Modification of Cells and Animals for Investigation and Treatment of Diseases	Institut für Pathologie, Universität Graz
FSP 79	Silicon Chemistry	Institut für Anorganische Chemie, Technische Universität Wien
FSP 80	Numerical Simulation in Tunneling	Institut für Baustatistik, Technische Universität Graz
FSP 81	Gas-Surface Interactions	Institut für Experimentalphysik, Universität Graz
FSP 82	Dynamic Genome	Institut für Botanik, Universität Wien
FSP 83	Number-Theoretical Algorithms and their Applications	Institut für Analysis und Numerik, Universität Linz
FSP 87	Cultural History of the Western Himalaya	Institut für Kunstgeschichte, Universität Wien
FSP 88	Immunology of allergen-specific Immune Responses	Institut für Genetik und Allgemein Biologie, Universität Salzburg
FSP 90	Nanoscience on Surfaces	Institut für Experimentalphysik, Universität Graz
FSP 91	Cognitive Vision - Key Technology for a Personal Assisant	Institut für Automatisierung und Regelungstechnik, Technische Universität Wien
FSP 72	Two-dimensional Protein Crystals	Zentrum für Ultrastrukturforschung, BOKU Wien
FSP 73	Stellar Astrophysics	Institut für Astronomie, Universität Wien
FSP 74	Genetic Modification of Cells and Animals for Investigation and Treatment of Diseases	Institut für Pathologie, Universität Graz

Table A4_3: Host organisations and locations of SFB networks

																						No. of SFB participations per		type	
SFB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21		host	location	univ.	non univ.
TU Graz	**X**		**X**						**x**													3		x	
Uni Graz	X			**X**			**x**							x				x				5		x	
med. Uni Graz			X				x															2		x	
Universitätsklinik							x															1		x	
Joanneum Research			x																			1			x
ÖAW	x																					1			x
NIMH-CNE							x															1	8		x
Uni Innsbruck		**x**											x		**x**					**x**		4		x	
med. Uni Innsbruck																				x		1		x	
Uniklinik		x																				1		x	
ÖAW																				x		1	I4		x
Uni Klagenfurt			x																			1	1	x	
Uni Wien				x	**x**	**x**					**x**	x		**x**	x	x	**x**					9		x	
WU Wien										**x**									**x**			2		x	
TU Wien										x	x					**x**						3		x	
med. Uni. Wien					x	x					x			x			x	**x**				6		x	
Universitätsklinik						x												x				2		x	
Atominst. der öst. Uni.														x	x	x						3		x	
ÖAW														x								1			
BOKU								**x**														1		x	
ÖFAI										x												1			x
Nat.his. Museum														x								1	13		x

SFB	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20	21		No. of SFB participations per host	location	type univ.	non univ.
Uni Leoben									x													1	1	x	
Uni Salzburg												x		x								2	2	x	
Uni Linz													x						x			2	2	x	
Ottawa																x						1	1		x
Uni Heidelberg															x							1	1	x	
Uni München															x	x						2	2	x	
																					Sum			20	7
total institutes	3	2	4	2	2	3	4	1	2	3	3	2	2	7	5	5	2	3	2	3	60				
total number locations	1	1	2	2	1	1	1	1	2	1	1	2	2	3	4	3	1	2	2	1	34				
No. of sub-projects	18	11	20	23	12	12	17	12	13	6	12	10	22	19	20	18	14	14	11	7	291				
No. of subproject in leading institute	15	10	14	19	6	8	7	12	12	4	6	8	21	10	13	11	10	9	10	4	209				
Share of sub-project in host of leading institute	0,83	0,91	0,70	0,83	0,50	0,67	0,41	1,00	0,92	0,67	0,50	0,80	0,96	0,53	0,65	0,61	0,71	0,64	0,91	0,57	0,72				

bold: leading institute of the SFB

Table A4_4: Host organisations and locations of FSP networks

																No. of FSP participations per		Type	
FSP	70		72	73	74	79	80	81	82	83	87	88	90	91		host	location	uni	non uni
TU Graz		x				x	**x**	x		x	x		x	x		8		x	
med.Uni Graz		x			**x**													x	
Uni Graz		x						**x**					**x**			4		x	
ÖAW		x														1			x
Uni Innsbruck							x	x	x				x			4		x	
Med. Uni Innsbruck		x														1		x	
Uniklinik		x														1	5		x
Uni Wien	x	**x**	x	**x**	x				**x**		**x**		x			8		x	
TU Wien	**x**			x		**x**	x	x		x			x	**x**		8		x	
Med. Uni. Wien												x				1		x	
Vet. Uni Wien					x				x							2		x	
ÖAW											x					1			x
BOKU	x		**x**									x				3		x	
ÖFAI														x		1			x
CURE														x		1			x
NOVARTIS												x				1			x
Bundesdenkmalamt											x					1	14		x

FSP	70	71	72	73	74	79	80	81	82	83	87	88	90	91		No. of FSP participations per host	location	Type uni	non uni
Uni Leoben										x				x		2	2	x	
Uni Salzburg					x					x		**x**				3		x	
Landeskrankenhaus		x														1			x
Landesklinikum für Dermatologie												x				1			x
Kinderspital												x				1	4		x
Uni Linz										**x**			x			2	2	x	
Uni München					x											1	1	x	
Uni Köln									x							1	1	x	
Nat. Univ. of Singapore										x						1	1	x	
															Sum			15	11
total	3	7	2	2	5	2	3	4	4	6	4	6	6	5	59				
total	1	4	1	1	4	2	3	3	3	6	2	2	4	3	39				
Number of sub-projects	5	12	7	9	8	10	7	6	13	13	7	16	8	7	128				
No. of subproject in leading institute	3	3	5	8	3	4	3	2	7	2	4	11	2	1	58				
Share of sub-project in host of leading institute	0,60	0,25	0,71	0,89	0,38	0,40	0,43	0,33	0,54	0,15	0,57	0,69	0,25	0,14	**0,45**				

bold: leading institute of the FSP

Table A4_5 Interdisciplinary scope of SFB networks***

	No. of sub-projects	No. of different 2 digit discipl.	IIS 2*	No of different 4 digit discipl.	IIS 4*	gini**	density[96]
SFB 1	*13*	*4*	*0,31*	*9*	*0,69*	*0,41*	*0,36*
SFB 2	10	5	0,50	11	1,10	0,29	0,36
SFB 3	*17*	*4*	*0,24*	*12*	*0,71*	*0,42*	*0,12*
SFB 4	19	6	0,32	8	0,42	0,23	n.a.
SFB 5	12	4	0,33	11	0,92	0,44	0,38
SFB 6	*12*	*6*	*0,50*	*14*	*1,17*	*0,34*	*0,27*
SFB 7	17	6	0,35	18	1,06	0,39	0,34
SFB 8	12	7	0,58	16	1,33	0,28	0,39
SFB 9	*13*	*4*	*0,31*	*13*	*1,00*	*0,40*	*0,33*
SFB 10	6	2	0,33	5	0,83	0,13	0,66
SFB 11	*9*	*2*	*0,22*	*9*	*1,00*	*0,43*	*0,64*
SFB 12	9	5	0,56	8	0,89	0,10	0,27
SFB 13	*13*	*2*	*0,15*	*5*	*0,38*	*0,43*	*0,14*
SFB 14	16	7	0,44	11	0,69	0,25	0,13
SFB 15	*16*	*1*	*0,06*	*7*	*0,44*	*0,44*	*n.a.*
SFB 16	*15*	*3*	*0,20*	*16*	*1,07*	*0,26*	*n.a.*
SFB 17	*11*	*5*	*0,45*	*11*	*1,00*	*0,47*	*0,19*
SFB 18	11	7	0,64	14	1,27	0,51	n.a.
SFB 20	9	4	0,44	10	1,11	0,39	n.a.
SFB 21	6	3	0,50	6	1,00	0,40	n.a.

* IIS = Index of interdisciplinary scope, calculated as number of different discipline (at 2 digit or 4 digit level) represented by the subprojects of the network divided by number of subprojects.

** Gini coefficient, concentration measure, the higher gini, the more concentrated the distribution of sub-discilines is. Gini has been defined on the level of 4 digits only.

*** italics: networks that are clearly rooted in natural science (see Table 4_4)

[96] The concept of density has been discussed in Chapter 5.3. It describes the intensity of relations within a network as the share of all existing bilateral cooperations out of all possible cooperations in a network.

Table A4_6: Interdisciplinary scope of FSP networks**

	No. of sub-projects	No. of different 2 digit discipl.	IIS 2*	No of different 4 digit discipl.	IIS 4*	gini	density[97]
FSP 70	*5*	*5*	*1,00*	*10*	*2,00*	*0,08*	*0,500*
FSP 71	*12*	*7*	*0,58*	*14*	*1,17*	*0,30*	*0,121*
FSP 72	*8*	*3*	*0,43*	*7*	*1,00*	*0,35*	*n.a.*
FSP 73	*8*	*2*	*0,25*	*5*	*0,63*	*0,46*	*0,194*
FSP 74	7	4	0,57	10	1,43	0,15	0,143
FSP 79	*8*	*2*	*0,25*	*7*	*0,88*	*0,38*	*0,089*
FSP 80	7	2	0,29	7	1,00	0,23	0,143
FSP 81	*6*	*2*	*0,33*	*5*	*0,83*	*0,24*	*0,667*
FSP 82	*8*	*1*	*0,13*	*4*	*0,50*	*0,25*	*0,50*
FSP 83	*11*	*1*	*0,09*	*12*	*1,09*	*0,42*	*n.a.*
FSP 87	5	5	1,00	8	1,60	0,43	n.a.
FSP 88	10	4	0,40	7	0,70	0,39	n.a.
FSP 90	*7*	*2*	*0,29*	*6*	*0,86*	*0,10*	*n.a.*
FSP 91	6	3	0,50	8	1,33	0,48	n.a

* IIS = Index of interdisciplinary scope, calculated as number of different discipline (at 2 digit or 4 digit level) represented by the subprojects of the network divided by number of subprojects.
** italics: networks that are clearly rooted in natural science (see Table 4_4)
*** Mean out of those for which data is available.

97 The concept of density has been discussed in Chapter 5.3. It describes the intensity of relations within a network as the share of all existing bilateral cooperations out of all possible cooperations in a network.

Figure A4_1: Index of interdisciplinary scope (IIS4)*: SFB

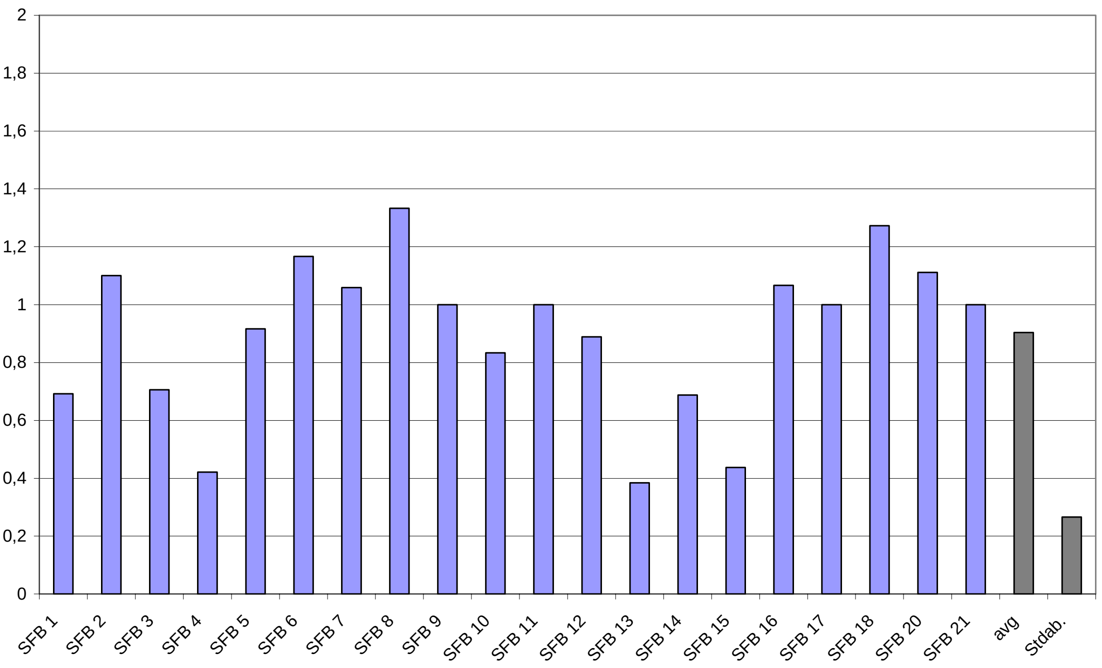
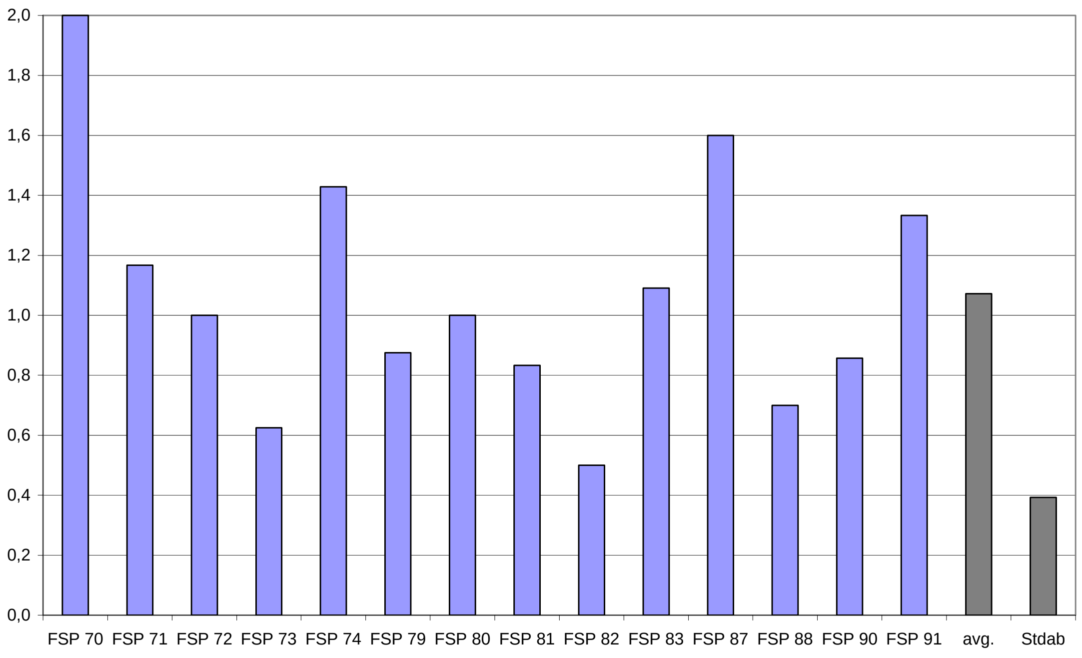


Figure A4_2: Index of interdisciplinary scope (IIS4)*: FSP



* Defined as the number of different 4 digit scientific sub-disciplines divided by the number of subprojects, thus taking into account the size of the network. The higher this measure, the broader the disciplinary scope of a network

Figure A4_3: Concentration of sub-disciplines (gini coefficient*): SFB

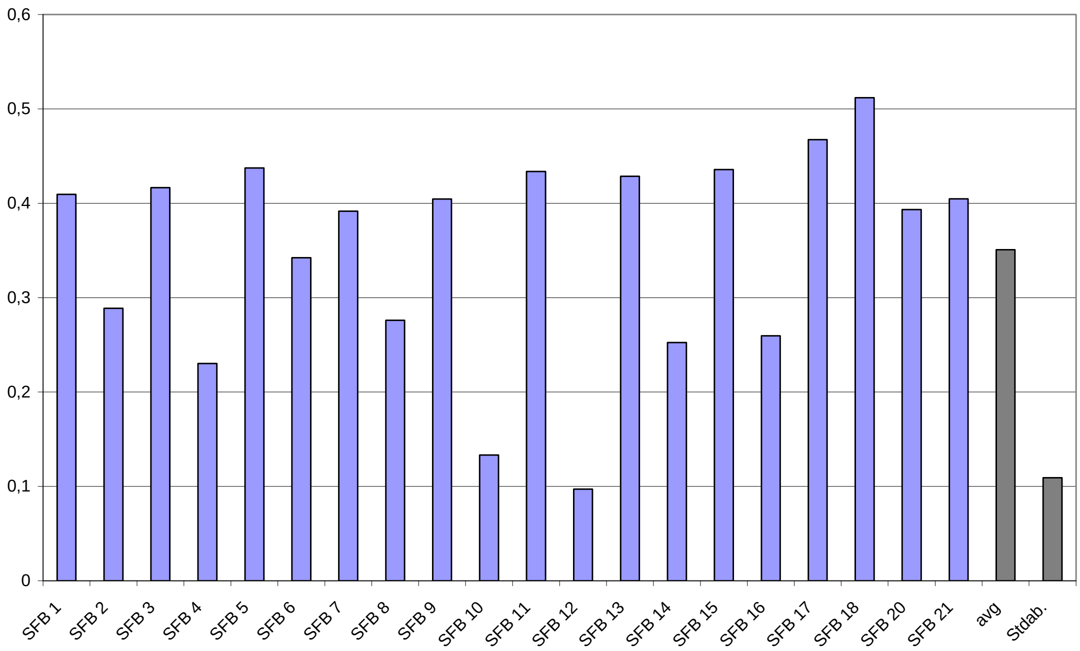
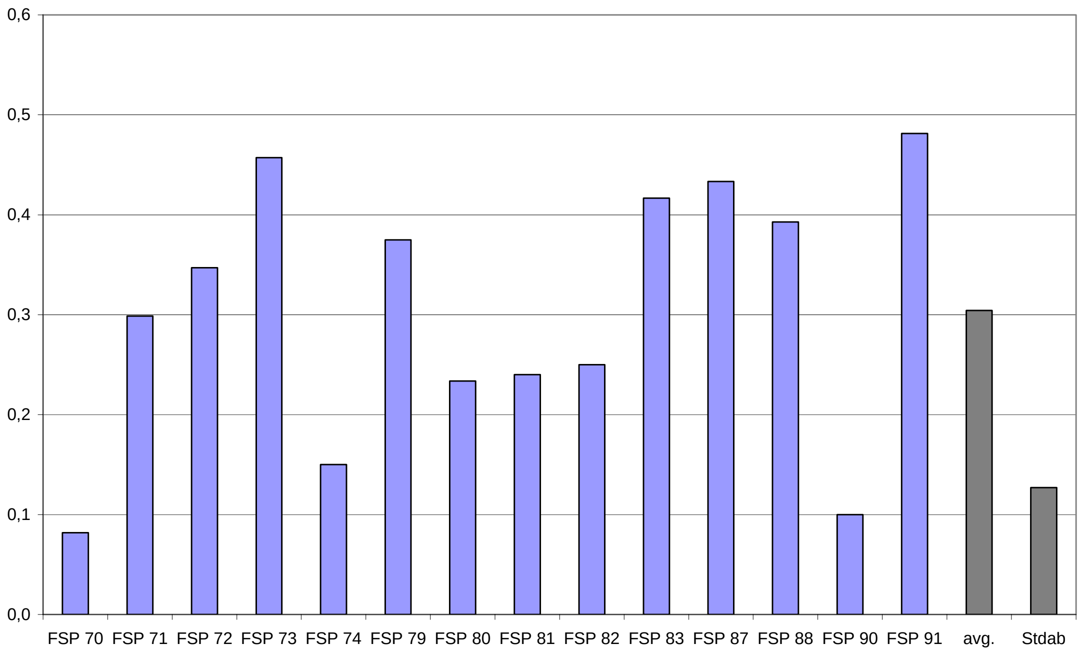


Figure A4_4: Concentration of sub-disciplines (gini coefficient*): SFB



* A concentration indicator ranging from 0 to 1, the higher the gini-coefficient, the higher the concentration (the more unevenly the weight of sub-disciplines)

Figure A4_5: Composite indicator of interdisciplinarity (IIS4 – gini)*: SFB

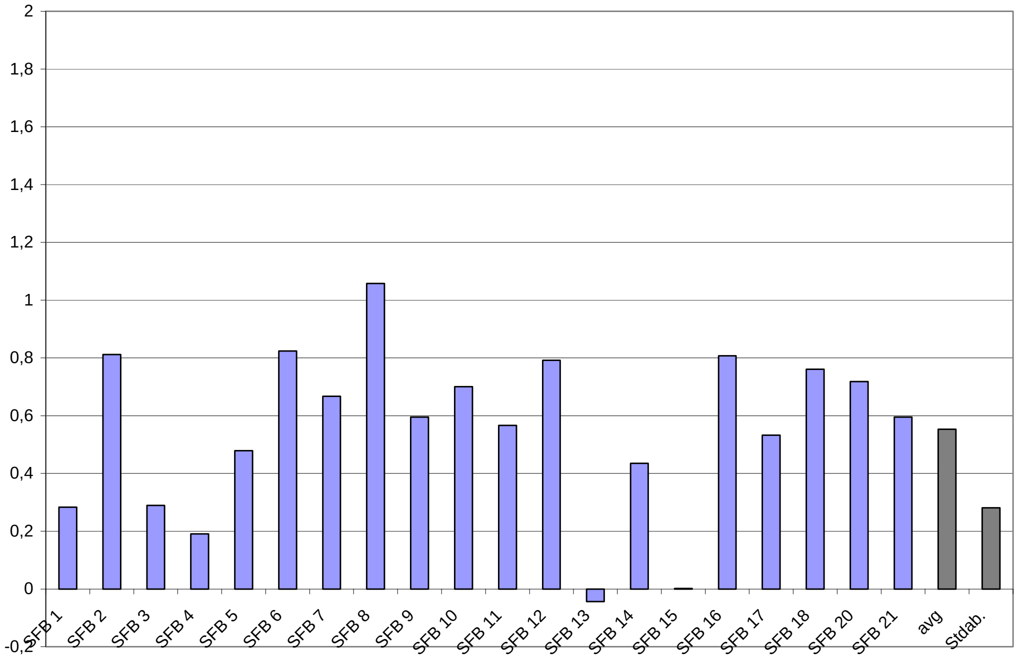
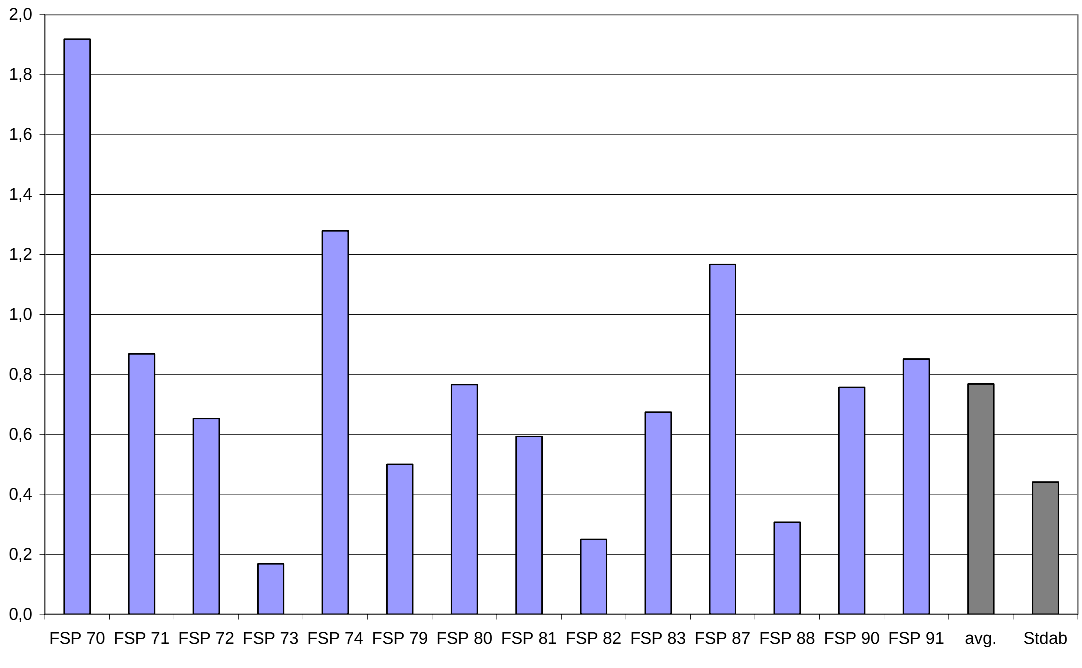


Figure A4_6: Composite indicator of interdisciplinarity (IIS4 – gini*): FSP



* A combination of interdisciplinary scope and concentration of sub-disciplines, taking into account quantity (of sub-disciplines, size of the networks and relative weight of the disciplines represented). The higher the value, the more interdisciplinary the networks.

Statistical Analysis of the Relation Between Network Density and Output

As seen in Chapter 6, the relationship between collaboration and deviation from the overall level of quality shows a high level of negative correlation between density and overall deviation. The calculation is based on the figures obtained for each of the networks that published in 1996 and in 2001 (see Table A4_7) and a correlation analysis (Table A4_8). Table A_7 indicates the quality of publications from each of the two programmes which were carried out in the analysis as well as the network density. The first column indicates the project number; the second gives the number of papers with a count below, while the third indicates the count above average of the respective journals. The fourth column shows the number of nodes (the sub-projects) in the network, while the fifth gives the values of network density calculated from the detailed analysis of documentary records of collaboration activities of the researchers. Column six gives the sum of chi-square values which measure the deviation from the expected value, which is based on the overall distribution of papers above and below for each project score[98]. The final column indicates whether the projects publications were above or below their respect averages, "above" meaning that out of all papers produced in the two years (1996 and 2001) there are more papers above the average citation score than papers that are below the average citation score.

[98] This technique takes the square root of the number of the publications for each of the projects that are above and below. An overall figure for the two sets of publications (above and below) is also created. The extent to which the points then deviate from a line drawn through the overall figure and through the origin provide the measure of deviation (chi-squared). These chi-squared values for each point and then added to provide the measure of deviation of each project from the overall trend.

Table A4_6:All projects network density and publication outputs

Project	Papers from Project with Count < Expected	Papers from Project with Count > Expected	Nodes (=No. of sub-projects)	Network Density	Sum of Chi-Squared Values	Project Above* or Below
SFB1	22	25	18	0.36	0.35	Above
SFB2	31	23	11	0.36	0.86	Below
SFB3	14	3	20	0.12	6.63	Below
SFB5	22	18	12	0.38	0.24	Below
SFB6	14	8	12	0.27	1.37	Below
SFB7	19	20	17	0.34	0.09	Above
SFB8	2	3	12	0.39	0.25	Above
SFB9	31	26	13	0.33	0.24	Below
SFB10	8	6	6	0.66	0.2	Below
SFB11	15	17	12	0.64	0.23	Above
SFB12	1	0	10	0.27	0.96	Below
SFB13	6	17	22	0.14	5.77	Above
SFB17	4	1	15	0.19	1.66	Below
FSP70	3	1	4	0.50	0.92	Below
FSP71	0	2	12	0.12	2.09	Above
FSP73	9	8	9	0.19	0.02	Below
FSP74	5	14	8	0.14	4.68	Above
FSP79	4	0	10	0.09	3.82	Below
FSP80	3	1	7	0.14	0.92	Below
FSP81	8	16	6	0.67	3.05	Above
FSP82	0	5	13	0.06	5.23	Above
FSP88	5	2	16	0.21	1.15	Below

* Above = out of all papers produced in the two years (1996 and 2001) there are more papers above the average citation score than papers that are below the average citation score.

Source: Data from Evidence Ltd, 2004, and from ISI / PREST

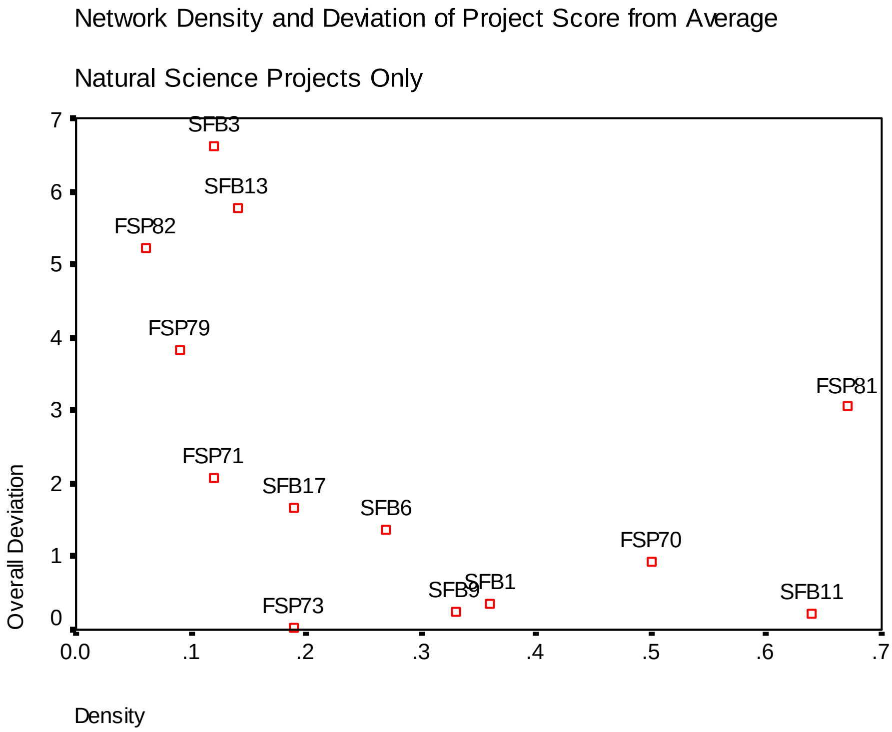
Table A4_7:Pearson correlation between deviation of quality and network density

		Overall Deviation	Density
Overall Deviation	Pearson Correlation	1	-.518(**)
	Sig. (1-tailed)	.	.007
	N	22	22
Density	Pearson Correlation	-.518(**)	1
	Sig. (1-tailed)	.007	.
	N	22	22

** Correlation is significant at the 0.01 level (1-tailed).

Source: Data from Evidence Ltd, 2004, and from ISI / PREST

Figure A4_7: Network density and deviation of project score from average: natural science projects only



Source: Data from Evidence Ltd, 2004, and from ISI / PREST

Appendix 5 - Data sources

Overview of primary documents of the networks

Table A5_1:Structural data of network funding

	Proposals			External Reviews					Reports		
SFB	initial	1st interim	2nd interim	initial	1st interim	2nd interim	3rd interim	final	1st interim	2nd interim	final
1	1	1	1	1	1	1	1	1	1	1	1
2	1	1	1	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	0	open	1	1	open
4	1	1	1	1	1	1	1	open	1	1	open
5	1	1	1	1	1	1	0	open	1	1	open
6	1	1	1	1	1	1	0	open	1	1	open
7	1	1	1	1	1	1	0	open	1	1	open
8	1	1	0	1	1	0	0	nein	1	0	1
9	1	1	1	1	1	1	0	open	1	1	open
10	1	1	0	1	1	0	0	1	1	1	1
11	1	1	1	1	1	1	0	open	1	1	open
12	1	1	open	1	1	open	0	open	1	open	open
13	1	1	1	1	1	1	0	open	1	1	open
14	1	1	open	1	1	open	0	open	1	open	open
15	1	1	open	1	1	open	0	open	1	open	open
16	1	1	open	1	1	open	0	open	1	open	open
17	1	1	open	1	1	open	0	open	1	open	open
18	1	open	open	1	open	open	0	open	open	open	open
20	1	open	open	1	open	open	0	open	open	open	open
21	1	open	open	1	open	open	0	open	open	open	open

open: not produced yet, 0: not available

Table A5_2: Proposals, reports and reviews of FSP

	Proposals		External Reviews			Reports	
FSP	**initial**	**interim**	**initial**	**interim**	**final**	**interim**	**final**
70	1	1	1	1	0	1	1
71	1	1	1	1	0	1	0
72	1	1	1	1	0	1	0
73	1	1	1	1	1	1	1
74	1	1	1	1	1	1	1
79	1	1	1	1	1	1	1
80	1	1	1	1	1	1	1
81	1	1	1	1	1	1	1
82	1	1	1	1	1	1	1
83	1	1	1	1	open	1	open
87	1	1	1	1	open	1	open
88	1	1	1	1	open	1	open
90	1	open	1	open	open	open	open
91	1	open	1	open	open	open	open

open: not produced yet, 0: not available

Interview Programme

Introduction

The interview programme developed for this project was intended to provide support the gathering of data for the analysis on all the main areas of the study:

- Contextualisation
- Concept consistency with Goals
- Design fit for goals
- Implementation effect on goals
- Impacts conform to goals

For this reason, questionnaires were designed to cover multiple areas of questions and to be administered to a range of different groups of interviewees, as follows:

- Programme Managers/ FWF staff
- Austrian experts
- International Experts
- Participants
- Applicants and Non-applicants
- Rejected Applicants

In addition, the questionnaire was also used to provide a record of the important issues with which the study team were concerned and to which reference could be made in the course of supplementary interviews with staff involved in the other recent parallel studies undertaken on the Austrian research system.

The Questionnaire which was used in the interview process both on the telephone and face to face is given in the next section. The questionnaire is a structured questionnaire with opportunity for the interviewee to investigate certain topics in more detail.

During the interview process, certain issues increased in their importance and were accordingly investigated in progressively more detail. The questionnaire was divided into the following sections:

- Instructions / Protocol - Questionnaire for personal interviews
- Preamble Introduction

- Historical Perspective and Major Legitimisation
- Concept Consistency with Goals
- Concept and Design and Operation Issues
- Implementation Issues
- Impact Issues

PROGRAMME EVALUATION OF RESEARCH NETWORKS FOR THE AUSTRIAN SCIENCE FUND (FWF) – Questionnaire Checklist and Protocol for Administering the Questionnaire

Instructions / Protocol - Questionnaire for personal interviews
Where possible a) from their own personal experience of participation in the projects, and b) through their knowledge of how the networks have operated for others? The interviewee was asked for their experience of SFB and FSP as appropriate
Preamble Introduction
What was the main motivation for you to apply for a project?
Did you have previous experiences with networking / Collaboration activities?
What was the origin of the new cooperation, of the idea to propose a project (previous cooperation, from scratch?)
Please comment on the assumptions of the programme: collaboration enhances excellence and innovative basic research; there is too little pooling, co-operation in Austria; pooling of resources at one place/university can do that job; what are, in your opinion, the major legitimisation criteria for having this scheme?
Historical Perspective and Major Legitimisation
Major legitimisation of the programmes today, any changes?
As regards basic legitimisation: What are the major differences between the two programmes?
Concept Consistency with Goals: Relevance / appropriateness (do they still fit the challenges re-searchers face and the needs of Austrian science system - and the mission of the FWF)/ ACHIEVEMENTS as regards the following GOALS of the networks (Differentiation between relevance/appropriateness on the one hand and achievements on the other)
Formation of research networks with high international visibility (cooperation culture broadened, self-sustained, or will extra funding be always necessary?
Complex and demanding topics (but also: new areas and / or established areas with more excellence?)
(SFB) Relative weight of research within universities
(SFB) mid term/long term topics (duration of SFB/FSP adequate), research horizons wider?)
Interdisciplinary with clear focus (has there been too little interdisc.), has there been departmentalisation?
Coordination of personnel and material resources (has there been too little coordination)

Added value through combination in a network
(SFB) training of young scientists
Increasing attractiveness of university research to top scientists
Improving the international competitiveness of Austrian research
Improving visibility to the public
SFB-specific goals
(SFB) bundling of research-capabilities on one location (overcoming of departmentalisation within one location? requirement too strict, too lose?
(SFB) exceptional efficiency
(SFB) autonomous concentration of research at a university
(SFB) influence on "scientific profile" of research location/university
(SFB) Special SUPPORT from university
(SFB) attraction of additional funding from local bodies (city, province)
(SFB) other achievements make the science system ready for even more complex co-operation (K-plus?)
Are there goals missing that are becoming more important?
FSP-specific goals
(FSP) nation-wide bundling of resources: but lesser coherence requirements and shorter time-span
(FSP) efficient networks of excellence (preparation of SFB-like work, relative weight of research within the universities)
(FSP) less coherent (combination of sub-project)
Are there goals missing that are becoming more important?
Concept and Design Issues
Appropriateness / weaknesses
Greatest shortcomings of the programmes?
Backing of the universities (contracts willingness adequate; ,?
General
(SFB)The single location prerequisite: national critical mass vs. transaction costs of geographical distance?
(SFB)Possibilities to have lasting integration over 10 years: how to deal with core scientists leaving the network?
Do you think the focus on interdisciplinarity is good, or should SFB/FSP also be mono-disciplinary in order to go the limits of a discipline?
FSP: The multi- location possibility: curse or blessing?
Flexibility of networks (add ons, kick out etc.)
Do you think the focus on co-operation / networking in the FWF funding is appropriate, or is collaboration often a hindrance (flexibility etc.)

Major challenges for the system
What are the major changes in the context for Austrian Scientists?
Are the FWF-programmes appropriate to meet these challenges or should there be adjustments:
Internationalisation: do the programmes give enough room for international inclusion and participation, should the funding scheme be changed to enhance internationality?
General
ERA, European Research Council: does the SFB concept allow Austrian researchers to play a significant role in the European wide research
Pressure on economic usability of basic research (third mission of universities), (technical disciplines under-represented?
Consequences of university law
Raising costs of research (laboratory equipment...
Any "new" changing modes of knowledge production
General judgements - alternatives
Two separate programmes (SFB / FSP) are still necessary? What basic changes in the overall configuration of FWF programme could you envisage and why?
Alternative Concepts:
1) A scheme for LOOSE NETWORKING, EVEN LESS COHERENCE? Or should FSP be integrated in SFB?
2) SFB-like approaches in EXPLORATIVE AREAS (with researchers that are about to become excellent in new areas they create through SFB)? Or is the ex-ante excellence in established areas a condition sine qua non?
3) Only funding of transaction costs?
Do you think that the FWF is spending too little / too much on networking programmes (as compared to other finding, as compared to other countries?) (18%)
As compared to other schemes: Judgement of the Austrian way of funding basic research via FWF (SFB/FSP)?
Given budget constraints and specialisation of research: would you argue for a top down funding model with given thematic priorities? Is the existing allocation of network funds to the various areas and disciplines adequate, or too broad for Austria?
(See above) Internationality of SFBs / FSPs: with neighbouring, close countries, apart from EU, within EU-programmes
Pmplementation Issues
Do Implementation, operation and management of the programmes ensure that the goals are met (effectiveness)? Is the management efficient, both on the level of SFB as well as on the level of the programme as such?

Judgement of the overall management of the programme by FWF staff? Formal requirements (monitoring, reporting, controlling) adequate?
Application procedure: fair? Costs? Consulting? Did the evaluation procedure influence the proposal (e.g. overselling of aspects you assumed fit the international discussion - rather than the focus of your work)
Could SFB and FSP applications be coordinated with other programmes?
What are strengths of the administrative procedures at FWF (personnel, flexibility, informality....)
More global budgets instead of clear ex ante planning with little flexibility?
What improvements (management) would you suggest?
Is assistance / support given during the whole life cycle of the project sufficient and efficient?
How do you judge evaluation (mid-term, ex post)?
Do you think the evaluations reflect the peculiarities of the SFB and FSP-Programmes and the various thematic areas in which scientists can apply?
Strengths/Weaknesses, improvements as regards evaluations?
Are evaluators / FWF too strongly pressing teams to re-group and / or to change their research direction?
Is there enough co-operation monitoring by FWF? Could you envisage supporting schemes to make co-operation more effective (organisational learning)
What about trouble shooting (apart from evaluations)? Is trouble shooting adequate?
Could the participation of women be enhanced?
Contribution and involvement of regions and municipalities?
Can you think of any unintended effects of the FWF administration?
What changes could the FWF make to ensure that effective and efficient networks are created?
Impact Issues
Please give any information you have on the impacts of the networks
Do the outputs and the impacts of the programme provide evidence of efficiency and effectiveness?
Did you do the research anyway? [re: additionality]
How did you carry it out?
Was it in the same way as you planned in your application? What were the differences?

The Interviewees

Criteria for selection

The aim of the research was to ensure wherever possible that responses were taken from as wide a range and as representative a range of individuals and organisations as possible to ensure coverage of the issues from all possible key aspects. In a research study which is tightly constrained by resource availability, it is important to ensure that all possible value is obtained from the interviews and in some cases it may be important to rely upon one person to give more than one institutional perspective. As noted above, when interviewees are questioned, it is our practice to ask interviewees to comment on and assess both a) their direct experience and b) their general understanding of the issues which are raised by us. This ensures a fuller coverage of views, obtains more information and encourages the interviewee to think reflectively about the process in which they are engaged.

The view of the study team was that the interviews should select from the following groups [*specific functional groups*]:

- Programme Managers/ FWF staff/ FWF Board [PM]
- Austrian experts [AE]
- International Experts [IE]
- Participants [P]
- Applicants and Non-applicants [A-NA]
- Rejected Applicants [RA]

It was also the aim of the study group to ensure that where possible the evaluation took evidence that took account of the following to ensure a representative feature [*strategic and representative considerations*]:

- The relationship between the FWF and other major institutions within the Austrian research system;
- Take account of the extent of variation by discipline across the Austrian research system;
- Take account of the extent of variation by type of research institution;
- Take notice of any regional variations within Austria.

The resulting profile of interviewees is shown in the following tables, and clearly indicates the intention to include interviewees from a range of specific functions or *specific functional groups* related to the concept, design, implementation, operation and impact of the FWF and the *strategic and representative considerations*.

Table 1: Interviewees

Name	Location	Status[PM] [AE] [IE] [P] [A-NA] [RA]	Subject Area
Arnold Schmidt	Vienna	[AE] [P]	Physics
Alfred Taudes (SFB10)	Vienna	SFB [P]	Mathematics & Economics
Rudolf ZECHNER (SFB7)	Graz	SFB [P]	Microbiology
Jürgen BESENHARD (SFB 9)	Graz	SFB[P]	Inorganic Chemistry
Paul WEINGARTNER (SFB12)	Salzburg	SFB [P]	Philosophy
Falko NETZER (FSP 81)	Graz	FSP [P] [RA]	Experimental Physics
Kurt ZATLOUKAL (FSP 74)	Graz	FSP [P]	Pathology
Fatima FERREIRA (FSP 88)	Salzburg	FSP [P]	Genetics and Biology
Rauch Helmut (SFB 15)	Vienna	FSP [P]	Physics
Michael Lang (SFB20)	Vienna	SFB [P]	Economics Taxation
Helga Mitterbauer (SFB4)	Graz	SFB [P]	History
Johannes Feichtinger (SFB4)	Graz	SFB [P]	History
Bernhard-Michael Mayer (SFB)	Graz	SFB [P] [PM]	Pharmacology
Georg Kresse (FSP 81)	Vienna	FSP [P]	Physics
Georg Winkler	Vienna	[AE]	University of Vienna
Michael Stampfer	Vienna	[AE]	WWTF
Ben Martin	UK	FWF - Panel [IA]	Social Sciences
Steven Holloway	UK	[IA]	Chemistry
Michael Schmid	Vienna	[P] [RA]	Physics
Gottfried Kirchengast	Graz	[NA]	Meteorology & Geophysics
Georg Wick	Vienna	[AE] [PM] [P]	FWF
Gerhard Kratky	Vienna	[PM]	FWF
Laurenz Niel	Vienna	[PM]	FWF
Rudi Novak	Vienna	[PM]	FWF
Roland Würschum	Graz	[RA]	Physics
Stefan Titscher	Vienna	[AE]	Government BMBWK
Rupert Pichler	Vienna	[AE]	Government BMVIT
Peter Skalicky	Vienna	[AE]	TU Vienna
Friedrich M. Zimmermann	Graz	[AE]	Graz
Franz G. Rammerstorfer	Vienna	[AE]	TU Vienna

The total coverage of different types, based on the table above was as follows:

Type of Interviewee Experience	Number
Programme Managers	5
Austrian Experts	9
International Experts	2
Participants	16
Applicants - Non Applicants	1
Rejected Applicants	3
Total Coverage	36

Appendix 6 – Analysis of the Data Collected in the FWF consortium review 2004 of FWF by Technopolis

This appendix contains the results of our analysis of data collected by the Consortium for the purposes of the FFF and the FWF review. Our analysis has concentrated upon the following: - a) differences at the level of outputs between the two kinds of projects; and – b) at the level of project operation in terms of project collaboration, and project leadership.

A comparison with the Einzelprojekten has been carried out in relation to the scientific quality of the results. This data has been obtained through from the Joanneum part of the International team led by Technopolis which collected data from project leaders across the main 3 forms of research funding of the FWF.

Specific Comparisons - Outputs

A number of observations can be in relation to scientific quality, but it should be noted that as it has not been possible to standardize to take account of inputs (size – number of scientists working, and of equal importance, the length of time over which the projects have operated) the conclusions are very tentative and may be misleading. The data we have used for scientific quality is as follows:

- peer-reviewed papers per sub-project
- peer-reviewed papers in the Science Citation Index per sub-project
- number of Scientific Prizes Awarded

In relation to peer-reviewed papers per sub-project, the analysis of variance shows that the networks do achieve different numbers of papers in the peer-reviewed journals with the single projects receiving the lowest number.

Number of Publications in Peer-reviewed Journals

Type of Project	Mean	N	Std. Deviation
Einzelprojekten	2.8178	1081	5.16192
FSP	6.6875	16	7.98932
SFB	10.0750	40	15.21030
Total	3.1275	1137	6.00722

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Sum of Transdisciplinary Partners * Type of Project	Between Groups	(Combined)	.220	2	.110	.065	.937
	Within Groups		1917.953	1135	1.690		
	Total		1918.173	1137			

When the number of papers submitted to ISI journals are considered, here the differences remain, although they are larger.

Papers Published in SCI/SSCU/AHCI-Journals

Type of Project	Mean	N	Std. Deviation
Einzelprojekten	2.1730	1075	4.08109
FSP	4.0625	16	3.82045
SFB	7.0750	40	11.62091
Total	2.3731	1131	4.64173

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Papers Published in ISI Citation Index Journals	Between Groups	(Combined)	973.013	2	486.506	23.479	.000
	Within Groups		23373.530	1128	20.721		
	Total		24346.543	1130			

Influence of Gender of Project Leader on ISI Papers?

A test was done to see if the gender of the project leader had any effect on the number of papers appearing in ISI journals. This was for all both network and for single projects.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Davon in SCI/SSCU/AHCI -Journals	Mann	983	2.5148	4.85760	.15493
	Frau	148	1.4324	2.63973	.21698

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
Davon in SCI/SSCU/AHCI -Journals		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
	Equal variances assumed	14.236	.000	2.652	1129	.008	1.0823	.40818	.28145	1.88319
	Equal variances not assumed			4.059	322.552	.000	1.0823	.26662	.55778	1.60685

Observation

The number of papers appearing in ISI journals is higher in projects led by men than women in this sample.

The Effect of Networks Productivity of Projects Led by Women

Here we sought to answer the question of whether projects led by women are more or less successful in terms of ISI publications achieved if they are network projects or if they are single projects.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Davon in SCI/SSCU/AHCI-Journals	Single Project	142	1.3803	2.59222	.21753
	Network Project	6	2.6667	3.66970	1.49815

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Davon in SCI/SSCU/AHCI-Journals	Equal variances assumed	.860	.355	-1.171	146	.244	-1.2864	1.09881	-3.45802	.88525
	Equal variances not assumed			-.850	5.213	.433	-1.2864	1.51386	-5.13054	2.55777

Observation

The results of both this test, a (t-test), and a non-parametric test, suggest that there is no statistically significant difference between the number of ISI papers produced in networks led by women and ISI papers produced in single projects led by women. The number of cases is as can be seen, very small.

The Effect of Networks Productivity of Projects Led by Men

Here we sought to answer the question of whether projects which are led by men are more or less successful in terms of ISI publications achieved if they are network projects or if they single projects.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Davon in SCI/SSCU/AHCI-Journals	Single Project	933	2.2937	4.25041	.13915
	Network Project	50	6.6400	10.53422	1.48976

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Davon in SCI/SSCU/AHCI-Journals	Equal variances assumed	52.695	.000	-6.283	981	.000	-4.3463	.69171	-5.70373	-2.98892
	Equal variances not assumed			-2.905	49.859	.005	-4.3463	1.49625	-7.35184	-1.34081

Observation

When projects led by men are considered, network projects produce a larger number of ISI papers than single projects. This effect though has not been standardized to take account of duration and number of staff involved.

Network Programmes and Prizes Won

In relation to the number of scientific prizes awarded, the F statistic shows a significant difference between the means, with network projects receiving a higher number of prizes.

Report

Wissenschaftliche Preise, Ehrungen im Rahmen des Projektes

Network or Non-Network Project	Mean	N	Std. Deviation
Research Project	.1980	1081	.70161
Network Project	.8571	56	2.88840
Total	.2304	1137	.94460

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Wissenschaftliche Preise, Ehrungen im Rahmen des Projektes * Network or Non-Network Project	Between Groups	(Combined)	23.134	1	23.134	26.510	.000
	Within Groups		990.493	1135	.873		
	Total		1013.627	1136			

Networks and Single Projects – Habilitations Worked on Within Projects

This section examines whether there is a difference between the number of habilitations worked on within single and within network projects.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Habilitationen, die im Zusammenhang mit dem Projekt standen	Single Project	1080	.1389	.36426	.01108
	Network Project	56	.3393	.54861	.07331

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Habilitationen, die im Zusammenhang mit dem Projekt standen	Equal variances assumed	38.322	.000	-3.896	1134	.000	-.2004	.05143	-.30131	-.09948
	Equal variances not assumed			-2.703	57.542	.009	-.2004	.07414	-.34884	-.05196

Observation
The observation which can be made here is that the number of habilitations which are worked on in regard to network projects is higher than for single projects.

FSP and SFB – Habilitations Worked On

This section examines whether there is a difference between the number of habilitations worked on within FSP and within SFB projects.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Habilitationen, die im Zusammenhang mit dem Projekt standen	FSP	16	.4375	.62915	.15729
	SFB	40	.3000	.51640	.08165

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Habilitationen, die im Zusammenhang mit dem Projekt standen	Equal variances assumed	1.939	.169	.845	54	.402	.1375	.16270	-.18870	.46370
	Equal variances not assumed			.776	23.517	.446	.1375	.17722	-.22866	.50366

Observation

The observation which can be made here is that there is no significant difference between the number of people who work on habilitations between FSP and SFB.

Comparisons in Terms of Participation Patterns

The data available from the WIFO project also presents information on interdisciplinarity within the sub-projects. The result of an analysis of this data shown below indicates that the number of transdisciplinary partners per sub-project does not vary between the 3 types of project. In terms of interdisciplinarity, taking into account all the projects, there is no significant difference in the level of interdisciplinary involvement. This data is however data concerning the input to a project, and does not concern the success of the output. It does not therefore provide information on the extent of the impact of publications by project type and the relation with interdisciplinarity.

Report

Mean Number of Transdisciplinary Partners by Project

Type of Project	Mean	N	Std. Deviation
Einzelprojekten	.9020	1082	1.29598
FSP	.8125	16	1.37689
SFB	.9500	40	1.37654
Total	.9025	1138	1.29886

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Sum of Transdisciplinary Partners * Type of Project	Between Groups	(Combined)	.220	2	.110	.065	.937
	Within Groups		1917.953	1135	1.690		
	Total		1918.173	1137			

Leadership of Single and Network Projects by Gender

The following tables present the results of analysis of the leadership of projects.

Network Project * Sex Crosstabulation

			Sex		Total
			Mann	Frau	
Network Project	Single Project	Count	1362	197	1559
		Expected Count	**1362.9**	**196.1**	**1559.0**
		% within Network Project	87.4%	12.6%	100.0%
		% within Sex	95.6%	96.1%	95.6%
		% of Total	**83.6%**	**12.1%**	**95.6%**
	Network Project	Count	63	8	71
		Expected Count	**62.1**	**8.9**	**71.0**
		% within Network Project	88.7%	11.3%	100.0%
		% within Sex	**4.4%**	**3.9%**	**4.4%**
		% of Total	3.9%	.5%	4.4%
Total		Count	1425	205	1630
		Expected Count	**1425.0**	**205.0**	**1630.0**
		% within Network Project	**87.4%**	**12.6%**	**100.0%**
		% within Sex	100.0%	100.0%	100.0%
		% of Total	87.4%	12.6%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.116(b)	1	.734		
Continuity Correction(a)	.025	1	.875		
Likelihood Ratio	.119	1	.730		
Fisher's Exact Test				.856	.454
Linear-by-Linear Association	.116	1	.734		
N of Valid Cases	1630				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.93.

Observation

There is no difference between the single and network projects in terms of the gender of their leadership.

Age of Project Leader – Connection with Gender?

The following analysis examined the difference in age between male and female project leaders.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Alter der Projektleiter zur Zeit der Antragsentscheidung	Mann	1423	48.0281	52.67050	1.39626
	Frau	205	44.3171	9.21061	.64330

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Alter der Projektleiter zur Zeit der Antragsentscheidung	Equal variances assumed	.273	.601	1.006	1626	.314	3.7111	3.68770	-3.52208	10.94419
	Equal variances not assumed			2.414	1590.283	.016	3.7111	1.53732	.69566	6.72645

Observation

There is no statistically significant difference between the ages of female and male project leaders, when considering all types of projects together.

Networks and Single Projects – Habilitation Qualified Staff Working in Projects

This section examined the differences in the number of habilitation qualified staff working on networks and single projects.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Mitarbeiter mit Habil	Single Project	1081	.2368	.50495	.01536
	Network Project	56	.5536	1.52458	.20373

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Mitarbeiter mit Habil	Equal variances assumed	34.595	.000	-3.878	1135	.000	-.3168	.08169	-.47702	-.15648
	Equal variances not assumed			-1.550	55.627	.127	-.3168	.20431	-.72609	.09259

Observation

The number of people who have habilitation and who work on network projects is higher than for single projects.

FSP and SFB Projects – Habilitation Qualified Staff Working in Projects

This section examined the differences in the number of habilitation qualified staff working in FSPs and in SFBs.

Group Statistics

	Type of Project	N	Mean	Std. Deviation	Std. Error Mean
Mitarbeiter mit Habil	FSP	16	.2500	.57735	.14434
	SFB	**40**	**.6750**	**1.75977**	**.27824**

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Mitarbeiter mit Habil	Equal variances assumed	1.038	.313	-.941	54	.351	-.4250	.45144	-1.33009	.48009
	Equal variances not assumed			-1.356	52.861	.181	-.4250	.31345	-1.05375	.20375

Observation

The number of people who work on FSP projects who have habilitation is not significantly different than the numbers who work on SFBs.

End of Report