EVALUATION FWF SPECIAL RESEARCH PROGRAMMES (SFB)

Final Report

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Executive Summary

This final report has been prepared by AIT – Austrian Institute of Technology and the Katholieke Universiteit Leuven (KU Leuven, sub-contractor) for the programme evaluation of the Special Research Programmes (SFB) of the Austrian Science Fund (FWF). The evaluation was carried out between January 2019 and February 2020 and critically reviews the SFB programme based on projects granted in the period 2004-2018. The aim of this evaluation is to assess the SFB programme's outputs, outcomes, and impacts against its stated objectives and to provide recommendations for the future implementation of the programme. The SFB programme is expected to fulfil the following three objectives:

- Support outstanding research in Austria by creating long-term, generally multidisciplinary/interdisciplinary and (by international standards) exceptionally productive research networks (SFBs) which should reach "critical mass"
- Expand human resources in science and research and improve gender-balanced orientation of research and education
- Achieve broader effects on the Austrian science and research landscape by supporting universities and other research institutions in the autonomous creation of focus areas in their research profiles and improve public awareness of top-quality research by supporting science communication, knowledge transfer and appropriate dissemination strategies

Based on these objectives, the terms of reference and this study identified five evaluation dimensions based on the overarching objectives of the programme. The first three relate directly to the specific SFB objectives and expected impacts of the programme, while the fourth dimension concerns the adequacy of FWF processes for selection, management, and support of SFB throughout its lifecycle, and the fifth dimension relates to the correspondence of the SFB programme to FWF objectives and the Austrian research and innovation system:

- Support for outstanding research in Austria
- Enhancement of human resources in science and research and improved gender balance
- Achievement of broader effects on the Austrian science and research system
- Effectiveness and efficiency of programme implementation
- Coherence of the SFB programme with overarching objectives

In order to address the evaluation dimensions outlined above, a theory-based evaluation and contribution analysis mixed-method evaluation design was chosen. Evidence was collected by means of a literature review, portfolio analysis, bibliometric analysis, control groups (FWF Stand-alone projects and rejected SFB), counter-factual analysis, a large interview programme of individual and focus group interviews, and two online surveys.

This Executive Summary presents the key findings and conclusions along the five evaluations dimensions with relevant recommendations for the future orientation and implementation of the SFB programme embedded in the corresponding sections.

Key findings and recommendations

Coherence and contextualization of the SFB programme

The SFB programme is still the only basic research oriented and network-based research programme in Austria and has therefore a unique selling proposition with a strong relevance for Austria's research and innovation system and an excellent reputation among researchers and university leaders.

The programme is strictly bottom-up oriented and exclusively focused on research excellence. This constitutes a unique feature in international comparison, where the use of thematic priority setting is wide-spread, and the strategic orientation of basic research networks has changed.

Two major changes in the configuration of the programme occurred since the 2004 evaluation: Firstly, the overall acceptance rate decreased from 54% to 14%. Secondly, the share of SFB funding in the total FWF funding decreased from 14.7% in the year 2014 to 5.6% in 2018. The FWF did not follow the recommendation of the 2004 evaluation which indicated that provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks.

The programme exhibits a strong dominance of the Natural Sciences (57%) and Human Medicine & Health Sciences (26%), a concentration that is higher than that found in the Stand-alone projects. The distribution does not quite reflect the overall intention of the programme, which explicitly addresses researchers “from all disciplines”. The skewed disciplinary distribution is to some extent due to structural differences in Social Sciences and Humanities and the Natural Sciences (e.g., small size of Social Sciences and Humanities research in Austria, a lack of natural networks, lack of incentives, approach to research). However, the eligibility requirement of concentration of at least 50% of sub-projects at one location seems to be a barrier to researchers in Social Sciences and Humanities to participate in SFB to some extent. The existing disciplinary distribution and the high rejection rates of the programme also constitute an evident barrier to application.

Compared with the last evaluation, the programme has lost momentum and transformed to an extremely competitive niche rather than a systemic oriented flagship programme that is capable to shape profile building of research organisations. The following factors are responsible for this transformation: 1) A low level of absolute annual funding, 2) a negative trend in the share of funding provided for by the FWF, 3) a tight concentration on a limited number of disciplines, and 4) acceptance rates of just about 14%. This is worrying, as all system level analyses confirm an increasing relevance of building new and sustaining critical mass, establishing better career prospects for young high-potential principal investigators, and sharpening of research profiles at Austrian R&I institutions.

Against these findings, the following recommendations are given:

Recommendation 1: FWF’s funding share allocated to network programmes should aim to reach a minimum level of 25%.

Given the level of ambition of the programme, such as achieving broader effects on the Austrian research landscape, the resources do not suffice. For pursuing the overarching objectives set, a better endowment with resources from the FWF budget is needed for network programmes.

Recommendation 2: FWF should elaborate measures that allow stronger participation of more disciplines and support the emergence of new fields of excellence.

Measures could comprise the introduction of calls for certain disciplines as well as measures focussing on structural impact for sharpening research profiles at Austrian R&I institutions. Recent system level analyses confirm an increasing relevance of building new and sustaining critical mass and establishing better career prospects for young high-potential principal investigators. It therefore could also be considered to incorporate aspects of relevance and impact in the funding decision process.

Support for outstanding research

The analyses performed clearly show that SFB succeeded in supporting exceptional research as evidenced by the outstanding publication and citation record of the funded projects. The publication profile of the SFB program and its projects in the period 2004–2017 displays a strong continuity in the growth and development of the scientific activity. The publication analysis shows that SFB researchers receive a high citation impact and that their work reflects a very high scientific standard, and SFB PIs in general publish in high impact journals and receive more citations than expected for these journals. SFB projects also exceed national averages and outperform Stand-alone projects along all metrics of citation impact.

The excellence in scientific outcomes is not paralleled by achievements in terms of interdisciplinarity and international collaboration. SFB projects involve fewer internationally co-authored publications compared to the Austrian average, and average interdisciplinarity scores of the SFB program lies below the average of Stand-alone projects and the Austrian average. Interdisciplinarity is typically a result of very closely related (sub-) disciplines working in a sub-project. It is mainly found in fields of science with clearly overlapping content such as biology and medical theoretical sciences and clinical medicine. In this respect, interdisciplinary co-operation in SFBs resembles to a large extent the cross-disciplinary structure of Stand-alone projects.

In somewhat stark contrast is SFB participants’ own assessment of interdisciplinarity in the programme. Interdisciplinarity is seen as one of the key attributes that makes the SFB attractive and unique and SFB researchers perceive their projects as highly interdisciplinary. On the other hand, interviewees stressed that interdisciplinarity is merely a means to an end. The evidence on this apparent contradiction in opinions on interdisciplinarity shows that researchers have different understandings of the differentiation between multi- and interdisciplinarity; a lack of intrinsic motivation for interdisciplinary integration; and that the peer review process is perceived as detrimental to interdisciplinary projects integrating non-closely related fields of science, thus causing strategic choices of disciplinary distribution in SFB proposals to maximize success rates.

Against these findings, the following recommendations are given:

Recommendation 3: FWF should keep the overall programme structure (network size, funding provided, duration etc.) and principles of a two-stage peer review process.

The two-stage peer review selection system is in principle capable of identifying research networks that can deliver outstanding results in terms of publication impact. For funded SFBs, framework conditions (network size, amount of funding per projects, etc.) which allow delivery of outstanding research results are provided. Hence, there is no need to change programme fundamentals such as the two-stage peer review process and structural characteristics in terms of network size and funding per project.

Recommendation 4: FWF should incorporate measures that strengthen the performance of multi-/interdisciplinary research.

Having the ambition to fund highly multi-/interdisciplinary research networks is sensible. However, the ambition is not being met by the programme. Against the background of the objectives set, FWF should define and integrate review criteria for inter-/multidisciplinarity in the review process. Weighting scores for interdisciplinarity and an interdisciplinary panel design could help to better adhere to the own objectives set.

Enhancement of human resources and gender mainstreaming

The SFB programme is seen as among the most prestigious research grants on national and European level. As such, participation in an SFB has large positive impacts on the internal and external visibility of involved researchers, their reputation and recognition in the scientific community, as well as on their national and international collaboration networks.

SFBs are also particularly well-suited for improved training of PhD students due to their collaborative nature, large network, and scientific excellence and the SFB programme supports a large proportion of early-career researchers.

A consideration of key researchers shows that women are on average slightly younger than male PIs, but at the same time heavily underrepresented. An increasing age of the key researcher as well as an increasing age of the SFB coordinator significantly decrease the probability of success; the size of the effect is albeit low. It is career attainment, proxied by carrying the title of professor, which increases the probability of acceptance in both the first and second stage. Overall, SFB decision processes do not discriminate against younger PIs. However, rejected sub-project leads in granted SFB are observably younger than their successful counterparts. Qualitative analyses support this finding, where SFB participants reported their perception that rejected sub-projects were disproportionately led by younger key researchers. In general, the possibility to exclude individual sub-projects from funding was heavily criticised by participants as this also displays a certain disregard for the scientific and interpersonal contribution of individual sub-projects to the whole network entity that in sum lead to higher impacts.

The statistical analysis furthermore highlights two aspects of the application process: 2) women are less likely to make it through the first stage of the process, 3) the second stage does not favour male or female researchers. Especially the first stage of the application process favours established researchers (professors) and success rates increase with age.

The SFB programme does not live up to its own expectation of funding research excellence while “boosting gender mainstreaming and gender-balanced orientation of research and education” in its activities and results. Specific, structured measures for gender mainstreaming and diversity in SFB networks are absent in most networks. While the challenge is acknowledged, efforts and development of measures at network level are missing. Except in Medicine and Social Sciences, the share of female PhD students employed in SFBs, is considerably lower than the share of PhD graduates in the respective field of science.

Against these findings, the following recommendations are given:

Recommendation 5: FWF should take stronger consideration of the network level in funding decisions and limit interventions into the network composition of SFB

The configuration of a network should be the choice of the applicants, who may best consider the required balance of networks in terms of its key researchers. While interventions into the structural composition of networks should not be prohibited, they should be limited and consequences of removing sub-projects should be considered.

Recommendation 6: FWF should incorporate measures that strengthen gender mainstreaming at a network level

Existence and appropriateness of gender mainstreaming measures applied are neither considered in the funding decision processes nor in the activities of most networks. As SFB research networks represent the elite of all Austrian research networks, specific measures need to be set which guarantee that gender mainstreaming measures are being effectively applied at the network level and capable to develop synergies with organisational strategies.

Broader effects on the Austrian science and research landscape

Long-term collaboration with researchers from other institutions in Austria, increasing research productivity through tighter integration of research and establishing or expanding a research group at the host institution are the core motivations to apply for an SFB. These motivations are very much in line with the programme ambition to support profile building.

The programme is very attractive for the participating researchers because it offers the chance to focus on ambitious research questions with new horizons while tackling new challenges and developing/establishing new concepts and paradigms in their research fields. The main mentioned impact mechanisms are the secure funding for long-term research, its significant investment and collaboration at a network level, and the knowledge circulation facilitated through the collaboration. Projects share a joint vision, have a high level of trust among each other, and the intensity of collaboration is high. The conditions for achieving impact are favourable.

The actual effect on the research profiles of the host institutions was questioned as the programme rather funds existing spots of excellence and reinforces existing strengths. Nevertheless, the results of third-party funding are used by participating organisations to indicate their research priorities and SFBs rank in the top-league for this purpose.

The SFB host organisations provide structural support (top-up funding and additional individual measures for e.g. infrastructure provision) which goes beyond the level of support for other research projects and reflects the structural relevance and prestige of the programme at an organisational level. However, SFB funding has no impact on offerings for new permanent positions and the sustainability of the research groups still requires new third-party funding.

Against these findings, **Recommendation 1 and Recommendation 2** of this evaluation study could contribute to better achieving broader effects on the Austrian science and research landscape.

Programme implementation and management

The two-stage application procedure for the SFB is uniformly well regarded and in line with selection procedures internationally. However, the turnaround time between concept proposal and funding decision of minimum 14 months is seen as too long, while the time for drafting the full proposal is too short for its length and complexity.

The overall availability and quality of information is good. There is broad agreement that the response time and professionalism of FWF is very good overall. However, there is some dissatisfaction with the service-orientation of the FWF and its inflexible processes involving aspects such as fixed starting dates of projects and demands placed on the language of application and evaluation.

The explicitly stated aim of the SFB programme is to promote tightly interconnected interdisciplinary research networks, with the expectation that the collaboration produces outcomes that are greater than the sum of their parts. Contrary to this aim, the evaluation process and criteria is discipline-based and places strong emphasis on the scientific quality and reputation of individual project leads as evidenced by their publication track records. The possibility to exclude individual sub-projects from funding also displays a certain disregard for the scientific and interpersonal contribution of individual sub-projects that in sum lead to higher impacts. Lastly, there is no evaluation dimension or criterion assessing the degree and quality of interdisciplinary cooperation.

The evaluation process and criteria could be better used to facilitate the achievement of programme goals in enhancing human resources, boosting gender mainstreaming, and promoting young/early career researchers.

There is dissatisfaction regarding the communication and transparency of the decision-making process (provision of written reviews, instruction of reviewers, balancing review quality), with clear room for improvement in these aspects to more effectively utilize the evaluation process, including the hearing.

The FWF currently does not provide support for project implementation going beyond funding and administrative dimensions and requirements. However, the programme’s goals and interest from researchers indicates a need for action to introduce additional measures related to knowledge transfer, public awareness and dissemination.

Against these findings, the following recommendations are given:

Recommendation 7: FWF should simplify and harmonize application and reporting instructions, forms, and templates.

There is room for improvement concerning the length and complexity of the administrative efforts involved in applying for and implementing an SFB grant, which in turn could improve satisfaction with FWF’s administrative processes.

Recommendation 8: FWF should speed up the communication of reviewer assessments to SFB applicants.

Reviewer assessments should be communicated in advance to the hearing, as this would likely contribute to improving the project selection process and enable better assessment of an application’s scientific quality.

Recommendation 9: FWF should provide additional support mechanisms for promoting knowledge transfer and dissemination beyond the scientific community.

The current programme objectives state that support mechanisms for promoting knowledge transfer and dissemination beyond the scientific community should be pursued. If this target is being taken seriously, FWF needs to build-up specific support strategies for fostering outreach of the networks.

1 Introduction

1.1 Background

The FWF is Austria's central funding body for the promotion of basic research and aims to strengthen the country's science and research performance through **supporting excellent research** and **optimal conditions** for excellence. Like for many other European and international funding organizations, a central instrument to achieve this overall aim is by establishing networks and/or centres of excellence programmes.

The first such Austrian programme "Forschungsschwerpunkte" (FSP), rebranded as "Nationale Forschungsnetzwerke" (NFN) later on, was launched in 1975. In 1993, the "Spezialforschungsbereiche" (SFB) was established as a complementary programme with the objective to foster **regional centres of excellence** at one research location (mostly located at universities but also research institutions such as the Austrian Academy of Sciences) and sharpen the scientific profile of the given location. During the streamlining of the FWF's Priority Research Programmes in 2010, the FWF discontinued the NFN and redesigned the SFB by incorporating key aspects of the NFN into the new SFB.

The SFB programme aims to **strengthen Austria as a location for high-level scientific research** and enhance the **competitiveness of the country's innovation system** by supporting the establishment of sustainable, extremely productive and internationally visible research units at one research institution (under certain conditions at multiple locations), which are **generally multidisciplinary/interdisciplinary** and supporting these institutions in developing strategic focus areas in their research profiles.

The SFBs differ from some of the similar international research network programmes in that the FWF's approach to funding is based entirely on a **bottom-up principle**, where the SFBs serve to advance a research institution's **research strategy and research profile**. Hence, the choice of specific research topic, domain, and research team are at the discretion of the involved researchers/scholars and their respective research institution(s).

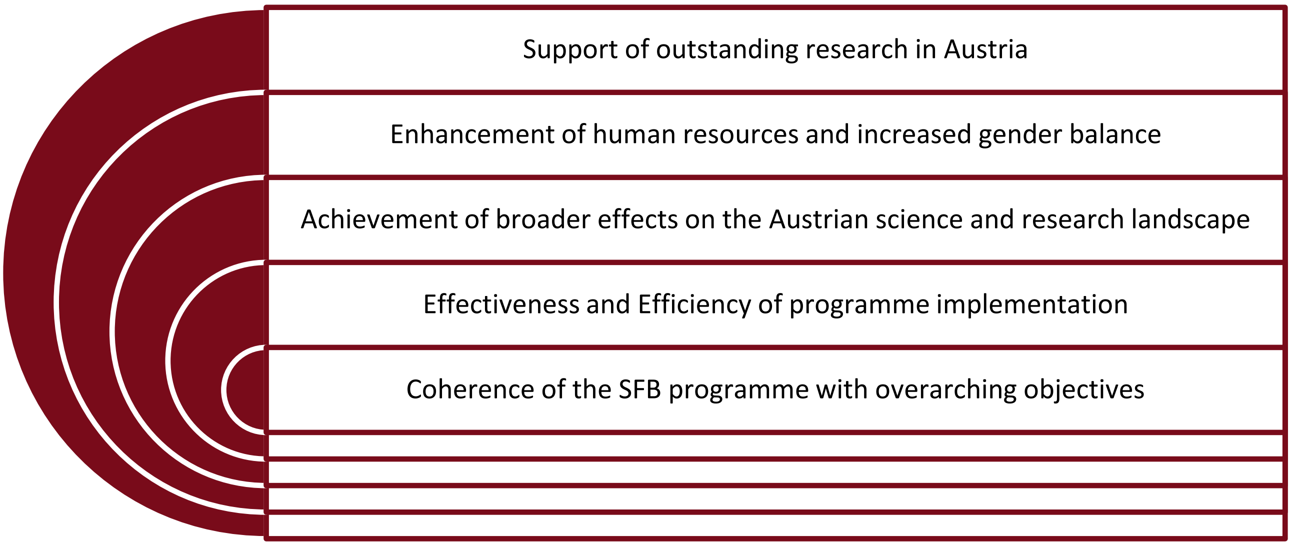
The SFB programme pursues the following three overarching objectives:

1) Support **outstanding research** in Austria by creating long-term, **multidisciplinary/interdisciplinary** and (by international standards) exceptionally productive research networks (SFBs) which should reach "critical mass"
2) Expand **human resources** in science and research and improve **gender-balanced** orientation of research and education
3) Achieve broader effects on the Austrian science and research landscape by supporting universities and other research institutions in the **autonomous creation of focus areas** in their research profiles and **improve public awareness** of top-quality research by supporting science communication, knowledge transfer and appropriate dissemination strategies

1.2 Key evaluation dimensions

Against the background of objectives and funded networks, the evaluation questions raised in the terms of references relate to three impact dimensions (support for outstanding research, human resources and gender balance, broader effects) depicted in the figure below.

Figure 1: Main evaluation dimensions of the SFB Programme evaluation



Source: AIT based upon Terms of References

All three **impact dimensions** relate to the following different **levels of impact**, which need to be considered and differentiated in the evaluation:

- The **individual level**: i.e. the impact on project co-ordinators, sub-project leaders and participating researchers in the project
- The **organisational level**: i.e. the impact on participating institutes and the organisations (universities etc.) in which the projects operate
- The **system** level: i.e. the impact of the projects on a) the addressed fields of research in which the projects operate and b) the Austrian research innovation system including the civil society and industry concerning matters of knowledge transfer

The fourth evaluation dimension relates to **programme implementation** and poses the overarching question, whether the operationalisation/management of the programme is effective and efficient in terms of its selection procedures, monitoring systems and regulations (guidelines, indicators etc.) as well as the support structures throughout the life cycle of an SFB.

The fifth evaluation dimension raises the question, to which extent the SFB correspond with the overarching objectives of FWF and the Austrian Research and Innovation (R&I) system.

1.3 Methodological approach

The overall methodological approach to this evaluation study followed the key principles of **theory-based evaluation** (Blamey and Mackenzie 2007, Carvalho and White 2004, Chen 1990, Mayne 2001) and **contribution analysis** (Mayne 2011, Mayne 2008). For gathering the relevant evidence, the study was informed by a mix of sources and recognised research methods (**mixed methods approach**).

A large part of the quantitative analysis in this study is based on various advanced **bibliometric indicators**. Appropriate standardisation and normalisation allows gauging publication output and citation impact against the reference standard representing the World's top research in the field. Propensity score matching was applied to identify an appropriate set of Stand-alone projects as a synthetic **control group**. The two funding programmes have been compared using a **counter-factual analysis** to identify statistically robust differences between the projects. Finally, the rejected SFB applications serve as a second control group to distinguish structural differences between successful and unsuccessful sub-projects.

The SFB evaluation comprised **two online targeted surveys**. The **SFB participant survey** invited SFB **coordinators and sub-project leads** as well as **unsuccessful applicants** to participate in an online-survey, based on the FWF contact database. In addition, a manual search for the email addresses of **PhD students**

and early career researchers in granted SFBs was carried out. In total, 1362 persons were invited to participate in the survey. The objectives of the survey are to yield quantitative and qualitative insight on the evaluation dimensions with particular focus on: human capacity building, critical mass, and programme efficiency. For this purpose, a combination of open and closed questions was used to ensure in-depth responses. The questionnaire targeted the respondents' background, experience with project application and administration (programme implementation) as well as impact on their career, organisation and international reputation.

A second online survey targeted **SFB reviewers** of both concept and full proposals from the years **2017 to 2019**. Based on data provided by the FWF, 254 reviewers were invited to participate in the survey. The aim was to gain quantitative and qualitative insight into the effectiveness of the selection procedures and evaluation dimensions, as well as a strong focus on potential for improvement in evaluation approach, dimensions, and implementation. Therefore, the questionnaire used both open and closed questions to ensure in-depth responses.

Both surveys yielded very good response rates: The SFB participant survey totals 211 PI responses (SFB coordinators and sub-project leads), resulting in a response rate of 31.3%, and an additional 97 responses of PhD students involved in an SFB, a response rate of 22.6%. The reviewer survey reached 65 respondents or a response rate of 25.6%.

Table 1 Survey response rates

	SFB PIs	**SFB PhDs**	**Reviewer survey**
Number of contacts	825	543	254
Undeliverable	151	114	9
Sample size	674	429	245
Number of responses	211	97	65
Response rate	31.3%	22.6%	26.5%

Source: AIT – SFB surveys

Furthermore, **individual and group interviews (focus groups)** were carried out to gather in-depth qualitative data to complement and contextualize quantitative results. In sum, 31 persons were interviewed individually or in a group setting – the complete list of interviewed persons can be found in Appendix 11.4. A total of 14 SFB coordinators, vice-rectors and representatives of university/research organization management, as well as experts of the Austrian research and innovation system were interviewed in a **semi-structured, guideline-based approach**.

Two focus groups with a total of 17 participants were held in September 2019 to test and validate preliminary findings and collect more data. Discussions were based on results of preceding qualitative and quantitative tasks and included a future-oriented component to identify and discuss potential for improvements to programme design and implementation. Focus group 1 focused on researchers in the **social sciences and humanities** (SSH), where 8 carefully selected participants discussed their experiences with the SFB programme. Focus group 2 was dedicated to **medicine and the natural and technical sciences**. This disciplinary approach enabled the validation of findings and additional data collection while taking into consideration the discipline-specific needs and requirements of researchers for excellent science and research funding.

2 The SFB in the context of the Austrian R&I system

This chapter aims to provide an overview on the **main rationales and impact considerations** of the SFB against the background of the objectives of the FWF funding portfolio and recent trends in the national and European R&I system. Thereby, it addresses the overarching questions of programme coherence, i.e. whether and to which extent SFB is corresponds with the overarching objectives of FWF and the Austrian Research and Innovation (R&I) system.

The chapter first positions the SFB in the context of the FWF portfolio. It then provides an outline of the SFB impact pathway, i.e. the mechanisms through which the programme seeks to deliver impact. Thereby, it establishes a reference framework for the evaluation dimensions of the programme. It then provides an overview on core characteristics of the programme and positions the programme in the context of recent developments of the Austrian R&I system. As a result, the chapter draws key conclusions on the relevance and coherence of the programme, i.e. the 'programme fit' against the background of the FWF funding portfolio and the national and European funding conditions.

2.1 SFB in context of the FWF portfolio

The Austrian Science Fund is the main research funding organisation in Austria supporting basic research. The purpose of the FWF is to support the ongoing development of Austrian science and basic research at a high international level[1]. As stated in the previous FWF Network Programme Evaluation (Edler et al. 2004), 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 research, the support of disciplines and their development, and the attempt to ensure that Austrian research is conterminous with the world research.

The current programme portfolio of the FWF focuses on three domains: 1) the exploration of new frontiers, 2) the development of Human Resources, and 3) the interaction between science and society. The majority of FWF funding is devoted to the first category. Therein, the promotion of individual researchers via the support for Stand-alone projects constitutes the cornerstone of FWFs activities since its foundation. International co-operations, the network-based SFB and a number of prizes and awards complement the programme portfolio in the first category. The second category comprises the collaborative doctoral programmes (DKs), individual mobility grants, and career development schemes for female researchers. The third category includes small-scale application-oriented basic research programmes in dedicated fields (Clinical research, Quantum Technology), support for artistic research and support for scientific publications and for science communication.

In the relevant time frame of this SFB programme evaluation (2004-2018), a number of changes in the FWF portfolio took place. In 2004, after the completion of the last evaluation of the FWF network programmes, the FSP have been renamed to "National Research Networks (NFN)". It was intended to emphasize the network character of these joint projects, which as a rule were distributed over several locations. NFN and SFB were merged in 2009 and the principle of a collaboration at one location for SFB was lifted.

Furthermore, some initiatives to develop and broaden the role of FWF have been launched since the last SFB evaluation. These included the creation of a Translational Programme[2] to support attempts to transfer basic research findings towards suitable areas of application, and the creation of the FWF DK Programme[3], which were both introduced in 2004. The Translational Programme, which was supported by the Austrian ministry of innovation and transport, was discontinued in 2012.[4] The DK nowadays constitute an integral part of the FWF funding portfolio with a higher funding volume than SFB.

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[1] See: https://www.fwf.ac.at/en/about-the-fwf/corporate-policy/

[2] See: https://m.fwf.ac.at/fileadmin/files/Dokumente/info-Magazin/info49-04-02.pdf

[3] See: https://www.fwf.ac.at/de/forschungsfoerderung/fwf-programme/dks/

[4] See: https://www.diepresse.com/747683/wissenschaftsfonds-fwf-macht-stehpause-auf-rekordniveau

Specific initiatives supporting strategic oriented research, transfer of basic research findings to industrial application (Bridge[5]), or long-term research collaboration between research and industry (e.g. COMET[6]) are located within the Austrian Research Promotion Agency (FFG).

Considerations for the funding of “Excellence Clusters” developed in 2006[7] did not materialize so far and therefore, only in very recent times FWF actually launched a number new funding programmes in 2018/2019. These include:

- The programme **Young Independent Researcher Groups** (in cooperation with the Austrian Academy of Sciences, ÖAW) aims at promotion of young post-docs and supports an interdisciplinary, complex and current topic in mixed teams of between 3 and 5 researchers for a time period of 4 years.
- The programme **Research Groups**, aims at funding linkages between inter- or multidisciplinary research teams of three to five internationally renowned researchers regardless of their location.
- The programme **Quantum Research and Technology** (QFTE) (in cooperation with the Austrian Research Promotion Agency, FFG) took up the relevance of Knowledge transfer from basic research in quantum physics to the development and application of quantum technologies and vice versa.
- With the pilot project -**1000 Ideas Programme** (1st call for proposals Nov. 2019), the FWF supports the promotion of completely new, daring or particularly original research ideas that lie outside the current scientific understanding. The key aim is to investigate future-oriented research topics with high scientific and transformative potential.

While the FWF network programmes never comprised more than one fifth of the total annual budget granted for projects, its funding share has declined in recent years. Between 2004 and 2018, SFBs (including NFNs) allocated on average 11.2% of the total FWF funding per year, while Stand-alone Projects (EP) accounted for 48.9%. In relation to the total amount of public funding in these years, the amounts spent on EP represent 3.5% and for SFB 0.8% of the federal R&D expenditures.[8]

Back in 2004, the FWF-SFB evaluation stated that 18% (of FWF total) were allocated to the two network programmes based on data for the period 2001-2003. While SFBs and FSPs have been merged since then, the total share of funding nowadays accounts for only 7% in the period 2016-2018, indicating a particularly significant decrease in recent times. The figure below displays the actual share of EP- and SFB-funding and granted sub-projects in each year and shows an overall declining share of SFB funding and grants after 2011.

According to the FWF Annual Reports, the high demand for SFBs since 2004 decreased in 2007 by 25%, but due to the successful prolongation of four already running SFBs and one NFN, the overall SFB/NFN funding increased.[9] The decline of funding in the year 2013 resulted from a significant decrease of applications compared to the previous year (from 27 new applications and 35 extensions of sub-projects in 2012 to 22 new applications in 2013).[10] In the following year 2014, the SFB funding reached again the third highest share in the FWF funding portfolio (13.8%), but decreased since then to 5.5% in 2018.

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[5] See: https://www.ffg.at/en/programme/bridge

[6] See: https://www.ffg.at/en/programme/bridge

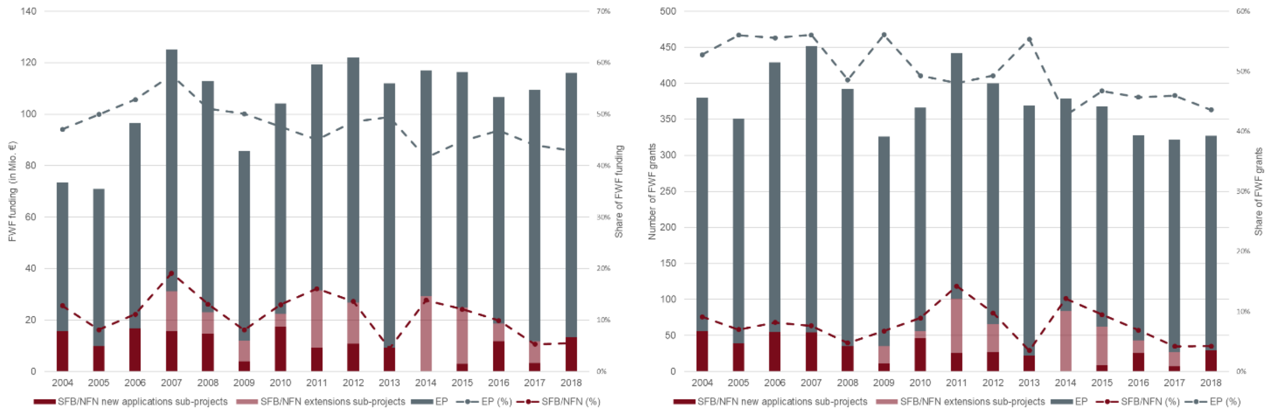
[7] See: https://repository.fteval.at/203/1/2006_Exzellenzinitiative%20Wissenschaft.pdf

[8] Based on data from the FWF Annual Reports 2004-2018 and the Austrian Research and Technology Report 2017 and 2018.

[9] See FWF Jahresbericht 2007, 53.

[10] See FWF Annual Report 2013, 49.

Figure 2: Share of FWF funding and grants for SFB/NFN sub-projects and EPs between 2004 and 2018



Note: Funding data on extended subprojects first available from 2007; data on the number of extended sub-projects first available from 2009
Source: FWF Annual Reports 2004-2008; Austrian Science Fund (FWF) funding statistics 2009-2018 (zenodo)

Hence, while the 2004 evaluation concluded that “the SFBs 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”, this does not hold true today. Despite being the only basic research network programme in Austria, its overall significance in the portfolio with a funding volume of 13,3 Mio. € in 2018 has decreased. Instead, more funding is devoted to human resources-oriented DK (19 Mio. € in 2019) and international funding programmes, which operate predominantly in a Stand-alone project mode with bilateral co-operations.

Compared to other network programmes, the share of SFB funding in FWF total is alarmingly low: The German DFG dedicates around 25% of its total budget to its SFB – the Collaborative Research Centres[11], while additional network funding programmes such as the Priority Programmes and the Research Centres are available. In Denmark, the primary network funding scheme, DNRF’s Centers of Excellence, have accounted for around 80% of the total expenditure of the foundation in recent years (see Aksnes et al 2012). Additionally, various Center of Excellence-like initiatives exist in parallel (e.g. Pioneer Centers).

2.1.1 The SFB impact model

There is wide agreement in the scientific literature that excellent and high-level basic research is one of the key drivers for the innovative capability of regions or countries, and thus, crucial for their overall socio-economic development (see, e.g., Porter 1996). Moreover, it is stressed that particularly excellent research is increasingly conducted within a complex web of interacting researchers, coming from different scientific and institutional backgrounds (see, e.g., Powell and Grodal 2005, Scherngell 2013, among others).

Research networking programmes like the SFBs pick up these scientific insights and lay the foundation for nationally funded research groups to address major scientific issues, to advance the frontiers of existing research and potentially pave the way for social and economic innovations. They seek to enhance ‘Research collaboration’, which is a special form of collaboration, undertaken for the purpose of research, where ‘research’ is implicitly seen as scientific research (Amabile et al., 2001, Katz & Martin, 1997). Research collaborations can thereby be characterized by (1) the profession of the participants, (2) the institutional affiliation, and (3) the structural level of the collaboration (Amabile et al. 2001). Sonnenwald (2007) further adds (4) the disciplinary focus (including a specific focus on science-industry collaboration) and (5) the geographical focus.

The growth of research collaboration as a phenomenon within the research system has attracted quite some attention in the academic literature but is also of major concern for research policy makers and funding

11 https://www.dfg.de/en/research_funding/programmes/coordinated_programmes/collaborative_research_centres/facts_figures/index.html

organisations (see Scherngell 2013 for an overview). **The potential benefits, costs and factors influencing the performance of research collaboration** have been put under investigation, as research policy makers seek to design funding programmes that contribute to strengthening the competitiveness of national research and innovation systems for the benefits of society (see Table 2 for an overview).

Table 2: Benefits from research collaboration

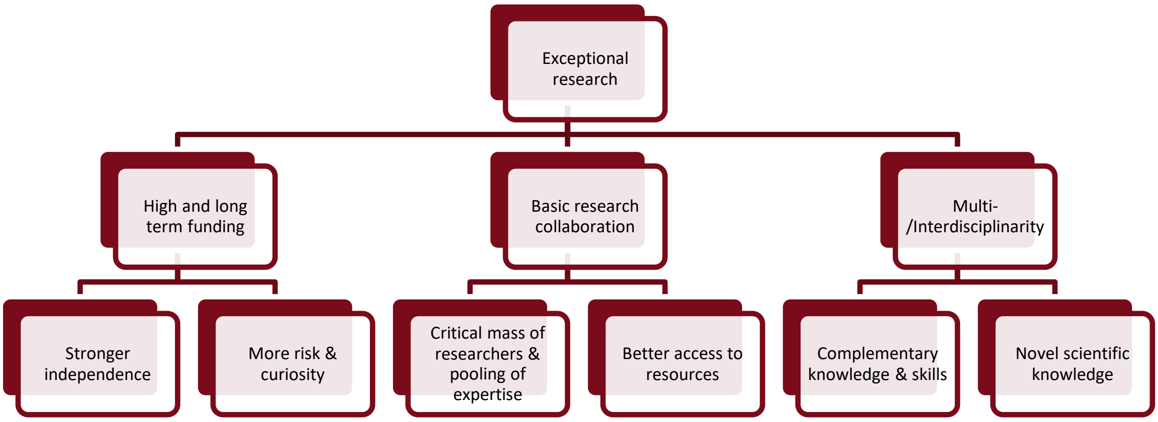
Potential benefit	Source
Access to expertise	Katz and Martin, 1997; Melin 2000; Scherngell 2013; Hoekman et al. 2013
Access to resources, such as infrastructures	Melin, 2000; Beaver, 2001; Heinze & Kuhlmann, 2008; Vanrijnsoever, Hessels, & Vandeberg, 2008; Sonnenwald, 2007
Exchange of ideas esp. across disciplines	Beaver & Rosen, 1978, 1979b, 1979a; Katz & Martin, 1997; Melin, 2000; Heinze & Kuhlmann, 2008; Birnholtz, 2007
Pooling expertise for complex problems	Beaver, 2001; Birnholtz, 2007; Sonnenwald, 2007; Paier and Scherngell 2011
Keeping own activities focused	Heinze & Kuhlmann, 2008
Learning new skills	Heinze & Kuhlmann, 2008; C. S. Wagner, Brahmakulam, Jackson, Wong, & Yoda, 2001
Higher productivity	Beaver, 2001 S. Lee & Bozeman, 2005; Sooryamoorthy & Shrum, 2007; Scherngell et al. 2014
Higher quality of results	Rigby & Edler, 2005
Access to funding	Beaver, 2001; Heinze & Kuhlmann, 2008
Prestige	Beaver & Rosen, 1978, 1979b, 1979a; Katz & Martin, 1997; Vanrijnsoever et al., 2008
Political factors	Sonnenwald, 2007
Personal factors	Sonnenwald, 2007
Fun and pleasure	Katz & Martin, 1997; Melin, 2000; Beaver, 2001

Source: Adapted from Bukova, 2010

SFBs incorporate a programme design, which inherently aims at exploiting the benefits from research collaborations as outlined above. Firstly, the programme seeks to facilitate the creation of exceptional research by facilitating long-term, basic research collaboration of multi- /interdisciplinary research groups. Through these programme characteristics, the programme may lead to **higher scientific quality, productivity and ground-breaking research results**. Key hypotheses reflected in Figure 3 are that:

- High and long-term funding of a group of researchers lead to stronger independence of researchers, more out of the box and curiosity driven research.
- The collaborative character of research facilitates the creation of a research-network of critical mass researchers, pooling of expertise, and better access to complementary resources
- The multi-/interdisciplinary character of the research networks allows researchers from different disciplines to look at similar questions, which may lead to entirely new combinations of complementary skills and knowledge and novel scientific knowledge.

Figure 3: Impact pathway – Exceptional research

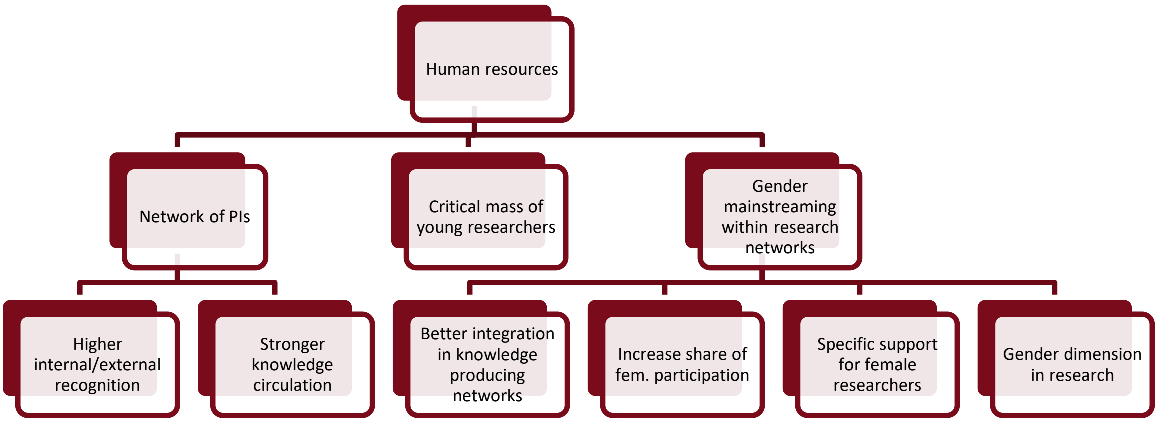


Source: Own illustration

Secondly, SFB seek to enhance Austria's **human resources** for science and research while boosting gender mainstreaming and **gender-balanced research.** The enhancement of human resources is not elaborated in detail in the programming document, but a number of expectations related to the human resource dimension are that, SFB networks:

- contribute to the **career advancement of young researchers** through better integration in knowledge producing networks,
- **foster the personal career of PIs** through stronger internal/external recognition,
- contribute to a **boosting of gender mainstreaming** through better integration in knowledge networks, specific support for female researchers and, going beyond the human resources dimension, the integration of a gender dimension in research.

Figure 4: Impact pathway - Enhancing human resources and boosting gender mainstreaming

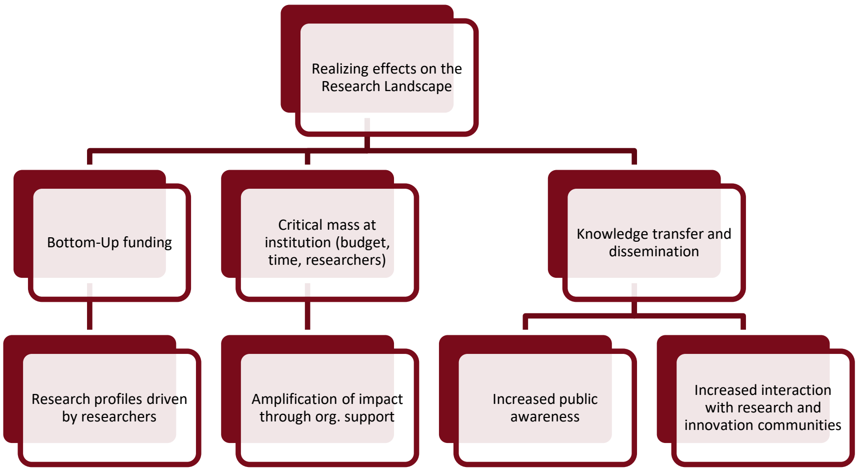


Source: Own illustration

Thirdly, the FWF SFB programmes seek to realize **broader effects on the Austrian research landscape** through the autonomous **sharpening of focus areas** in the research profiles of organisations, as well as in science communication, **knowledge transfer and dissemination** strategies to **increase public awareness** of high quality research. Key hypotheses are that:

- Bottom-up funding of research networks allows institutional research profiles to be driven by researchers
- Universities amplify impact of this research through provision of specific support
- Knowledge transfer and dissemination mechanisms lead to increased public awareness and interaction with research and innovation communities

Figure 5 Realizing broader effects on the research landscape



Source: Own illustration

The desired impacts of SFB and its core characteristics remained very stable, when being compared with the last evaluation of the FWF network programmes:

- The SFB programme still focusses on funding of research teams within universities and other basic research-oriented institutes.
- The focus of funding is not on the institutional level, but on the individuals participating in the research.
- The teams are multilateral and big. They share a common vision, goals, research programme and working plan.
- With a maximum duration of 8 years, the duration of the cooperation can be characterized as long term. The duration is subject to the outcome of a reviewing process that can see projects altered significantly or stopped altogether should major problems be detected.
- The projects are characterized by a concrete cooperation between individual teams and sub-projects, but not all network members need to contribute to a joint common task with clear division of labour, as in a large scale industrial R&I project.
- The nature of the cooperation is a clearly defined research design and the main purposes of the collaboration are to complement each other's work, common development of methods, and common usage of infrastructure and equipment.
- The stage of scientific activity is geared towards the creation of pure basic research, i.e. the production of new knowledge. No strategic goals (e.g. specific application orientation) need to be attached.
- The intended disciplinary reach of the projects is multi-or interdisciplinary and the networks should be located at one research location[12] (at least 3 groups) but hosting by multiple institutions is not prohibited.
- The functional aims of the SFB are to encourage interaction between researchers and to carry out multi-/interdisciplinary research on complex and challenging research areas that will achieve international visibility and international excellence for Austrian research. These are complemented by a range of dissemination outputs such as public engagement at the level of research use and the training of young researchers.

A key consideration concerning the specific scientific aims of the SFB is that there is no thematic direction given. This reflects key principles of the FWF mode of operation. In other countries, the use of thematic priority setting within network programmes was already found to be widespread in the 2004 evaluation, when all comparator countries (Germany, Finland, Switzerland, Denmark) had network programmes where top-down / thematic priority setting was pursued. A comparison of the network programmes in Germany, Switzerland, and

[12] Research location = all research institutions located in a city/municipality; all research institutions within a maximum radius of 80 km (as the crow flies) that regularly cooperate with the research institution directly located at the site are also considered to be the same research location.

Denmark reveals that the same holds true today. All three either have multiple network programmes, which taken together operate in both top-down and response mode approaches, or have established programmes operating in hybrid modes: The German SFB (Collaborative Research Centres) operates entirely in a response mode approach, similar to the FWF SFB, but other network programmes such as the Priority Programmes and the Research Centres are established based on thematic priority areas. In Demark, the Centres of Excellence used to follow a top-down approach (cf. SFB evaluation 2004), but in recent years are established on a bottom-up basis. However, the Pioneer Centers programme introduced in 2019 is a complementary CoE scheme aimed at supporting networks in key priority areas (energy/climate and artificial intelligence). In the case of Switzerland, its National Centres of Competence in Research operates in a hybrid thematic priority setting system incorporating both thematic and response mode approaches.

Table 3 Comparison of network programmes and their modes of operation

Country	Network Programme	Mode of operation
Austria	Special Research Programmes	Bottom-up
Germany	Collaborative Research Centres	Bottom-up
	Research Centres	Thematic
	Priority Programmes	Thematic
Switzerland	National Centres of Competence in Research	Hybrid bottom-up/thematic priority setting
Denmark	Centres of Excellence	Bottom-up
	Pioneer Centers	Thematic

Source: Own compilation

2.1.2 Portfolio analysis of SFB

The following section is based on existing SFB monitoring data provided by the FWF and gives a descriptive overview of the SFB programme for the period 2004-2018. More specifically, it analyses the characteristics of the SFBs 23-73 in terms of funding and participation patterns, beneficiaries and disciplinary coverage. The project portfolio analysis considers the results of the SFB evaluation from 2004 (Edler et al., 2004, in the following also referred as Eval 2004) to reveal and highlight structural differences in the funding period after 2003.

Structural funding and participation data

Between 2004 and 2018, 29 SFBs were funded with an overall budget of more than 203 million euros. Within these 29 SFBs 331 individual sub-projects with 2,778 participants were funded (Table 4). While the size of SFBs in terms of number of sub-projects and participants compared to SFBs before 2004 remained quite the same (11.4 sub-projects per SFB and 8.39 participants per sub-project), the granted budget increased remarkably in nominal terms: the budget per SFB increased by 33%, the budget per sub-project by 44%, the budget per sub-project per granted year by 50% and the budget per granted year per participant finally by 71%.

Adjusted for inflation, the budget increased by approx. 6% per SFB and 15% per sub-project.

SFBs varied considerably in size. The largest SFBs comprised 19 sub-projects with more than 150 participants (F35, F43), while the smallest SFB included 7 sub-projects and 44 participants (F42). On average a SFB consisted of 11.4 sub-projects, 100.1 participants, 13 (sub-)project leaders and 87.1 participants. Most SFBs received funding for the full maximum period, only three SFBs (F23,F31 and F49) were terminated after the first evaluation.

Table 4: Structural funding and participation data

Characteristics	Eval 2004*	Eval 2019
SFB Nr	1-21	23-73
Period	1994-2003	2004-2018
Budget granted	105,848,509 €	203,783,859 €
N granted SFB	20	29
N granted sub-projects[13]	247	331
N sub-projects per SFB	12.35	11.4
Participants total[14] **(project leader + staff)**	2,057	2,778
Participants per sub-project	8.33	8.39
Budget grant / SFB	5,292,425 €	7,027,030 €
Budget grant / SFB in 2018 value[15]	*6,631,890 €*	*7,027,030 €*
Budget grant / sub-project	428,536 €	615,661 €
Budget grant / sub-project in 2018 value[15]	*536,993 €*	*615,661 €*

Source: SFB project database, calculations AIT; *… Edler et al. (2004), 44.

Beneficiaries by funding and participation

36 different organisations host SFB sub-projects. The majority are still universities (24), but the share of public research organisations increased from 20% before 2004 to 41%. Furthermore, the number of hosts from abroad increased from two to ten (mostly from Germany, but also single organisations from Switzerland and Canada[16]).

Figure 6 displays the amount of funding, the number of hosted sub-projects and the number of SFB participations of each organisation receiving more than 1 million €. The four main beneficiaries in terms of funding and number of sub-projects are the Medical University of Vienna, the University of Vienna, the Technical University of Vienna and the University of Innsbruck. While the Medical University of Vienna receives the highest funding amount, the University of Vienna takes part in the highest number of SFBs (17 out of 29).

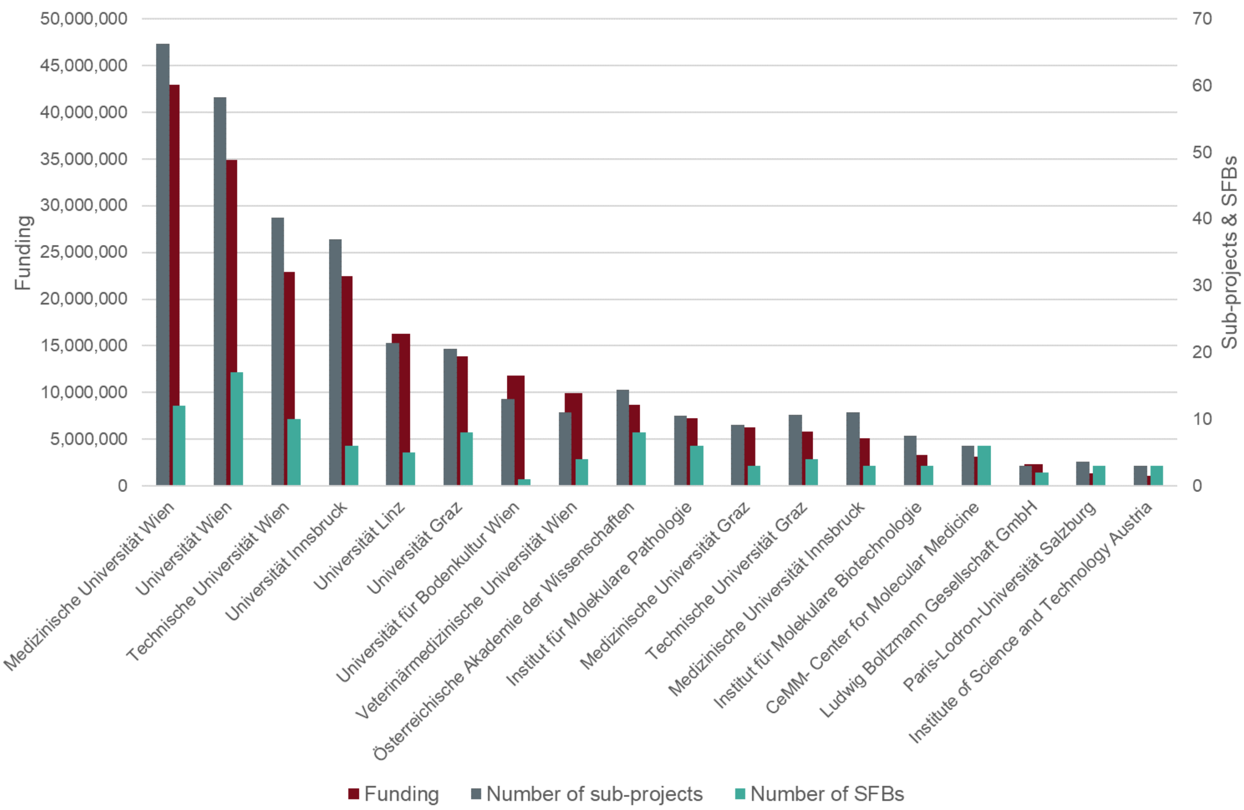
[13] This number includes all granted subprojects with proposal type "Neuantrag" or "Neues Teilprojekt in Verlängerungsphase", sub-projects with proposal type “Verlängerung” were not considered.

[14] For the identification of participation numbers, we followed the definition of Edler et al. (2004, 44) and included all individuals ever to be part of the SFBs, being scientific personnel or not. Double counting has been systematically avoided by considering only researchers and staff with a valid Personen_ID.

[15] Calculations based on: https://www.inflationtool.com/euro?amount=5292425&year1=2004&year2=2018

[16] In fact, the University of Toronto appears as host institution, because of a double assignment of an Austrian researcher.

Figure 6: Structural funding and participation data

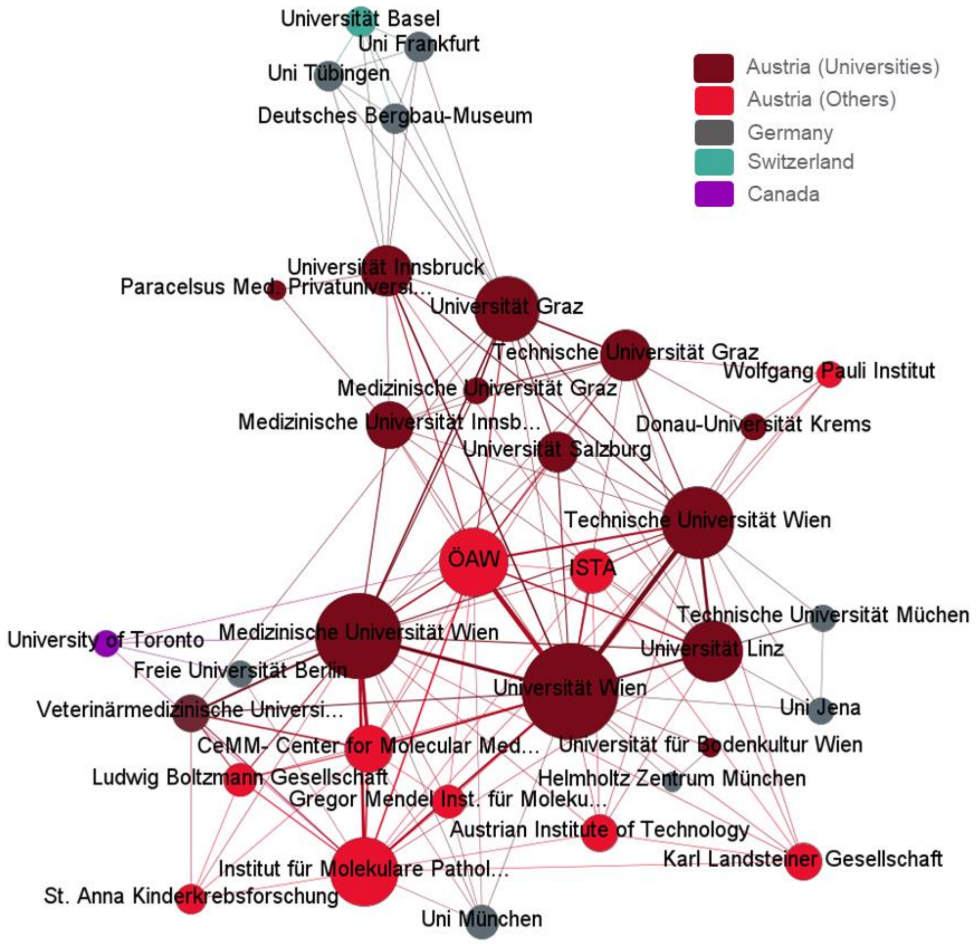


Source: SFB project database, calculations AIT.

Compared to the results of the last evaluation, we can also observe that the sub-projects of the SFBs are more frequently spread across a higher number of institutions and different locations than before 2004. This reflects the merger of the programme with the NFN programme, which was intended to connect different locations and different host institutions. On average, the 11.4 sub-projects per SFB are situated at 4.2 host institutions, whereas the average number of host institutions of SFBs before 2004 is 2.7. It is important to note that there is a high variance between SFBs, ranging from one to eight different hosts and from one to five different locations per SFB.

Figure 7 shows the network of hosts or beneficiaries based on joint participation in SFBs. Nodes represent the individual organisations, which are connected, when they participate together in the same SFB. The size of the nodes displays the number of different partners and the size of the connections represents the number of joint participations. Organisations are close to each other, when they often host sub-projects within the same SFB. The colour of the nodes, finally, indicates the country of origin.

Figure 7: Network of beneficiaries based on joint SFB participation



Note: nodes… research units; node size… number of partners; node colour… country of origin and type of institution; edge width… number of joint sub-projects
Source: SFB project database, calculations AIT.

The research units with the highest number of different partners are those with highest funding (Medical University of Vienna, University of Vienna and Technical University of Vienna). The network visualisation suggests that joint participation in SFBs is often determined by the same geographical location (e.g. Vienna / Graz), a similar thematic orientation (general / medical / technical) and a similar type of research unit (universities / research organisations).

Disciplinary coverage

For the identification of the disciplinary coverage of SFBs we used the assignment of all SFB sub-projects to one or more scientific categories of the Austrian Fields of Science Index of Statistic Austria[17] and calculated the share of scientific disciplines based on aggregated project data.

The assignment of all SFB sub-projects to one or more scientific disciplines reveals a strong concentration on a small set of disciplines (1-digit level) and sub-disciplines (3-digit level). On the 1-digit level we can observe a strong bias towards Natural Sciences (57%) and Human Medicine & Health Sciences (26%). Only 8% of the sub-projects are dedicated to the Humanities, 4% to Social Sciences, 3% to Technical Sciences and 2% to Agricultural Sciences & Veterinary Medicine.

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[17] This index, originally developed in 2002 (ÖFOS 2002), was updated in 2012 (ÖFOS 2012). The SFB monitoring data includes both, assignments based on ÖFOS 2002 as well as on ÖFOS 2012. For the analysis we therefore developed a concordance between both classifications and reassigned scientific disciplines on the 4-digit level of ÖFOS 2002 to scientific disciplines on the 6-digit level of ÖFOS 2012.

In comparison, the German Collaborative Research Centres display a lesser degree of disciplinary concentration on the 1-digit level and better representation of the SSH: Out of 275 projects, the Life Sciences (cf. Human Medicine & Health Sciences in SFB) are the largest discipline (43.3%), followed by the Natural Sciences (26.2%), Engineering (17.1%), and the Social Sciences and Humanities (13.5%)[18].

Interviews show that the required network size (5-15 principal investigators) is not seen as a major barrier for participation and hence does not explain the small number of Social Sciences and Humanities (SSH) projects. Such underrepresentation of SSH in the SFB programme can partially be explained by the overall small size and lack of critical mass of Social Sciences and Humanities in Austria. For decades, SSH received much less attention by policy than technological and industrial R&D (Metris, 2012) and support from national funding agencies did not keep up with the increasing number of social science researchers (Fleck, 2010). Kuzeluh (2008) stresses that a short-term and fragmented research funding for the SSH in Austria and a lack of an overarching thematic-programmatic focus has led among others to structural fragmentation and individualization of excellence and international presence and scientific output.

Hence, rather than the required size, unfavourable starting conditions for SSH research, as compared to the Natural Sciences research, are a major barrier to participate in a research programme which provides funding for well-established poles of excellence. The group interview with SSH researchers showed that the eligibility requirement of concentration of at least 50% of sub-projects at one location seems to be a barrier to some extent. It also identified barriers related to the structural composition and ways of working in the social sciences and humanities: The interview participants stressed the lack of (natural) networks in their research areas. In some areas, there is a lot of potential for cooperation and network formation due to the broad nature of sub-disciplines, however, there are no 'naturally' existing networks of closely related sub-disciplines (e.g. medicine and biology) and no incentive mechanisms for researchers to pursue network activities/projects. Interview participants also indicated that there seems to be a certain self-perception among SSH researchers as individual scholars in whose best self-interest it would be to pursue their own research area narrowly as opposed to large interdisciplinary network collaboration research. Finally, when confronted with the existing disciplinary distribution and the high rejection rates, there is broad agreement among interviewed SFB participants that it is pointless to apply for a Social Science or Humanities SFB and most would think twice before even starting such a complex process.

Table 5: Number of projects and funding in the four major sub-disciplines

Sub-Discipline	N Projects	Budget
106 Biology	73	46,902,788 €
301 Medical-Theoretical Sciences, Pharmacy	64	41,144,117 €
103 Physics, Astronomy	57	39,243,137 €
101 Mathematics	**45**	**24,822,436 €**

Source: SFB project database, calculations AIT.

The concentration on only a small set of different disciplines finds its continuation also on the 3-digit level. Within Natural Sciences and Human Medicine & Health Sciences only four sub-disciplines cover 72% of the sub-projects and 75% of the granted budget. Accordingly, it can be stated that the main emphasis of scientific research in SFBs is placed on Biology, Medical-Theoretical Sciences & Pharmacy, Physics & Astronomy as well as on Mathematics (Table 5).

[18] https://www.dfg.de/foerderung/programme/koordinierte_programme/sfb/zahlen_fakten/index.html

Table 6: Size and relative costs by discipline

	Eval 2004*		Eval 2019	
	Natural Sciences	Non-Natural Sciences	Natural Sciences	Non-Natural Sciences
Number of SFBs	9	11	13	16
Sub-projects / SFB	13.22	11.64	12.08	10.88
Participants / sub-project	8.98	7.72	9.18	8.40
Budget granted total	52,893,903	52,954,605	99,383,562	104,400,297
Budget grant / SFB	5,877,100	4,814,055	7,644,889	6,525,019
Budget grant / sub-project	444,486	413,707	633,016	600,002
Budget grant / sub-project / granted year	54,339	61,262	82,116	91,467
Budget grant / granted year / participants	6,049	7,937	11,510	11,986

Source: SFB project database, calculations AIT; *… Edler et al. (2004), 57.

For the disciplinary classification of SFBs, we followed the approach of Edler et al. (2004) and used the distribution of disciplines in sub-projects on the 1-digit level of the Austrian Fields of Science Index of Statistic Austria to differentiate between Natural Sciences SFBs, in which all or almost all sub-projects are within the area of Natural Sciences, and Non-Natural Sciences SFBs, which comprises all other disciplines (i.e. Technical Sciences, Human Medicine, Health Sciences, Agricultural Sciences, Social Sciences and Humanities). The evaluation from 2004 revealed that on average Natural Science SFBs have more sub-projects, which leads to higher budgets per SFB. However, the ratio budget per participant and budget per sub-project per year is smaller in the Natural Science than in the Non-Natural Science.

Besides an increased available budget on every level (per SFB, per sub-project and per participant), SFBs after 2003 show the same disciplinary patterns: larger SFBs in Natural Sciences in terms of participants and budget than in other disciplines, but a smaller yearly budget on the sub-project and participants level.

Acceptance and rejection rates

Between 1994 and 2003 37 SFBs were applied for, of which 20 were funded. Edler et al. (2004) stated a high overall acceptance rate of 54% (including the concept (first stage) as well as full proposals (second stage)) with an even higher rate in the hearing stage, where more than 90% of the proposals were accepted.

In the time period between 2004 and 2018, the number of proposals increased strongly from 37 to 206 proposals in total, from which 29 were funded. The overall success rate (first and second stage) thus declined from 54% to 14%. While between 1994 and 2003 nearly all SFB proposals in the second stage have been finally accepted, only 57% of the SFB proposals in the current evaluation period mastered the second stage successfully. Due to the low numbers the SFB acceptance rate shows a high variance in the single years between 2004 and 2018 but reveals a tendency to decrease in recent years (Figure 8). This tendency is on the one hand certainly related to the growing number of applications, but it is also in line with the decrease in the overall FWF acceptance rate, which declined between 2006 and 2018 by nearly 20 percentage points (Figure 8).

The decline in acceptance rates has to be seen in the context of the overall availability of FWF's budget. While the share of purely institutional funding for basic research is still very high in Austria, the level of available competitive funding for basic research is notoriously low: Although the funds that are distributed through the FWF are expected to grow again in the next few years, this growth should not be enough to reach the level of important countries in comparison, since Austrian spending per capita in 2016 was only around 20% of those in Switzerland and about 50% of those in Germany, Finland, Sweden or the Netherlands[19]. In view of the high rejection rates of very well rated research projects at the FWF, this represents a clearly noticeable barrier on the further development of high quality research in Austria.

Figure 8: SFB acceptance rates compared to FWF total acceptance rate

Source: SFB project database, calculations AIT

The results indicate that the requirements for a successful proposal increased during the last years. 70% of the SFB proposals in the years between 2004 and 2011 that reached the second stage were accepted, but after 2011 only 46% of the SFB proposals in the second stage were funded. On the other hand, we are confronted with a strong increase of the funding rate for granted SFBs from 61.2% (Eval 2004) to 79.0% (Eval 2019). Against the background of an increasing number of applications, the decline of the acceptance rate is not surprising. However, if we put these figures in relation to the declining share of SFB funding in the total FWF funding from 14.7% in the year 2014 to 5.6% in 2018 (see Figure 2), the question arises as to which factors are decisive for the declined funding of SFBs.

In terms of scientific disciplines, we differentiate between SFBs, which are classified totally by one scientific discipline at the 1-digit level, those which are classified by more than 70% by a specific scientific discipline and those which are classified by three or more different scientific disciplines. Thus, we defined three different categories for each scientific discipline (e.g. “Nat”, “Nat mainly” and “Cross-Discip. Nat”) and assigned the SFBs accordingly. Table 7 displays the number of applied and rejected proposals in the different categories.

Compared to SFBs before the year 2004[20], the share of SFBs characterised by considerable parts of Natural Sciences increased from 50% to 55%. In contrast, the share of SFBs in Medicine increased from 20% to 31%. On the contrary, the share of SFBs in the Humanities and the Social Sciences declined from 15% to 10% (Humanities) and from 10% to 3% (Social Sciences). In addition, SFBs with considerable parts in Technical Sciences and Agricultural Sciences & Veterinary Medicine received no funding between 2004 and 2018.

[19] See: Wolfgang Polt, (2019), Braucht die Grundlagenforschung mehr Geld?, Commentary in Wiener Zeitung vom 27.11.2019.

[20] See Edler et al. 2004, 56.

Table 7: Acceptance and rejection rates by scientific disciplines

Scientific discipline	total	rejected (stage 1)	rejected in (stage 2)	granted (stage 2)	acc. rate (stage 2)	acc. rate (total)
Natural Sciences	**104**	**79**	**9**	**16**	**64%**	**15%**
Nat	70	55	5	10	67%	14%
Nat mainly	12	5	4	3	43%	25%
Cross-Discip. Nat.	22	19	0	3		14%
Technical Sciences	**8**	**8**				**0%**
Tech	1	1				0%
Tech mainly	8	8				0%
Cross-Discip. Tech.	1	1				0%
Human Medicine & Health Sciences	**48**	**33**	**6**	**9**	**60%**	**19%**
Med	11	11				0%
Med mainly	20	12	4	4	50%	20%
Cross-Discip. Med.	17	10	2	5		29%
Agricultural Sciences & Veterinary Medicine	**1**	**1**				**0%**
AgVet	1	1				0%
Social Sciences	**28**	**23**	**4**	**1**	**20%**	**4%**
Soc	12	11		1	100%	8%
Soc mainly	10	8	2			0%
Cross-Discip. Soc.	6	4	2	0		0%
Humanities	**17**	**11**	**3**	**3**	**50%**	**18%**
Hum	3	2		1	100%	33%
Hum mainly	10	8	1	1	50%	10%
Cross-Discip. Hum.	4	1	2	1	33%	25%
Total	**206**	**155**	**22**	**29**	**57%**	**14%**

Note: SFBs of decision type "abgesetzt" and "zurückgezogen" in Stage 1 are not considered in this table
Source: SFB project database, calculations AIT

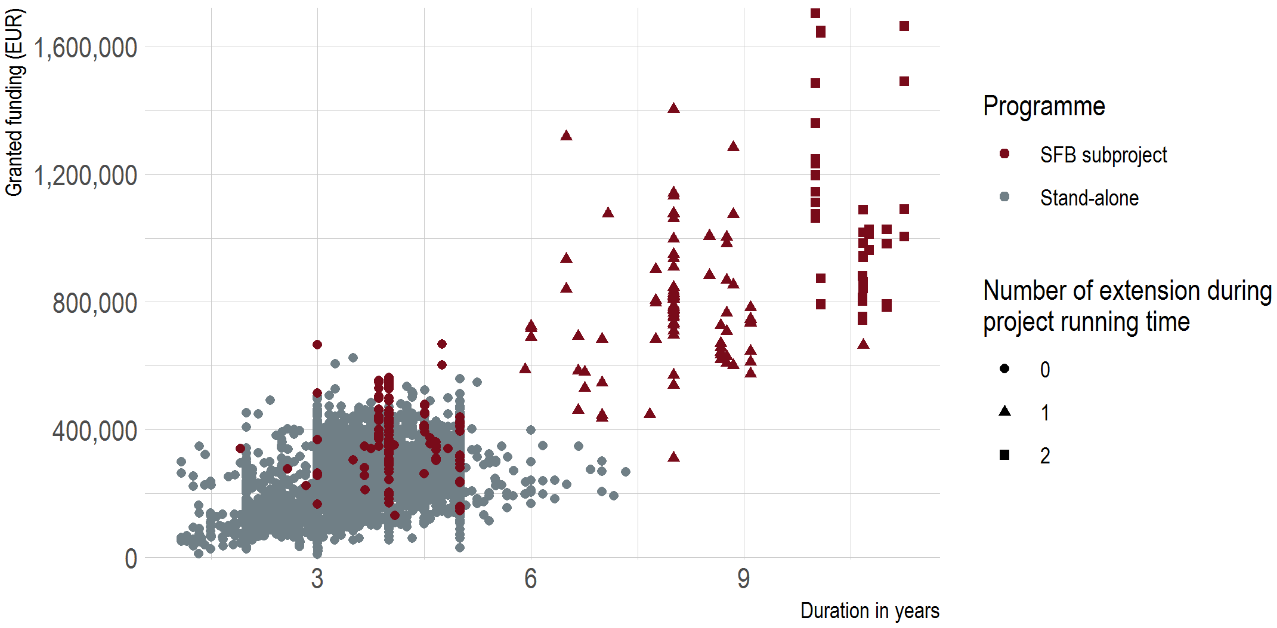
With an average rate of 14%, the overall acceptance rate of SFBs in Human Medicine & Health Sciences as well as in Humanities is above average, while the approval rate in the Social Sciences remains well below the average. However, it should be noted that the number of cases in some disciplines is very low and the ratio can change rapidly in a few years. Proposed SFBs in Technical Sciences and Agricultural Sciences & Veterinary Medicine have already been rejected in the first stage. The counts on the level of the individual categories are low, but there seems to be a general tendency towards a higher acceptance rate for proposals of SFBs with a higher disciplinary diversity.

2.1.3 SFB compared to Stand-alone projects

The objective of this section is to compare the SFB programme to Stand-alone projects in terms of main project characteristics such as field of science, proportion of female researchers, and requested budget. The analysis is based on SFB sub-projects and individual Stand-alone projects as unit of analysis. After a comparison regarding size and duration of the projects, the results of a statistical model are presented to identify statistically significant differences between the two programmes.

SFBs are by construction substantially larger than individual Stand-alone projects. SFB sub-projects, however, are comparable to Stand-alone projects as shown in Figure 9. The red circles represent SFB sub-projects without extensions, while triangles and squares show projects with one and two extensions, respectively. Granted funding increases almost linearly with the project duration.

Figure 9: Comparison of Stand-alone projects and SFB sub-projects in terms of granted funding, duration and number of extensions (excluding coordination projects)



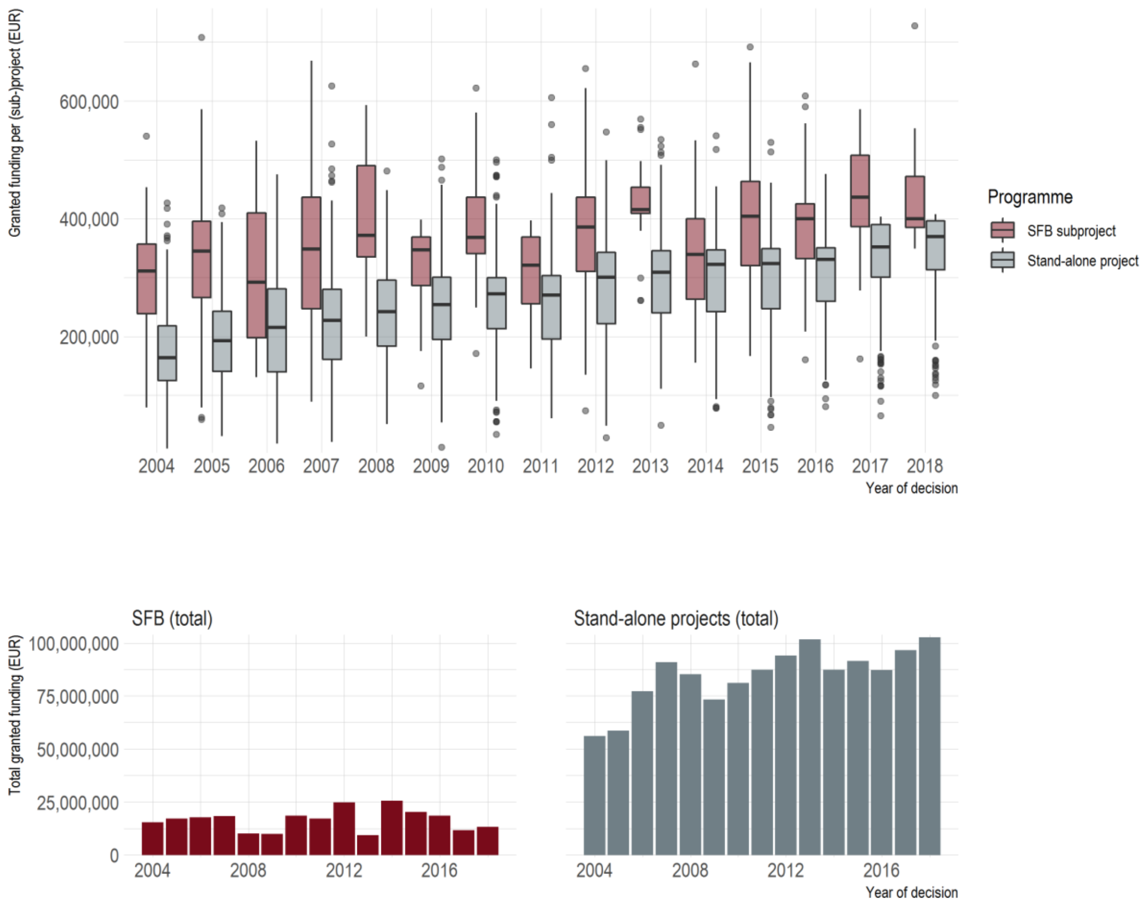
Source: SFB project database, calculations AIT

The top panel in Figure 10 shows the distribution of granted funding for SFB sub-projects[21] and Stand-alone projects for each year in the evaluation. SFB sub-projects receive higher funding than Stand-alone projects on average with a higher standard deviation and large outliers towards the top. 13 SFB sub-projects received funding of more than 750,000 Euro. This difference, however, diminishes over time as SFB sub-projects increase more slowly in volume compared to the steep increase of average funding for Stand-alone Projects; median funding for a Stand-alone project more than doubled between 2004 to 2018. While the difference in median funding between SFB sub-projects and Stand-alone projects was 147,000 Euro in 2004, this difference shrank to 32,000 Euro for the funding decisions made in 2018. The two types converge in terms of average funding over time.

A similar trend is visible for total funding amounts as shown in the bottom two panels of Figure 10. While total funding for SFB sub-projects remains at a similar level over the course of the evaluation period, the volume of funding for Stand-alone projects almost doubled. SFB funding, moreover, is less steady over time.

[21] Each SFB includes one coordination project among its sub-projects which are excluded from this analysis for comparability with Stand-alone projects.

Figure 10: Average and total project funding in the SFB and Stand-alone programmes by the year of the funding decision

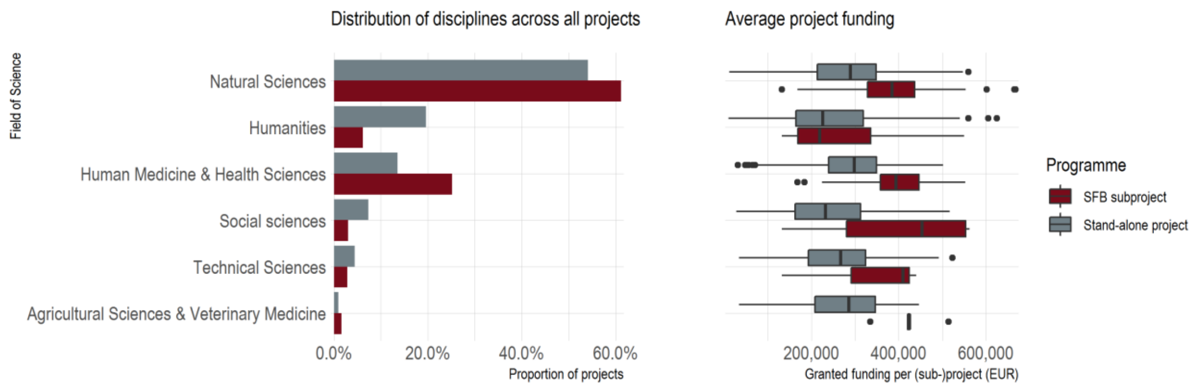


*Note: The boxplots in the top panel show the distribution of project funding for SFB sub-projects (excluding extensions and coordination projects) and Stand-alone projects. The lower and upper hinges correspond to the first and third quartiles (the 25th and 75th percentiles). The bar in the middle depicts median project funding. The upper (lower) whisker extends from the hinge to the largest (lowest) value. Data beyond the end of the whiskers are outlying points and are plotted individually (their distance to the hinge is larger the 1.5 * times the length of the box). 13 outliers among the SFB sub-projects are not displayed in the chart as their granted funding exceeds 750,000 Euro. The two bottom panels show the total amount of funding in the SFB and Stand-alone programmes by year of funding decision.*
Source: SFB project database, calculations AIT.

The left panel in Figure 11 depicts the proportion of projects related to fields of science in SFB sub-projects and Stand-alone projects. In both programmes, more than half of all projects are related to Natural Sciences. SFBs, however, feature a higher proportion of Medicine related sub-projects than Stand-alone projects, while Stand-alone projects are proportionally more focussed on Humanities and Social Sciences. These proportions are congruent to the total funding volumes distributed by field of science. Looking at the disciplinary focus within projects, it can be stated that SFB sub-projects are more concentrated in terms of fields of science than Stand-alone projects which is further analysed in Section 3.3.

The right panel in Figure 11 shows the distribution of project funding in the two programmes by field of science. Similarly to the distribution of funding over time, SFB sub-projects receive in the median more funding than Stand-alone projects across disciplines. Hence, the higher project funding over time as highlighted in Figure 10 is not caused by a different composition of the two programmes in term of disciplines.

Figure 11: Proportion of projects involving the specific field of science within SFB and Stand-alone projects and average project funding



Note: The left plot shows the proportion of projects associated with the six Fields of Science. If projects are related to more than one discipline, projects are proportionally attributed. The boxplots in the right plot show the distribution of project funding for SFB sub-projects (excluding extensions and coordination projects) and Stand-alone projects across the disciplines.

Source: SFB project database, calculations AIT

As a basis for the definition of a representative control group for SFB sub-projects, a statistical model was designed capturing the structural differences between the two programmes. The model regresses the type of funding (SFB sub-project versus Stand-alone project) on project and applicant characteristics. Coordination projects and project extensions which only apply to SFB projects were excluded for better comparability between the programmes. The analysis, thus, imitates a counter-factual decision between applying for an SFB grant or a Stand-alone project grant and serves two main purposes:

1) Gather insight into the structural differences between SFB and Stand-alone applicant and
2) as a basis for finding comparable pairs of SFB sub-projects and Stand-alone projects for further comparison as control group.

The results are shown in Annex 10.2.3 and confirm the observations above. SFB is selected as funding programme for large and long projects which are more concentrated in terms of scientific disciplines and with an emphasis on Medical Sciences. The model also highlights a higher importance of international partners in the SFB sub-projects.

Among successful Stand-alone and SFB sub-projects, the gender of the project coordinator does not appear as statistically significantly related to the choice of funding instrument. The proportion of female researchers is negatively related to SFB sub-projects in favour of Stand-alone projects. This effect disappears, however, once we control for the gender of the coordinator. A decision tree in Figure 44 visualizes the main points for the hypothetical decision whether a research project will be applied for as a Stand-alone project versus as an SFB sub-project. The decision tree orders the variables by the amount of variance that they explain (see for 10.2.3 details).

2.2 Changes in the context – new challenges

This section reflects upon the broader context of the Austrian and European research and innovation system, in the light of the SFB programme and analyses whether SFB is a relevant programme, given existing and future trends of the Austrian R&I system. The very recent innovation system review on Austria (OECD 2018) as well as the ERA progress report name a number of pertinent challenges and trends related to the Austrian Science, Technology and Innovation (STI) system. Among these are:

- Building an **internationally excellent research system**, which has not yet been realized. The OECD report acknowledges, that the potential and excellence of Austria's research community has been impeded – among other factors – by a **lack of competitive funding of basic research relative** to many leading innovators like the Netherlands, Sweden and Switzerland. At present, Austria's ability to sufficiently equip its public universities with suitable infrastructure and human resources, particularly

PhD students involved in basic research is limited; Austria's ability to specialize to a greater extent than today in more science-based industries could be hindered due to this fact. Also the ERA progress report 2018 acknowledges that the **level of basic research funding is mediocre**, just about the average of the EU-28 countries. Although the goal is to increase it to the level of leading research nations by 2020 (BMVIT and BMWFW, 2011), it currently remains much lower than in other ERA countries that are regarded innovation leaders such as Switzerland, Germany, the Netherlands or Finland (Schuch and Gampfer, 2017). This hinders the growth of research excellence.

- The **international visibility** of the Austrian R&I system as indicated by international rankings is judged to be limited as is the **attractiveness** of Austrian higher education institutions **to recruit high-profile academics** and to provide internationally competitive **career prospects**.

- Improving the **steering of universities towards strategic goals** has not yet emerged, as performance agreements with universities have failed to effectively steer the HEIs towards high quality. Despite an increased university autonomy since 2004, strategic capacity building within the Austrian HEIs landscape has only taken place to a limited degree. The 2004 evaluation of the FWF network programme estimated that it is likely that university strategies will increasingly have to work with and take account of funding from the FWF, as they become more responsible for the use of their resources, including both teaching and research resource. This is not yet visible today in Austria.
  In other European countries like Germany and Finland, research councils and federal/state governments started providing support for developing institutional strategies of research organisations. For example, in Germany the Excellence Initiative provided funding for institutional strategies that are aimed at developing top-level university research in Germany and increasing its competitiveness at an international level[22]. The funding covers all measures that allow universities to develop and expand their areas of international excellence over the long term and to establish themselves as leading institutions in international competition. DFG Research Centres are an additional instrument that aim to enhance a university's research profile and priorities on the basis of existing structures. Unlike the Excellence Strategy, the Research Centres operate in a top-down priority setting mode, where new centres are established on the basis of thematic calls[23]. In Finland, Academy of Finland funds initiatives for universities, in which – based on their own strategies – universities are invited to apply for funding with concrete plans for improving conditions for high-quality/high-impact research, detailing proposed profiling measures with clear schedules for each step[24]. Key concepts are related to a 'profiling area', i.e. a research area that a university aims to develop according to its strategy. Profiling areas can be: 1) existing high-quality areas, 2) emerging areas with potential to reach the top level, and 3) new areas with high potential. Furthermore, the Academy of Finland's Centres of Excellence (CoE) represent the very cutting edge of science in their fields which combine research and training and comprise joint funding by the Academy of Finland, universities, research institutes, the private business sector and other sources.

Table 8 Overview of comparable programmes and their characteristics

Country	Programme	Key aims	Funding
AT	Special Research Programmes	• Internationally competitive research networks • Support universities' strategic profiling	Public
DE	Collaborative Research Centres	• Internationally competitive research networks • Support universities' strategic profiling	Public

[22] https://www.dfg.de/en/research_funding/programmes/excellence_initiative/institutional_strategies/index.html

[23] https://www.dfg.de/en/research_funding/programmes/coordinated_programmes/research_centres/index.html

[24] https://www.aka.fi/en/research-and-science-policy/university-profiling/

	Research Centres	• Support universities' strategic profiling in top-down mode	Public
	Excellence Strategy	• Support universities' strategic profiling in bottom-up mode	Public
FI	Centres of Excellence	• Research and training networks at cutting edge of science	Public and private
	University Profiling	• Support universities' strategic profiling	Public
DK	Center of Excellence	• Excellent 'frontier research' networks	Public
	Research networks | Humanities	• Strengthen networks in humanities research	Public
CH	National Centres of Competence in Research	• Internationally competitive research networks between universities and private sector • Contribute to better structuring of research landscape	Public and private

Source: Own compilation

In addition to the immanent challenges regarding the excellence dimension of the Austrian research landscape, a number of international trends should be taken into consideration:

- The **globalisation of research** has further increased. This is not only reflected in an increasing number of international co-publications, but also new stars have risen. In 2016, China has surpassed the US at least when it comes to numbers of publications. A 2018 NSF report shows that China published more than 426,000 studies in 2016, or 18.6% of the total documented in Elsevier's Scopus database[25]. That compares with nearly 409,000 by the United States. India surpassed Japan, and the rest of the developing world continued its upward trend.

- The **conceptualization of basic research in policy making** has changed tremendously. Already back in 2003, the evaluation of the Austrian research promotion agencies stated that there is a need to reconsider the question of the relationship between Austrian research and the use that Austrian society makes of the research it produces. The research network programme of 2004 states that 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 **founding of the European Research Council (ERC)** implied a profound change in the traditional research funding principles of the EU Framework Programmes. These were previously based exclusively on cooperation and targeting organisations and specific research areas. The ERC supports frontier research, cross-disciplinary proposals and pioneering ideas in new and emerging fields that introduce unconventional and innovative approaches. The ERC's mission is to encourage the highest quality research in Europe through competitive funding and to support investigator-driven frontier research across all fields of research, on the basis of scientific excellence.
  With the creation of the ERC in 2007, not only the notion of research excellence has entered the European Research Area, but also a new conceptualization of basic research. The concept of 'frontier research' as distinct from excellence was suggested by an expert group that was tasked with providing a convincing argument that ERC-funded research could simultaneously support fundamental research and useful knowledge (Luukonen 2013). The concept was adopted to highlight that emerging research areas embrace substantial elements of both basic and applied research and the term 'frontier research' has also entered into ERA declarations and debates, as exemplified by the Lund Declaration

[25] https://www.nature.com/articles/d41586-018-00927-4

(European Commission 2009). Hence, the conceptualization of 'frontier research' in the course of the foundation of the ERC shows a changing paradigm towards higher demands for usefulness and all forms of economic and societal impact.

- In addition to the ERC, a number of European funding instruments emerged, which stepwise extended the notion of basic research by integrating a stronger relevance dimension. Programmes in this respect include The Future Emerging Technologies (FET) programmes FET-Open (first introduced in FP5 1998-2002), FET ProActive and FET-Flagships, launched in 2013, which invest in transformative frontier research and innovation with a high potential impact on technology, to benefit our economy and society.[26] In Horizon Europe, a mission-oriented R&I policy approach is currently being developed. Five mission areas haven been selected, 1) Adaptation to climate change including societal transformation; 2) Cancer, 3) Healthy oceans, seas, coastal and inland waters, 4) Climate-neutral and smart cities and 5) Soil health and food. The mission-oriented approach reflects the increasing demand for addressing societal challenges through research and innovation. In its conceptualization, missions are not about prioritising applied research and innovation over basic fundamental research, but they are a new way to frame the conversations between the two, galvanising new forms of collaboration (Mazzucato 2018).

2.3 Key findings

The results in a nutshell

- SFB is still the only basic-research-oriented and network-based research programme in Austria. Contrary to international developments, the programme did not change its strategic orientation. Also, no other strategic network programmes for basic research were introduced to the National R&I system.
- The acceptance rate of the programme and the total share of funding within the FWF budget decreased heavily. The FWF did not follow the recommendation of the 2004 evaluation which indicated that provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks.
- Limited budget provisions resulted in a concentration of funding in existing fields of excellence. The network distribution across fields of science does not align with the intention to address researchers "from all disciplines".
- Compared with the last evaluation, the programme has lost momentum and transformed to an extremely competitive niche rather than a systemic oriented flagship programme that is capable to shape profile building of research organisations.
- Given the endowment of resources in the timeframe of this evaluation, the programme in its present form does not have the capacity to achieve broader impacts at the national system level.

SFB is still the only basic-research-oriented and network-based research programme in Austria aiming at the achievement of international visibility and international excellence for Austrian research. Except from a decrease in the maximum funding period from 10 to 8 years, and a streamlining of SFB and NFN into one programme, no big changes in the strategic and specific objectives or the structural composition of the programme (budget, number of partner etc.) have been put forward.

The programme has no thematic priority setting and is exclusively focused on research excellence. This constitutes a unique feature in international comparison, where the use of thematic priority setting is wide-spread and the strategic orientation of basic research networks has changed: new conceptualisations of frontier research emerged, network programmes reinforced strategy building processes of research organisations, and focus on strengthening emerging fields of science or economic and social impact was given to them.

[26] See: https://ec.europa.eu/programmes/horizon2020/h2020-sections

Two major changes in the configuration of the programme occurred: Firstly, the overall acceptance rate decreased from 54% to 14%. Secondly, the share of SFB funding in the total FWF funding decreased from 14.7% in the year 2014 to 5.6% in 2018. The number of applications has risen considerably and the requirements for success have increased. Hence, the question arises as to which factors were decisive for this decline? On the one hand, the higher demand for all FWF funding schemes was not met by an overall increase of available FWF budget. On the other hand, FWF's major intention seemed to be, to keep-up funding for stand-alone projects and devote relatively more funding to human resources-oriented DK (19 Mio. € in 2019) and international funding programmes than to research networks.

Already the 2004 evaluation showed that "the relative weight of the network programmes appears to be low, maybe even too low compared to other countries, given that the institutional funding in Austria has a greater weight than in most other countries…" and " provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks". The data above confirm that the situation has considerably deteriorated compared to the last evaluation and the programme has been marginalised.

As a result of the higher competition in the programme, a concentration in existing fields of excellence in Austrian research occurred. 57% of SFBs are located in the Natural Sciences (57%) and Human Medicine & Health Sciences (26%). 8% of the sub-projects are dedicated to the Humanities, 4% to Social Sciences, 3% to Technical Sciences and 2% to Agricultural Sciences & Veterinary Medicine. This overall distribution does not align with the overall intention of the programme, to address explicitly researchers/networks "from all disciplines".

The skewed disciplinary distribution of SFB is to some extent certainly due to structural performance differences in Austria, and different publication cultures between the Social Sciences, Technical Sciences and the Natural sciences. In addition, also the eligibility requirement of concentration of at least 50% of sub-projects at one location seems to be a barrier to researchers in Social Sciences and Humanities to participate in SFB to some extent. The very high rejection rates of the programme and the existing disciplinary distribution of funding, in which some broad research fields are virtually absent from the portfolio, constitute an evident barrier to even apply for funding for representatives from many scientific disciplines. It is surprising to us, that some still have the courage to take the effort.

Compared with the last evaluation, the programme has lost momentum and transformed to an extremely competitive niche rather than a systemic oriented flagship programme that is capable to shape profile building of research organisations. The following factors are responsible for this transformation: 1) A low level of absolute annual funding, 2) a negative trend in the share of funding provided for by the FWF, 3) a tight concentration on a limited number of disciplines, and 4) acceptance rates of just about 14%. This is worrying in so far, as all system level analyses confirm an increasing relevance of building new and sustaining critical mass, establishing better career prospects for young high-potential principal investigators, and sharpening of research profiles at Austrian R&I institutions. Given the endowment of resources in the timeframe of this evaluation, and bearing in mind the system level analysis performed by the OECD and the ERA progress report, we observe that the programme in its present form does not have the capacity to achieve broader impacts at the national system level.

3 Support for outstanding research

The objective of this evaluative dimension is to analyse the extent SFBs contribute to outstanding research in Austria. Bibliometric methods are used to monitor, screen and analyse the scientific output and impact of the programme based on the Web of Science indexed publication output of granted SFB projects and sub-projects in order to assess the support of the program for outstanding research in Austria by means of bibliometric indicators. It concerns the publication data that are indexed in the 2004–2017 volumes of Clarivate Analytics Web of Science Core Collection (WoS) restricted to the three journal databases Science Citation Index Expanded (SCIE), Social Sciences Citation Index (SSCI), Arts & Humanities Citation Index (AH&CI).

As such, this chapter comprises a bibliometric trend analysis and a set of advanced bibliometric indicators characterising in a first section the publication activity of the program and the projects, in a second section the visibility and citation impact and in the last section the interdisciplinarity of the research output.

Starting with the evaluation of the publication activity, the first section analyses further the publication output, the research profile of the program and projects and the evolutionary aspect of the program as most of the projects are rather limited in time. This also addresses the intensification of international collaboration and co-operations.

The second section is devoted to the citation analysis. This analysis already reflects the international standing of SFB research output with respect to the standard world citation scores allowing benchmarking and international comparison. It provides different reference standards including the World, Europe and Austria and reference standards. This provides information on the evolution of the research profile of the Austrian universities and introduces the FWF's Stand-alone projects as a control group.

The last section assesses the contribution of SFB projects to interdisciplinary research in Austria in the fields and disciplines relevant to those projects. This report follows the bibliometric approach to interdisciplinarity according to which interdisciplinary research is reflected by the integration of information from different disciplines. In particular, the cited references of scientific publications are considered to reflect these sources of information.

3.1.1 Data source and retrieval

The publication and citation study are based on bibliographic data indexed in the Web of Science Core Collection (WoS) of Clarivate Analytics. Bibliographic data and metadata have been extracted for WoS-indexed journal articles based on matched publication lists of the projects and on information in the funding acknowledgement section of the papers. The publication lists are provided by FWF and contain besides bibliographic information and DOI also the assignment to project, sub-project and PIs. Advanced record matching techniques are used to link the publication list with the bibliographic database including automated procedures and manual validation and reliability checks. Funding information is extracted from the Web of Science database so that additional publications could be attributed to projects, sub-projects and PIs.

The publication-activity analysis is conducted for the entire period 2004–2017 and three sub-periods, namely 2004–2007, 2008–2012, 2013–2017. The citation analysis is based on three-year citation windows (publication year and the two subsequent years) and therefore limited to the period 2004–2016 as citation data of 2019 to complete the three-year citation window for 2017 publications are not yet available.

All data is based on data retrieved and extracted from the above-mentioned database. One important feature of this database is that all authors, institutional addresses and references for all indexed publications over an extended time window are recorded and available. Only 'citable' papers (document type: article, letter, note and review) are taken into account (document type: article, letter, note and review). Bibliographic data are cleaned and processed to bibliometric indicators according to the standard rules in the field (see, e.g., Glänzel et al., 2009).

A strict full-counting scheme has been applied to publications and citations. This applies to both subject matter and affiliation. The papers were assigned to project, sub-projects and countries based on the corporate address given in the by-line of the publication. All countries indicated in the address field were thus taken into account; publication counts have *not* been fractionated according to addresses. This is necessary to analyse collaboration patterns, but this approach does not allow summing up publication counts from a lower level of aggregation to a higher one. The bibliometric analysis has therefore to be conducted at each level of aggregation separately.

The assignment of papers is based on the ECOOM classification system with science fields and disciplines. In this system, journals are assigned to and grouped into cognitive-logical disciplines. This scheme with 16 fields and 74 disciplines is hierarchically built on top of the Web of Science Subject Categories comprising about 250 categories. The assignment of an individual paper to a Subject Category is made through the journal where this paper has appeared. Thus, a paper can be assigned to more than one subject category. The complete subject classification scheme can be found in the Annex 10.1.

3.1.2 Bibliometrics

The study is based on a number of indicators provided by advanced bibliometric methodology. Appropriate standardisation and normalisation allows gauging against the reference standard representing the World's top research in the field. For this purpose, publication and citation data are used. Citation counts have been processed with a three-year citation window. A detailed description of the provided bibliometric indicators is provided in the Annex 10.2.1 of this report.

3.2 The quality of SFB research

3.2.1 Publication activity

First the results of the retrieval and record matching exercise is presented. The publication lists as obtained from the FWF on the output of SFB projects contains in total 15,186 entries divided in 7 distinct categories where only the first one '1.1 Journal articles' is relevant to this analysis. Publications that are to be attributed to multiple project or sub-projects appear multiple times in this list. Table 9 provides an overview of the contents of the publication list. The 12,829 journal articles cover a publication window ranging from 1992 to 2018

Table 9: Number of publications per type as provided in SFB publication list

Publication Types	Count
1.1 Journal articles	12,829
1.2 Proceedings	746
1.3 Books	70
1.4 Collections; Lexica	1,386
1.5Re-issued Collection; Lexica or Proceedings	45
1.6 Working Paper/Preprints	106
1.7 Research Data	4
Total	15,186

Source: SFB Publication Database, calculations KU Leuven

After careful data cleaning and matching, 5,911 WoS-indexed journal articles were identified for the period 2004–2017. Table 10 shows the evolution of the publication output over three consecutive time periods. The SFB program has about 422 WoS papers per year on average. The number of journal papers has increased with an average annual growth rate of about 4.3%. Table 11 shows the annual evolution of the total SFB journal literature in the period 2004–2017.

Table 10: Number of SFB publications in the period 2004–2017

	2004–2007	2008–2012	2013–2017	2004–2017
Publications in SFB list	2,078	3,026	2,877	7,981
Unique WOS publications	1,137	2,042	2,732	5,911

Source: SFB Publication Database and Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

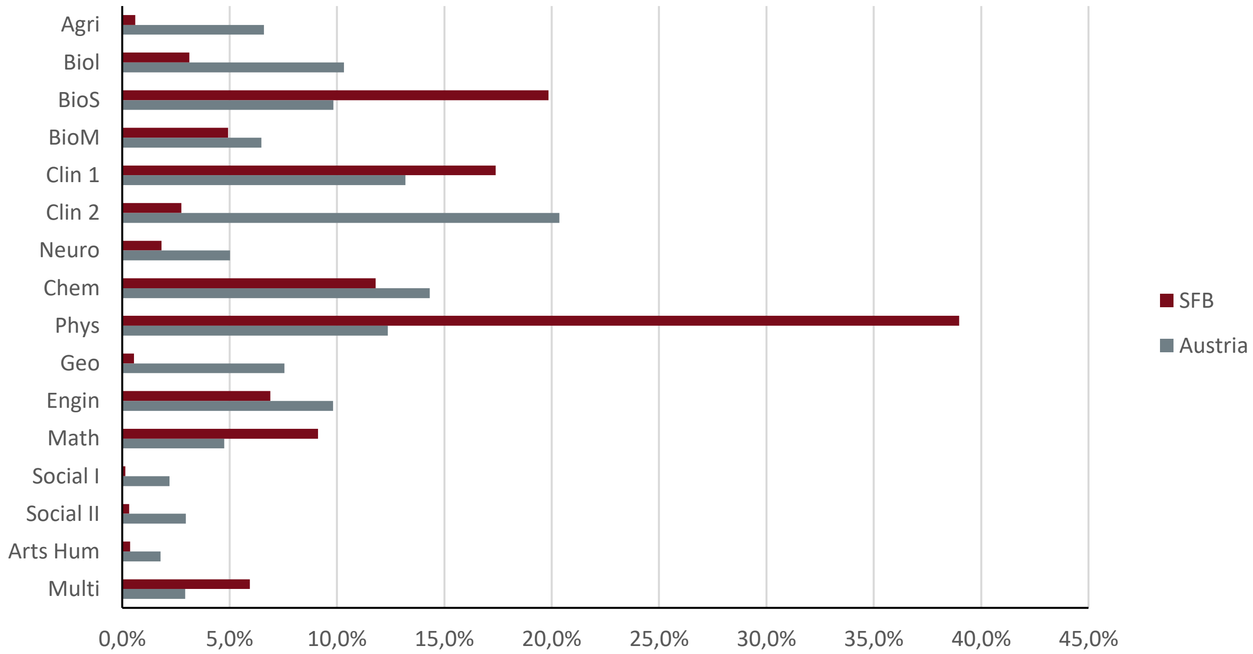
Table 11: Annual and cumulative growth of the publication output of SFB publications

Year	Yearly output	Cumulative number of papers since 2004	Year	Yearly output	Cumulative number of papers since 2004
2004	294	294	2011	439	2,670
2005	294	588	2012	509	3,179
2006	271	859	2013	492	3,671
2007	278	1,137	2014	607	4,278
2008	350	1,487	2015	604	4,882
2009	382	1,869	2016	502	5,384
2010	362	2,231	2017	527	5,911

Source: SFB Publication Database and Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

The distribution of publications over ECOOM science fields is given in Figure 12. The figure compares the publication profile of the SFB projects with Austria's total output. While Austria's overall publication output is characterised by a strong focus on clinical research with shares in both internal and non-internal specialties (Clin1 & Clin2), ranging between 25% and 30%, the SFB projects are mainly in Physics (Phys) and Biosciences (BioS). In addition, the fields 'Internal Medicine' (Clin1), 'Chemistry' (Chem), 'Mathematics' (Math), 'Engineering' (Engin) and 'Biomedical research' (BioM) are prominent. Since the distributions are extremely skewed, disciplines with less than 40 publications over the full publication window are omitted in field specific analyses[27]. The bibliometric analysis at the aggregated level is, of course, based on *all* SFB papers in *all* disciplines.

Figure 12: Share of publications across ECOOM Fields for SFB and Austria



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

Table 12 reflects a substantial portion of publications in multidisciplinary journals like Science, Nature, PLoS One and PNAS-US. Given the broad scope of papers published in these journals, the set of publications from multidisciplinary journals is omitted in *field specific* analyses.

Table 12: Evolution of publications in the multidisciplinary journals

Journal	2004–2007	2008–2012	2013–2017	2004–2017
NATURE	15	17	19	51
NATURE COMMUNICATIONS		2	46	48
PLOS ONE		26	64	90
PNAS-US	6	11	33	50
SCIENCE	6	11	20	37
SCIENTIFIC REPORTS		4	48	52

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

[27] Two SFBs from SSH disciplines fall within the evaluation period. These projects are however small and started recently. Hence Social Sciences and Humanities do not exceed the threshold of publications to be considered in the field specific analyses.

The number and share of international papers, defined as papers with at least two different countries mentioned in the by-lines of the paper, of SFBs and Austria as a whole according to the WoS can be found in Table 13.

Table 13: International co-publications in the period 2004–2017 according to the WoS

	2004–2007	2008–2012	2013–2017	Total
International Publications	581	1,284	1,747	3,612
Share in total (SFB)	51.1%	62.9%	63.9%	61.1%
Share of int. pubs in Austria	54.1%	61.8%	68.8%	63.3%

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

The share of international papers in all SFB publications is increasing over time but is slightly below Austria's average share over the 14-year period. The interpretation of this deviation is not straightforward as co-publication patterns are influenced by multiple factors (subject profiles, size of community, expertise, economic factors, and others). Different selection biases might play a distinct role in the high-level SFB projects.

3.2.2 Citation impact

The four citation rates (detailed methodology in the Annex 10.1.1) form an indicator quadruplet that should best be considered and interpreted together. Their mathematical relation reveals details about publication strategy and factual impact with respect to what should be expected on the basis of the publications' subject.

Table 14 Definition of citation impact indicators

MOCR: Mean Observed Citation Rate is the average number of citations per publication

It reflects the factual citation impact of a country, region, institution, research group etc. It is the average number of citations per publication defined as the ratio of citations in a three-year citation window to publications.

RCR: Relative Citation Rate compares a publication's citation rates against the average citation rates of the journal in which it appeared

RCR = 0 corresponds to uncitedness, **RCR < 1 means lower-than-average**, **RCR > 1 higher-than-average citation rate**, RCR = 1 if the set of papers in question attracts just the number of citations expected on the basis of the average citation rate of the publishing journals.

NMCR: Normalized Mean Citation Rate compares a publication's citation rates against standards set by its subfield

Its neutral value is 1 and **NMCR >1 indicates higher-than-average citation rate**, **NMCR<1 indicates lower-than-average citation rate** than expected on the basis of the average citation rate of the subfield.

NMCR/RCR: gauges the journal excepted citation rate against the field expected one

The score is independent of actual citations received by the publication set but it provides indications of the citation level of the journals in which the research is published.

Table 15 How to interpret the citation impact indicators

The four indicators should best be considered and interpreted together. The **most 'favorable' situation is NMCR>RCR>1** which means that the author under study publishes on an average in journals with a higher-than-discipline standard and receives even more citations (on an average) than the standard set by the journals in which the papers are published.

RCR<1<NMCR means that the latter standard is not reached and, for instance, NMCR<1<RCR means that the researcher achieved a higher citation impact than expected on the basis of the journals in which he/she has published but these journals, on average, do not belong to the top journals in their discipline.

The citation-based indicators for the SFB program are presented in Table 16. It is stressed again that citations are based on three-year citation windows. The analysis is therefore restricted to the period 2004–2016. The table also provides the citation indicators for those publications with international collaboration.

Table 16: Citation-impact indicators for the SFB program publications in 2004–2016

Period	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
2004–2007	All	1,137		12849	11.30	1.26	1.88	1.49
	Int Collab	581	51.1%	7303	12.57	1.28	2.04	1.60
2008–2012	All	2,042		25434	12.46	1.15	1.91	1.66
	Int Collab	1,284	62.9%	17477	13.61	1.20	2.09	1.74
2013–2016	All	2,205		31043	14.08	1.19	2.07	1.74
	Int Collab	1,409	63.9%	23074	16.38	1.24	2.37	1.91

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

According to Table 16, the factual citation impact of SFB papers is above the journal expectation and that, in turn, is distinctly above the field-based expectation. The situation is stable, even improving. In other words, we find the most favourable situation here: MOCR > MECR > FECR for the three periods between 2004 and 2016. The same is expressed by the three relative indicators RCR, NMCR NMCR/RCR. In other words, the PIs of SFB projects in general publish in high impact journals (with respect to their field) and receive more citations than expected for these journals.

In order to assess the impact of the SFB programme for the support of outstanding research in Austria the citation indicators from Table 16 can be compared to the publications attributed to FWF funded Stand-alone projects and Austria's score. Using a Propensity Score Matching approach a representative sample of Stand-alone projects has been selected to provide a robust control group. Table 17 presents the Stand-alone projects while Table 18 gives the national scores.

Table 17: Citation-impact indicators for the FWF Stand-alone project publications in 2004–2016

Period	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
2004–2007	All	252		1,935	7.68	0.96	1.26	1.31
	Int Collab	144	57.1%	1,225	8.51	1.01	1.37	1.35
2008–2012	All	1,562		13,039	8.35	1.04	1.39	1.34
	Int Collab	950	60.8%	9,201	9.69	1.09	1.56	1.43
2013–2016	All	1,987		20,406	10.27	1.12	1.62	1.44
	Int Collab	1,229	61.9%	14,418	11.73	1.16	1.83	1.57

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

SFB program clearly outscores both the Stand-alone projects and the Austrian overall publication set. The scores for all citation indicators are well above the national reference standard.

Table 18: Citation-impact indicators for the Austrian publications in 2004–2016

Period	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
2004–2007	All	37,822		243,684	6.44	1.17	1.27	1.09
	Int Collab	20,445	54.1%	166,701	8.15	1.29	1.53	1.19
2008–2012	All	62,206		463,395	7.45	1.20	1.40	1.17
	Int Collab	38,434	61.8%	359,620	9.36	1.32	1.67	1.27
2013–2016	All	62,276		533,566	8.57	1.22	1.47	1.20
	Int Collab	42,419	68.1%	435,963	10.28	1.31	1.70	1.29

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

Figure 13 to Figure 15 give the NMCR score of the SFB programme and Austria in the three time windows for the ten selected ECOOM science fields. As mentioned above, the smaller fields are omitted from this analysis. As the output in Neurology (Neuro) is also too small in the first period, the value is not given.

The exceptional score in the Physics field is consistent of the three periods with values between 2.2 and 2.4. The top score of Bio Sciences in the first period is decreased a bit later but still above the national reference.

These changes of NMCR value can be observed in all other fields, outperforming the Austrian reference standard except for the Internal Medicine (Clin1) with a score on par with Austria.

Figure 13: Field specific NMCR of SFB and Austria for 2004–2007

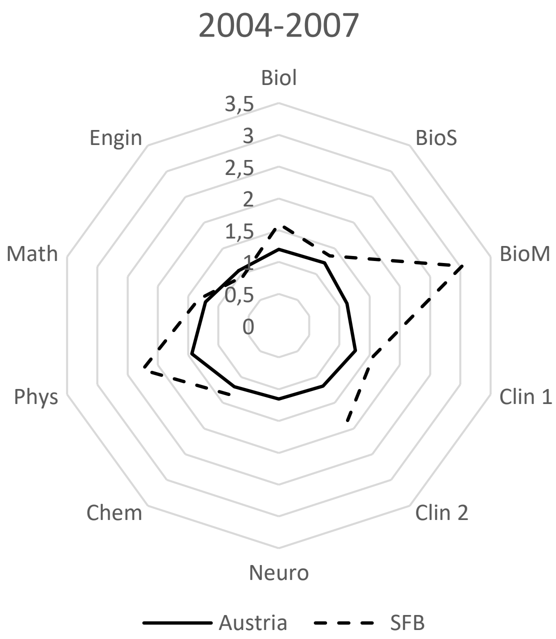


Figure 14: Field specific NMCR of SFB and Austria for 2008–2012

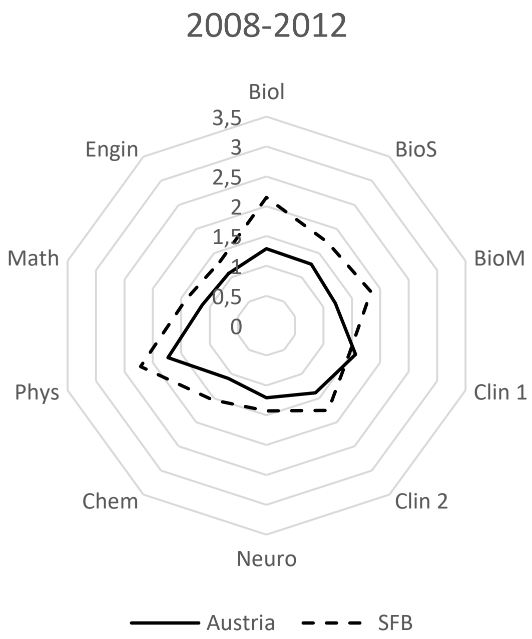
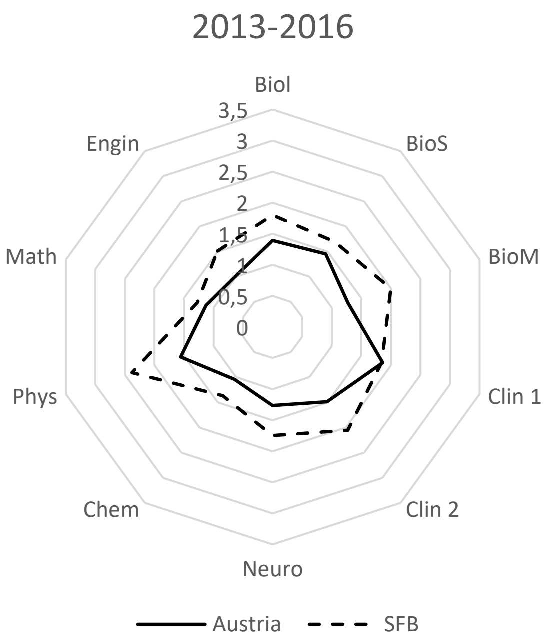


Figure 15: Field specific NMCR of SFB and Austria for 2013–2016



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

The next analysis gives more details about the distribution of citations than mean values can do. For details on the 8th indicator we refer to the detailed description in the Annex 10.1.110.1.1. The four CSS classes are obtained by intervals defined by adjoining scores (see, e.g., Glänzel et al., 2014). This method is a real alternative to percentiles but has two important advantages: 1. CSS is not biased by ties in the underlying citation ranking and 2. CSS scores are self-adjusting and thus not defined on arbitrary pre-set values. The four classes stand for 'poorly cited' (1), 'fairly cited' (2), 'remarkably cited' (3) and 'outstandingly cited' (4). Although CSS is not directly linked to percentiles, the distribution of papers over classes is about 70% (1), 21% (2), 6%–7% (3) and 2%–3% (4). Deviations of the researchers' profile provide a multifaceted picture of their citation impact. Results for the SFB program are provided in Table 19. These indicators underline the previous assessment of a strong support for outstanding research by the program

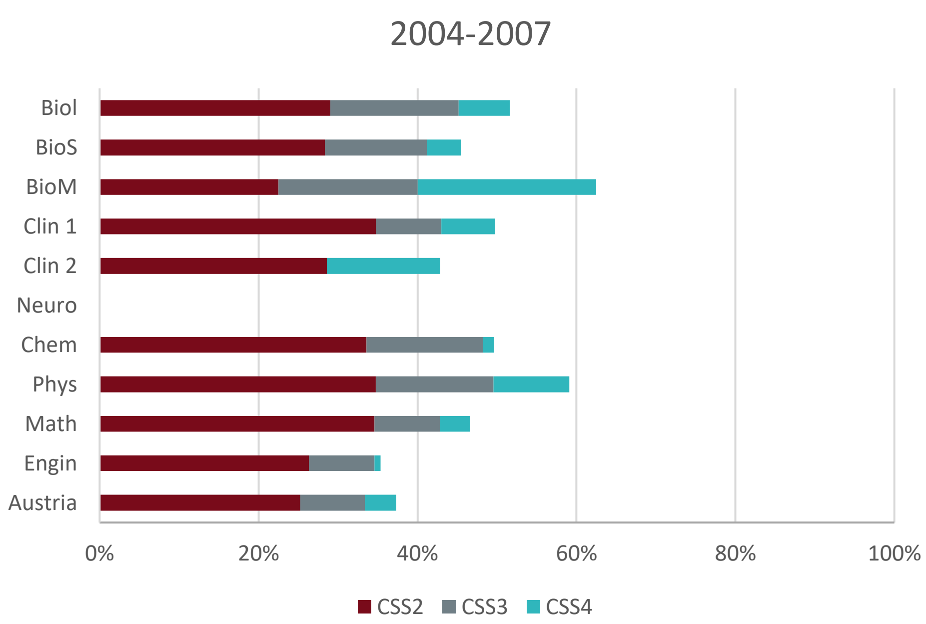
Table 19: Distribution over CSS classes for SFB publications in 2004–2016

Period	Publication Set	Publications	CSS1	CSS2	CSS3	CSS4
2004–2007	All	1,137	47.1%	33.2%	12.5%	7.3%
	Int Collab	581	44.4%	31.8%	14.6%	9.1%
2008–2012	All	2,042	43.2%	34.5%	15.9%	6.4%
	Int Collab	1,284	37.9%	37.2%	17.6%	7.3%
2013–2016	All	2,205	41.7%	37.8%	14.1%	6.3%
	Int Collab	1,409	37.8%	38.2%	16.0%	8.0%

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

The distribution of SFB publications in the three highest classes over the 10 science fields is given in Figure 16 -18. Given the fact that the shares of the four classes sum up to 100% the share of the lowest CSS class can be seen in the remainder up to the right of each horizontal bar.

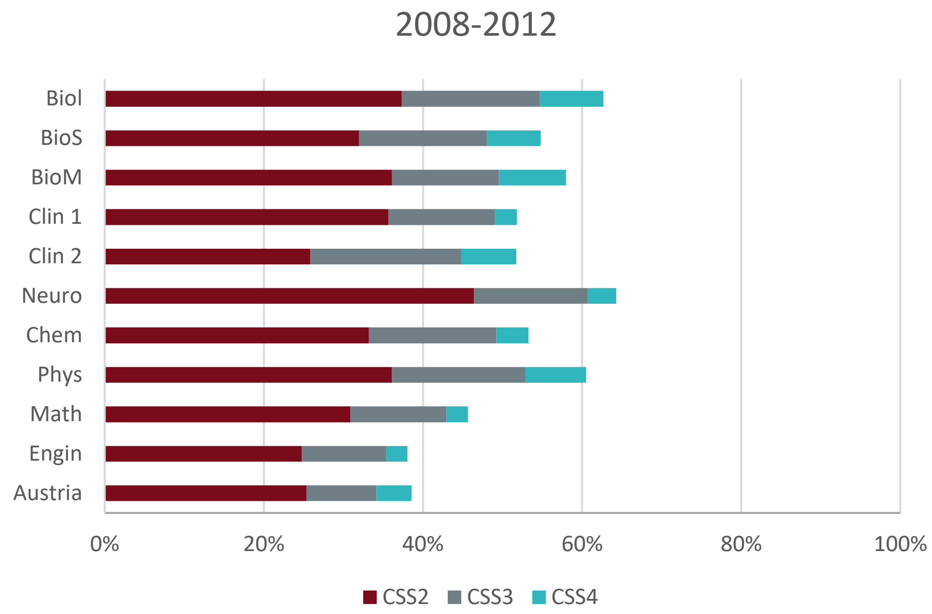
Figure 16: Distribution of CSS classes 2-4 for 10 science fields and Austria for 2004–2007



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

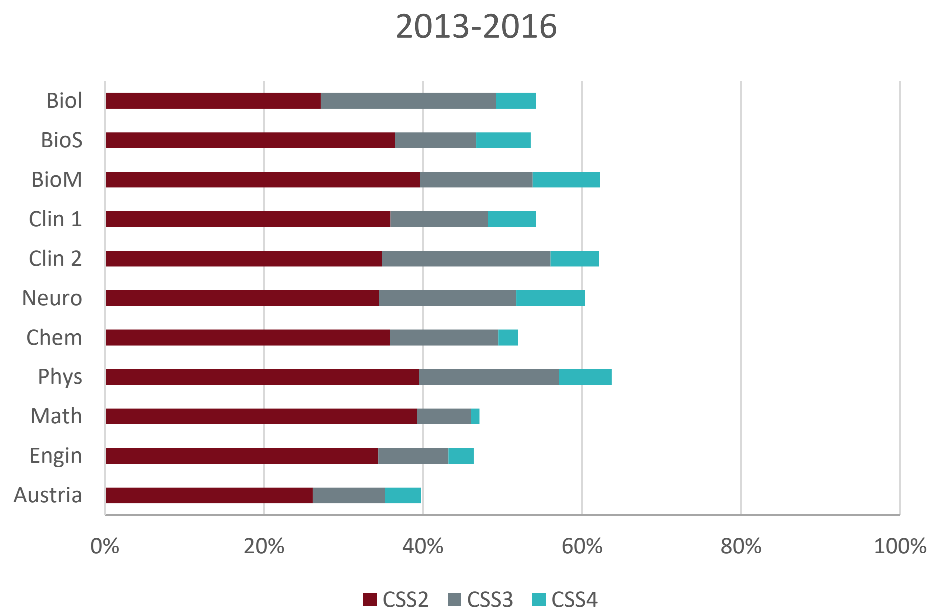
The above-mentioned reference standard of 70% (Class 1), 21% (Class 2), 6%–7% (Class 3) and 2%–3% (Class 4) is more than a rule of thumb (see Albarrán & Ruiz-Castillo, 2011; Glänzel et al., 2014), it can be directly used for benchmarking. The share of SFB papers indexed in the WoS of the poorly cited papers is distinctly below the reference standard except for the engineering field.

Figure 17: Distribution of CSS classes 2-4 for 10 science fields and Austria for 2008–2012



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

Figure 18: Distribution of CSS classes 2-4 for 10 science fields and Austria for 2013–2017



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

To complement the CSS scores of the SBF-program, the scores for the FWF Stand-alone projects are given. Once again, comparing these with the SBF program stresses the exceptional scores for the latter.

Figure 19: Distribution over CSS classes for FWF Stand-alone publications in 2004–2016

Period	Publication Set	Publications	CSS1	CSS2	CSS3	CSS4
2004–2007	All	252	53.6%	32.1%	9.1%	5.2%
	Int Collab	144	53.5%	29.2%	11.1%	6.3%
2008–2012	All	1,562	55.0%	30.6%	10.0%	4.4%
	Int Collab	950	51.3%	31.5%	12.2%	5.1%
2013–2016	All	1,987	51.1%	31.6%	12.7%	4.6%
	Int Collab	1,229	47.8%	31.4%	15.3%	5.5%

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

The Annex 10.2.1 provides more detailed figures with additional information for each of the projects.

3.3 Promotion of multi-/interdisciplinary research

The SFB programme aims to promote tightly interconnected research establishments pursuing **multi-/interdisciplinary work** on complex research topics, with interdisciplinarity defined by the FWF as “the integration-oriented cooperation between persons from at least two disciplines with regard to common goals and results in which the disciplinary perspectives are brought together to form an overall vision”[28].

As an expanded working definition in this evaluation, we refer to the definition set forth in a National Academies' report: "Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice."[29] In contrast, in multidisciplinary research, various disciplines address scientific and social challenges independently.

This chapter summarizes the results of the portfolio analysis, bibliometric analysis, survey and interviews to assess the degree of interdisciplinarity of SFB projects and publications.

3.3.1 Interdisciplinarity in SFB Projects

Interdisciplinarity in SFB Projects is measured by the extent to which different disciplines of the ÖFOS 2012 classification are addressed within the same SFB sub-project.[30] Based on SFB monitoring data of 331 sub-projects assigned to 195 sub-disciplines (6-digit level), we calculated and visualised the findings as a network, where nodes represent the sub-disciplines, which are connected when they are mentioned in the same project. The size of nodes represents the number of sub-projects, which are assigned to the respective subdiscipline. The size of the edges displays the number of joint projects between two sub-disciplines and the colour of the nodes refers to the highest level of the Austrian classification of science disciplines (1-digit level).

[28] https://www.fwf.ac.at/en/research-funding/fwf-programmes/special-research-programmes-sfb/

[29] Committee on Facilitating Interdisciplinary Research, Committee on Science, Engineering, and Public Policy (2004). *Facilitating interdisciplinary research*. National Academies. Washington: National Academy Press, p. 2.

[30] The ÖFOS classification integrates various dimensions and collection categories that are not well suited for determining interdisciplinary (e.g. other natural sciences, or output-oriented disciplines such as "vaccine development", or biochemistry, which are determined by interdisciplinarity have become own disciplines). We are aware of the weaknesses of the concept of determining interdisciplinarity, as an available proxy and in the sense of comparability with the previous evaluation, we used the same approach as Edler et.al. (2004) and evaluated the disciplinary classification of the projects by the project managers. For more in-depth analyses, a qualitative survey on interdisciplinarity in the SFBs at the person level would have to be carried out.

The resulting network (Figure 20) displays four main clusters, two clusters with a stronger interdisciplinary orientation and two disciplinary clusters:

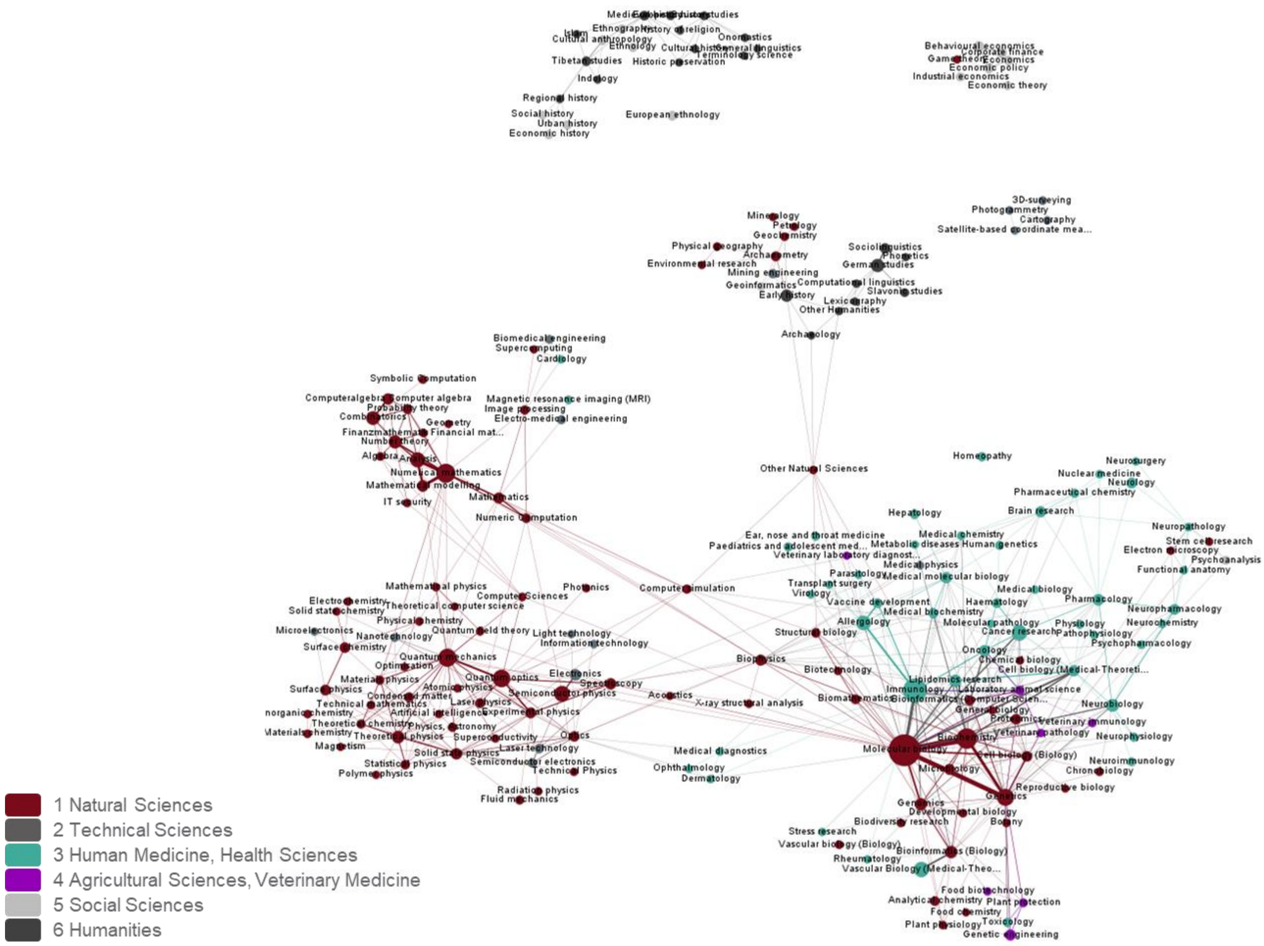
The *first* interdisciplinary cluster is the largest cluster in the network and situated in the bottom right area of the network. It comprises fields with clearly overlapping thematic orientation and is based on sub-projects assigned to “Biology”, “Medical-Theoretical Sciences, Pharmacy” and “Clinical Medicine”. Most frequently mentioned subdisciplines in this cluster are “Molecular biology” (24.3 projects), “Immunology” (16.1 projects), and “Biochemistry” (12.7 projects).

The *second* interdisciplinary cluster, located on top of the network, consists of several separate components and is mainly dedicated to the Social Sciences and Humanities with some connections to the Natural Sciences. In this cluster, no sub-discipline obtains a central position or is assigned to more sub-projects than others.

The *third* cluster focuses mainly on “Physics, Astronomy” with single connections to disciplines in the Technical and. Medical Sciences is positioned in the bottom left area of the network. Central disciplines, assigned to more sub-projects than others, are “Quantum mechanics” (10.6 projects) and “Quantum optics” (9.8 projects). The *fourth* cluster, finally, is formed by subdisciplines around Mathematics and Information Technologies, which is connected by single links with the first and the third cluster. The most prominent sub-discipline in this cluster is “Numerical mathematics” (assigned to 11.2 projects).

Only a limited number of sub-disciplines connect these four clusters. “Other Natural Sciences” link the interdisciplinary Medical Science cluster and the SSH cluster, and “Computer Simulation” together with “Biophysics” forms the connection between Medical research (first cluster), Quantum research (third cluster) and Mathematics (fourth cluster).

Figure 20: Connectedness of SFB sub-disciplines (6-digit level)



Note: nodes… scientific disciplines (ÖFOS 2012, 6-digit level); node size… number of sub-projects; node colour… scientific discipline (ÖFOS 2012, 1-digit level); edge width… number of joint sub-projects

For the comparison of the degree of interdisciplinarity of SFBs before and after 2004, we calculated the same indicators Edler et al. used for the SFB evaluation in 2004 (Edler et al 2004, 58f). First, by the *Index of interdisciplinarity scope (IIS)*, which is defined as the number of different (sub-)disciplines divided by the number of sub-projects (to take into account the size of SFBs). The higher the measure, the broader the disciplinary scope of the SFB. The second indicator measures the “quality” of interdisciplinarity or the *concentration of disciplines (Gini-coefficient)* and considers the relative weight of the individual disciplines within the SFB. Ranging between 0 and 1, the higher the Gini-coefficient, the higher the concentration (i.e. the weight of individual disciplines). A Gini-coefficient of 0 indicates all subdisciplines are equally distributed, whereas a Gini-coefficient of 1 means that the SFB consists of only one discipline.

Table 20 compares the results of the calculation with the results of the SFB evaluation 2004. While the number of sub-projects per SFB slightly decreased since the former evaluation, the degree of interdisciplinarity remains the same on the 3-digit level (IIS 3) and increased on the 6-digit level (IIS 6) from 0.90 to 1.08.

Table 20: Range of interdisciplinarity and concentration of disciplines

Scientific discipline	N sub-projects	N disciplines (3-digit level)	IIS 3	N disciplines (6-digit level)	IIS 6	Gini
Total						
Eval 2004*	12.3	4.35	0.37	10.7	0.9	0.35
Eval 2019	11.4	4.10	0.38	12.24	1.08	0.52
Natural sciences						
Eval 2004*	13.22	3.44	0.27	10.67	0.83	0.4
Eval 2019	12.08	3.31	0.30	11.46	1.00	0.49
Non-Natural sciences						
Eval 2004*	11.55	5.09	0.45	10.73	0.97	0.31
Eval 2019	10.88	4.75	0.45	12.88	1.14	0.54

*Source: Edler et al. 2004, 61

On the level of different disciplines, the results show that although Natural Sciences SFBs are still slightly bigger than Non-Natural Sciences SFBs, they are less interdisciplinary at the 3- digit level. Cooperation between disciplines in the Natural Sciences seems to be less common than the cooperation of different disciplines within and across Medicine, Humanities and Social Sciences. Interdisciplinarity increased at the 6-digit level to the same degree in the Natural Sciences as well as in the Non-Natural Sciences, indicating that in both cases the number of different sub-disciplines within the main disciplines, which contribute to the projects, raises.

Simultaneously, the concentration of disciplines (Gini coefficient) increased since the SFB evaluation 2004, especially in the Non-Natural Sciences. While SFBs in the Non-Natural Sciences network comprise more different disciplines, they seem to concentrate more on one or two major disciplines.

3.3.2 Interdisciplinarity in Publications

This report follows the bibliometric approach to interdisciplinarity according to which interdisciplinary research is reflected by the incorporation of information from different subjects (e.g., Rafols & Meyer, 2010; Leydesdorff & Rafols, 2011; Zhang et al., 2016). In particular, the cited references of scientific publications are considered to reflect these sources of information. According to this approach, there are three aspect that have to be taken into consideration when quantifying and measuring the extent of interdisciplinarity.

(1) *Variety* is the number of non-empty subject categories to which cited references are assigned. Assuming that all things are equal, the greater the variety, the greater the diversity.

(2) *Balance* is a function of the pattern of the assignment of elements across subject categories. Balance is also called evenness or concentration. Mathematically this can be expressed, e.g., by the Gini index. All else being equal, the more balanced the distribution, the larger the diversity.

(3) *Disparity* refers to the manner and the degree in which things may be distinguished, that is, how different from each other are the types of things that we observe. All else being equal, the higher the disparity, the greater the diversity.

Zhang has found a Hill-type indicator $^{2}D^{S}$ according to Leinster and Cobbold (2012) that expresses all three elements of interdisciplinarity and has a stronger discriminative than the usually applied Rao-Stirling measure. The indicator is based on subfield assignment since subject categories proved too narrow and subjects are partially too much interrelated for an interdisciplinarity analysis, while, in turn, the granularity of major research areas such as the 22 fields according to the Clarivate Analytics *Essential Science Indicators* (http://ipscience-help.thomsonreuters.com/inCites2Live/8300-TRS.html) proved to coarse for such exercises. In this study the 74 subfields according to the extended WoS-based Leuven-Budapest classification scheme (cf. Glänzel & Schubert, 2003) is used. $^{2}D^{S}$ takes real values larger than or equal to 1. According to our experience (Zhang et al., 2016), values above 5.0 reflect strong interdisciplinarity and $^{2}D^{2} > 10$ can already be considered extreme. Because of the short reference list of letters and the extensive list in reviews, the application of the $^{2}D^{S}$ indicator is restricted to articles.

Table 21 gives a first reference for the interdisciplinarity scores of the SFB publications. It needs to be stressed that the indicator used in this report cannot be normalised by subject, the scores are sensitive to particular research profiles. As seen in Figure 12, the SFB profile distinctly deviates from Austria's profile which puts a constraint on the comparability of the scores between Austria and SFB.

Table 21: Average interdisciplinarity score, worldwide, for Austria and the SFB program, 2004–2017

	World	Austria	SFB
2004–2007	1.94	1.99	1.88
2008–2012	2.05	2.08	2.01
2013–2017	2.08	2.09	1.98

Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

A more detailed comparison is provided in Figure 21 to Figure 23 with the interdisciplinarity scores per ECOOM science fields. These scores put the overall averages in a more nuanced light. The scores for the publications in Physics, Chemistry, Mathematics and Engineering are more-or-less in line with Austria's reference score while the scores for the output of SFB in the life sciences is less stable. Interdisciplinarity in Biology, Bio Sciences is below the national standard while it is above for the smaller fields Neurology and External Medicine (Clin2). Internal Medicine is just slightly below while the score of Biomedical research is fluctuating around the reference. The field comparison serves as an explanation for the lower SFB for the complete publication set compared to Austria and the world: the publication profile of SFB is more oriented towards Physics which has overall a lower score than the other fields.

Figure 21: Interdisciplinarity scores for SFB and Austria over science fields: 2004–2007

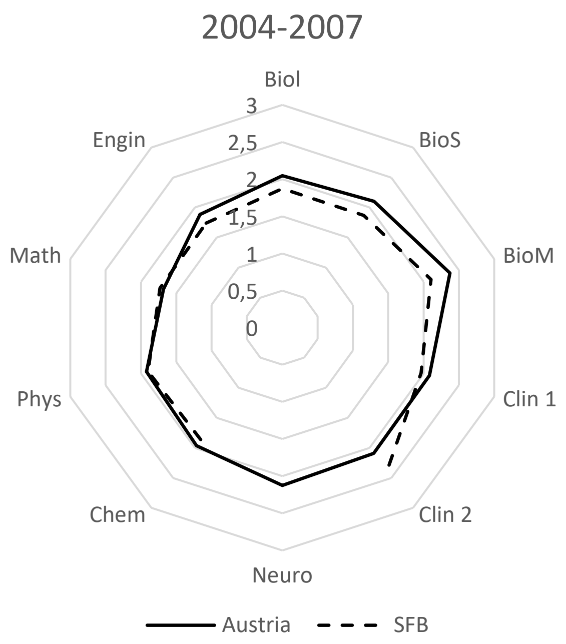


Figure 22: Interdisciplinarity scores for SFB and Austria over science fields: 2008–2012

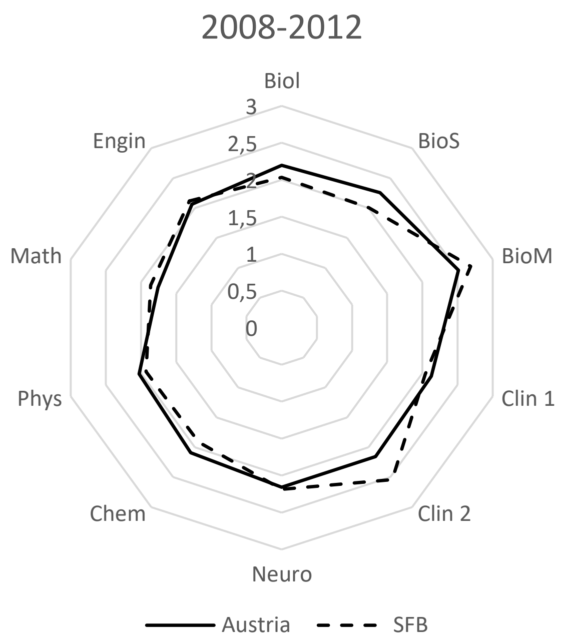
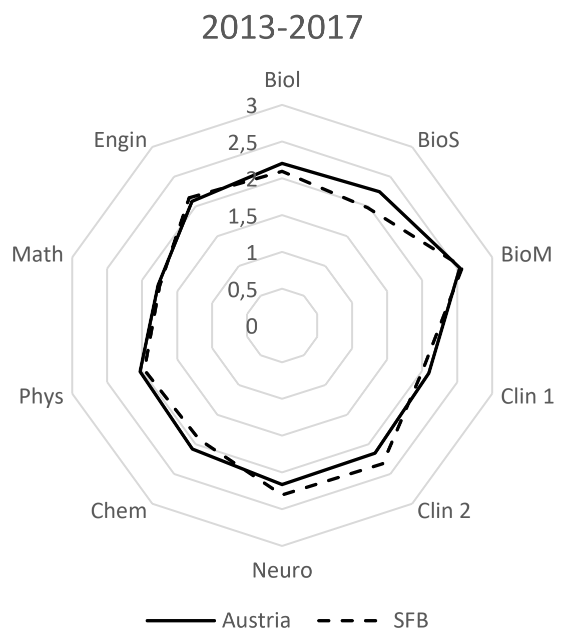


Figure 23: Interdisciplinarity scores for SFB and Austria over science fields: 2013–2017



Source: Web of Science Core Collection of Clarivate Analytics, calculations KU Leuven

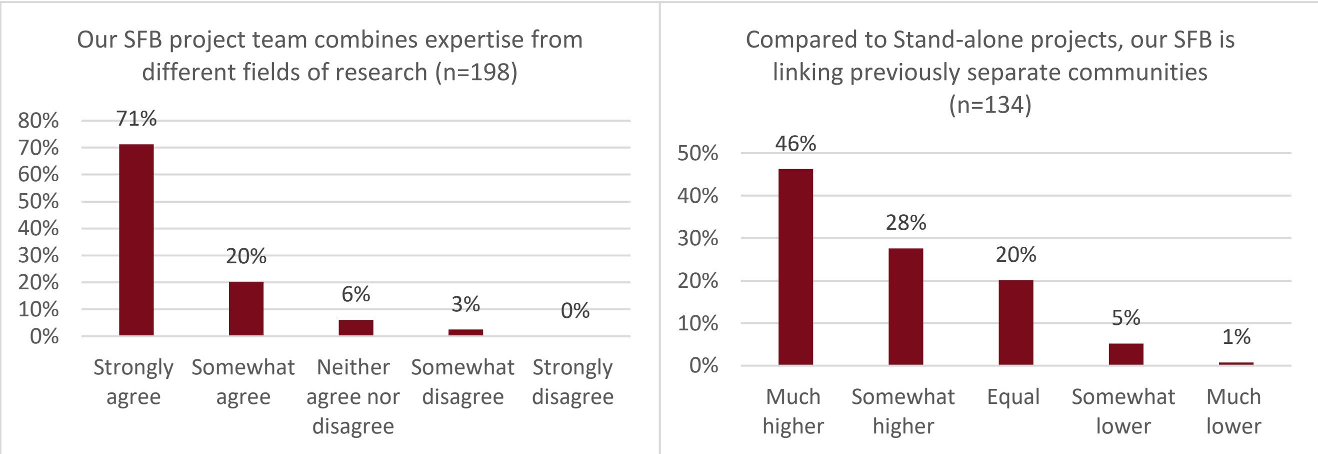
The reasons for the lower score of physics are still not clear. The indicator that is used is partially based on the similarity between the cited disciplines in the reference lists of papers. It is possible that the papers in physics have more references to limited set of disciplines, but the opposite might also possible. Due to a higher interdisciplinary nature of physics the cited disciplines could be more densely connected and thus more similar resulting in lower interdisciplinarity scores. Similar effects are also observable with other measures that are based on similarity between cited disciplines like novelty (Wang et al. 2017). In fact, contradicting phenomena can have a similar effect on the outcome of the indicators or trivial variables like number of references can have strong influence.

3.3.3 Interviews / Understanding of multi – and interdisciplinarity

There is broad agreement among interviewed participants that interdisciplinarity is one of the key attributes that makes the SFB attractive. It is understood not only as a strategic aim of the programme, but researchers highlight that the possibility to propose interdisciplinary research topics as among the key motives for SFB participation. The programme's orientation explicitly promoting interdisciplinarity is seen as a unique feature in the Austrian R&I funding system for basic research and interview participants highly appreciate the opportunity to propose interdisciplinary research that benefits them as an individual researcher and the network. Survey participants rank the opportunity to "collaborate with researchers from different fields of science" in the overall fourth spot of key motivations for SFB application.

Furthermore, nine out of ten survey participants stressed that their SFB team combines expertise from different fields of research, and two thirds favorably compared their SFB to their FWF Stand-alone project(s) on the topic of linking previously separate scientific communities in their project (see Figure 24).

Figure 24 Survey results interdisciplinary collaboration



Source: SFB Survey 2019

At the same time, interdisciplinarity is, sometimes sceptically, seen as a mandatory requirement of an SFB. All interview participants stressed that interdisciplinarity is not a goal by itself, but rather a means to an end – in this case, enabling the work on specific (new) research questions. As such, collaboration with researchers from another discipline forms only when there is a need for specific expertise and specific contribution(s) to a question.

This apparent contradiction in opinions on multi- and interdisciplinarity points towards different understandings of the differentiation between multi- and interdisciplinarity where some interviewees view the use of an analytical tool from another discipline, such as mathematical modelling or computer simulation, as a mark of interdisciplinarity. Additionally, it suggests a lack of intrinsic motivation for 'true' interdisciplinarity which demands the integration and synthesis of theories, concepts, and insights of all involved disciplines that characterizes interdisciplinary research. The literature broadly agrees that interdisciplinarity relies on the integration of disciplines (see e.g. Lattuca 2001 on 'integration' as the litmus test of interdisciplinarity) whereas multidisciplinarity is characterized by the juxtaposition of disciplines (see e.g. Klein 2010). Integration as the benchmark of interdisciplinarity also matches the FWF's definition of interdisciplinarity as the "*integration-oriented interaction of people from at least two disciplines with regard to common goals and results, with the disciplinary perspectives being brought together to form an overall view*." The academic literature points to the role of challenges of disciplinary integration in research, including communication between disciplines (see Naiman 1999, Bark et al. 2016, among others), institutional policies governing hiring, promotion, and tenure based on disciplinary excellence (see e.g., National Academy of Sciences 2005), and challenges of evaluating interdisciplinarity for research funding organizations (see e.g. Strang and McLeish 2015).

Such challenges in evaluation practices can explain the wariness among interviewed SFB participants against proposing 'exotic', e.g. combining physics and philosophy, collaborations in a project due to the impression that the programme's review process is detrimental to the actual amount of interdisciplinarity allowed/enabled since peer reviewers will inevitably evaluate a proposal based on the extent a proposed SFB will contribute to their own discipline (see also Chapter 6 on the evaluation process).

The majority opinion among interviewed researchers from all disciplines is that it is next to impossible to be granted funding for an SFB with high levels of interdisciplinary collaboration that encompasses not 'naturally' occurring or non-closely related fields of science. Overall, interviews have shown that while the possibility for interdisciplinarity is highly appreciated, the relatively low degree of interdisciplinarity observed in funded projects can likely be explained by applicants' own accounts of strategic considerations to increase the likelihood of success and thus not a key priority, even if synergy potentials exist and are acknowledged.

3.4 Key findings

The results in a nutshell

- The SFB clearly succeeded in supporting exceptional research as evidenced by the bibliometric analysis: SFB projects outperform national averages and Stand-alone projects along all metrics of citation impact. The publication profile displays strong continuity and growth of scientific activity. Publications reflect a very high scientific standard and SFB researchers receive a high citation impact. SFB PIs generally publish in high impact journals and receive more citations than expected for these journals.
- SFB projects involve fewer internationally co-authored publications compared to the Austrian average.
- SFB publication's average interdisciplinarity scores lie below the average for Stand-alone projects and the Austrian average. Interdisciplinarity in SFB projects is typically a results of very closely related (sub-) disciplines working in a sub-project, mainly found in fields of natural science with clearly overlapping content, and resembles the disciplinary structure of Stand-alone projects.
- In contrast, SFB researchers appreciate the opportunity for interdisciplinarity and perceive their projects as highly interdisciplinary, often in the context of using another discipline's analytical tools. This closely resembles the definition of multidisciplinarity as opposed to interdisciplinarity as the integration of disciplines.
- SFB researchers perceive the peer review process as detrimental to high levels of interdisciplinarity, especially between non-closely related (sub-) disciplines, therefore leading applicants to strategic considerations of disciplinary distribution in applications.

The analyses performed clearly show that SFB succeeded in supporting exceptional research as evidenced by the outstanding publication and citation record of the funded projects. The following key findings describe the SFB's support for outstanding research:

- The publication profile of the SFB program and its projects in the period 2004–2017 displays a strong continuity in the growth and development of the scientific activity.
- The publication analysis shows that SFB researchers receive a high citation impact and that their work reflects a very high scientific standard.
- SFB projects exceed national averages and outperform Stand-alone projects along all metrics of citation impact.
- The bibliometric analysis reaffirms the SFBs' highly successful publication strategy: The PIs of SFB projects in general publish in high impact journals (with respect to their field) and receive more citations than expected for these journals.

The excellence in scientific outcomes is not paralleled by achievements in terms of interdisciplinarity and international collaboration:

- SFB projects involve fewer internationally co-authored publications compared to the Austrian average.
- Interdisciplinarity is typically a result of very closely related (sub-) disciplines working in a sub-project. It is mainly found in fields of science, with clearly overlapping content such as biology and medical theoretical sciences and clinical medicine. In this respect, interdisciplinary co-operation in SFBs resembles to a large extent the cross-disciplinary structure of Stand-alone projects.

- In terms of average interdisciplinarity scores, the SFB program lies below the average for Stand-alone projects and the Austrian average.

In somewhat stark contrast is SFB participants' own assessment of interdisciplinarity in the programme. On the one hand, interdisciplinarity is seen as one of the key attributes that makes the SFB attractive and unique in the Austrian R&I funding system for basic research. Survey and interview results highlight that researchers perceive their projects as highly interdisciplinary, whereas the analysis of funded projects and publications demonstrates the opposite. On the other hand, interviewed SFB participants stress that interdisciplinarity is merely a means to an end, i.e., collaboration between disciplines forms only when and if there is a need for specific expertise, often in the context of using another discipline's analytical tools as opposed to interdisciplinarity as the integration of disciplines. The evidence on this apparent contradiction in opinions on interdisciplinarity shows that researchers:

- Have different understandings of the differentiation between multi- and interdisciplinarity, and a lack of intrinsic motivation for interdisciplinarity;
- Perceive the peer review process as detrimental to highly interdisciplinary projects with high levels of interdisciplinarity among non-closely related fields of science;
- Incorporate strategic considerations of disciplinary distribution in SFB proposals to maximize the chances of success.

4 Enhancement of Human Resources

4.1 Promotion and integration of researchers

The promotion and integration of researchers is one of the central components of the overall SFB programme goals of enhancing human resources for science and research in Austria. The impacts on researcher profiles and careers is expected to be achieved by:

- Raising the internal and external recognition and reputation of PIs
- Better integration of early career researchers, i.e. PhD students and young PostDocs, in knowledge production networks, and improved education/training conditions

4.1.1 Age distribution and career development

The average age (mean) of key researchers, i.e., SFB coordinators and sub-project leads, is 46 years at the beginning of their contract, with a range between 30 to 64. There is not only a significant gap between the number of male and female PIs, but also a marked difference in the age distribution by gender. Male PIs are older on average by approximately two years, while the median value is similarly higher. A one-sided t-test shows that the difference in means is statistically significant at the 5%-level. Furthermore, the most frequent age group (mode) among men is 50-52, while it is 42-46 among women.

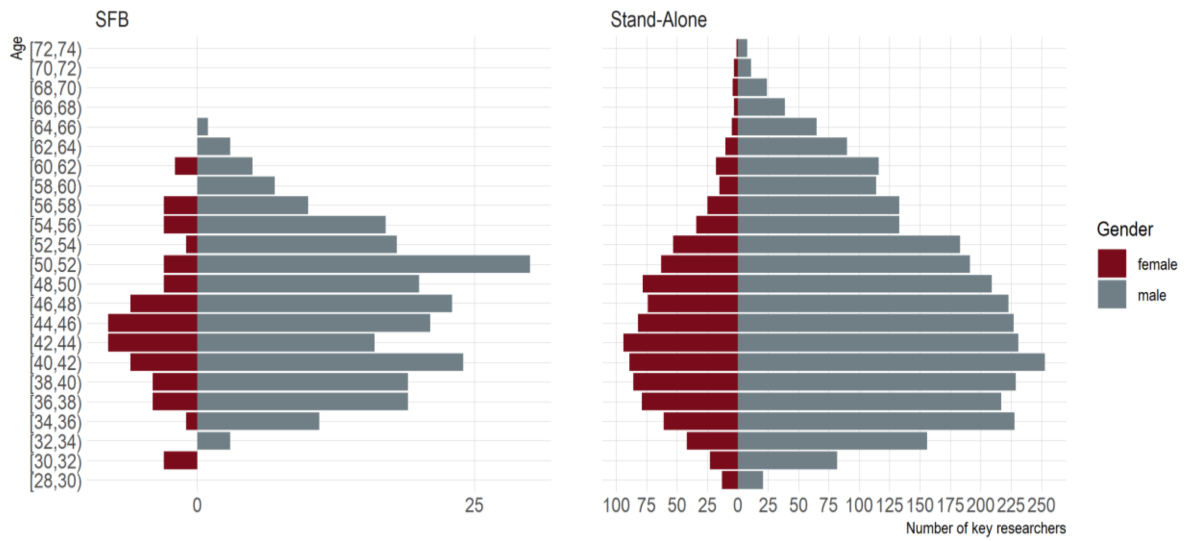
Table 22: Age distribution of male and female key researchers in SFB projects between 2004 - 2018

	Mean	Min	Q1	Median	Q3	Max
Male	46.70	33.11	40.47	46.77	51.86	64.24
Female	44.96	30.38	40.48	44.43	48.45	60.54
Total	**46.38**	**30.38**	**40.46**	**46.27**	**51.66**	**64.24**

Source: SFB project database, calculations AIT.

In comparison to SFB projects, the median age of key researchers in Stand-alone projects is 1.34 years lower. There is, however, no statistically significant difference in mean age of key researchers between the two programmes. Figure 25 illustrates the distribution of age groups for male and female key researchers in the two programmes. The distribution of key researcher age in Stand-alone projects is characterised by a higher standard deviation and higher skewness towards younger researchers compared to key researchers in SFB projects. The median age difference between male and female researchers is approximately the same in SFB projects and Stand-alone projects.

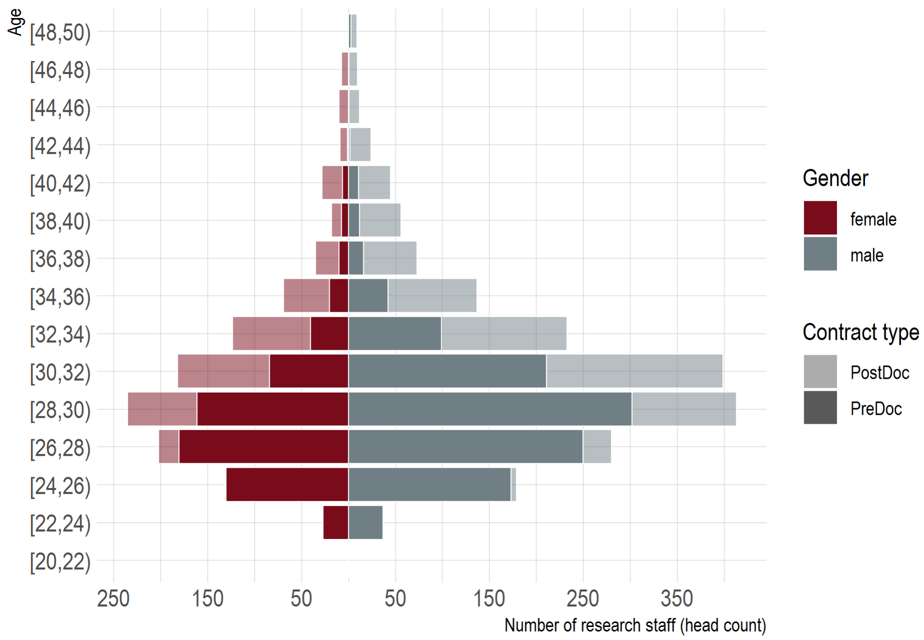
Figure 25: Number of male and female key researchers in granted SFB projects and Stand-alone projects between 2004 - 2018



Source: SFB project database, calculations AIT.

Pre- and PostDocs in the SFB are, as expected, significantly younger, with a mean age of 32 years among PostDocs and 28 years among PreDocs. Thus, the term 'early career' researchers will be used to refer to both unless otherwise specified. Among early career researchers, the age gap between men and women is smaller than for experienced researchers, and the overall gender ratio (number of male vs. female young researchers) is more balanced.

Figure 26: Headcount of research staff in granted SFB projects by age, gender and type of contract between 2004 - 2018



Source: SFB project database, calculations AIT.

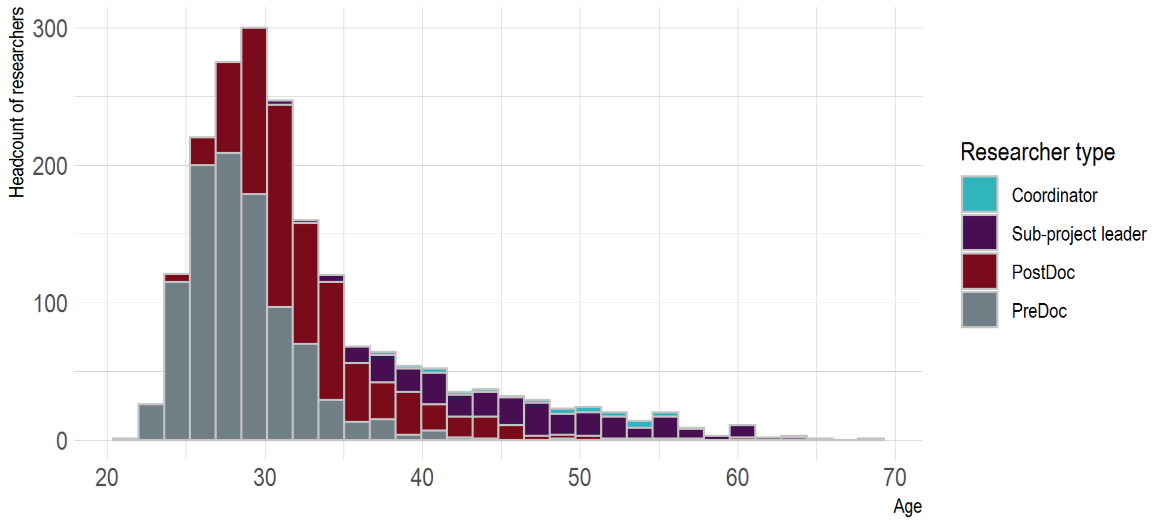
Table 23 Age distribution of male and female Pre-/PostDocs in SFB projects between 2004 - 2018

Contract type	Gender	Mean	Min	Q1	Median	Q3	Max
PostDoc	Male	34.35	23.71	30.54	32.67	30.54	69.64
PostDoc	Female	33.84	24.58	30.19	32.43	30.19	58.19
PreDoc	Male	29.13	20.80	26.65	28.77	26.65	48.36
PreDoc	Female	28.60	22.05	26.16	27.99	26.16	57.66
Total	**Total**	**31.00**	**20.80**	**27.63**	**30.01**	**27.63**	**69.64**

Source: SFB project database, calculations AIT.

Looking at all researchers involved in SFB projects jointly highlights the large proportion of supported early career researchers. On average, for every SFB coordinator we observe approximately 8 sub-project leaders, 25 PostDocs and 33 PreDocs during the entire running time of an SFB. In the median, SFB coordinators (49.6) are 4 years older than other sub-project leaders (45.6), which are in turn approximately 14 years older than employed postdoctoral researchers (32). Doctoral students are in the median 28 years old when they commence their employment in the SFB.

Figure 27: Headcount of key researchers and research staff in granted SFB projects by age between 2004 - 2018



Note: The histogram shows the headcount of researchers by age brackets according to their role in the SFB. If a researcher took up several roles within an SFB, the highest role was counted. Researchers are counted once for each SFB regardless in how many sub-projects they participate.

Source: SFB project database, calculations AIT.

From the analysis of age distribution by gender and role, one can conclude that project leads in SFBs tend to be older, particularly male PIs, and hence, assuming linear career progressions, highly experienced researchers.

The age distribution in SFBs was a key subject of discussion in both focus groups, where participants reported higher failure rates of sub-projects led by younger PIs particularly within granted SFB and the perception that the SFB programme is primarily an instrument for highly experienced and established researchers. A large part of this pattern is attributed to the selection process and criteria, that place a strong emphasis on individual scientific excellence and publication track records, where young PIs with less experience and smaller networks are disadvantaged compared to senior researchers boasting scientific fame and awards.

A statistical analysis was performed to test the impressions expressed by focus group participants and measure the effect of age and gender on success rates in the SFB application process. In a logistic model, the funding decision (grated versus rejected) was regressed on applicant and project characteristics for first stage applications, second stage applications and jointly for both stages. For given project characteristics, the coefficients can be interpreted as factors which increase or decrease the probability of acceptance. Figure 28 provides an overview of the regression coefficients, while the full results are presented in Appendix 10.2.2.

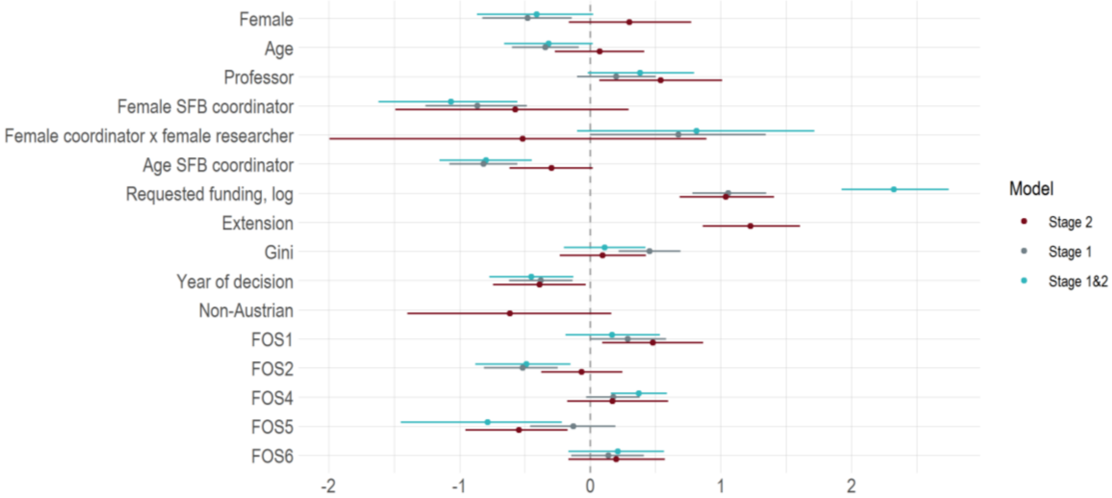
In the first application stage and in the joint model the age of the key researcher as well as the age of the SFB coordinator significantly decrease the probability of success. Although the effect is statistically significant, the size of the effect is low; the observed median age between successful and unsuccessful key researchers is approximately one year. Furthermore, an additional year of age reduces the probability of success merely by a small fraction of a percentage point. This finding does not support the hypothesis that the application process is biased in favor older PIs.

A possible explanation for the negative relationship between age and success in the application process might be the actual track-record of the individual which could not be proxied with the available data. For example, applying for an SFB as a professor at an early age might indicate rapid career progression signaling high potential to reviewers.

Among second stage applicants, however, the average age of researchers is statistically indistinguishable between successful and unsuccessful applicants. In the second application stage, it is possible for an SFB to be granted with the rejection of individual sub-projects. Sub-project leaders of rejected sub-projects within granted SFB are in the median 2 years younger than their successful SFB colleagues. It is conceivable that this situation reduces the negative effect of age on success in the second stage and gives rise to the impression that the application process is biased towards older PIs.

Finally, career attainment – proxied by carrying the title of professor – increases the probability of acceptance in both the first and second stage. Although the results cannot establish causality, they emphasize a general pattern of the SFB programme supporting researchers with high career attainment and rapid career progression.

Figure 28: Logit model coefficients regressing application decisions on applicant and project characteristics in the first and second application stage



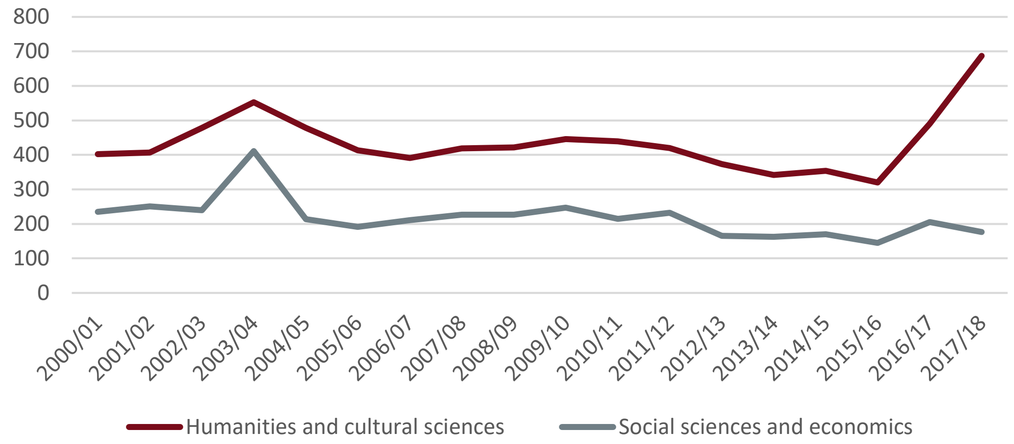
Note: Points display estimated coefficients from a logistic regression of application decisions on applicant and project characteristics in the first and second application stage and jointly for the first and second stage. Handles represent 95% confidence-intervals.
Source: SFB project database, calculations AIT.

The quantitative and qualitative analyses yield converging findings in terms of the type of researchers supported by the SFB programme. The focus groups participants perceive a disadvantage for young sub-project leads in granted SFB and a perception that the SFB primarily supports established researchers; the quantitative model supports this claim where we observe that rejected sub-project leads in granted SFB are in the median two years younger than their successful peers. Career attainment, proxied by academic title, increases the probability of success. However, the quantitative model does not support the hypothesis that lower age reduces the chances of success. Furthermore, the distribution of researchers supported by SFB is skewed towards young and early career researchers.

The higher rejection rates of young PIs within granted SFB are somewhat worrying, particularly given the practice to exclude individual groups relatively often (see chapter 6 for details of selection process). Both group interviews highlighted that in view of the network benefits of SFB participation, it is precisely younger PIs and PostDocs that benefit the most from structured collaboration with a wide network of excellent researchers, and the recognition and visibility from SFBs for their future career development. The academic literature on the motives for research collaboration find that the most commonly cited reasons include, among others, access to expertise, access to resources or equipment, to obtain prestige or visibility, and to learn tacit knowledge about a technique (see e.g. Meadows 1974, Melin 2000, Thorsteindottir 2000, Katz and Martin 1997, Beaver 2001). Considering such key motives for research cooperation, it is evident why younger researchers will both want to pursue collaboration as well as how they could benefit most from cooperation and network effects: Early career researchers will gain expertise and tacit knowledge through collaboration with more experienced researchers from other institutions and research fields as well as exchange with their peers; participation in a prestigious project at an early career stage such as an SFB will increase their visibility and future employability.

A special problem related to human resources could potentially exist in the Social Sciences and Humanities due to the size and structure of these research fields. Interviews reveal that in SSH, the lack of human resources concerns both senior and early career researchers. At the top, the difficulty lies in gathering a group of project leaders with matching research interests and right track record due to small, specialized research areas within SSH, especially the humanities. At the level of young researchers (PhD students, early career PostDocs), it is reportedly difficult for successful SFBs to hire PhD students in their specializations due to falling PhD graduate rates. This perception of researchers is partly corroborated by PhD graduation rate statistics between 2000 and 2017: In both the humanities and social sciences, PhD graduations peaked noticeably in the year 2003/04, followed by a downward trend in every year thereafter (see Figure 29). However, perhaps surprisingly, PhD graduations have risen significantly in 2016 and 2017 in the humanities and cultural sciences, exceeding the previous peak by approx. 25%.

Figure 29 Number of PhD graduations in Social Sciences and Humanities per year



Source: unidata, BMBWF; calculations AIT

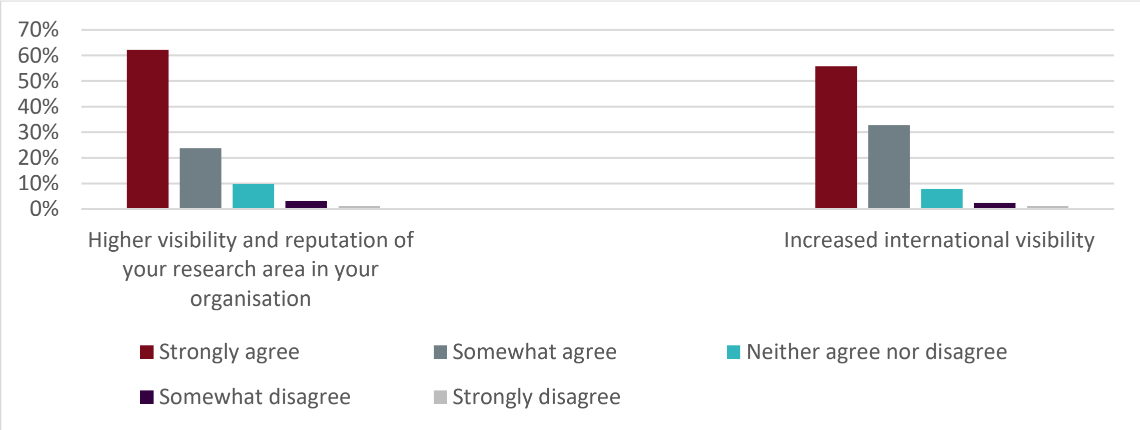
The group interview discussions attribute decreasing numbers of students who go on to earn a PhD to a lack of career perspectives in SSH research. The status of SSH in society and policymaking is directly related, since efforts at policy and university levels have tended to focus on promoting STEM and related sciences (see also chapter 2 for the wider policy context).

4.1.2 Reputation and visibility effects of SFB participation

There is a sense among interview participants that the SFB ranks at or at least near the top of the ‘hierarchy’ of funding programmes for research in terms of prestige and status: 1) ERC/Wittgenstein, 2) SFB, 3) FWF Stand-alone projects, 4) Other FWF projects, 5) Research and Innovation Actions in H2020. The prestige and recognition associated with the programme is also evident in the survey responses, where precisely this aspect ranks at number 6 among the key motivations for SFB application. Securing SFB funding sends a strong reputation signal externally in the scientific community but also internally at the host university/organization concerning the reputation of the researcher, positioning of the research topic, and strengthened bargaining position against university management. Survey respondents corroborate these findings – 62% strongly agree and 24% somewhat agree that their SFB has led to higher visibility and reputation of their research area at their own organization.

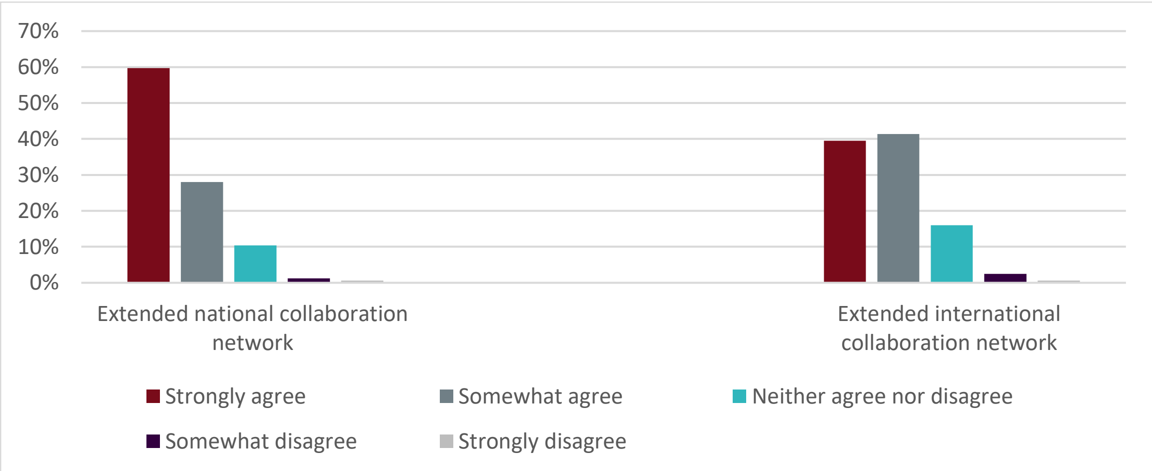
56% of survey respondents strongly agree, an additional 33% somewhat agree, that participation in an SFB has increased their international visibility. Furthermore, visibility effects are also reported at network level, where the increased international visibility of the research network ranks at number 2 of key outcomes of an SFB project. Interviews found that the mechanism for higher international visibility is usually through word-of-mouth and news spreading quickly among scientific networks. Visibility is additionally achieved through presence of SFB researchers and topics at international conferences (e.g. agenda-setting through panels dedicated to an SFB topics) enabled by SFB-funding. For some SFBs, (international) visibility is also achieved through dedicated dissemination and public awareness efforts, e.g. citizen science project funded by FWF as add-on to SFB. All interviewees unanimously declared high positive impacts on their individual national and international visibility, recognition, and reputation by securing an SFB grant.

Figure 30 Internal and external visibility effects (n=164)



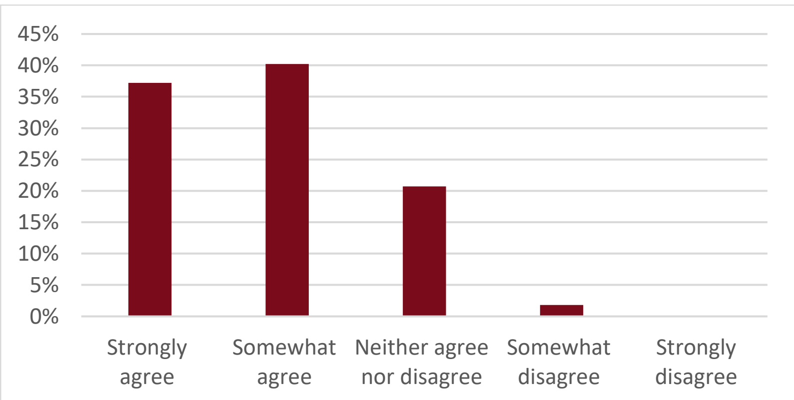
Given such strong visibility and reputational effects of an SFB, it is thus not surprising that survey respondents also report positive impacts on their collaboration networks: 60% strongly agree that the SFB helped extend their national collaboration networks and 40% report extended international collaboration networks.

Figure 31 Effects on national and international collaboration networks (n=162)



The group interviews also revealed that SFB projects have strong pull-effects, i.e. amassing all/most experts and resources for a particular research area in one place. Such pull-effects also impact team compositions, which oftentimes tend to become more international through reputation and visibility effects of SFB. Survey results support this conclusion, where 37% strongly agree and a further 40% somewhat agree.

Figure 32 Enhanced capability to attract and support international researchers (n=164)

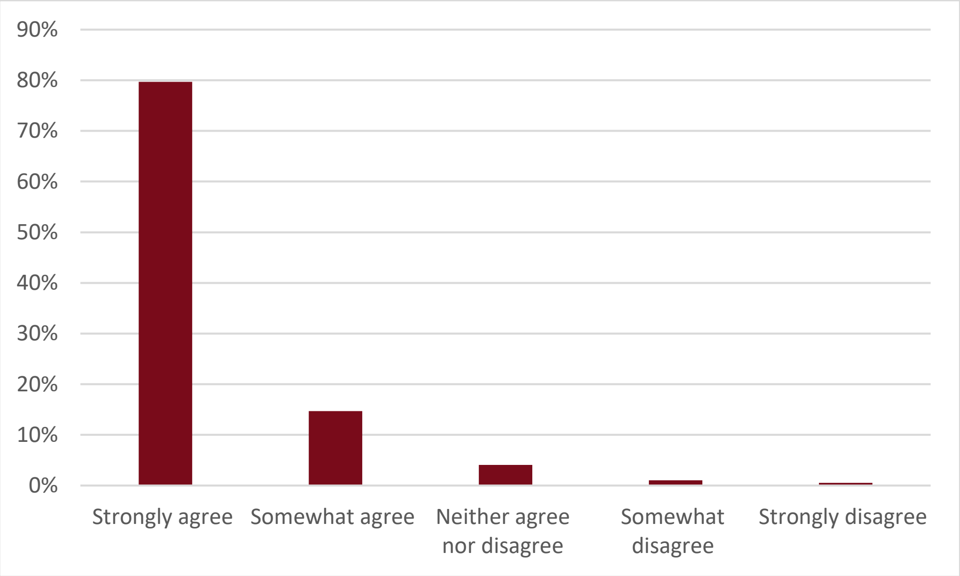


4.1.3 Training and integration of PhD students

A key factor in achieving the expected impact of the SFB programme on the enhancement of human resources for research, is the topic of promoting the career development and training of the next generation of researchers. Thus, the inclusion and education of PhD students should be a central component of SFB activities and outcomes.

All interview participants showed strong commitment to the education and training of early career researchers and emphasized the importance of PhD student integration for their projects. Furthermore, survey respondents stressed the mutual benefits of collaboration for both senior and junior researchers in an SFB (80% strongly agree that collaboration was mutually beneficial).

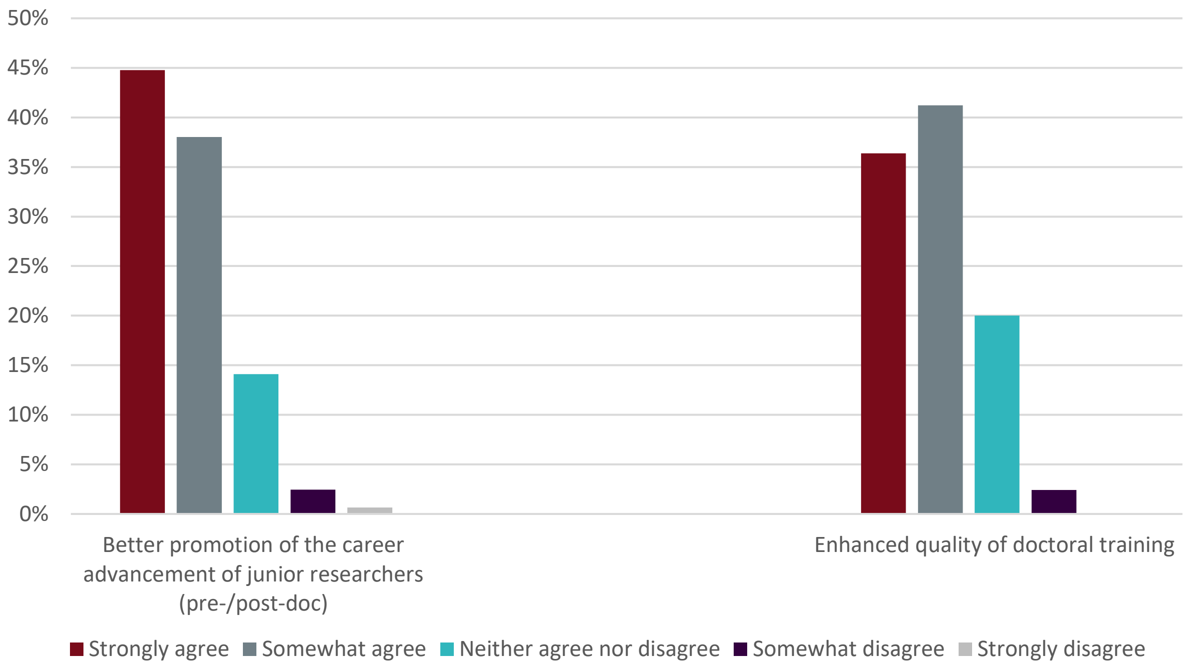
Figure 33 Benefits for both senior and junior researchers from collaboration in SFB (n=197)



Moreover, 64% of survey respondents report that their SFB has dedicated formats for the inclusion and networking of PhD students involved in the project. According to interviews, participants highlighted that the collaborative nature and integration of multiple PIs and research groups is particularly well-suited for the training and promotion of early career researchers, particularly PhD students and young PostDocs. The network aspect of SFBs facilitates various collaborative formats of joint training, joint seminars and workshops, mobility placements, as well as informal career advancement formats such as networking events, career advice, and discussion in the network. Of special importance is the formal and informal exchange with both experienced researchers and peers, as well as a 'critical mass' of PhD students in an SFB overall. Furthermore, most interviews point to the inclusion of all staff, particularly PhD students and early career researchers in various forms of general SFB activities, from regular meetings, research group discussions, and participation in all research and scientific activities to SFB workshops and conferences.

In this context, those SFB leads with experience in concurrent Doctoral Programmes (DKs) highlight the high synergy effects between DKs and SFBs on the aspect of PhD training. In cases where a PI is involved in both, their PhD students are typically also included in both activities. Some further emphasized the benefits of a concurrent SFB to complement the DK: For PhD students' future careers and prospects, SFBs offers the best 'on-the-job' training due to high-level science and specialized scope of research. Survey results support this finding. 45% strongly agree and 38% somewhat agree that their SFB has led to better promotion of career advancement of junior researchers. A further 77% of respondents strongly or somewhat agree that their SFB has led to improved quality of doctoral training.

Figure 34 Career advancement and quality of PhD training (n=158)



Source: SFB survey

4.2 Gender dimension

The SFB programme aims high, as it sets out to boost gender mainstreaming in research through better integration of female researchers in knowledge networks, specific support for female researchers and, going beyond the human resources dimension, through an integration of a gender dimension in research.

In this section, we analyse whether and to which extent a gender balance was strived for in the programme and its networks, and which means were incorporated to support gender mainstreaming in the programme.

In order to provide an overview on the gender balance in the programme, we first analyse the participation structure of men and women in the SFB differentiated by category of personnel. Where possible, we compare the structure with the situation at Austrian universities. We then analyse, whether the gender of the project coordinator has any effect on the outcome of the project grant decision. Following the statistical analysis we then focus on the applied instruments for supporting gender mainstreaming in SFBs.

4.2.1 The participation structure of women in SFB

Compared to the first evaluation period (Edler et al. 2004), the representation of female researchers increased from 32.9% to 40.6% in total, which lies slightly above the overall share of women working scientifically at Austrian Universities (39.3%).

The share of women only slightly increased in Natural Sciences (+1.5%), but especially in Non-Natural Sciences (+12.4%) and it is remarkable that the share of women in the Non Natural Science SFBs (53.3%) is far above the overall share of women working in Non Natural Sciences at Austrian Universities (42.8%).

While the share of women as (Sub)Project leaders is low (19.3%), particularly in the Natural Sciences (11.9%), the share in Non Natural Sciences (26.4%) aligns with the overall share of female Professors (including Univ./Assoz./Assist. Professors and Universitätsdozenten) at Austrian Universities (25.9%)

Table 24: Participation structure: Share of women

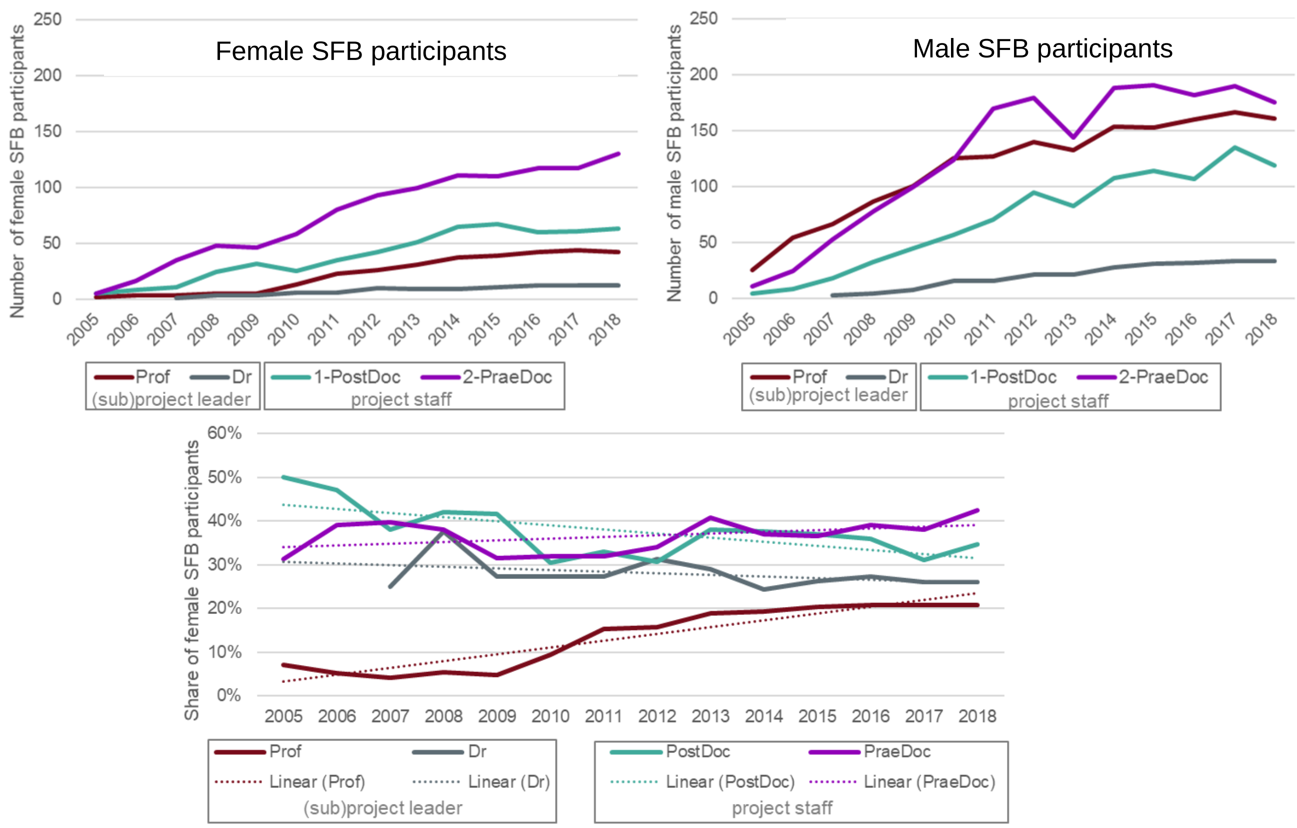
	EVAL 2004*	EVAL 2019	EVAL 2019 (SUB)PL	UNIDATA: PROFESSORS AND EQU.	EVAL 2019 POSTDOC OR PREDOC (STAFF)	SCIENTIFIC PERSONNEL AT UNIV.
Total	32.9%	40.6%	**19.3%**	25.9%	**37.2%**	39.3%
Natural Sciences	25.5%	27.0%	11.9%	n/a	**24.8%**	29.5%
Non-Natural Science	40.9%	53.3%	26.4%	n/a	53.3%	42.8%

* Source: Edler et al. (2004), 55

Concerning the change of participation of women over time by level of experience, Figure 35 reveals a mixed trend:

- The number of female Post-Docs only increased very slowly in absolute terms until 2015, then it even decreased. As the number of male Post-Docs increased at a higher pace, the overall share of female Post-Docs decreased from 50% in 2004 to 34% in 2018.
- The number of female Pre-Docs increased continuously over time. The share of female Pre-Docs reached 40% for the first time in 2007, then decreased for a couple of years, and slightly exceeded 40% again in 2018.
- While the number and the share of sub-project leaders of SFB holding a professorship has started to increase since 2010, contributing to an overall level of 20% today, the share female sub-project leaders that only hold a doctorate degree, has slightly decreased.

Figure 35: Participation by sex and levels of experience



Source: SFB project database

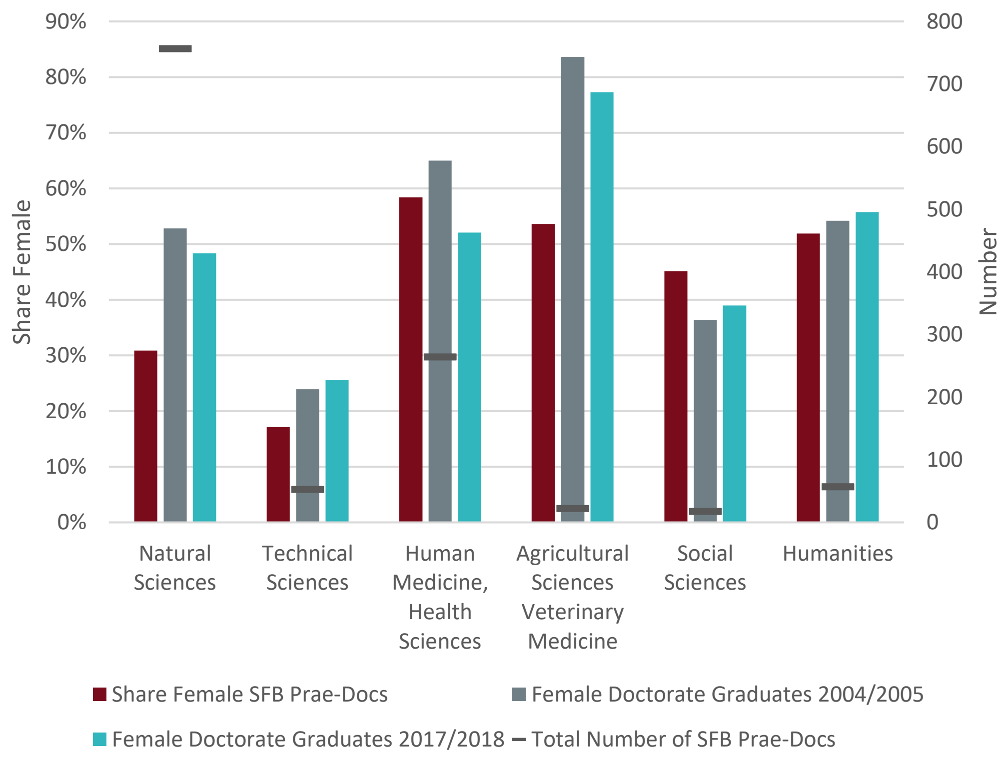
For all FWF programs, an overall 20% mark of grant applications by women was already achieved a decade ago, while their proportion among FWF project employees then stood at 40% (see Austrian Research and Technology Report 2010). The same report also noted that generational change alone will not dissolve this unequal distribution, as similar developments in the humanities suggest; there, the number of female graduates rose sharply in the 1970s, but the number of female professors remains very low at only 18 % (Kozeluh 2008).

The FWF has noted that the participation of women as (sub)-project leaders within the flagships programmes of the science fund, SFB and DK has not yet gone beyond a 20% level for a very long time. It decided in 2018 to keep a target quota of 30% for the participation of the underrepresented sex for these programmes and included in its decision criteria, that given the same scientific quality, the share of female researchers is part of the funding decision process.[31]

The share of women participating at the Pre- and Post-Doc level indicate that the programme does not contribute to potentially decrease the gender gap in the Austrian science and research system. On the contrary, the decreasing share of women participating at Post-Doc level is worrying.

The figure below shows, that the gender gap of the SFB programme is particularly high in the Natural Sciences, where about 46% of all doctorate graduates are female but only 30% of SFB Pre-Docs employed. A narrower differentiation by field of sciences in the Natural Sciences may help to explain why this gap is so huge in the Natural Sciences. According to the SheFigures 2018 report, vast differences in graduates within the Natural Sciences in Austria exist. In Biological and related sciences, women doctorate graduates account for 59.4% in 2016, in Environment 36.4%, in Physical sciences 28.1% and in Mathematics and statistics 26.7%.

Figure 36: Share of female Pre-Docs in SFB compared with female doctorate graduates in Austria



Source: FWF – SFB project data and unidata

Notably, the figure above also shows that in all fields of science the share of women in doctorate graduates has decreased when comparing the years 2004/2005 with 2017/2018 except in the Social Sciences and Humanities. This negative trend for Austria is also confirmed by the EU SheFigures 2018 report, which shows

[31] https://www.fwf.ac.at/fileadmin/files/Dokumente/Antragstellung/SFBs/g_hintergrundinformation-zielquote.pdf

a negative compound annual growth rate in female doctorate graduates in the period 2013-2016 for all narrow fields of Natural Sciences.

Against the background of a mediocre participation of women in the programme, interviewees in all disciplines unanimously raised glass ceiling problems at mid-/senior researcher level as a challenge, while a few coordinators reported that they paid some attention to inclusion of female sub-project leaders and researchers in the partner composition. Most interviewees reported a lack of female master and doctoral graduates, thus complicating recruitment of female PhD students and PostDocs. Biology and medicine have been notable exceptions.

One focus group debated the hiring practice for SFB PhD students and PostDocs. The common practice that PhD students are hired by individual sub-projects rather than the entire SFB was questioned, as this would allow to put stronger emphasis on a better gender-balance within the team. The necessity for international recruitment of PhD students was highlighted in the discussion too as it was deemed to be difficult to find very good PhD students at all, in particular given the short administrative timelines allowed for by the FWF.

Going beyond participation patterns, based upon the structural characteristics of the SFB sub-projects, we also analysed whether the funding decisions are disadvantageous for women.

Figure 28 in the previous section displays the results of a statistical model identifying the factors which are related with positive application decision based on applicant and project characteristics. Our analysis shows female key researchers and female SFB coordinators are related to significantly lower acceptance rates in the first application stage. Among second stage applicants, the proportion of successful women is statistically indistinguishable from the success rate of male researchers. Looking at the marginal effects in the joint model (first and second stage), women are approximately 8% less likely to receive an SFB sub-project grant than men.

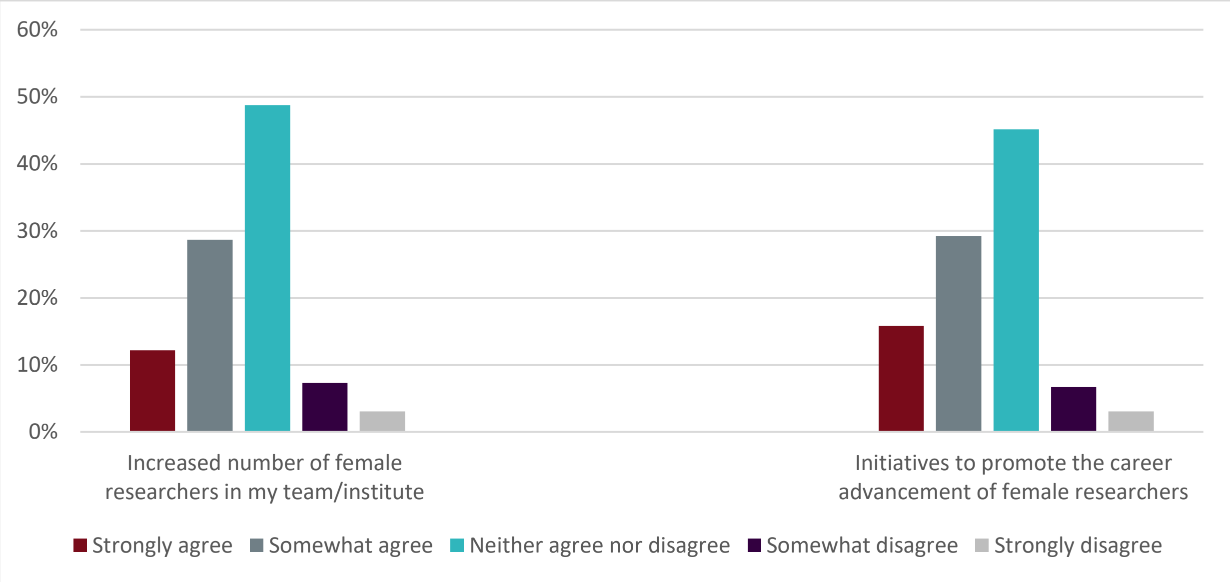
4.2.2 Gender mainstreaming measures within the research network

In the survey among the sub-project leaders we asked about the main types of results and outcomes from an SFB project. Survey participants were allowed to rank up to five most important results according to their priority. Among all eleven impact dimensions, the “Incorporation of specific measures for increasing gender balance in and across participating institutions” ranked lowest.

The vast majority of researchers indicated that the inclusion of gender-specific research topics (78%) and the incorporation of specific gender equality and diversity measures (68%) was just about equal to that of the FWF Stand-alone projects.

Also in the interviews, only a very limited number indicated that some gender specific measures to support the advancement of female researchers have been brought forward and a few coordinators reported that they paid some attention to inclusion of female sub-project leaders and researchers in partner composition. Some organised international schools for PhDs, intertwined with high end workshops of international scholars and specific networking meetings for women.

Figure 37: The gender dimension in the research networks (n=164)



Source: SFB Survey

Specific measures at SFB network level and maybe even across SFB networks could at least alleviate one of the most persistent problems in science and research, that a disproportionate fraction of qualified women drop out of research careers in the very early stages. For example, a 2006 survey of chemistry doctoral students by the Royal Society of Chemistry in London found that more than 70% of first-year female students said that they planned a career in research; by their third year, only 37% had that goal, compared with 59% of males (RSC 2008).

However, for the most part, SFB projects lack specific measures to promote gender balance and the career paths of female researchers, although acting in research networks of considerable size, in which gender specific mentoring of young researchers, and important exchange among peer-fellows and female role models could take place. It comes therefore as no surprise that only 12% of sub-project leaders strongly agreed that the SFB contributed to an increased number of female researchers in the team or the institute and only 16% stated that initiatives to promote the career advancement of female researchers were taken.

4.3 Key findings

The results in a nutshell

- Career attainment, proxied by academic title, increases the probability of success, and rapid career progression seems to be particularly important for success as an SFB (sub-) project lead.
- Both quantitative and qualitive evidence indicates that in cases where a granted SFB has had sub-projects rejected, those sub-project leads are observably younger than their counterparts.
- The SFB succeeds in supporting a large number of early-career researchers, PhD students and PostDocs, and offer ideal opportunities to provide improved PhD training due to their network structure, collaborative nature, and high-quality research.
- SFB ranks among the most prestigious funding programmes and effectively promotes the national and international recognition and visibility of involved researchers, as well as enlarging their collaboration networks.
- The SFB programme does not live up to its own expectation of funding research excellence while “boosting gender mainstreaming and gender-balanced orientation of research and education” in its activities and results.
- The share of female PhD students employed in SFBs, is considerably lower than the share of PhD graduates in the respective field of science. No specific, structured measures for gender mainstreaming and diversity in SFB networks are visible. Against this, there is some good reason to believe, that the SFBs is not capable of improving the conditions for women in research, as it does not even exploit the existing potential of women in the field.

- Female key researchers are less likely to make it through the first stage of the process, but the second stage does not favour male or female researchers.

The SFB programme partially fulfils its goals of enhancing human resources for science and research in Austria through integration of early career researchers and raising the profile of coordinators and sub-project leads.

Overall the SFB programme supports a large proportion of early-career researchers. Differences in the age distribution between key researchers of SFBs and Stand-alone projects are minimal. The median age of an SFB key researcher is 46,3 years. Career attainment, proxied by carrying the title of professor, increases the probability of acceptance in both the first and second stage. Furthermore, the negative relationship of age and probability of success highlights the importance of rapid career progression.

The quantitative and qualitative analyses yield converging findings in terms of the type of researchers supported by the SFB programme. The focus groups participants perceive a disadvantage for young sub-project leads in granted SFB and a perception that the SFB primarily supports established researchers; the quantitative model supports this claim where we observe that rejected sub-project leads in granted SFB are in the median two years younger than their successful peers. Career attainment, proxied by academic title, increases the probability of success. However, the quantitative model does not support the hypothesis that lower age reduces the chances of success. Furthermore, the distribution of researchers supported by SFB is skewed towards young and early career researchers.

The SFB programme is seen as among the most prestigious types of research grant on the national and European levels. As such, participation in an SFB has large positive impacts on the internal and external visibility of involved researchers, their reputation and recognition in the scientific community, as well as on their national and international collaboration networks.

SFBs are particularly well-suited for improved training of PhD students due to their collaborative nature, large network, and scientific excellence. SFB activities are for the most part open to all PhD students, and most have dedicated joint formats for PhD integration and networking. Collaboration is mutually beneficial for senior and junior researchers and successfully integrates PhD students into knowledge production networks.

The SFB programme does not live up to its own expectation of funding research excellence while “boosting gender mainstreaming and gender-balanced orientation of research and education” in its activities and results.

Except in Medicine and Social Sciences, the share of female PhD students employed in SFBs, is considerably lower than the share of PhD graduates in the respective field of science. No specific, structured measures for gender mainstreaming and diversity in SFB networks are visible. While the challenge is acknowledged, efforts and development of measures at network level are missing. Against this, there is some good reason to believe, that the SFBs is not capable of improving the conditions for women in research, as it does not even exploit the existing potential of women in the field.

The statistical analysis highlights two aspects of the application process: 1) female key researchers are less likely to make it through the first stage of the process, but 2) the second stage does not favour male or female researchers. Especially the first stage of the application process favours established researchers (professors) and success rates decrease with age.

5 Broader effects on the Austrian Science and research landscape

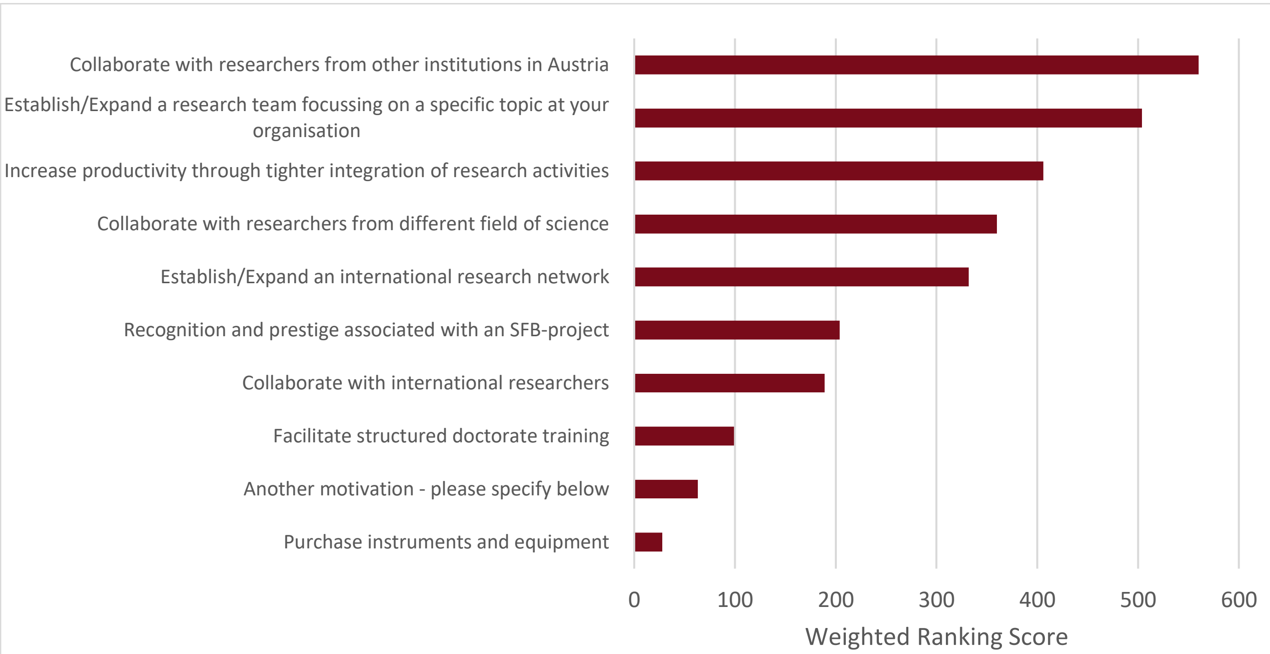
One of the overarching objectives of SFB is to realize broader effects on the Austrian research landscape. This means that the SFB program should support research organisations in building their research profile through bottom-up funding of a network of research groups, of which 50% are at one location. Science communication, knowledge transfer and dissemination strategies to increase public awareness of high quality research are also mentioned as objectives.

The analysis in this section is performed against the background of the persistent challenges of the Austrian R&I system and the decreasing budget provisions for the programme (see Chapter 1). It is based upon desk research and the results from the surveys and interviews performed in the course of this study.

5.1 Motivation for application

The ambition to reap benefits from national collaboration and build long-term research structures at an institution becomes visible when looking at the main motivation of applying researchers. The survey of sub-project leaders conducted in the course of this study demonstrates that the top motivations of SFB-researchers are to 1) collaborate with researchers from other institutions in Austria, 2) to establish/expand a research team focussing on a specific topic at the host institution, and 3) to increases productivity through tighter integration of research activities.

Figure 38: Motivations for applying for an SFB project (n=221)



Note: Weighted Ranking Score is computed as the sum of weighted values associated with an answer category. The weighted values are inversely related to the rank, e.g. if an option is ranked first it is weighted by a factor 10 while rank 2 is weighted by a factor 9, etc.
Source: SFB Survey 2019

In the interviews and the focus group, establishing an internationally visible and recognized research group was seen to be among the strongest motivations for participating in the programme too. The interviewees mentioned the potential of creating critical mass for new ideas at the home institution but also synergies through collaboration at a single research location and with other partners in Austria, which is not feasible to this extent in any other programme as core opportunities of the programme.

Interview participants from a focus group of Social Sciences and Humanities (SSH) researchers indicated that the SFB as an instrument for funding research networks is one of the main motives that drew them to the programme. It allows them to collaborate with excellent researchers across Austria and benefit from economies of scale that do not exist at one location. In this regard, the criteria that at least 50% of the sub-project research group have to be concentrated at one research location, was seen to be a drawback for the participants, because of the dispersed SSH landscape in Austria and missing network structures, whereas the overall minimum size in terms of number of participants was deemed to be appropriate.

The comparatively long and complex application phase for SFBs tends to have a strong mobilization and network formation effect on involved researchers. The application phase is where much of the mutual understanding and trust building of the network takes place by balancing research interests, developing a common vision, defining joint approaches, and finding a common 'language' across disciplines.

In the case a project is rejected, the contacts made during the application phase tend to last in a reduced and less intense form. The positive network effects however, typically do not exist after a proposal is rejected, and networks often slowly disintegrate.

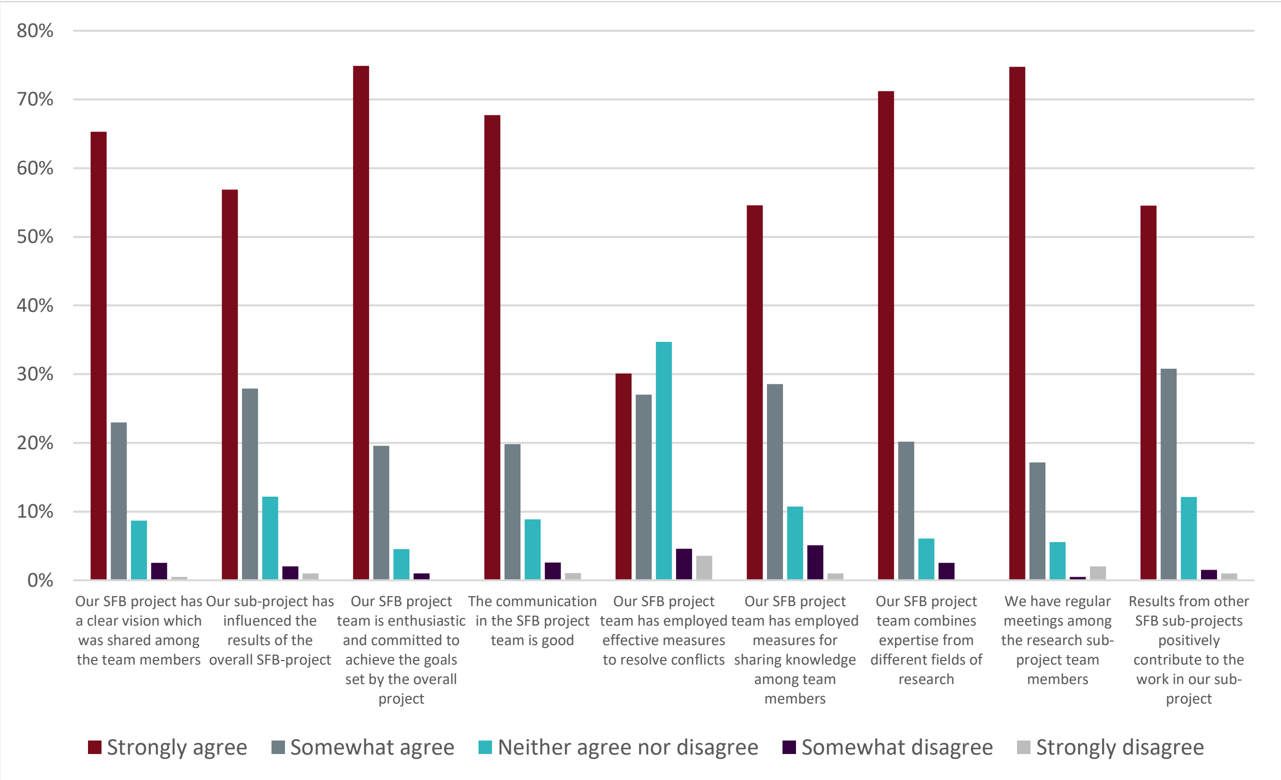
Most frequently, a rejected SFB's topic lives on and attempts are made resubmit a proposal in subsequent years or to place it in alternative funding programmes in reduced formats. Alternative programmes do not allow researchers to think in as long-term and interdisciplinary ways as the SFB.

5.2 Collaboration patterns within SFB-projects

For funded projects, the main mentioned impact mechanisms are the long-time duration of the programme, its significant investment and collaboration at a network level, and the knowledge circulation facilitated through the collaboration of project. The SFB networks allow researchers to work in a stable environment for up to eight years, a time span, which was also deemed to be long enough to invest in young academics (see chapter 4).

The SFB-networks exhibit very favourable network collaboration conditions. The overall assessment of the degree and impact of collaboration among the sub-projects is very positive (see figure below), potentially allowing for impacts to evolve. The SFB-projects are characterised by a clear vision among the team members, enthusiastic team members, complementary and complementary knowledge assets. The vast majority of researchers assert that their own sub-project has an influence on the overall results of the SFB-project and, vice versa, that the results from other SFB sub-projects contribute to the work in their own sub-projects.

Figure 39: Characteristics of collaboration within SFB projects (n=192)

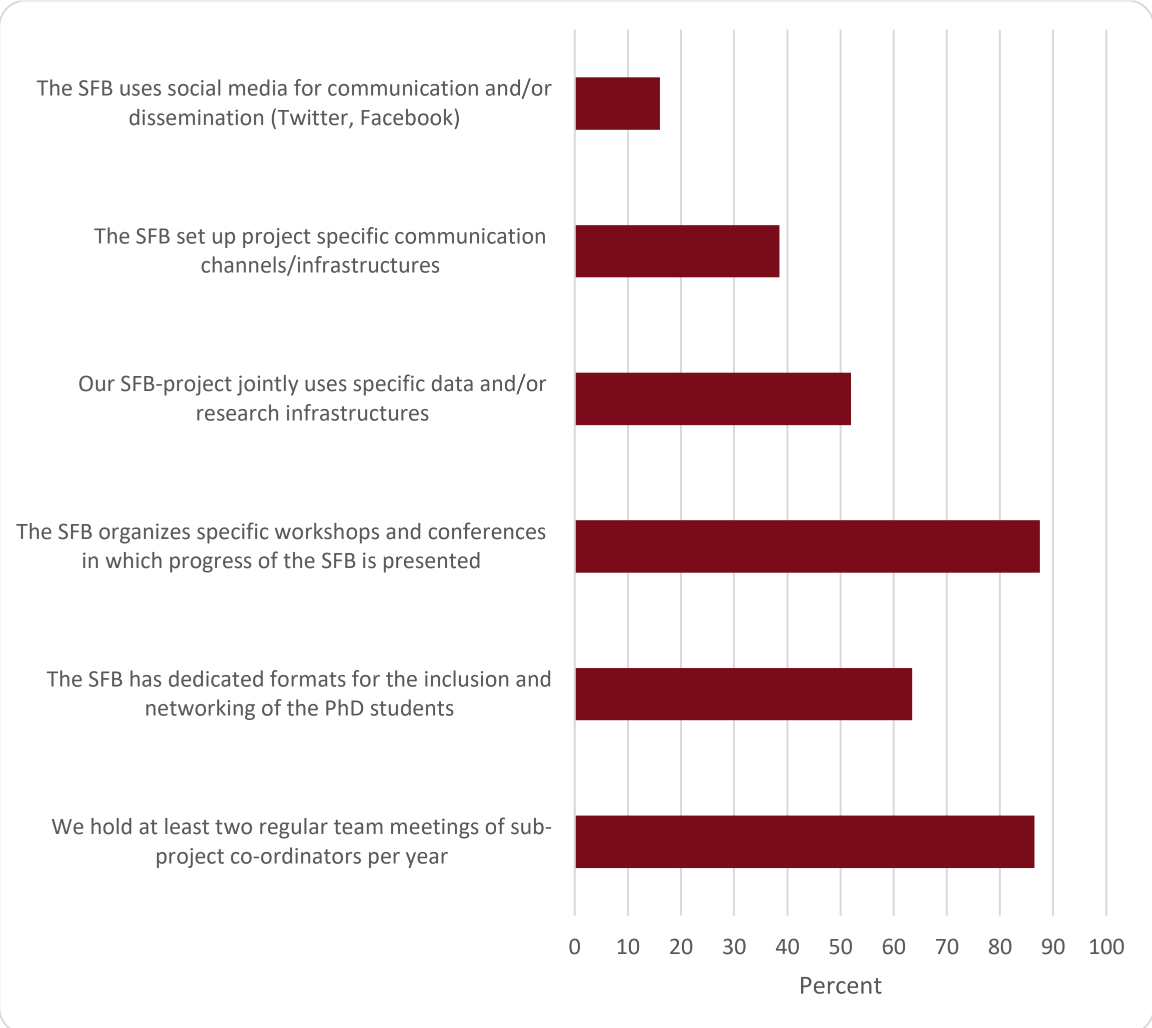


Source: SFB Survey

86% of all SFB hold at least two full SFB meetings per year. The intervals in which team meetings of sub-project coordinators meet also suggest close collaboration for the majority of projects: 42% percent meet up to once per month and 26% Up to once every three months whereas 30% meet two times a year and 2% only on an annual basis.

The main means of communication around an SFB are the provision of specific workshops and conferences, in which the progress made, and the results of the SFB are being presented within the scientific community. These dedicated project events contribute to the scientific reputation and knowledge circulation within the scientific community. 63.5% of projects also set up dedicated formats for the inclusion and networking of PhD students. 52% structure their collaboration around the use of joint infrastructures. Social media (16%) are rarely used as a means for communication and/or dissemination.

Figure 40: Means of communication within the collaborative process (n=200)



Source: SFB Survey

In addition to the collaboration in the SFB networks, 77% of SFB researchers indicated that they collaborated with international partners during their SFB project. The main motive for collaboration is the special competence of the co-operation partner (97%) and the scientific reputation of the partner (37%). About a quarter of the respondents indicated that the main motive for international co-operation was the facilitation of transdisciplinary co-operation, access to special data or equipment, or development and testing of new methods.

The main means of interaction are collaborative research (96%), collaborative publication activities (75%) and research stays at foreign institutions (33%) respectively guest stays of researchers at Austrian institutions (31%).

5.3 Main results and outcomes of SFB funding

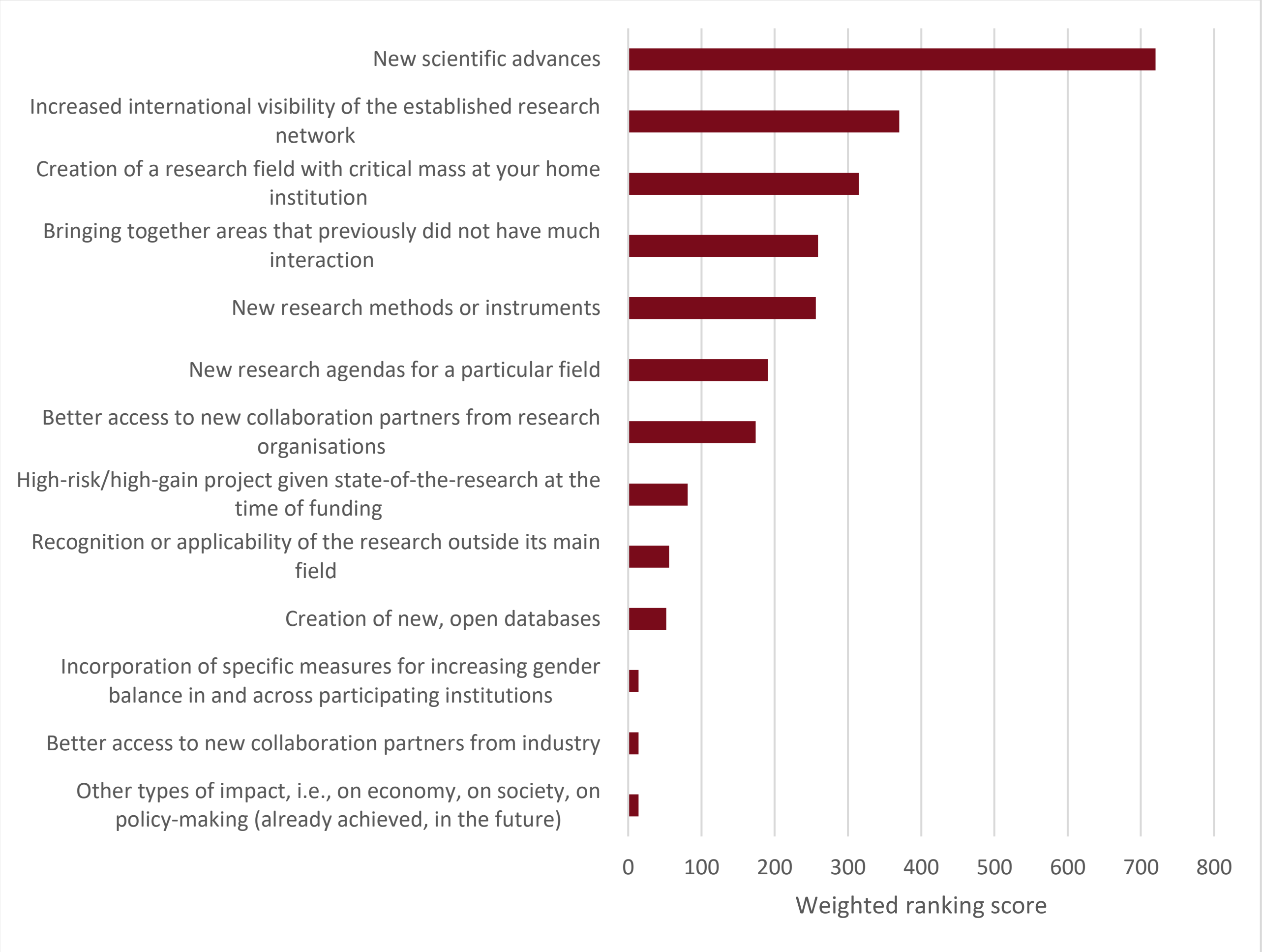
In terms of most important results and outcomes achieved, the SFB survey results show that apart from the dominating result of new scientific advances, an increased international visibility of the established research network and the creation of a research field with critical mass at their home institutions as the main result.

These findings are also confirmed in the individual interviews and the focus groups with researchers, but limited impact on long-term human capacity building was acknowledged in some instances, due to general limitations in the provision of tenure positions and attractive career models at university level.

Successful SFBs have a strong pull-effect on their discipline: It typically gathers the best and most prominent Austrian researchers and is able to attract the best young researchers and PhD students. SFB projects allows involved institutes to grow, educate more early career researchers and pursue ambitious research goals to support career development of researchers.

The SFB was seen as the only programme in Austria that grants long-term funding, which allows researchers to pursue long-term research goals to such an extent. Furthermore, it is attractive because it offers the chance to focus on ambitious research questions with new horizons while tackling new challenges and developing/establishing new concepts and paradigms in their research fields. It is designed to gather the 'best' researchers in the area, and it stimulates closer collaboration with the best senior and junior (PhD students, early PostDocs) researchers. At least in the scientific community, the SFBs lead to a better national and international recognition of research activities.

Figure 41: Most important results of SFB projects according to researchers' priority (n=165)



Note: Weighted Ranking Score is computed as the sum of weighted values associated with an answer category. The weighted values are inversely related to the rank, e.g. if an option is ranked first it is weighted by a factor 13 while rank 2 is weighted by a factor 12, etc.
Source: SFB Survey 2019

As noted in Chapter 4.1, there is a strong sense a that the SFB ranks at or at least near the top of the 'hierarchy' of funding programmes and securing an SFB sends a strong reputation signal to the scientific community in the field and the host university/organization. However, the recognition of the research outside the research field is limited and other types of impact (on society, on industry) are ranked lowest.

5.4 Profile-building and institutional support

At the level of university management, the scope of building up research profiles through SFBs was questioned in so far, as the programme was rather seen to fund existing spots of excellence than opening up new avenues. Given the extremely low acceptance rate of the programme, it was noted that these very strong groups getting an SFB rather reinforced existing strengths, than that it opened up new fields. One institutional representative noted that ERC grants, SFB, Wittgenstein prizes and START grants were the ones that confirmed existing areas of strengths, but with no surprise attached. Another one indicated, that they would be very surprised, if any SFB application would emerge out of a non-focus area of the institution.

The limited funding volume of the programme also limits the potential to contribute to a profile building of institutions. The Medical University of Vienna is the organization with the highest share of FWF SFB funding and one of the most successful Austrian universities in terms of third-party funding at national and EU level. Yet, in 2018 alone, total third-party research and innovation funding of the university amounted to 102.7 Mio. € while SFB funding for the 14 years 2004-2018 accounted only for 45 Mio. €. Correspondingly, the development plan of the Medical University of Vienna also states that a strengthened profile-building of the university's research clusters contributed to a further increase in the participation of excellence programmes like special programmes of the FWF (SFBs, DKs), Christian Doppler Laboratories, ERC grants, Ludwig Boltzmann Clusters and Institutes, and aws prototype funding[32].

However, for indicating areas of strength, the Austrian universities clearly draw upon the results of third party funding. For example, the University of Vienna notes, that their areas of strength are based upon those research priorities, where their university researchers managed to acquire significant competitive third party funding (e.g. EU, FWF, FFG or WWTF) or where they have acquired prizes and grants with a high prestige (e.g. ERC Grants, START – or Wittgenstein)[33].

As indicated by the age distribution of SFB grant holders (see section 5.1), it was also noted that these are to large extent very experienced people that have been truly successful already. The extremely low acceptance rate level of the programme was seen very critical as this raised the risk of systematically excluding younger principal investigators and therein most likely women from programme participation.

Representatives from the interviewed organisations declared that they provide administrative support for formal matters in the application process and to some extent also strategic advice concerning the composition of the team and the focus of the research activities. According to researchers interviewed, the complex and elaborate SFB application process demands project leaders and especially the coordinators to devote their time extensively to writing the application. In this regard, it was criticised that universities lack mechanisms to support and incentivize researchers to apply for SFBs. Interview participants identified several areas such as lightening the teaching burden for coordinators during the application phase and research support services offering specific expertise in application know-how and intelligence.

During the project phase representatives from the interviewed organisations reported that they were applying measures to provide additional support to their SFB research groups. Measures included the provision of top-up funding and the provision of specific support for infrastructures. This support is most pronounced at the host institution of the SFB coordinator. If only one SFB sub-project exists at an organisation, it seems that specific support is limited. As regards provision of additional posts and permanent positions, the impact of SFB funding is very limited.

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[32] https://www.meduniwien.ac.at/web/fileadmin/content/serviceeinrichtungen/rechtsabteilung/mitteilungsblaetter_2017-18/14_MB_20171220_MB_Entwicklungsplan_2019-2024.pdf

[33] https://www.univie.ac.at/fileadmin/user_upload/startseite/Dokumente/Leistungsbericht_2017_interaktiv.pdf

5.5 Key findings

The results in a nutshell

- The SFB is very successful at creating tightly integrated research networks and provides appropriate conditions to pursue ambitious, long-term research questions.
- SFB networks share a joint vision, have a high level of trust, and high collaboration intensity.
- The SFB succeeds in supporting a large number of early-career researchers, PhD students and PostDocs, and offer ideal opportunities to provide improved PhD training due to their network structure, collaborative nature, and high-quality research.
- The programme's effect on the research profiles of the host institution is questionable since it appears reinforce existing strengths. However, the SFB is often used by participating organizations to indicate their research priorities.
- The SFB display high levels of structural relevance and prestige for participating organizations. Host organizations provide structural support to SFB (top-up funding, individual measures such as provision of infrastructure, etc.) that goes beyond the level of support for other types of third-party funding.

Long-term collaboration with researchers from other institutions in Austria, increasing research productivity through tighter integration of research and establishing or expanding a research group at the host institution are the core motivations to apply for an SFB. These motivations are very much in line with the programme ambition to support profile building.

The programme is very attractive for the participating researchers because it offers the chance to focus on ambitious research questions with new horizons while tackling new challenges and developing/establishing new concepts and paradigms in their research fields.

The main mentioned impact mechanisms are secure funding for long-term research, its significant investment and collaboration at a network level, and the knowledge circulation facilitated through the collaboration among sub-projects. The SFB network share a joint vision, have a high level of trust among each other, and the intensity of collaboration is high. The conditions for achieving impact are favourable.

The actual effect on the research profiles of the host institutions was questioned as the programme rather funds existing spots of excellence and reinforces existing strengths. Nevertheless, the results of third-party funding are used by participating organisations to indicate their research priorities and SFBs rank in the top-league for this purpose.

The SFB host organisations provide administrative support and sometimes strategic support in the application process. During the SFB implementation top-up funding is granted at most host institutions and individual measures for the provision of infrastructure etc. are being applied as well. This structural support goes beyond the level of support for other research projects and reflects the structural relevance and prestige of the programme at an organisational level. However, SFB funding has no impact on offerings for new permanent positions and the sustainability of the research groups still requires new third-party funding.

However, the recognition of the research outside the research field is limited and other types of impact (on society, on industry) are ranked lowest.

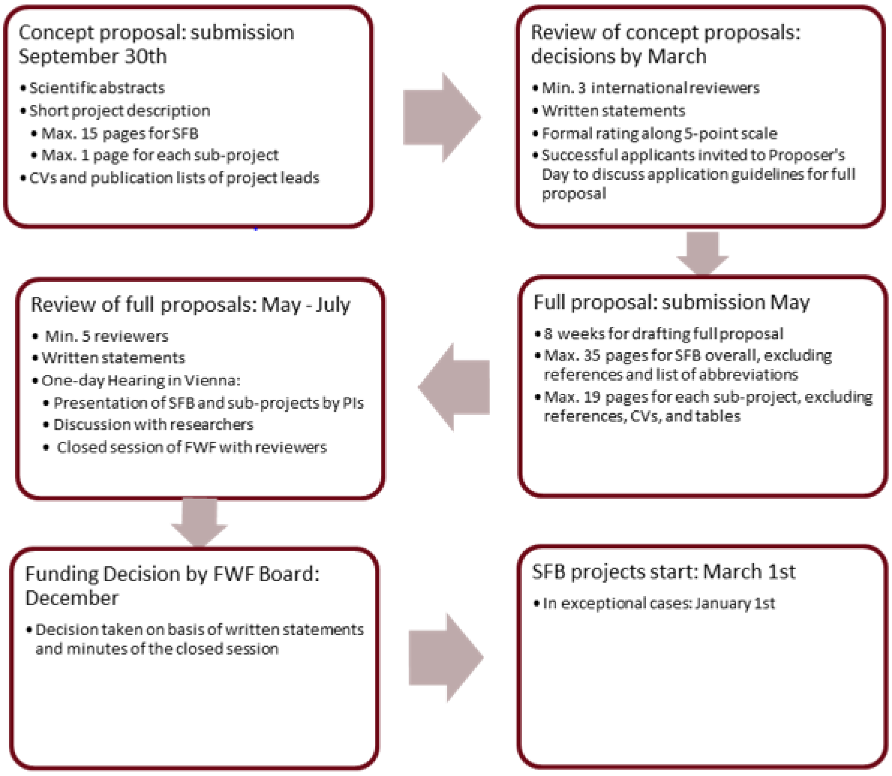
6 Programme Implementation and Management

6.1 Process of application and evaluation

The SFB programme is open to all Austrian research institutions without restrictions to the number of proposals per organization. In line with the goal of promoting strategic profile-building of universities, it aims to concentrate networks by requiring that at least 50% of sub-projects be hosted at one location. One SFB requires 5 to 15 researchers with a target ratio of at least 30% female researchers (decision-making criterion, but not a formal quota). An applicant is restricted to participating in a maximum of two SFBs concurrently, and to leading no more than one sub-project in an SFB. To be eligible, applicants must be at least part-time employed at an Austrian research institution (at least 25% not funded by the FWF in case a researcher is mainly based abroad). Furthermore, applicants must demonstrate their research qualification by providing their publication track record of the past 5 years.

The FWF uses a **two-stage review process** for the selection of projects, consisting of i) a **concept proposal** subject to a written review by a minimum of three international reviewers and ii) a **full proposal**, including a **one-day hearing** in Vienna, subject to a written review by a minimum of five international reviewers. SFB calls are opened once a year, with the total process from submission of concept proposal (end of September) to final funding decision of an SFB project (December of the following year) taking a minimum of 14 months (see Figure 42).

Figure 42 SFB application and evaluation process



Source: Own illustration based on FWF SFB Programme Document “Programminhalte, Verfahren & Aufgabenteilung“ (2012)

In **stage 1**, reviewers are asked to provide **written statements (reviews)** in response to pre-defined questions and evaluation dimensions as well a **formal rating** for the concept proposal via a five-point scale. In **stage 2**, reviewers are asked to provide **written statements** and **formal ratings** for the full application for **i) SFB overal**l, and **ii) single sub-projects**, before a **one-day hearing** in Vienna.

After the hearing, reviewers and FWF representatives discuss the individual aspects of the project in a **"closed session"** along a questionnaire provided by the FWF (see Appendix 11.3). In the process of project selection, it is possible that individual sub-projects are rejected while the overall SFB is funded. **Funding decisions** are taken by the FWF Board based on the contents of the written statements, the minutes of the closed session, and the formal ratings. The SFB applicants receive the written statements and the minutes of the closed session after a funding decision has been made.

Three sets of evaluation criteria form the basis of reviewers' written statements, one for the concept proposal, and two for the full proposal - one each for the SFB overall and the single sub-project (see Appendix 11.3). Although these differ in their details, there is considerable overlap in their broader evaluation dimensions and include:

- The scientific quality of the SFB
- The scientific quality of the research team
- The quality of the SFB organizational structure
- The quality of financial planning
- The SFB's broader effects on dissemination, science communication, and the commitment of its host university/research organization

The **formal rating** for both concept and full applications uses a **five-point scale**, from **"Excellent – funding with highest priority"** to **"Poor – rejection"** (see Appendix 11.3). In practice, due to budget limitations, only proposals with an "Excellent" rating are selected for funding.

6.2 Satisfaction with programme implementation and management

6.2.1 Satisfaction with the application process

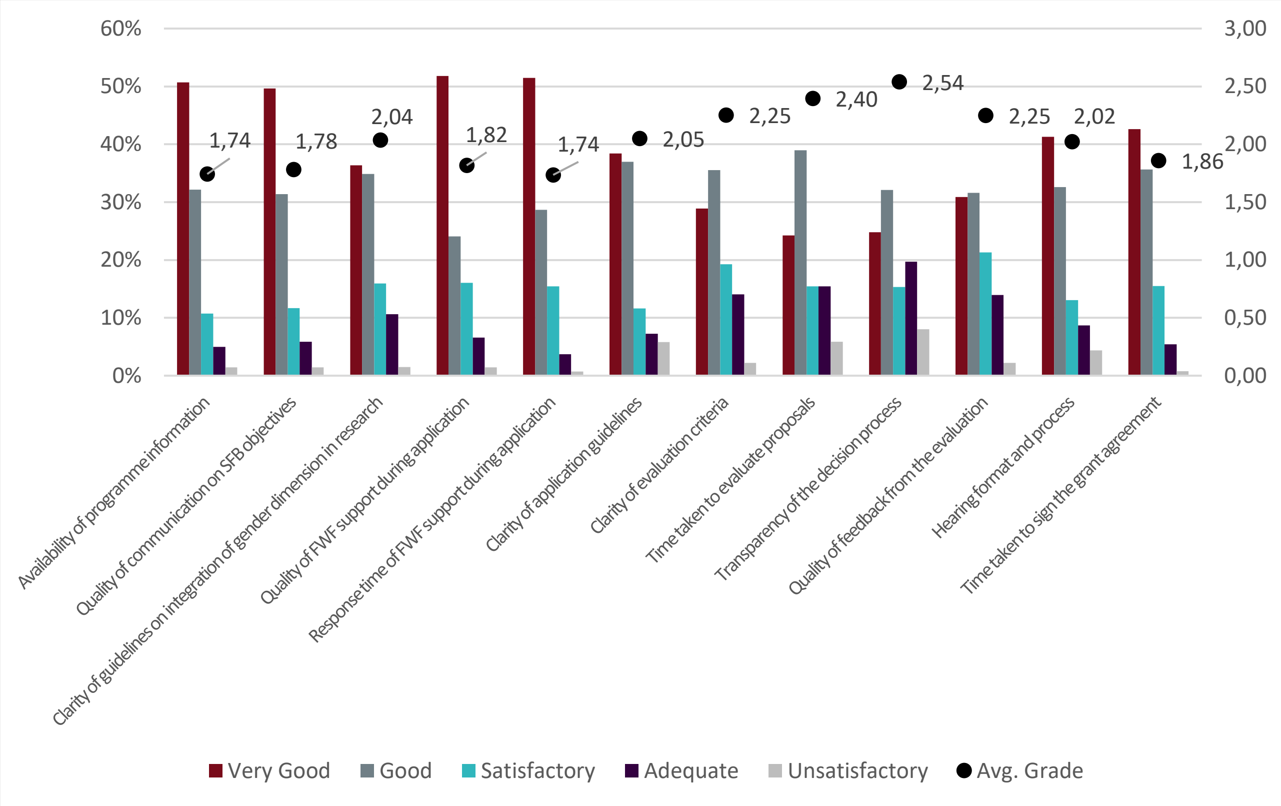
The researcher survey demonstrates that that there is **good to moderate satisfaction with FWF support and processes** during the application. Beneficiaries rate the **overall quality of FWF support** during the application process as good to very good (average grade using the Austrian grading system: 1.82). They were particularly happy with the **availability of information** on the SFB programme, the **response time** of the FWF staff during the application process, the **communication on SFB objectives**, as well as the time taken from communication of funding decision to signing the grant agreement. These results are in line with those of the individual and group interviews, where participants highlighted the professionalism and response time of most FWF staff who provide good support, but also highlight the need for more service-orientation in some cases. This most often relates to inflexible processes, which on the one hand are aimed at providing a clear framework and equal treatment of all applicants, but on the other hand unnecessarily complicate the application experience for certain research fields. Examples mentioned include the compulsory use of English language for application and hearing even in German linguistics and German studies and in cases where a reviewer was not fluent in English.

SFB beneficiaries rate the **clarity of guidelines** on the gender dimension in research and the clarity of overall application guidelines as "Good" (average grades of 2.02-2.05), but with some potential for improvement and streamlining. On the topic of guidelines, there was a general sense that their clarity has improved in the past years, but have room for being clearer, more coherent, and better communicated. One particular issue is that there is a large number of various application forms and tables to be completed, which could be **simplified and homogenized**, as well as **streamlining of application instructions and templates** to reduce the administrative burden on applicants.

SFB participants express **strong support for the 2-stage application process**. The use of a two-stage evaluation process for the SFB programme is also in line with comparable programmes internationally: Collaborative Research Centers in Germany, National Centers of Competence in Research in Switzerland, Center of Excellence programmes in Denmark, Norway, Finland, and Sweden, ERC grants – which are all based on a two-step application process. The FWF uses a short timespan between the first and second stages (approximately 8 weeks to draft the full proposal), which aims to reduce time and effort for the proposal. This is seen somewhat critically, since the requirements of a full proposal are quite comprehensive and demand a significant amount of work. There is agreement among applicants that the length of the full proposal should be considered and shortened to a size appropriate for such a duration, otherwise adjusting amount of time available for full proposal drafting should be considered.

However, the **duration of application from concept proposal to final funding decision** is seen as a major challenge for involved researchers: Survey participants rate the time taken to evaluate proposals as good to moderate (average grade 2.4), reflecting moderate satisfaction levels with the length of the application process. The official FWF timeline foresees a minimum of 14 months from concept submission to the funding decision by the FWF Board. In effect, this means that an SFB application takes up approximately two years of a researcher's time. Survey and interview participants stressed that a **faster turnaround time** between concept proposal and funding decision as well as pre-defined dates for communication of decisions would be highly desirable.

Table 25 Satisfaction with FWF support and processes during the application process (n=129)



Source: SFB Survey

Overall, the application (and project management if successful) is seen to be **quite complex and time-consuming**, especially on the part of SFB coordinators who feel that their additional coordination and administration efforts do not correspond to (prospective) funding granted. Beneficiaries unanimously stressed that the application phase does not only involve idea development and drafting the proposal, but rather serves the crucial function of network- and team-building that lays the foundation for cooperation in the project, increasing the coordination efforts required. There is widespread perception among coordinators that FWF Stand-alone Projects are more 'lucrative' and funding granted corresponds better with administrative burden.

There is a **high barrier to entry** for researchers, where group discussions have highlighted the necessity for project leads to be highly experienced in SFBs by leading/being involved in older SFBs or having applied before in order to successfully apply for an SFB project. Interview participants stressed the high level of **proposal 'know-how' or 'intelligence'** required from SFB applicants, which effectively bars a large number of researchers from participation. Furthermore, the interviews found that the very low success rates of SFB proposals are often compared to in effect entering a lottery and deters many researchers from even attempting an application, which is especially significant in the social sciences and humanities.

Evaluation criteria and transparency

The survey (see Table 25) reveals that there is dissatisfaction among beneficiaries regarding the clarity of the evaluation criteria (average grade 2.25) and the transparency of the decision process (average grade 2.54). This result is supported by individual and group interviews with beneficiaries as well as rejected applicants, which identify specific areas for improvement.

Evaluation criteria and process

SFB applicants point out that evaluation criteria are largely clearly defined and communicated. However, there is evidence that the criteria and the overall goals of the SFB should be better communicated to reviewers in order to facilitate effective decision-making. Since reviewers are exclusively selected from international disciplinary experts, it can be assumed that most if not all are unfamiliar with the Austrian research system, the SFB programme goals and its positioning in the FWF funding portfolio. Surveyed reviewers rate all aspects of the evaluation process as “Good” to “Excellent”, however, qualitative answers highlight room for improvement across all surveyed dimensions. A number of reviewers explicitly mentioned that several criteria and explanations are unclear for outsiders unfamiliar with Austrian science and research and its universities. These include the criterion “commitment of the university”, university internal processes for recruitment, the differential ranking of sub-projects as well as budget and financial plans.

The evaluation guidelines provided by the FWF have a strong focus on the quality of proposed research and the quality and visibility of sub-project leads measured by his or her publication track record. This focus on individual excellence and publication track record is evident in the overall selection procedure where not only the quality of the overall SFB is assessed, but the quality of each sub-project and its lead individually, i.e., the exclusion of sub-projects while its SFB is funded is possible and potentially expected. Furthermore, the evaluation criteria for both the concept and full proposal reflect an emphasis on the quality and visibility of the sub-project lead (criterion: scientific and scholarly potential measured by quality and international reputation). The focus on individual researchers is evident even in the pre-proposal stage, where the FWF defines 3 publication-based requirements that researchers have to meet to apply[34] and on which the initiation of the review process is based:

- Peer review: All publications (more than half for humanities) must be subject to a quality assurance procedure with high international standards (e.g. listed in WoS, Scopus, DOAJ or documented peer-review procedure on publisher’s website)
- Number and quality of publications commensurate with career stage: At least 2 peer-reviewed and internationally visible publications with substantial and independent contribution of applicant
- International nature: Most publications listed must be in English. For the humanities, most publications must have international reach

The analysis of programme data shows that out of 390 sub-project applications in granted SFBs, 331 were accepted, resulting in a rejection rate of 15.1% or in other words, an average of 2 sub-projects being rejected per funded SFB (see Table 26).

Table 26 Acceptance and rejection rates of sub-projects

Number of granted SFB	**29**
Number of granted sub-projects	331
Number of applied sub-projects in granted SFBs	390
Share of rejected sub-projects	15.1%
Granted sub-projects per SFB	11.4
Rejected (in ex ante evaluations) sub-projects per granted SFB	2.0

Source: SFB project database, calculations AIT

The survey of reviewers reveals that there is an expectation, and possibly even encouragement, that sub-projects will be rejected. Reviewers remarked feeling that there is a usual rule that some teams will not make it, which should be made clear from the beginning (“*Make clear from the beginning that the consortium is not evaluated as a whole, but that “weak” partners are likely not to make it.”*). They found the differential ranking between teams among the most difficult parts of the evaluation and report a focus on individual weaknesses

[34] See Chapter 1.6 of: https://www.fwf.ac.at/fileadmin/files/Dokumente/Antragstellung/SFBs/g_application-guidelines.pdf

of individual sub-projects rather than the consideration of the network where the whole is greater than the sum of its parts.

However, the key feature and impact logic of the programme rests on the goal of promoting research networks where the entity is greater than the sum of its parts, thereby promoting excellence, enhancing human resources and profile-building of universities. Evaluation procedures focusing on the quality of individual researchers and their sub-projects rather than giving most weight to the overall scientific benefits of large-scale cooperation runs counter to explicit SFB aims. The survey and interviews with beneficiaries shed light on the problems that individual exclusions cause for the cooperation in the SFB. Most SFBs undergo a period of intense network-building, i.e. building personal trust and relationships, in the application phase, where each sub-project and its team members are carefully assembled to contribute to specific scientific and social roles in the collaboration. The exclusion of certain teams in the evaluation thus causes i) unexpected and oftentimes unwanted twists in research topic, is ii) counterproductive to the efforts of interpersonal trust-building and cooperation of the network, and iii) is detrimental to the goal of promoting human resources for research since rejected sub-project leads within a granted SFB are younger than their accepted counterparts.

Reviewers also report difficulty in tracing the links between research groups and the degree of collaboration between sub-project leads in both stages of evaluation. In this context, the selection of projects should better take into consideration that the quality and impacts of network collaborations are greater than the sum of its parts, and thus recognize the counterproductive effects of exclusion of sub-projects on the whole entity by giving more weight to the interactional, collaborative, and coherence aspects of the overall SFB.

Evaluation criteria promoting gender mainstreaming and young researchers

Against the background of the findings that the SFB programme did not meet expectations regarding its success at enhancing human resources and boosting gender mainstreaming in research, project selection procedures could be adjusted to better facilitate such goals.

Researchers involved in SFBs have unanimously stated that the FWF target ratio of 30% female researchers in a project has increased their awareness for such challenges and sometimes kickstarted measures to better involve women through dedicated measures in recruiting and networking. Even if the target ratio is reached by only a small portion of SFBs, it marks a positive first step.

Both beneficiary and reviewer surveys found that evaluation criteria and weighting could be adjusted to further reinforce positive effects on the human resource impact pathway by requiring additional dimensions (e.g. modern management and governance structures, plan for fostering gender balance, mentoring system for young researchers, plans for recruitment of PhD students and Post-Docs, track record of PIs' mentoring experience and support for diversity, etc.) and giving 'extra points' for targeted impacts (e.g. based on the share of female researchers, the share of female coordinators and sub-project leads, share of young researchers leading sub-projects, etc.).

Evaluating interdisciplinarity

The results of the bibliometric analysis and the portfolio data show that the degree of interdisciplinarity of SFBs does not fulfil the goals and expectations of the programme. The interviews reveal that the evaluation procedure ranks among the most important deterrents for initiating highly interdisciplinary SFBs. The challenges and barriers of effective evaluation of interdisciplinarity in research funding has been widely discussed in the academic literature (see Strang and McLeish 2015, Lyall et al. 2011, among others).

The review model for the SFB can be classified as a discipline-based model of peer review: The international reviewers are peers selected based on the disciplinary distribution of the proposed project. The evaluation dimensions have a strong focus on the scientific quality of the topic and the individual researchers based on their publication track records. There is no evaluation dimension or criterion for assessing the interdisciplinarity of an SFB overall or a sub-project.

Interviewed beneficiaries recognize the limitations of discipline-based models of peer review and strategically choose the disciplinary and research team composition to increase the likelihood of winning funding.

Coordinators and sub-project leads across all disciplines have reported such pragmatic considerations when assembling their SFB as constituting a conscious choice.

The FWF chooses international peers based on their expertise in the same scientific field as the proposed project. Beneficiaries explicitly pointed out that those peers debate the scientific merits of an SFB and its sub-projects on the contribution it is likely to make to advance the state-of-the-art of their discipline. As such, interdisciplinary proposals evaluated by single discipline specialists are disadvantaged since interdisciplinary researchers oftentimes lack a set of qualified peers (see Strang and McLeish 2015, among others). Moreover, the literature identifies a lack of experience among reviewers, i.e., many researchers do not have interdisciplinary experience and likely no experience evaluating interdisciplinary projects.

Interdisciplinary projects, similar to network effects, are ‘more than the sum of their parts’ and require a different approach in evaluation. Such a process goes beyond the current evaluation criteria of the FWF and likely requires additional dimensions that engages analytically with the complex challenges of collaboration. The SFB programme with its inherent orientation towards collaborative networks could be an opportunity to implement effective processes for evaluating interdisciplinarity. The literature provides starting points for instituting such procedures, where the following aspects should be taken into consideration (see e.g. Strang and McLeish 2015, Lyall et al. 2011):

- Interdisciplinary research to be considered not as a superstructure imposed onto disciplinary specialties, but as the foundation of the disciplines
- Additional quality criteria for interdisciplinary research
- The choice of evaluators, their disciplinary and interdisciplinary backgrounds, and their roles in the evaluation
- Management of peer review panels by informed staff giving clear guidance on weighting disciplinary and interdisciplinary contributions

<u>Transparency</u>

Given the moderate satisfaction with the transparency of the application process (average grade 2.54), the survey and interviews highlight several areas contributing to a perceived lack of transparency.

Firstly, the communication of written statements to applicants only after FWF Board funding decision instead of as a basis for discussion in the hearing (see next section).

Furthermore, the perception of a lack of quality control of reviewer assessments on both sides of the process: Both beneficiaries and reviewers have noted occasions where ratings and written statements vary quite wildly across the panel. Particularly reviewers have highlighted their lack of knowledge of Austrian standards, leading to questions on the degree of ‘strictness’ usually applied. Furthermore, both groups support the implementation of a quality control process which might involve ‘normalizing’ scores and providing feedback to reviewers regarding the quality of their review as well as the whether their statements and scores are in line with others.

Finally, applicants point to a lack of clear guidelines and decision criteria for how the FWF Board arrives at a funding decision. Often mentioned are lack of explanation of discussions/deciding factors as well as the process as to how decisions are made if confronted with two or more proposals that are equally well reviewed. Researchers reported the perception that the evaluation process is focused on ‘nitpicking’ minor aspects in order to differentiate between ‘Excellent’ and ‘More Excellent’ to determine which are funded. Virtually all individual interview as well as both focus group participants believe that any feedback or discussion by reviewers during the evaluation process is gladly used as a pretext to reject applications that are in principle excellent. These experiences can partially explain transparency challenges but also highlights the problem of low level of FWF funds and the simultaneous decrease of the SFB’s relative importance in the FWF portfolio.

Hearing format and process

Applicants experience the **hearing format and process** as largely well organized and appreciate the standardized format, while also seeing some potential for improvement. This is reflected in the survey results, where the hearing format and process is rated with 2.02.

One area for improvement relates to the length of the hearing: There is a high level of support for **extending the length of the hearing** to 1.5-2 days on both researchers' and surveyed reviewers' part. Extending the length of the hearing would aid in better assessment of a proposal since it gives researchers more time for discussion with reviewers. Both applicants and reviewers highlight the importance of such face-to-face interactions for the overall review, particularly to assess the degree of collaboration across sub-projects. An extended hearing could also enable better involvement of university management in order to better evaluate a host organization's commitment and support for an SFB.

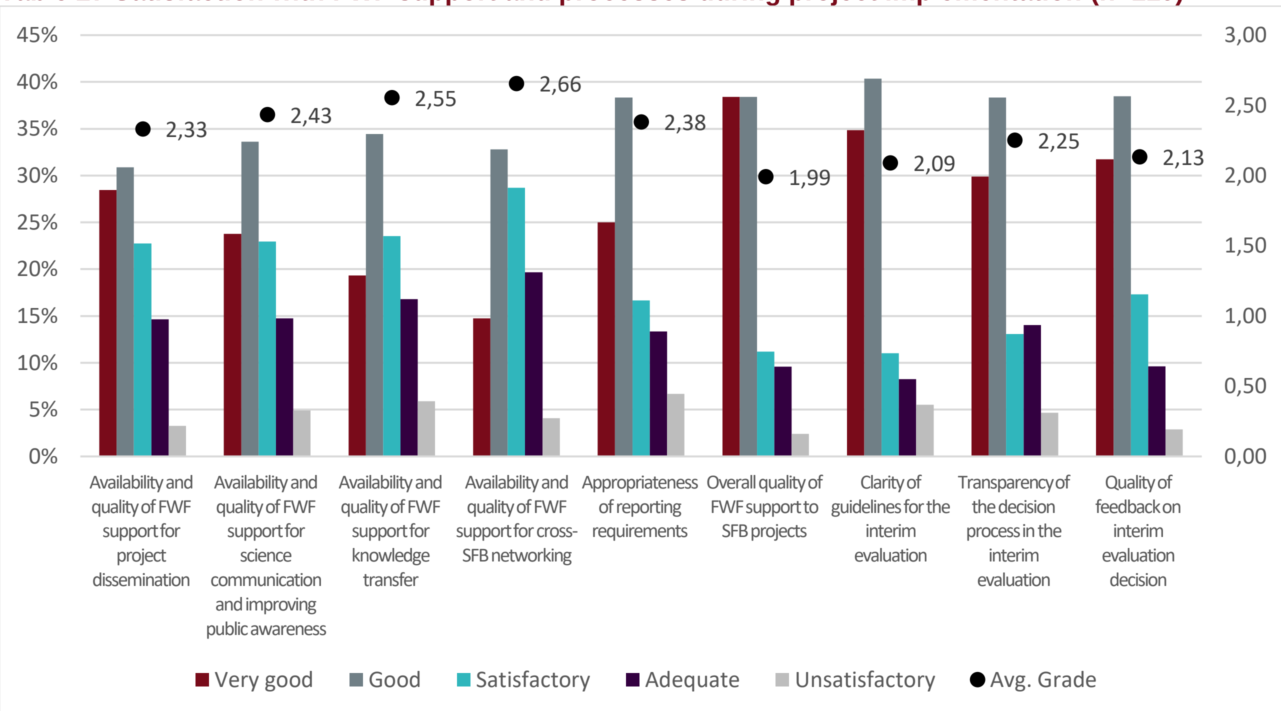
Another aspect relates to the **communication of written statements** to applicants only after a final funding decision has been made. Both reviewers and applicants view the hearing as a forum for discussion on all aspects of the SFB network and its individual sub-projects, including questions and recommendations that reviewers have had during their evaluation of the written proposal. SFB applicants receiving such written statements before the hearing would facilitate more in-depth discussions and could improve the effectiveness and efficiency of the hearing.

Both surveyed reviewers and interviewed SFB participants pointed to the **DFG hearing model**, where hearings take place on 2 days and include either a site visit or even take place directly at the host institution to better gauge an **institution's support and research conditions**. Additionally, if during the hearing it becomes evident that there exist barriers for doing research (e.g. support, infrastructure, personnel) the DFG hearings include the possibility to communicate any such problems to the university leadership. Such a hearing format resembles a forum that allows for 'Q&A' with university management and puts pressure on the leading institution to improve framework conditions for research.

6.2.2 Satisfaction with FWF during project implementation

SFB participants' level of overall satisfaction with FWF support during project implementation can be concluded as "Good" (average grade 1.99). Some potential for improvement mirrors those found in the application process: In terms of administrative burden of reporting (average grade 2.38), satisfaction is moderate. Beneficiaries point to similar challenges as in the application: The amount of time and effort required to fill various templates and forms for the interim and final reports, the additional burden on coordinators, and resulting potential for simplification and streamlining. Participants largely agree that SFBs require more administration than Stand-alone projects, but significantly less than H2020 Research and Innovation Actions.

Table 27 Satisfaction with FWF support and processes during project implementation (n=119)



Source: SFB survey

Additional aspects include largely good but not excellent ratings of the transparency of funding decisions in the interim evaluation (2.25), the quality of feedback from the interim evaluation decision (2.13), and the quality of guidelines for the interim evaluation (2.09).

Moderate scores for the availability and quality of FWF support for project dissemination, science communication, knowledge transfer, and cross-SFB networking activities (average grades 2.33-2.66) reflect the lack for such support and not their low quality. In light of the explicit programme goals of the SFB – dissemination, knowledge transfer, science communication and raising public awareness, such measures should exist to facilitate achievement of goals. Interviews with SFB beneficiaries show that there is broad interest in such measures in support of project implementation beyond the provision of funds. Areas include information on possible tools and strategies for science communication, creating public awareness for SFB results, and approaches for knowledge and innovation transfer. Additionally, a significant number of interviewees expressed their interest in FWF measures that aim at cross-SFB networking and activities to support exploring and exploiting synergies.

6.3 Key findings

The results in a nutshell

- The SFB's two-stage peer review process is universally well-regarded and appropriate to select scientifically outstanding projects.
- The overall availability and quality of information is good.
- Contrary to the aim of the programme, there are no evaluation dimensions and criteria assessing the degree and quality of interdisciplinarity.
- The possibility to exclude sub-projects in the selection process seems to disregard importance of networks in an SFB, where the whole is greater than the sum of its parts and tends to affect younger PIs. Both are detrimental to the programme goals of establishing tightly interconnected networks and enhancing human resources in research.
- There is room for improvement in the communication and transparency of the decision-making process, and in reducing the complexity and administrative burden of project application and implementation.
- There is no additional support for SFB regarding achievement of additional programme goals such as knowledge transfer and raising public awareness for research.

Overall satisfaction with FWF support and procedures seems to be good to moderate, with clear room for improvement in the decision process and support structures.

Decision process

The 2-stage application procedure for the SFB is uniformly well regarded and in line with selection procedures internationally (ERC, DFG, SNF, etc.). However, the turnaround time between concept proposal and funding decision of minimum 14 months is seen as too long. There is also evidence that the time for drafting the full proposal (approximately 8 weeks) is too short for the length and complexity of such a proposal. The length and complexity could be greatly reduced by simplifying and streamlining the instructions and various forms and templates.

The overall availability and quality of information is good. There is broad agreement that the response time and professionalism of FWF is very good overall. However, there is some dissatisfaction with the service-orientation of the FWF and its inflexible processes involving aspects such as fixed starting dates of projects and demands placed on the language of application and evaluation.

The explicitly stated aim of the SFB programme is to promote tightly interconnected interdisciplinary research networks, with the expectation that the collaboration produces outcomes that are greater than the sum of their parts. Contrary to this aim, the evaluation process and criteria are discipline-based and place strong emphasis on the scientific quality and reputation of individual project leads as evidenced by their publication track records. The possibility to exclude individual sub-projects from funding also displays a certain disregard for the scientific and interpersonal contribution of individual sub-projects to the whole entity that in sum lead to higher impacts. Furthermore, not only is the peer review process discipline-based (selection of disciplinary experts, no clear guidance for weighting disciplinary and interdisciplinary contributions), there is no evaluation dimension or criterion assessing the degree and quality of interdisciplinary cooperation.

The evaluation process and criteria could be better used to facilitate the achievement of programme goals in enhancing human resources, boosting gender mainstreaming, and promoting young/early career researchers.

There is room for improvement in the communication and transparency of the decision-making process, such as providing reviewers' written statements to applicants before the hearing to enable more effective hearings and in-depth discussions between reviewers and applicants, better instruction of reviewers, as well as measures to balance the quality of reviews. On the topic of hearing process, there is evidence that extending the length to 1.5-2 days would enhance quality of the review process.

Support structures

The FWF currently does not provide support for project implementation going beyond funding and administrative dimensions and requirements. However, the programme's goals aim at SFB's contributing to achieving broader effects on the Austrian research and innovation system, including the dissemination of results, raising public awareness for science and research, and promoting knowledge transfer. In this context, there is need for action to introduce measures to facilitate such activities. Such support mechanisms would also be met with high interest among SFB beneficiaries.

7 Conclusions & Recommendations

The SFB programme is still the only basic research oriented and network-based research programme in Austria and has therefore a unique selling proposition with a strong relevance for Austria's research and innovation system and an excellent reputation among researchers and university leaders. Although the programme is capable to support exceptional research as evidenced by the outstanding publication and citation record of the funded projects, we see a strong demand for change, as to a large extent the programme does not live up to the objectives set.

An alarming structural composition of the programme

Contrary to basic research programmes at the European level, the SFB programme did not take up new conceptualisations of frontier research, did not actively interlink with strategy building processes of research organisations, or focus on emerging fields of science and strategic impact on different dimensions of excellence. The core conceptualisation of the programme remained very much the same for the last 15 years. Also, no other strategic network programmes for basic research were introduced to the Austrian R&I system.

The programme in its present form funds existing spots of excellence and reinforces existing strengths rather than shaping research profiles of research organisations. Nevertheless, the results of third-party funding are used by participating organisations to indicate their research priorities. SFB ranks in the top-league for this purpose and considerable structural support is provided for SFB projects and not for other individual schemes.

Overall, the programme has lost momentum in the last 15 years and transformed into an extremely competitive niche rather than a systemic oriented flagship programme that is capable to shape the Austrian research and innovation system. The following factors are responsible for this transformation: 1) A low level of absolute annual funding, 2) a negative trend in the share of funding provided by the FWF resulting in 3) acceptance rates of just about 14%, and 4) a tight concentration on a very limited number of disciplines. As shown by the evidence, FWF did not keep up or even enlarge the share of budget that goes to the networks, as recommended by the previous evaluation conducted in 2004.

Against these findings, the following recommendations are given:

Recommendation 1: FWF's funding share allocated to network programmes should aim to reach a minimum level of 25%.

Given the level of ambition of the programme, such as achieving broader effects on the Austrian research landscape, the resources do not suffice. The FWF did not follow the recommendation of the 2004 evaluation which indicated that provisions are certainly needed to keep up or even enlarge the share of budget that goes to the networks. For pursuing the overarching objectives set, a better endowment with resources from the FWF budget is needed for network programmes.

Recommendation 2: FWF should elaborate measures that allow stronger participation of more disciplines and support the emergence of new fields of excellence.

The demand for network funding has increased much faster than supply provided by FWF. A high concentration of funding for existing spots of excellence is the consequence. The starting conditions for Social Sciences, Humanities and Technical Sciences are different from the Natural Sciences and the Medical Sciences in terms of a) existing critical mass vs. fragmentation of the research landscape, 2) alternative funding opportunities for specific disciplines, and 3) measurement of excellence due to different publication cultures. Measures could comprise the introduction of calls for certain disciplines as well as measures focussing on structural impact for sharpening research profiles at Austrian R&I institutions. Recent system level analyses confirm an increasing relevance of building new and sustaining critical mass and establishing better career prospects for young high-potential principal investigators. It therefore could also be considered to incorporate aspects of relevance and impact in the funding decision process.

A focus on scientific excellence, but interdisciplinarity is strictly limited

The analyses performed clearly show that SFB succeeded in supporting exceptional research as evidenced by the outstanding publication and citation record of the funded projects. The following key findings describe the SFB's support for outstanding research:

- The publication profile of the SFB program and its projects in the period 2004–2017 displays a strong continuity in the growth and development of the scientific activity.
- The publication analysis shows that SFB researchers receive a high citation impact and that their work reflects a very high scientific standard in international comparison.
- SFB PIs generally publish in high impact journals and receive more citations than expected for these journals.
- SFB projects exceed national averages and outperform Stand-alone projects along all metrics of citation impact.

The excellence in scientific outcomes with a high international recognition is not paralleled by achievements in terms of interdisciplinarity and does not live up to the expectations in this regard:

- Interdisciplinarity is typically a result of very closely related (sub-) disciplines working in a sub-project. It is mainly found in fields of science, with clearly overlapping content such as biology and medical theoretical sciences and clinical medicine. In this respect, interdisciplinary cooperation in SFBs resembles to a large extent the cross-disciplinary structure of Stand-alone projects.
- In terms of average interdisciplinarity scores in publications, the SFB program lies below the average for Stand-alone projects and below the Austrian average.

The majority opinion among interviewed researchers from all disciplines is that it is next to impossible to be granted funding for an SFB with high levels of interdisciplinary collaboration that encompasses non-closely related fields of science. The stated objective to fund research on multi-/interdisciplinary topics is actually prevented by the selection procedure and a self-selection bias of participants – who anticipate the strategic challenges of the selection process. The evaluation process and criteria are discipline-based and place strong emphasis on the scientific quality and reputation of individual project leads as evidenced by their publication track records.

Against these findings, the following recommendations are given:

Recommendation 3: FWF should keep the overall programme structure (network size, funding provided, duration etc.) and principles of a two-stage peer review process.

The two-stage, peer review selection system is in principle capable of identifying research networks that can deliver outstanding results in terms of publication impact. For funded SFBs, framework conditions (network size, amount of funding per projects, etc.) which allow delivery of outstanding research results are provided. Hence, there is no need to change programme fundamentals such as the two-stage peer review process and structural characteristics in terms of network size and funding per project.

Recommendation 4: FWF should incorporate measures that strengthen the performance of multi-/interdisciplinary research.

Having the ambition to fund highly multi-/interdisciplinary research networks is sensible. A multi-/interdisciplinary character of the research networks would allow researchers from different disciplines to look at similar questions, which may lead to entirely new combinations of complementary skills and novel scientific knowledge. However, the ambition is not being met by the programme, as the SFB program lies below the average for Stand-alone projects and the Austrian average in terms of average interdisciplinarity scores in publications. Except from a bold statement to have the goal to fund "tightly interconnected research establishments for long-term and multi-/interdisciplinary" this is also not operationalised in the decision processes. Against the background of the objectives set, FWF should define and integrate review criteria for multi-/interdisciplinarity in the review process. Weighting scores for interdisciplinarity and an interdisciplinary panel design could help to better adhere to the own objectives set.

Enhancement of human resources but no boosting of gender mainstreaming

The SFB programme partially fulfils its goals of enhancing human resources for science and research in Austria through integration of early career researchers and raising the profile of coordinators and sub-project leads.

The SFB programme is seen as among the most prestigious research grants on national and European level. As such, participation in an SFB has large positive impacts on the internal and external visibility of involved researchers, their reputation and recognition in the scientific community, as well as on their national and international collaboration networks.

SFBs are also particularly well-suited for improved training of PhD students due to their collaborative nature, large networks, and scientific excellence and the SFB programme supports a large proportion of early-career researchers.

A consideration of key researchers shows that women are on average slightly younger than male PIs, but at the same time heavily underrepresented. An increasing age of the key researcher as well as an increasing age of the SFB coordinator significantly decrease the probability of success; the size of the effect is albeit low. It is career attainment, proxied by carrying the title of professor, which increases the probability of acceptance in both the first and second stage. Overall, SFB decision processes do not discriminate against younger PIs. However, rejected sub-project leads in granted SFB are observably younger than their successful counterparts. Qualitative analyses support this finding, where SFB participants reported their perception that rejected sub-projects were disproportionately led by younger key researchers. In general, the possibility to exclude individual sub-projects from funding was heavily criticised by participants as this also displays a certain disregard for the scientific and interpersonal contribution of individual sub-projects to the whole network entity that in sum lead to higher impacts.

The SFB programme does not live up to its own expectation of funding research excellence while “boosting gender mainstreaming and gender-balanced orientation of research and education” in its activities and results. Specific, structured measures for gender mainstreaming and diversity in SFB networks are absent in most networks. While the challenge is acknowledged, efforts and development of measures at network level are missing. There is some good reason to believe, that the SFB might contribute to reinforce glass ceiling as the programme does not tackle challenges at the network level.

Against these findings, the following recommendations are given:

Recommendation 5: In its funding decisions FWF should take stronger consideration of the network level and limit interventions into the network composition of SFB.

SFB peer review processes put strong emphasis on individual sub-projects, leading to a common practice of removing individual sub-projects from the network. The configuration of a network should be the choice of the applicants, who may best consider the required balance of networks in terms of its key researchers. While interventions into the structural composition of networks should not be prohibited, they should be limited and consequences of removing sub-projects should be considered.

Recommendation 6: FWF should incorporate measures that strengthen gender mainstreaming at a network level.

FWF aims at boosting gender mainstreaming but the existence and appropriateness of measures applied are neither considered in the funding decision processes nor in the activities of most networks. As SFB research networks represent the elite of all Austrian research networks, specific measures need to be set which guarantee that gender mainstreaming measures are being effectively applied at the network level and develop synergies with organisational strategies.

Room for improvement in application processes and programme support

The overall satisfaction with FWF support and procedures seems to be good to moderate, with clear room for improvement in the decision process and support structures.

While the 2-stage application procedure for the SFB is uniformly well regarded and in line with selection procedures internationally applied (ERC, DFG, SNF, etc.), the turnaround time between concept proposal and funding decision of minimum 14 months is seen as too long. There is also evidence that the time for drafting the full proposal (approximately 8 weeks) is too short for the length and complexity of such a proposal.

There is also room for improvement in the communication and transparency of the decision-making process, such as providing reviewers' written statements to applicants before the hearing to enable more effective hearings and in-depth discussions between reviewers and applicants, better instruction of reviewers, as well as measures to balance the quality of reviews. On the topic of hearing process, there is evidence that extending the length could enhance the quality of the review process.

The FWF currently does not provide support for project implementation going beyond funding and administrative dimensions and requirements. However, the programme's goals aim at SFBs contributing to achieving broader effects on the Austrian research and innovation system, including the dissemination of results, raising public awareness for science, and promoting knowledge transfer. In this context, there is need for action to introduce measures to facilitate such activities. Such support mechanisms would also be met with high interest among SFB beneficiaries.

Against these findings, the following recommendations are given:

Recommendation 7: FWF should simplify and harmonize application and reporting instructions, forms, and templates.

There is room for improvement concerning the length and complexity of the administrative efforts involved in applying for and implementing an SFB grant, which in turn could improve satisfaction with FWF's administrative processes.

Recommendation 8: FWF should speed up the communication of reviewer assessments to SFB applicants.

Reviewer assessments should be communicated in advance to the hearing, as this would likely contribute to improving the project selection process and enable better assessment of an application's scientific quality.

Recommendation 9: FWF should provide additional support mechanisms for promoting knowledge transfer and dissemination beyond the scientific community.

The current programme objectives state that promoting knowledge transfer and dissemination beyond the scientific community should be pursued. If this target is being taken seriously, FWF needs to build-up specific support strategies for fostering outreach of the networks.

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10 Appendixes

10.1 ANNEX I Methodology

10.1.1 Bibliometric Analyis

In particular, the following indicators are calculated for trend analysis, comparison and benchmarking:

1. Number of publications.
2. Share of papers with international collaboration in the total set of publications
3. Number of citations in a three-year citation window
4. MOCR: Mean Observed Citation Rate which is the average number of citations per publication

The normalized citation rates (Glänzel et al., 2009) allow to assess the relationship between the factually achieved citation impact, the visibility/publication strategy and the subject standard.

5. RCR: Relative Citation Rate, based on Journal Expected Citation Rate
6. NMCR: Normalized Mean Citation Rate, based on Field Expected Citation Rate
7. NMCR/RCR: ratio between Journal and Field based Expected Citation Rate
8. Number and share of papers in the 4 CSS classes where the two upper classes represent highly and outstandingly cited papers according to the scheme of the self-adjusting method of Characteristic Scores and Scales (CSS) (Glänzel, 2007; Glänzel et al., 2014);

On the basis of these statistics the program and project publication output, visibility and citation impact as well as trends within the given period of fourteen years can be highlighted.

The fourth indicator, *Mean Observed Citation Rate* (MOCR), is defined as the ratio of citation count (i.e., in a three-year citation window) to publication count. It reflects the factual citation impact of a country, region, institution, research group etc.

The fifth indicator (RCR) compares the MOCR against the *Mean Expected Citation Rate* (MECR). This expected citation rate for a single paper is defined as the average citation rate of all papers published in the same journal in the same year. Instead of the one-year citation window to publications of the two preceding years as used in the Journal Citation Report (JCR), a three-year citation window to one source year is used, as indicated above. For a set of papers assigned to a given country, region or institution in a given field or subfield, the indicator is the average of the individual expected citation rates over the whole set. The MECR is used as an auxiliary measure.

The ratio, RCR = MOCR/MECR, is called *Relative Citation Rate* (RCR). This indicator measures whether the publications of a country or institution attract more or less citations than expected on the basis of the impact measures, i.e., the average citation rates of the journals in which they appeared. Since the citation rates of the papers are gauged against the standards set by the specific journals, it is largely insensitive to the big differences between the citation practices of the different science fields and subfields. It should be stressed again that in this study, a 3-year citation window to one source year is used for the calculation of both the enumerator and denominator of RCR. RCR = 0 corresponds to uncitedness, RCR < 1 means lower-than-average, RCR > 1 higher-than-average citation rate, RCR = 1 if the set of papers in question attracts just the number of citations expected on the basis of the average citation rate of the publishing journals. RCR has been introduced by Schubert & Braun (1986) and largely been applied to comparative macro and meso studies since (e.g., Braun et al., 1985).

The sixth indicator is the *Normalised Mean Citation Rate* (NMCR). NMCR is defined analogously to the RCR as the ratio of the Mean Observed Citation Rate to the weighted average of the mean citation rates called *Field Expected Citation Rate* (FECR). Since subject assignment is not unique, it has to be fractionated for each publication. This procedure guarantees additivity over subjects. This latter indicator is a second expected citation rate and is used as an auxiliary indicator here. In contrast to the RCR, NMCR gauges citation rates of the papers against the standards set by the specific subfields. In particular, we have NMCR = MOCR/FECR. Its neutral value is 1 and NMCR >(<) 1 indicates higher (lower)-than-average citation rate than expected on the basis of the average citation rate of the subfield. The NMCR indicator has been introduced by Braun and Glänzel (1990) in the context of measuring national publication strategy and been used along with RCR in quantitative studies of national, regional and institutional research assessment (Glänzel et al., 2009).

The ratio between NMCR and RCR is given in indicator #7 and gauges the journal excepted citation rate against the field expected one. The score is independent of actual citations received by the publication set but it provides indications of the citation level of the journals in which the research is published.

These four indicators should best be considered and interpreted together. Several “constellations” are possible here, for instance, NMCR>RCR>1 (or MOCR > MECR > FECR) which reflects the most favourable situation, means that the author under study publishes on an average in journals with a higher-than-discipline standard and receives even more citations (on an average) than the standard set by the journals in which the papers are published. RCR<1<NMCR (MECR > MOCR > FECR) means that the latter standard is not reached and, for instance, NMCR<1<RCR means that the researcher achieved a higher citation impact than expected on the basis of the journals in which he/she has published but these journals do, on an average, not belong to the top journals in their discipline.

Versions of these indicators are used also at CWTS in Leiden. In particular, MOCR coincides with *Citations per Paper* (CPP), a version of MECR is *Mean Journal Citation Score* (JCSm), a version of RCR is called CPP/FCSm at CWTS, *Mean Field Citation Score* (FCSm) is a version of $MECR|_S$ and CPP/FCSm is a version of NMCR (cf. Moed et al, 1995).

Indicator #8 in the list of indicators given in the introduction is the most complex, but gives more details about the distribution of citations than mean values can do. The characteristic scores and scales are obtained from iteratively truncating samples at their mean value and recalculating the mean of the truncated sample until the procedure is stopped or no new scores are generated. Usually three scores are sufficient, where the first one is identical with the mean value of the reference population. The resulting four classes are obtained by the intervals defined by adjoining scores (see, e.g., Glänzel et al., 2014). This method is a real alternative to percentiles but has two important advantages: 1. CSS is not biased by ties in the underlying citation ranking and 2. CSS scores are self-adjusting and thus not defined on arbitrary pre-set values. The four classes stand for ‘poorly cited’ (1), ‘fairly cited’ (2), ‘remarkably cited’ (3) and ‘outstandingly cited’ (4) papers. Papers in class 3 and 4 can be considered highly cited. CSS provides robust classes in terms of their insensitivity to publication year, citation windows and subject. Although CSS is not directly linked to percentiles, the distribution of papers over classes is about 70% (1), 21% (2), 6%–7% (3) and 2%–3% (4). Deviations of the researchers’ profile provide a multifaceted picture of their citation impact. A researcher’s share in certain classes might be higher or lower than, or equal to the corresponding standard and his/her profile might thus follow the above-mentioned reference standard or be more or less polarised than the standard or more skewed towards poorly or highly cited papers, respectively. A researcher might have more highly cited papers than expected and at the same time less poorly cited papers than expected, but he/she might have more poorly cited papers then the reference standard.

10.1.2 Definition of control groups

The aim of this task was the definition and identification of a suitable control group for comparison of SFB funded projects in the bibliometric analysis as well as for descriptive statistics. To isolate the effect of SFB funding on the factors to be evaluated, a suitable and statistically robust control group was defined. Comparing performance in SFB to another funding programme ignores the fact that the programme already aims at efficient, well-networked researchers and, thus, overestimates the impact of the funding. Selection and self-selection bias – from the FWF’s decision to fund a project and excellent researchers’ decisions to apply for an SFB grant respectively – can have major effects on the assessment of the programme’s impact. These are examples of potential biases arising from characteristics which affect the assignment of the funding rather than the effect of the funding.

While a comparison with unsuccessful SFB applicants appears to be an obvious choice for a control group, it is conceivable that the group of successful and unsuccessful applicants differ in important structural criteria which could explain performance differences not caused by the SFB’s support. A logistic regression of the funding decision (binary dependent variable) on explanatory variables (e.g. proportion of women and junior researchers) and other covariates (e.g. research field) was be performed to test the hypothesis that successful and unsuccessful SFB applicants are structurally different and what factors correlate with positive/negative funding decisions (see Scherngell et al. 2013 for a similar application to ERC proposals). The regressions were split by first stage applications, second stage application and for both application phases jointly. The results of this regression can be found in Appendix 10.2.2.

The results suggest that concept proposals rejected in the first stage are structurally different to funded projects in terms of applicant and project characteristics. Factors which increase the probability for being rejected in the first stage include gender (of the coordinator and the key researchers), age (of the coordinator and the key researchers), requested funding volumes, and to a lesser degree interdisciplinarity. Applications which are rejected in the second stage, however, do not differ substantially in terms of their characteristics compared to granted projects.

Rejected applications can practically only be assessed on a researcher level or an institutional level as the applications never manifested in a project. Methodological and data collection reasons, however, did not permit the continuation of this avenue for the bibliometric analysis. On the one hand, too few publications on the researcher level did not permit a representative analysis using rejected researcher information. On the other hand, high overlap between granted and rejected SFB applications within research organisations would have contaminated the institutional control group.

Another promising avenue for determining a suitable control group was the large sample of FWF Stand-alone project. This approach suffers from similar technical difficulties in sample specification as mentioned above. The large number of tand-alone projects, however, enabled a structured approach using statistical matching techniques, namely propensity score matching, to determine the most valid subset of projects for the control group. More specifically, a quasi-experimental setting was designed for comparing outcomes between SFB projects and a group of the FWF's Stand-alone projects which match according to a set of pre-defined criteria.

Propensity score matching distinguished a representative sub-set for comparison by identifying pairs of projects that are comparable in background variables, but where only one received funding through SFB and the other project received funding through Stand-alone project funding. The matching was performed according to several categories depending on their role for selection and self-sorting as well as data availability:

- Duration and starting date of the project
- Project volume
- Gender-balance as well as the gender of the coordinator
- Several specifications regarding the age and tenure of researchers and
- Field of science.

In a the first stage of setting up the statistical matching, a logistical model was set up regressing the funding programme (SFB versus Stand-alone) on project and applicant characteristics on the application level. The results of this regression are presented in section 10.2.3. The propensity score is then calculated as the predicted value of the logistic model and gives the probability of a projects outcomes (SFB versus Stand-alone), given her background characteristics. Linking pairs of projects that have a comparable propensity score, where one received funding via SFB and the other did not, automatically produces two comparable groups. The advantage of propensity score matching is that the impact of the funding for all individuals where counterfactuals exist can be subsequently estimated whereby a comparison of means is sufficient.

10.2 ANNEX II Tables

10.2.1 Bibliometrics

Table 28: Share of publications in 10 ECOOM science Fields 2004–2017

Project	Publications	Biol	BioS	BioM	Clin 1	Clin 2	Neuro	Chem	Phys	Math	Engin
F 03	30									76.7%	43.3%
F 06	45		68.9%		28.9%						
F 07	43		55.8%								
F 09	67							77.6%	55.2%		
F 11	63							19.0%	52.4%		25.4%
F 13	155								21.3%	79.4%	32.3%
F 15	201								91.5%		
F 16	330							22.1%	90.6%		7.0%
F 17	95	16.8%	85.3%								
F 18	338	4.1%	14.8%	8.3%	81.1%						
F 21	263	4.2%	57.4%	5.3%	35.4%			11.0%			
F 23	82			13.4%	53.7%					20.7%	13.4%
F 25	519							24.5%	91.7%		12.5%
F 28	216	8.8%	38.4%	8.3%	54.2%						
F 30	399	2.8%	66.4%	8.8%	27.1%	3.5%		2.8%			
F 32	358		6.1%	12.0%	5.0%	8.4%			15.6%	63.4%	31.8%
F 34	133		80.5%								
F 35	235		31.1%	24.3%	14.5%	18.3%	12.8%	17.0%			7.2%
F 37	108	43.5%	37.0%	20.4%				24.1%			
F 40	602								87.4%		
F 41	558							20.3%	88.2%	2.3%	3.6%
F 43	119	21.8%	77.3%								10.1%
F 44	111		31.5%	15.3%		24.3%	41.4%				
F 45	175							81.1%	37.1%		
F 46	248		11.3%		72.2%						
F 47	127		28.3%	8.7%	81.1%						
F 49	212							9.9%	85.8%		
F 50	80								17.5%	76.3%	23.8%
F 54	55			18.2%	65.5%						
F 55	30									96.7%	

Table 29: Citation indicators for all WOS-indexed publications 2004–2016

Period	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
2004–2007	All	4,121,915		19,525,259	4.74	1.00	1.00	1.00
	Int Collab	759,169	18.4%	5,165,385	6.80	1.14	1.32	1.17
2008–2012	All	6,593,507		33,119,671	5.02	1.00	1.00	1.00
	Int Collab	1,358,322	20.6%	9,911,531	7.30	1.13	1.36	1.21
2013–2016	All	6,307,088		35,951,937	5.70	1.00	1.00	1.00
	Int Collab	1,514,547	24.0%	12,110,100	8.00	1.12	1.34	1.20

Table 30: Citation indicators for all EU-indexed publications 2004–2016

Period	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
2004–2007	All	1,495,624		7,997,021	5.35	1.04	1.09	1.05
	Int Collab	512,746	34.3%	3,744,665	7.30	1.17	1.39	1.19
2008–2012	All	2,343,644		13,518,843	5.77	1.04	1.13	1.09
	Int Collab	882,309	37.6%	6,946,819	7.87	1.15	1.44	1.25
2013–2016	All	2,155,563		13,948,235	6.47	1.03	1.14	1.10
	Int Collab	940,133	43.6%	7,978,175	8.49	1.14	1.42	1.25

Table 31: Citation indicators for all SFB Project publications 2004–2016

Project	Publication Set	Publications	Share in total	Citations	MOCR	RCR		NMCR	NMCR/RCR
F 03	All	30		129	4.30	1.44	1.53	1.07	
	Int Collab	13	43.3%						
F 06	All	45		661	14.69	0.98	1.67	1.70	
	Int Collab	28	62.2%	392	14.00	0.87	1.60	1.83	
F 07	All	43		472	10.98	1.13	1.45	1.29	
	Int Collab	19	44.2%						
F 09	All	67		365	5.45	0.83	1.20	1.45	
	Int Collab	27	40.3%	151	5.59	0.85	1.25	1.47	
F 11	All	62		615	9.92	1.47	2.27	1.55	
	Int Collab	44	71.0%	554	12.59	1.66	2.69	1.62	
F 13	All	155		429	2.77	1.15	1.14	1.00	
	Int Collab	56	36.1%	186	3.32	1.28	1.45	1.13	
F 15	All	201		4337	21.58	1.68	3.65	2.17	
	Int Collab	119	59.2%	2359	19.82	1.54	3.49	2.26	
F 16	All	329		3097	9.41	1.30	1.91	1.47	
	Int Collab	213	64.7%	2191	10.29	1.34	2.00	1.50	
F 17	All	95		1234	12.99	1.05	1.53	1.46	
	Int Collab	35	36.8%	537	15.34	1.18	1.86	1.58	
F 18	All	338		3662	10.83	1.13	1.26	1.12	
	Int Collab	211	62.4%	2412	11.43	1.14	1.34	1.18	
F 21	All	259		3769	14.55	1.02	1.63	1.60	
	Int Collab	120	46.3%	2124	17.70	1.00	1.94	1.94	
F 23	All	81		1085	13.40	0.89	1.95	2.20	
	Int Collab	48	59.3%	764	15.92	0.99	2.54	2.58	
F 25	All	509		4725	9.28	1.05	1.88	1.80	
	Int Collab	306	60.1%	3271	10.69	1.04	2.09	2.00	
F 28	All	203		2703	13.32	0.89	1.54	1.74	
	Int Collab	129	63.5%	2013	15.60	0.92	1.77	1.92	
F 30	All	377		6789	18.01	1.31	2.10	1.60	
	Int Collab	226	59.9%	4858	21.50	1.38	2.45	1.78	
F 32	All	331		1625	4.91	1.20	1.29	1.08	
	Int Collab	219	66.2%	1204	5.50	1.26	1.35	1.07	

Table 32: Citation indicators for all SFB Project publications 2004–2016

Project	Publication Set	Publications	Share in total	Citations	MOCR	RCR	NMCR	NMCR/RCR
F 34	All	121		2234	18.46	0.91	2.01	2.21
	Int Collab	84	69.4%	1642	19.55	0.89	2.11	2.36
F 35	All	205		2295	11.20	1.13	1.60	1.41
	Int Collab	118	57.6%	1465	12.42	1.14	1.69	1.49
F 37	All	92		1389	15.10	1.64	2.25	1.37
	Int Collab	61	66.3%	1003	16.44	1.61	2.44	1.51
F 40	All	543		11817	21.76	1.43	3.54	2.49
	Int Collab	378	69.6%	9173	24.27	1.58	3.99	2.53
F 41	All	473		6059	12.81	1.23	2.15	1.74
	Int Collab	343	72.5%	4761	13.88	1.24	2.30	1.85
F 43	All	105		2063	19.65	1.04	2.32	2.24
	Int Collab	56	53.3%	917	16.38	0.97	1.99	2.06
F 44	All	96		1265	13.18	1.17	1.73	1.48
	Int Collab	58	60.4%	883	15.22	1.12	2.02	1.81
F 45	All	137		1336	9.75	0.90	1.34	1.49
	Int Collab	76	55.5%	922	12.13	0.91	1.68	1.84
F 46	All	203		2246	11.06	1.13	1.30	1.15
	Int Collab	125	61.6%	1541	12.33	1.23	1.46	1.19
F 47	All	93		1977	21.26	1.26	2.48	1.97
	Int Collab	80	86.0%	1844	23.05	1.30	2.67	2.05
F 49	All	181		2620	14.48	1.16	2.40	2.07
	Int Collab	113	62.4%	1829	16.19	1.28	2.68	2.10
F 50	All	59		172	2.92	1.01	0.91	0.90
	Int Collab	43	72.9%	149	3.47	1.04	0.97	0.94
F 54	All	29		363	12.52	1.47	1.62	1.10
	Int Collab	11	37.9%					

Table 33: NMCR for all SFB Project publications by ECOOM Science Field 2004–2016

Project	Publications	Biol	BioS	BioM	Clin 1	Clin 2	Neuro	Chem	Phys	Math	Engin
F 03	30									1.85	1.68
F 06	45		1.56		1.69						
F 07	43		1.34								
F 09	67							1.20	1.26		
F 11	62							0.82	1.67		0.52
F 13	155								1.47	1.16	0.95
F 15	201								3.35		
F 16	329							1.40	1.79		0.79
F 17	95	2.47	1.50								
F 18	338	1.17	0.80	1.99	1.28						
F 21	259	1.38	1.53	2.41	1.64			1.36			
F 23	81			3.47	1.85					2.10	1.51
F 25	509							1.73	1.75		0.85
F 28	203	1.62	1.54	2.10	1.50						
F 30	377	1.36	2.10	2.64	2.54	4.13		0.95			
F 32	331		0.93	1.09	1.46	1.04			1.71	1.50	1.47
F 34	121		1.67								
F 40	543								3.37		
F 41	473							1.79	2.00	2.31	0.90
F 43	105	3.40	2.21								2.97
F 44	96		1.51	2.49		2.40	1.61				
F 45	137							1.16	1.35		
F 46	203		1.07		1.46						
F 47	93		1.16		2.42						
F 49	181							1.08	1.97		
F 50	59								1.67	0.56	1.14
F 54	29				1.70						

Table 34: CSS distribution for all SFB Project publications 2004–2016

Project	Publication Set	Publications	CSS1	CSS2	CSS3	CSS4
F 03	All	30	46.7%	33.3%	13.3%	6.7%
	Int Collab	13				
F 06	All	45	55.6%	28.9%	8.9%	6.7%
	Int Collab	28	50.0%	32.1%	14.3%	3.6%
F 07	All	43	58.1%	20.9%	18.6%	2.3%
	Int Collab	19				
F 09	All	67	52.2%	37.3%	10.4%	0.0%
	Int Collab	27	51.9%	37.0%	11.1%	0.0%
F 11	All	62	54.8%	32.3%	9.7%	3.2%
	Int Collab	44	54.5%	29.5%	11.4%	4.5%
F 13	All	155	58.7%	32.3%	5.8%	3.2%
	Int Collab	56	55.4%	32.1%	3.6%	8.9%
F 15	All	201	31.3%	30.8%	19.9%	17.9%
	Int Collab	119	33.6%	23.5%	24.4%	18.5%
F 16	All	329	43.5%	34.3%	13.1%	9.1%
	Int Collab	213	44.1%	33.8%	13.1%	8.9%
F 17	All	95	44.2%	43.2%	5.3%	7.4%
	Int Collab	35	48.6%	31.4%	8.6%	11.4%
F 18	All	338	52.7%	34.3%	10.4%	2.7%
	Int Collab	211	50.7%	32.7%	13.3%	3.3%
F 21	All	259	52.1%	29.3%	13.9%	4.6%
	Int Collab	120	46.7%	35.0%	11.7%	6.7%
F 23	All	81	39.5%	38.3%	16.0%	6.2%
	Int Collab	48	27.1%	47.9%	16.7%	8.3%
F 25	All	509	47.3%	34.4%	14.3%	3.9%
	Int Collab	306	42.5%	36.3%	17.0%	4.2%
F 28	All	203	47.3%	36.9%	10.3%	5.4%
	Int Collab	129	38.8%	42.6%	10.9%	7.8%
F 30	All	377	39.0%	33.2%	18.0%	9.8%
	Int Collab	226	33.6%	30.5%	22.6%	13.3%
F 32	All	331	50.2%	38.1%	10.0%	1.8%
	Int Collab	219	47.0%	40.6%	11.0%	1.4%

Table 35: CSS distribution for all SFB Project publications 2004–2016

Project	Publication Set	Publications	CSS1	CSS2	CSS3	CSS4
F 34	All	121	28.1%	47.9%	15.7%	8.3%
	Int Collab	84	27.4%	48.8%	15.5%	8.3%
F 35	All	205	39.0%	44.4%	13.7%	2.9%
	Int Collab	118	34.7%	47.5%	14.4%	3.4%
F 37	All	92	22.8%	43.5%	25.0%	8.7%
	Int Collab	61	16.4%	52.5%	21.3%	9.8%
F 40	All	543	25.0%	38.5%	23.9%	12.5%
	Int Collab	378	22.5%	37.3%	24.9%	15.3%
F 41	All	473	34.0%	42.1%	17.8%	6.1%
	Int Collab	343	30.3%	43.1%	20.4%	6.1%
F 43	All	105	39.0%	36.2%	14.3%	10.5%
	Int Collab	56	42.9%	41.1%	7.1%	8.9%
F 44	All	96	42.7%	35.4%	12.5%	9.4%
	Int Collab	58	32.8%	39.7%	17.2%	10.3%
F 45	All	137	51.1%	34.3%	11.7%	2.9%
	Int Collab	76	47.4%	31.6%	15.8%	5.3%
F 46	All	203	59.1%	27.1%	10.3%	3.4%
	Int Collab	125	56.8%	27.2%	11.2%	4.8%
F 47	All	93	37.6%	36.6%	15.1%	10.8%
	Int Collab	80	35.0%	38.8%	13.8%	12.5%
F 49	All	181	32.0%	37.6%	22.7%	7.7%
	Int Collab	113	29.2%	34.5%	28.3%	8.0%
F 50	All	59	72.9%	25.4%	0.0%	1.7%
	Int Collab	43	72.1%	25.6%	0.0%	2.3%
F 54	All	29	27.6%	58.6%	13.8%	0.0%
	Int Collab	11				

Table 36: Share of CSS3 and CSS4 publications for SFB projects with at least 20 publications between 2004 and 2016.

Project	Publications	Biol	BioS	BioM	Clin 1	Clin 2	Neuro	Chem	Phys	Math	Engin
F 03	30									21.7%	23.1%
F 06	45		16.1%		15.4%						
F 07	43		20.8%								
F 09	67							9.6%	10.8%		
F 11	62							8.3%	12.1%		0.0%
F 13	155								18.2%	9.8%	8.0%
F 15	201								35.9%		
F 16	329							20.5%	22.1%		8.7%
F 17	95	25.0%	13.6%								
F 18	338	14.3%	6.0%	10.7%	11.7%						
F 21	259	18.2%	18.9%	35.7%	18.3%			21.4%			
F 23	81			45.5%	16.3%					23.5%	27.3%
F 25	509							20.5%	17.5%		6.3%
F 28	203	31.6%	13.9%	33.3%	12.3%						
F 30	377	18.2%	29.0%	35.3%	29.3%	50.0%		10.0%			
F 32	331		4.8%	11.6%	12.5%	12.0%			16.7%	13.3%	15.5%
F 34	121		20.6%								
F 35	205		4.9%	26.4%	21.4%	25.6%	27.6%	5.7%			15.4%
F 37	92	36.6%	37.8%	35.3%				37.5%			
F 40	543								34.9%		
F 41	473							22.2%	23.2%	9.1%	7.1%
F 43	105	36.4%	24.1%								18.2%
F 44	96		14.3%	33.3%		41.7%	21.4%				
F 45	137							12.8%	15.1%		
F 46	203		11.5%		15.6%						
F 47	93		12.0%		26.0%						
F 49	181							15.8%	26.5%		
F 50	59								10.0%	0.0%	6.7%
F 54	29				22.2%						

Table 37: The Leuven-Budapest Classification Scheme for the Sciences, Social Sciences and Humanities

0. **MULTIDISCIPLINARY SCIENCES**
   X0 multidisciplinary sciences

1. **AGRICULTURE & ENVIRONMENT**
   A1 agricultural science & technology
   A2 plant & soil science & technology
   A3 environmental science & technology
   A4 food & animal science & technology

2. **BIOLOGY (ORGANISMIC & SUPRAORGANISMIC LEVEL)**
   Z1 animal sciences
   Z2 aquatic sciences
   Z3 microbiology
   Z4 plant sciences
   Z5 pure & applied ecology
   Z6 veterinary sciences

3. **BIOSCIENCES (GENERAL, CELLULAR & SUBCELLULAR BIOLOGY; GENETICS)**
   B0 multidisciplinary biology
   B1 biochemistry/biophysics/molecular biology
   B2 cell biology
   B3 genetics & developmental biology

4. **BIOMEDICAL RESEARCH**
   R1 anatomy & pathology
   R2 biomaterials & bioengineering
   R3 experimental/laboratory medicine
   R4 pharmacology & toxicology
   R5 physiology

5. **CLINICAL AND EXPERIMENTAL MEDICINE I (GENERAL & INTERNAL MEDICINE)**
   I1 cardiovascular & respiratory medicine
   I2 endocrinology & metabolism
   I3 general & internal medicine
   I4 hematology & oncology
   I5 immunology

6. **CLINICAL AND EXPERIMENTAL MEDICINE II (NON-INTERNAL MEDICINE SPECIALTIES)**
   M1 age & gender related medicine
   M2 dentistry
   M3 dermatology/urogenital system
   M4 ophthalmology/otolaryngology
   M5 paramedicine
   M6 psychiatry & neurology
   M7 radiology & nuclear medicine
   M8 rheumatology/orthopedics
   M9 surgery

7. **NEUROSCIENCE & BEHAVIOR**
   N1 neurosciences & psychopharmacology
   N2 psychology & behavioral sciences

8. **CHEMISTRY**
   C0 multidisciplinary chemistry
   C1 analytical, inorganic & nuclear chemistry
   C2 applied chemistry & chemical engineering
   C3 organic & medicinal chemistry
   C4 physical chemistry
   C5 polymer science
   C6 materials science

9. **PHYSICS**
   P0 multidisciplinary physics
   P1 applied physics
   P2 atomic, molecular & chemical physics
   P3 classical physics
   P4 mathematical & theoretical physics
   P5 particle & nuclear physics
   P6 physics of solids, fluids and plasmas

10. **GEOSCIENCES & SPACE SCIENCES**
   G1 astronomy & astrophysics
   G2 geosciences & technology
   G3 hydrology/oceanography
   G4 meteorology/atmospheric & aerospace science & technology
   G5 mineralogy & petrology

11. **ENGINEERING**
   E1 computer science/information technology
   E2 electrical & electronic engineering
   E3 energy & fuels
   E4 general & traditional engineering

12. **MATHEMATICS**
   H1 applied mathematics
   H2 pure mathematics

13. **SOCIAL SCIENCES I (GENERAL, REGIONAL & COMMUNITY ISSUES)**
   Y1 education, media & information science
   Y2 sociology & anthropology
   Y3 community & social issues

14. **SOCIAL SCIENCES II (ECONOMIC, POLITICAL & LEGAL SCIENCES)**
   L1 business, economics, planning
   L2 political science and administration
   L3 law

15. **ARTS & HUMANITIES**
   K0 multidisciplinary journals
   K1 arts & design
   K2 architecture
   K3 history & archaeology
   K4 philosophy & religion
   K5 linguistics
   K6 literature

10.2.2 Control group: Rejected SFB applications

Table 38: Multivariate logit regression output explaining funding decision based on applicant and project characteristics

	Binary dependent variable: Accepted (1) / rejected (0)		
	Logit model		
	Only second stage	Only first stage	First and second stage
Applicant characteristics			
Female sub-project leader	0.258	-0.472***	-0.413*
	(-0.236)	(-0.172)	(-0.225)
Age of sub-project leader	0.002	-0.026***	-0.025**
	(-0.012)	(-0.008)	(-0.011)
Non-Austrian°	-0.556		
	(-0.393)		
Professor	0.580**	0.273*	0.471**
	(-0.239)	(-0.152)	(-0.206)
Female SFB coordinator	-0.595	-0.907***	-1.145***
	(-0.45)	(-0.199)	(-0.271)
Interacation: Female sub-project leader * female SFB coordinator	-0.46	0.710**	0.823*

	(-0.724)	(-0.342)	(-0.462)
Age SFB coordinator	-0.026*	-0.061***	-0.054***
	(0.014)	(0.010)	(0.009)
Project characteristics			
Requested funding, log†	1.615***	1.669***	4.148***
	(-0.287)	(-0.272)	(-0.398)
Application for extension°	1.214***		
	(-0.189)		
Year of the decision†	-0.047**	-0.061***	-0.071***
	(-0.023)	(-0.017)	(-0.022)
Gini	0.338	1.544***	0.405
	(-0.627)	(-0.42)	(-0.558)
FOS1: Natural sciences	0.005**	0.003	0.002
	-0.002	-0.002	-0.002
FOS2: Engineering and technology	-0.003	-0.015***	-0.015***
	-0.006	-0.005	-0.006
FOS3: Medical and health sciences			
FOS4: Agricultural sciences	0.007	0.010*	0.021***
	-0.009	-0.006	-0.006
FOS5: Social sciences	-0.013***	-0.002	-0.012**
	-0.005	-0.003	-0.005
FOS6: Humanities	0.003	-0.003	-0.002
	-0.004	-0.003	-0.004
Constant	-20.822***	-25.520***	-63.979***
	(-3.62)	(-4.224)	(-6.199)
Observations	802	1,740	1,740
Log Likelihood	-471.562	-913.127	-591.226
Akaike Inf. Crit.	975.125	1,854.255	1,210.452
Note:			*p<0.1;* ***p<0.05;*** p<0.01

† Related to second stage for (1) and related to first stage for (2) and (3)

° Does not apply to first stage applications

10.2.3 Control Group: Standalone Projects

Table 39: Multivariate logit regression output of SFB versus Standalone project based on applicant and project characteristics

	Dependent variable: SFB sub-project (1) or Standalone (0)			
	(1)	(2)	(3)	(5)
Duration	0.808***	0.789***	1.585***	0.518**
	(0.100)	(0.099)	(0.137)	(0.223)
Requested funding, log	4.537***			4.564***
	(0.379)			(0.387)

Gini, quintiles	-0.115**			-0.099*
	(0.058)			(0.059)
Granted funding, log		4.257***		
		(0.384)		
Requested funding per year, log			4.404***	
			(0.383)	
Female coordinator	0.191	0.295	-0.436**	
	(1.056)	(1.035)	(0.209)	
Female ratio among key researchers	-0.621	-0.754		-0.438**
	(1.086)	(1.066)		(0.212)
Gini			-1.032*	
			(0.587)	
Average age among key researchers	0.005	0.012	0.008	0.008
	(0.010)	(0.010)	(0.010)	(0.010)
Average age among all researchers				
Number of key researchers	-0.776***	-0.709***		0.451
	(0.252)	(0.251)		(0.892)
Number of key researchers per year			-3.899***	-5.085
			(1.135)	(3.741)
FTE per year				
Starting year	0.089***	0.056**	0.093***	0.095***
	(0.021)	(0.023)	(0.021)	(0.022)
International researchers	0.877**	0.899**	0.956**	0.961**
	(0.383)	(0.377)	(0.382)	(0.383)
FOS1		0.004		0.004
		(0.003)		(0.003)
FOS2		-0.003		-0.005
		(0.008)		(0.008)
FOS3		0.010***		0.010***
		(0.003)		(0.004)
FOS4		0.008		0.007
		(0.010)		(0.011)
FOS5		0.002		0.002
		(0.005)		(0.006)
dummy_FOS1			0.565**	
			(0.255)	
dummy_FOS2			-0.478	
			(0.338)	
dummy_FOS3			0.693***	
			(0.195)	

dummy_FOS4			0.172	
			(0.457)	
dummy_FOS5				
Observations	4,475	4,475	4,475	4,475
Log Likelihood	-596.085	-600.836	-585.960	-588.370
Akaike Inf. Crit.	1,212.171	1,229.672	1,201.920	1,206.740
Note:				*p<0.1;* ***p<0.05;*** p<0.01

Figure 43: Decision Calendar showing different review panel session timing for SFB and Stand-alone projects

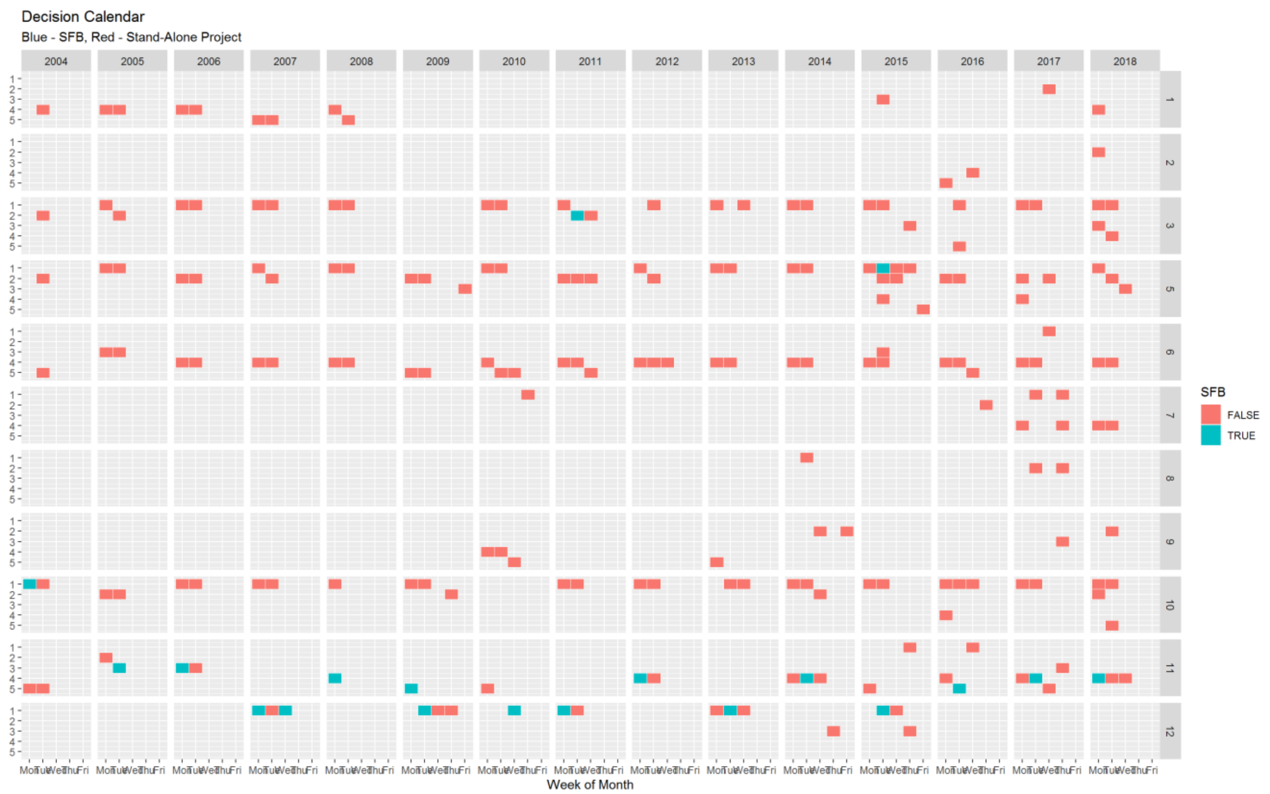
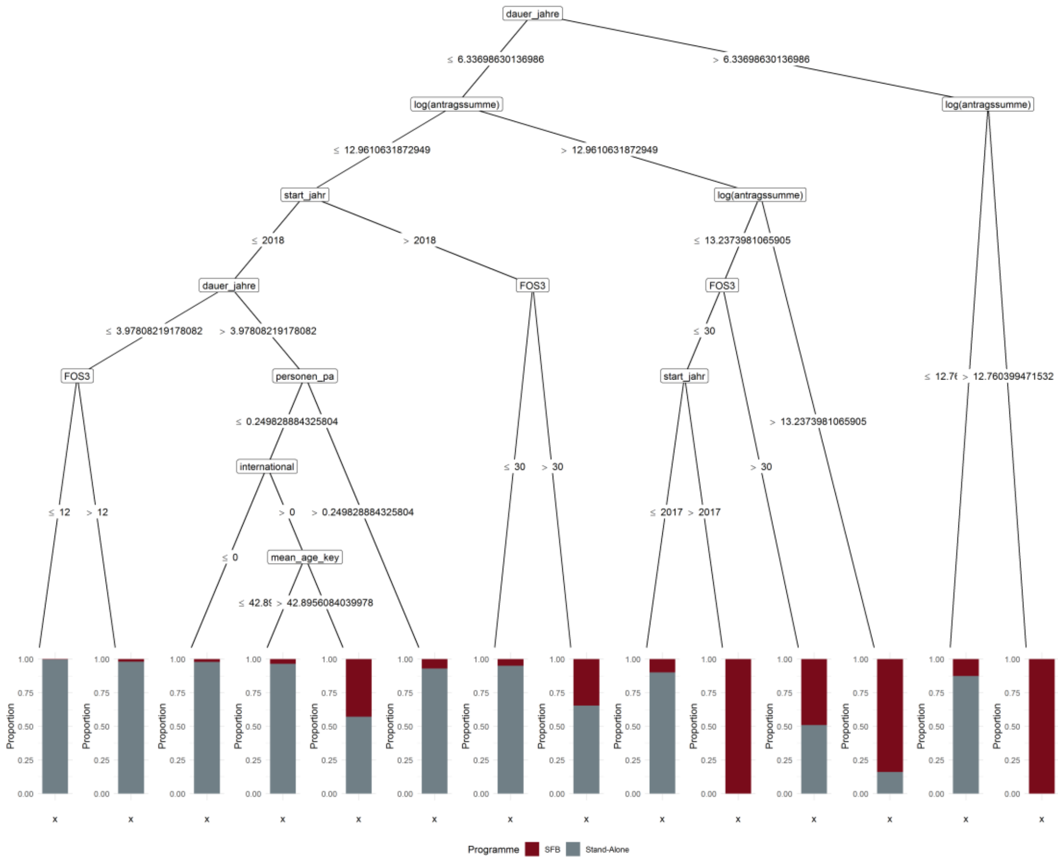


Figure 44: Decision tree showing the variables which explain the decision between applying for an SFB subproject versus a Stand-alone projects by the amount of variance explained



10.2.4 Portfolio Analysis

Table A 1: Number of accepted and rejected SFB

Year	rejected (stage 1)**	rejected (stage 2)**	accepted (stage 2)*
2004	8	1	2
2005	12	2	1
2006	8		3
2007	4	2	2
2008	2	2	2
2009	6		1
2010	7		4
2011	10		1
2012	17	3	3
2013	8	2	2

2014/15	18	3	1
2016	17	2	3
2017	16	2	1
2018	22	3	3
Total	**155**	**22**	**29**

* Initial acceptance date; ** final rejection date

Table A 2: Rejection data

	Eval 2004*	**Eval 2019**
Number of granted SFB	20	29
Number of rejected SFB	17	177
Number of granted sub-projects	247	331
Granted sub-projects per SFB	12.35	11.41
Rejected sub-projects per granted SFB	2.3	2.0
Funding rate budget (for granted SFBs)	61.2%	79.0%

* Source: Edler et al (2004), 47

Table A 3: Participation structure: levels of experience

	Eval 2004[+]					**Eval 2019**				
	Prof	Dr	Ma/Dipl	other	none	Prof*	Dr**	Ma/Dipl***	other****	none*****
Participants total	224	528	439	54	641	276	790	1,135	205	757
Participants per SFB	11.2	26.4	22.0	2.7	32.0	9.5	27.2	39.1	7.1	26.1
Particip. per sub-project	0.91	2.14	1.78	0.22	2.6	0.95	2.28	3.27	0.57	2.24

[+] Source: Edler et al (2004), 54

* includes *Univ. Prof., Ao. Prof., Ass. Prof., Assoc. Prof., Prof., Dozent, Privatdozent*

** Dr in Letzter bekannter akad Titel and PostDoc in Dienstvertrag

*** PraeDoc in Dienstvertrag (if status changes to PostDoc during project course, double counting is possible)

**** Techn_Personal in Dienstvertrag

**** Sonstiges_Personal in Dienstvertrag

Table A 4: Application and rejection structures

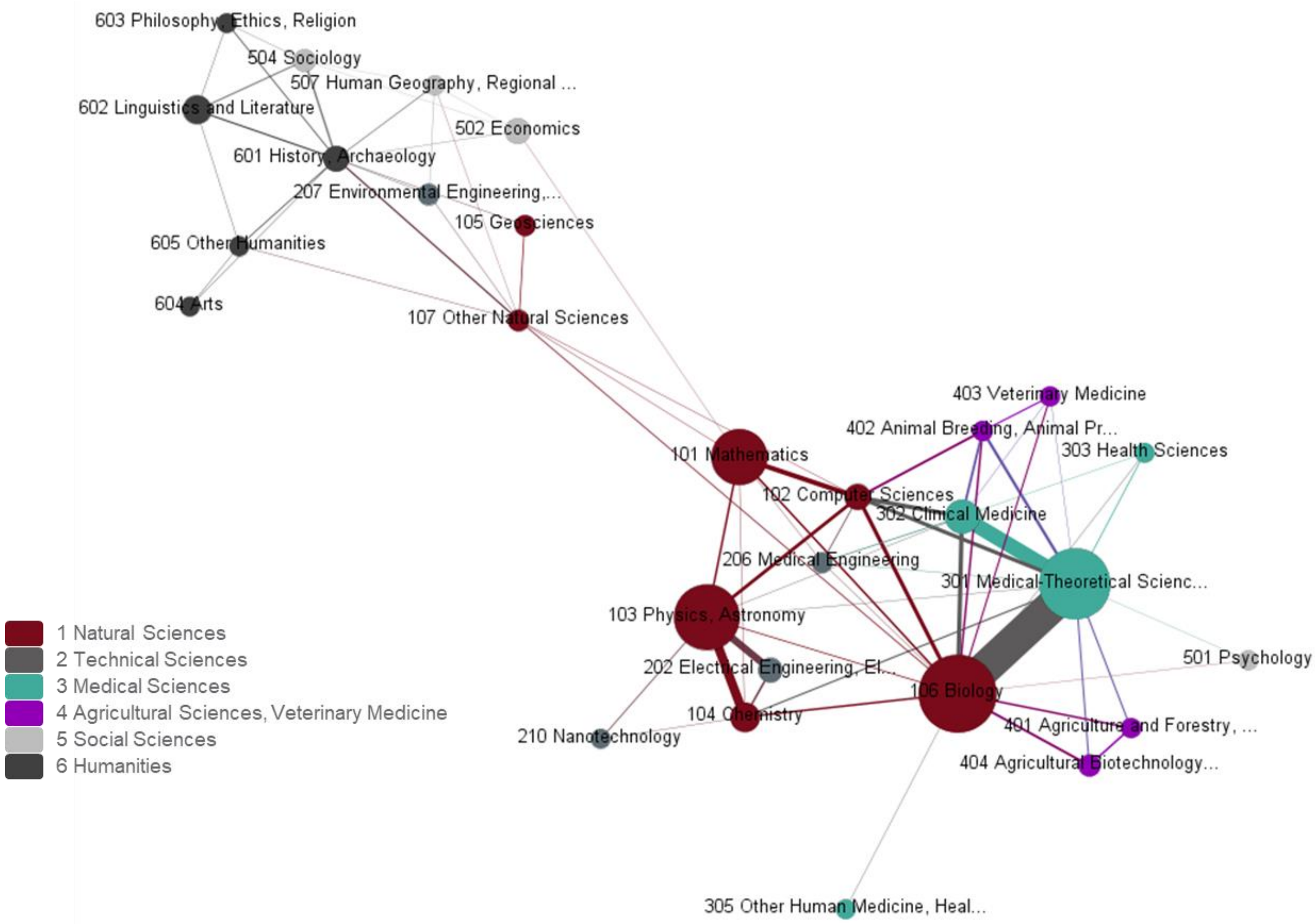
	Eval 2004*				Eval 2019					
FoS	**total**	**rejected**	**granted**	**acc. rate (total)**	**total****	**rejected (stage 1)**	**rejected (stage 2)**	**granted (stage 2)**	**acc. rate (stage 2)**	**acc. rate (total)**
Nat	14	5	9		70	55	5	10		
Nat mainly					12	5	4	3		
Nat - Tech					3	3				
Nat - Tech - Soc					1	1				
Nat - Med	1		1	67%	7	6		1	64%	15%
Nat - Med - AgVet					5	3		2		
Nat - Med - AgVet - Soc					2	2				
Nat - Soc					1	1				
Nat - Soc - Tech					1	1				
Nat - Hum					2	2				
Tech	2	2			1	1				
Tech mainly				0%	6	6			0%	0%
Tech - Nat					1	1				
Med	7	3	4		11	11				
Med mainly					20	12	4	4		
Med - Nat				57%	11	5	2	4	60%	19%
Med - Nat – Tech					1	1				
Med - Nat – AgVet					1			1		
Med – Soc					4	4				
AgVet	1		1	100%	1	1			0%	0%
Soc	6	4	2		12	11		1		
Soc mainly					10	8	2			
Soc – Nat				33%	2	2			20%	4%
Soc - Med					3	2	1			
Soc - Med - Nat					1		1			
Hum	6	3	3		3	2		1		
Hum mainly					10	8	1	1		
Hum - Nat - Tech - Soc				50%	2		1	1	50%	18%
Hum - Med - Soc					1	1				
Hum - Soc					1		1			
Total	**37**	**17**	**20**	**54%**	**206**	**155**	**22**	**29**	**57%**	**14%**

* Source: Edler et al (2004), 56;

** SFBs of decision type "abgesetzt" and "zurückgezogen" ins Stage 1 not considered

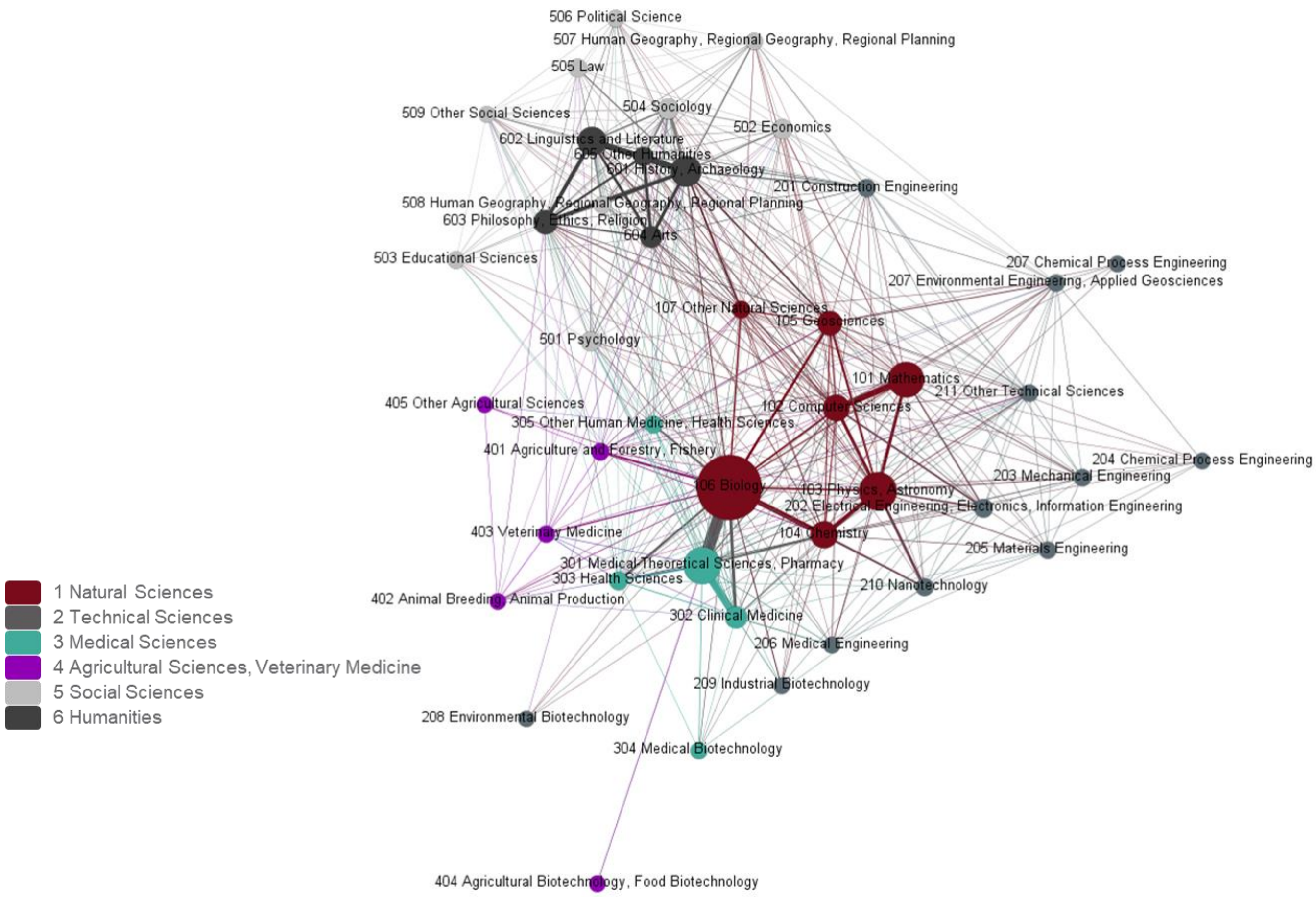
10.2.5 Interdisciplinarity

Figure A 1: Connectedness of sub-disciplines in SFBs (3-digit level)



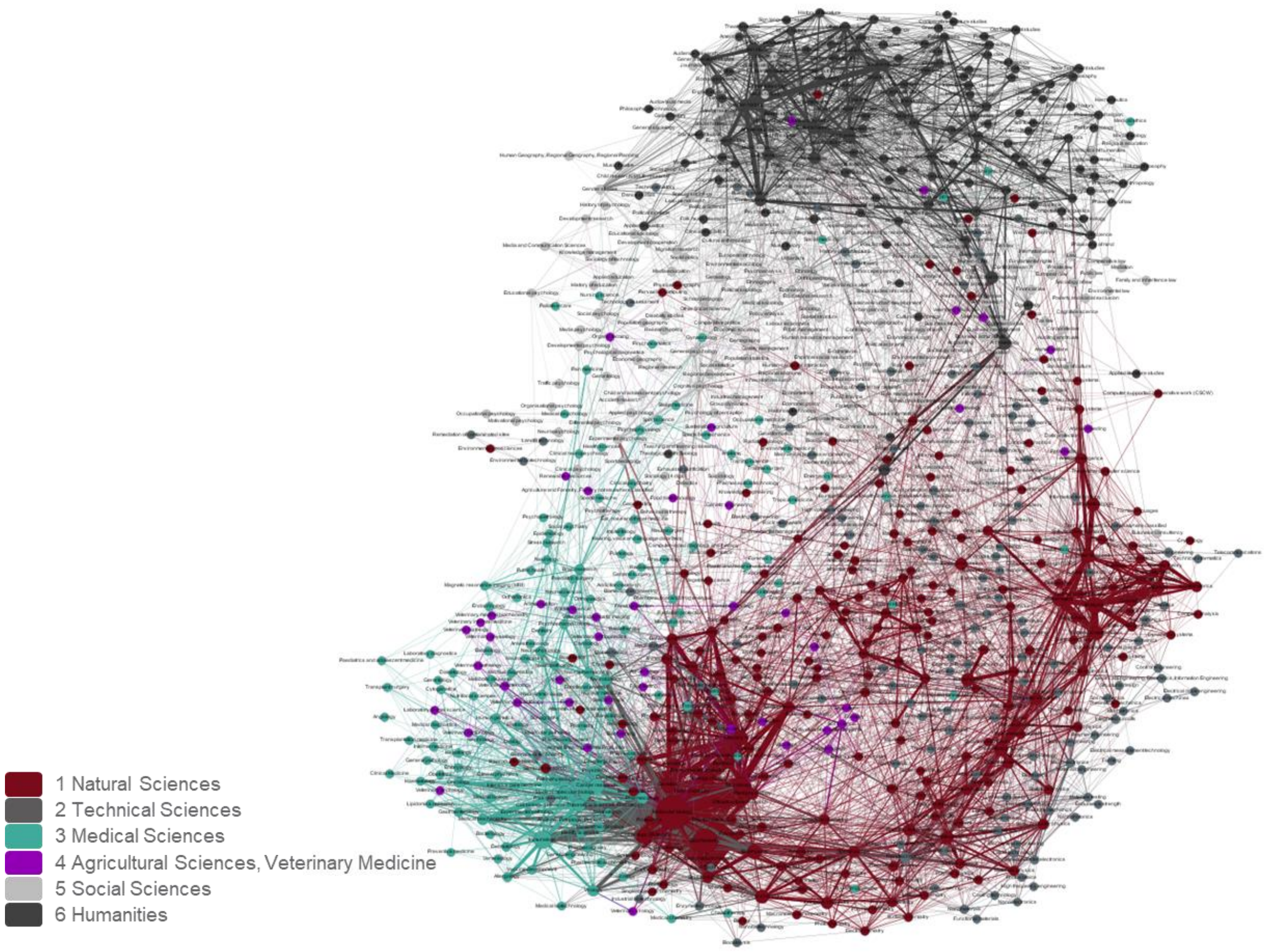
Note: nodes… scientific disciplines (ÖFOS 2012, 3-digit level); node size… number of sub-projects; node colour… scientific discipline (ÖFOS 2012, 1-digit level); edge width… number of joint sub-projects

Figure A 2: Connectedness of sub-disciplines in EPs (3-digit level)



Note: nodes… scientific disciplines (ÖFOS 2012, 3-digit level); node size… number of sub-projects; node colour… scientific discipline (ÖFOS 2012, 1-digit level); edge width… number of joint sub-projects

Figure A 3: Connectedness of sub-disciplines in EPs (6-digit level)



Note: nodes… scientific disciplines (ÖFOS 2012, 6-digit level); node size… number of sub-projects; node colour… scientific discipline (ÖFOS 2012, 1-digit level); edge width… number of joint sub-projects

10.3 Application guidelines and criteria

10.3.1 Evaluation criteria: Concept proposal

Quality of SFB research programme • Quality of research: international competitiveness, scientific innovation potential, ethical aspects • Thematic coherence and expected added value of SFB • Reflection on gender orientation in research, if relevant
Quality and composition of the team • Scientific qualification of sub-project leaders: Scientific/scholarly potential - quality and international reputation, available time resources for research • Integration of young researchers • Gender balance
Broader effects • Dissemination strategy including open access policy and science communication • Quality of such measures for visibility of the SFB, including beyond the scientific community (“public awareness”
Organization and finance • Quality of SFB organization: • Internal coherence, cooperation within SFB, appropriateness of relations between short- and long-term perspectives • Quality of network structures (communication and information processes) and framework conditions

10.3.2 Evaluation criteria: Full proposal

Overall evaluation of the SFB	Evaluation of the single sub-project

Scientific quality of the proposed project judged by prevailing international standards
• Topicality, innovation, competitiveness, gender relevance, ethical aspects (if relevant)
• Does this application belong to the best 5% you have reviewed within the last years?
	Scientific quality of the proposed project judged by prevailing international standards
	• Importance and quality of the project for the scientific community:
	    • Innovative aspects, impact of the expected results on the discipline
	    • Clarity of hypothesis and goals, appropriateness of methods and dissemination strategy
	    • Gender relevance of the research questions addressed appropriately (if relevant)

Scientific quality of the research team • International competitiveness, international cooperations, attractiveness to other top researchers, visibility, gender balance	**Scientific quality of the research team** • International competitiveness, quality of cooperation • Publication track record • Impact on the career development of researchers involved
Quality of the network structure • Internal coherence, forms of cooperation, quality of the network, appropriateness of the relation between short-term and long-term perspectives, dissemination strategy	**Quality of the network structure** • Forms of cooperation, position within the network and impact on the network • Appropriateness between short-term and long-term perspectives
Quality of the financial structure • Quality of work and time plan, financial planning, organizational structure of the SFB	**Quality of the financial structure** • Quality of work and time plan, financial planning
Quality of the commitment of the university • Degree of financial and organizational support	

Overall evaluation, open questions, recommendations	**Single project part evaluation, open questions, recommendations**
• Additional aspects that should have been addressed in the proposal • Recommendations to increase the success of the project	• Additional aspects that should have been addressed in the proposal • Recommendations to increase the success of the project

10.3.3 Questions for the Closed Session in the Hearing

The SFB project as a whole	The individual sub-projects
Research programme • Is the programme innovative and internationally competitive by addressing the topical questions? Does it belong to the best 5% of the discipline? Are there any comparable programmes or competitors? • Are the overall research questions appropriate and is the long-term perspective feasible? • Are there gender specific aspects in the research programme that are relevant? If yes, what are they and do the applicants/does the applicant address those appropriately? • Is the programme well focused, coherent and will it produce added value (=is the sum of the parts more than the individual parts)?	**Project Part – Research goals** • How important is the project for the scientific community and to which extent will it break new scientific grounds? • Are the goals of the project part well defined and is the conceptual / theoretical and methodological approach innovative and appropriate? • How important is the project in scientific terms for the SFB network?
Human resources • Is the group of researchers & scholars well prepared to implement an internationally visible centre of excellence (e.g. all relevant competences included etc.)? Is the gender balance of the group appropriate? • How would you rate the plans to integrate early stage researchers?	**Project Part Leader** • How would you describe the scientific qualification and potential of the project part leader based on his or her track record and international visibility?
Potential additional aspects • Is the actual institution hosting the SFB proposal and its infrastructure appropriate? • Are the strategies for science communication of the SFB appropriate to make the programme internationally visible?	
Organisation of the SFB • How well is the project organized internally in terms of scientific management, communication structures and information exchange? • Are presented measures to support equal opportunities for female and male researchers appropriate?	

10.3.4 Proposal rating scheme

Excellent = Funding with highest priority
The proposed research project is among the best 5% in the field worldwide. It is potentially groundbreaking and/or makes a major contribution to knowledge. The applicant and the researchers involved possess – relative to their academic age – exceptional qualifications by international standards

Very good = Funding with high priority, if resources are available The proposed research project is among the best 15% in the field worldwide. It is at the forefront internationally, but minor improvements could be made. The researchers involved possess – relative to their academic age – high qualifications by international standards.
Good = Resubmission with some revisions The proposed research project is internationally competitive but has some weaknesses, and/or the applicant and the researchers involved possess – relative to their academic age – good qualifications by international standards.
Average = Resubmission with major revisions The proposed research project will provide some new insights but has significant weaknesses and/or the applicant and the researchers involved possess – relative to their academic age – fair qualifications by international standards.
Poor = Rejection The proposed research project is weak and/or the applicant and the researchers involved lack sufficient qualifications by international standards.

10.4 Interview guidelines

10.4.1 Interview guidelines – Project coordinators

Handling of data according to GDPR

- Participation in this interview is voluntary.
- The data collected in this interview will be recorded and the main facts from the interview will be documented. The interview transcripts will be made available to the members of the project consortium only. No transcripts will be disclosed to the FWF or any other third party.
- The main findings of the interviews will be presented in the final study report, which will be made publicly available by the FWF. Privacy in the publication will be guaranteed. All findings will be presented in an anonymised form.
- The list of interviewees will be annexed to the publicly-available report.
- The data acquired in the interviews will be stored on secure servers. Data will not be used for any other purposes than the study under consideration.
- Responsible entity for the processing of data related to this survey: AIT Austrian Institute of Technology GmbH (AIT), Giefinggasse 4, 1210 Vienna; www.ait.ac.at. You can reach the Data Processing Officer under dpo@ait.ac.at. AIT Austrian Institute of Technology GmbH processes personal data in accordance with Section 2d paragraph 2 Forschungsorganisationsgesetz.

Motivation and Project characterization

1. What have been the **main motivation** for setting up a SFB project?
2. How did you choose the **composition** of the sub-projects/partners?
    - Criteria for selection
    - Relevance of national/international partners
    - How are the SFB-Sub-projects connected? Which interaction among sub-projects is needed?
3. To which extent did the SFB support **co-operation between different sub-projects** of SFBs and their participating institutions? Which mechanisms were used to facilitate this co-operation? (e.g. joint meetings, joint publications, joint use of data and research infrastructures etc., staff exchange etc…)
4. To which extent did the SFB contribute to **facilitating international co-operatio**n, which would not have happened without the SFB support? (please explain the reason, why SFB was important for allowing for this type of co-operation)
5. Which role played an **interdisciplinary approach** in the SFB in your SFB project?
    - Why was interdisciplinarity important?
    - What have been the main benefits?
    - What have been the main challenges?
6. Which role played the integration of a **gender dimension** in the SFB in your SFB project?
    - How did you cope with the integration of a gender dimension in your project? (**Research dimension** and **Human Resources** dimension)
    - What have been the main benefits?
    - What have been the main challenges
    - How satisfied were you with the requirements of FWF in this regard?
7. Which role played **outreach to other project stakeholders**, citizens, end-users, industry in this project (i.e. the third mission of HEIs in this regard)?

- Which activities have been undertaken in this regard?
- How do you assess the relevance of these activities in this regard?
- What are the main obstacles for engaging in such activities
- What have been the benefits?

8. From your point of view, what are the main outcomes/results of your SFB project?
    - Which various types of results can be expected from an SFB project?
    - Who are the direct and indirect beneficiaries?
    - Do the projects involve the right stakeholders? Is there room/need for inclusion of other stakeholders?
    - Is there a need for stronger consideration of potential users / integration of end users?
9. From your point of view, what are the main factors for making an SFB project successful?
10. How do you assess the overall structure and requirements of an SFB?
    - What Sub-Project structures vs. scaling up to bigger overarching goals
    - Length and funding
    - Gender dimension
    - Integration of young researcher
11. Is there a need for stronger **emphasis on collaborative education and PhD education** in an SFB?
12. From your point of view, what is the difference for a PhD student being engaged in an SFB vs. being engaged in a single research project?
13. Is there a scope for stronger collaboration between for e.g. combination of doctorate colleges and SFBs?

Assessment of the effectiveness and efficiency of programme implementation

14. How satisfied are you with the administrative procedures in the life cycle of the SFB – project administration?
    - Information and application rules and procedures (in concept phase, stage 1)
    - Information and application rules and procedures for full proposals
    - Information on the review outcomes
    - Annual reporting and financial reporting
    - Final reports
15. Have there been any obstacles? Where do you see room for improvement? Why?
16. Is there scope for improving the support structures provided by the FWF?
17. Have you had experiences with other programmes (e.g. ERC, other H2020 research, FFG)?
    - How do you rate the FWF-SFB experience compared with the other agencies?
    - Given the funding volume and structure of an FWF-SFB (1 project co-ordinator, up to 15 sub-projects). Is it possible, to effectively pursue the overall objectives of the programme?
18. Where are the differences between an SFB-Project and a FWF stand alone project? Consider e.g the dimensions…
    - Degree of collaboration with national / International partners
    - Differences in research process
    - Flexibility of research process

- Opportunities for PhD education etc.

Broader Effects to the Science and Research Landscape

19. To which extent did the SFB facilitate capacity building at your institution in terms of:
    - Anchoring of your research field in university strategy?
    - Attractiveness of your institute/research location for international researchers / high potential PhD students etc.
    - Increasing international co-operation potential?
    - Strengthening of the knowledge formation in the field (e.g. databases etc.)
20. To which extent did the SFB – have an influence on the university commitments for allowing bottom-up profile building at the university?
    - What were the commitments by the university?
    - Which kind of investments/contributions were made by your university?
    - Did you receive additional support for reducing teaching hours, additional investment in terms of human capacity (e.g. new research groups, additional researchers beyond SFB-funds, new professorships in related fields etc.)
    - Additional investments in research infrastructures?
21. By which means did the SFB facilitate the promotion of 1) Dissemination Strategies, 2) Exploitation plans (inhouse->patenting, start-ups, etc.…), 3) Science Communication/Public Awarness and 4) Knowledge transfer (between sectors towards industry clusters)?
    - What was the contribution of your SFB – in this regard?
    - What was the contribution of your university?
    - What was the contribution of FWF programme management?
    - What was the overall impact of your SFB when thinking of the above mentioned dimensions 1)-4)?
22. Where do you see room for improvement concerning: 1) support for critical mass, 2) research profiles, 3) science communication

Relevance and Coherence

23. From your point of view, what are key trends and requirements for a modern science system?

e.g.…

- New mission orientation / Societal challenges
- Long-term funding opportunities
- New technical advancements: methods, digital opportunities
- Open science and innovation
- Public legitimation

24. Is the SFB as a programme, apt to correspond to the needs of a modern science system?
    - Why / Why not?
    - Where is there room for improvement?

10.4.2 Interview guidelines – Policymakers and experts

Handling of data according to GDPR

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- The data collected in this interview will be recorded and the main facts from the interview will be documented. The interview transcripts will be made available to the members of the project consortium only. No transcripts will be disclosed to the FWF or any other third party.
- The main findings of the interviews will be presented in the final study report, which will be made publicly available by the FWF. Privacy in the publication will be guaranteed. All findings will be presented in an anonymised form.
- The list of interviewees will be annexed to the publicly-available report.
- The data acquired in the interviews will be stored on secure servers. Data will not be used for any other purposes than the study under consideration.
- Responsible entity for the processing of data related to this survey: AIT Austrian Institute of Technology GmbH (AIT), Giefinggasse 4, 1210 Vienna; www.ait.ac.at. You can reach the Data Processing Officer under dpo@ait.ac.at. AIT Austrian Institute of Technology GmbH processes personal data in accordance with Section 2d paragraph 2 Forschungsorganisationsgesetz.

Introduction

1. What do you associate with the SFB programme?

The orientation of the SFB programme

2. The SFB are an excellence programme aiming to establish long-term oriented research networkst hat contribute to sharpening the research profiles of involved univiersities and Austria as a location for excellent science and research. How appropriate are these objectives in your opinion?
3. The SFB aims to promote interdisciplinary research
    a. To what extent do you think this goal is relevant?
    b. (Do you think that the SFB achieve this objective? Why/why not?)
4. The SFB aims to foster gender balance and gender-oriented research:
    a. Which measaures should be taken at the level of research funding?
    b. Which measures should be taken at the level of individual research organizations?
5. What should/could be the importance of inclusion of a broader range of stakeholders such as citizens, end-users, industry, etc. in SFB projects?
    a. Which advantages/disadvantages would you see in this context?
6. Which should be the key characteristics differentiating SFB from FWF Singe projects?
    a. Degree of collaboration with national / International partners
    b. Differences in research process
    c. Flexibility of research process
    d. Opportunities for PhD education etc.
7. In your opinion, what should be the main objectives and results of SFB?

Relevance and coherence

8. Which functions in the research system do the SFB fulfill well? Why?
9. From your point of view, what are key trends and requirements for a modern science system that should be taken up by research and innovation funding? E.g.
    a. Societal challenges
    b. Attractiveness of academic careers
    c. Open science and innovation
    d. ….
10. To what extent does the SFB programme satisfy such demands?
11. Where do you see potential for change / improvement?

10.5 Participants in individual and group interviews

Name	Organization
Karl Unterrainer	Vienna University of Technology
Rudolf Zechner	University of Graz
Rainer Blatt	University of Innsbruck
Michael Jantsch	Medical University of Vienna
Peter Valent	Medical University of Vienna
Christian Krattenthaler	University of Vienna
Michael Kirchler	University of Innsbruck
Gerhard Budin	University of Vienna
Monika Dannerer	University of Innsbruck
Karl Kaser	University of Vienna
Michael Müller-Camen	Vienna University of Economics and Business
Stefan Michael Newerkla	University of Vienna
Klaus Oeggl	University of Innsbruck
Georg Plattner	Kunsthistorisches Museum
Walter Pohl	Austrian Academy of Sciences
Martin Beyer	University of Innsbruck
Nicole Boucheron	Medical University of Vienna
Thomas Decker	University of Vienna
Margot Ernst	Medical University of Vienna
Markus Hartl	University of Vienna
Dagmar Kratky	Medical University of Graz
Otmar Scherzer	University of Vienna

Christian Schmeiser	University of Vienna
Johannes Schmid	Medical University of Vienna
Uwe von Ahsen	Austrian Science Fund
Michaela Fritz	Medical University of Vienna
Lucas Zinner	University of Vienna
Ulrike Tanzer	University of Innsbruck
Kurt Habitzel	University of Innsbruck
Robert Rebitsch	University of Innsbruck
Stefan Mühlbachler	Austrian Academy of Sciences
Anton Graschopf	Rat für Forschung und Technologieentwicklung
Sabine Haubenwallner	Austrian Science Fund