Portfolio Evaluation
FWF International Programmes

Final report

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Submitted by

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Preface

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1. Executive summary

E-1. This is the final report of the Portfolio Evaluation of the Austrian Science Fund (FWF) International Programmes. The evaluation has been carried out between June 2016 and September 2017. It has been conducted by a consortium of established research and consultancy bodies comprising the Zentrum für Soziale Innovation GmbH, Manchester Institute of Innovation Research, Deutsches Zentrum für Hochschul- und Wissenschaftsforschung (DZHW, subcontractor) and Digital Science (subcontractor).

E-2. This Executive Summary is organised in four main parts and covers the following: the report and terms of reference; the methods used in preparing and analysing the evidence base; key findings; and the conclusions and outlook.

E-3. The terms of reference for this evaluation result from FWF's need and interest to review its current portfolio of activities for the support of international cooperation. FWF's portfolio of international programmes has grown over a long period. With continuous budgetary pressures, Europe moving towards a new Framework Programme and new evidence emerging about the continuing internationalisation of research, there is a pressing need (shared by research councils and funding bodies in general) to assess the performance of existing programmes and to examine the case for continuation, adaptation, modification or even closure of such activities. The FWF proposed the following questions to be addressed by the evaluation:

- Is the international funding portfolio of FWF appropriate?
- Are the design and the management of the programmes appropriate?
- What are the impacts of the international programmes of FWF?
- Should/could the programmes under discussion be continued, improved or restructured?

Sub-questions have been defined for each of these overarching questions. They are introduced in the report below.

E-4. By means of context, we are aware that this evaluation is an important one for Austria in general. Funders with a high systemic relevance, like FWF, also face challenges of coordinating the institutional mission with external goals defined by national science policy-makers. In the case of FWF, there is no formal obligation to follow national policy priorities. However, whatever strategy FWF takes in regard of international cooperation, it will always be systemically relevant in the Austrian context.

Methods Used

E-5. In order to address the evaluation questions outlined above, we have designed and implemented a multi-method approach making use of the following:

- Quantitative methods (scientometrics including bibliometrics),
- Descriptive statistics of programme use, usage rates, etc.
- Secondary data from the iFQ survey and re-analysis of that data
- Qualitative (document analysis, interviews, survey, focus group) techniques.
- The quantitative techniques played a larger role towards the beginning of the project. The qualitative techniques were used in the later in the project for additional data collection and discussion of results of the quantitative analyses.

E-6. In order to be able to assess impact and performance aspects of the international programmes, we also designed a comparison group approach. Concretely, we apply a quasi-experimental evaluation design for comparing relevant outputs of International Projects and Stand Alone Projects. The comparison group has been constructed using statistical matching techniques. The goal was to select from the set of stand-alone projects of the regular FWF portfolio a group of matching projects that would be as similar as possible to the treatment group projects.

E-7. FWF colleagues provided us with data on the international projects (I-type projects), which include: projects in bilateral programmes, lead agency procedure programmes, EUROCORES and ERA-Nets. They also provided us with data on FWF-supported joint seminars and ESF Research Networking Programmes.

E-8. In order to assess output and impact of I-type projects (in general and in relation to the comparison group), we use bibliometric techniques. Our bibliometric analysis distinguishes the performance dimensions of activity, collaboration and scientific impact. All publications published between 2004 and 2014 (that were reported by I-type projects or could be connected to them through other means) were taken into account. Due to delay between publication and inclusion into the database the publication year 2015 is not fully covered. To facilitate the analysis of publication output across fields of science, we chose to aggregate the subject classification of journals available in Web of Science at the top level of the OECD's Fields of Science classification[1]

E-9. In order to provide this study with information about the reception and use of FWF-funded publications of different funding programmes within the scientific literature, advanced citation impact indicators are calculated and analysed (mean field-normalised citation rate (MFCR) and share of highly cited papers). These impact metrics, based on citation counts, do not claim to directly measure the scientific quality but rather to which degree subsequent research is based on

[1] The labels of the fields are Natural Sciences, Humanities, Engineering and Technology, Social Sciences, Medicine and Health, and Agricultural Sciences, cf. http://www.oecd.org/science/inno/38235147.pdf

the studied publications. For the citation analysis a three year citation window was used, thus for example for publications published in 2012, citations received between 2012 and 2014 were counted. The impact analysis covers the period of 2004 to 2012.

E-10. A differentiation according to the origin of collaboration partners was introduced in order to discover differences in impact patterns of projects with difference partner nations. We distinguished between seven country groups. Furthermore, co-publications with Germany were studied as a special case, this country being the major collaboration partner of Austria. Originally, a comparison of output and impact data with overall Austrian publication performance was intended, but following discussion also with the FWF this idea was discarded as the Austrian output and the FWF-supported output cannot be distinguished adequately.

E-11. Our interview programme within Austrian institutions including FWF was conducted in February and March 2017. Eight interviews were conducted with operative, administrative and scientific project officers from all the specialist departments at FWF, representatives of the Strategy Department for International Programmes (SDIP) as well as one interview at Austrian Federal Ministry of Science, Research and the Economy.

E-12. In order to assess the evaluation questions of appropriateness and impact in more detail, we also set up an online survey. PIs from the I-type project as well as from the matching stand-alone projects were asked about their background, international cooperation experience, needs and their assessment of FWF's programme portfolio and performance.

E-13. Further data collection methods include the analysis of final reports of I-type projects as well, an analysis of unsuccessful I-type applications and qualitative interviews providing international comparison on programme management aspects of the portfolio.

Key Findings

Question 1 - Is the international funding portfolio of FWF appropriate?

E-14. FWF's international programmes mobilise and, thus, support a segment of the Austria-based research community that is able to produce high-quality output with international colleagues. In this light, we conclude that FWF contributes significantly to the internationalisation of science in Austria. At the same time, it was stressed in various discussions in the course of this evaluation that FWF's contribution cannot change systemic issues that easily (e.g. a further international opening of the Austrian research system that was considered necessary by some participants in our focus group). We also observed that the international programmes support a segment of the Austria-based research community that is already well-established. While the population of PIs in international programmes are slightly younger than stand-alone project PIs (as per 1 January

2017), they are still 52 on average. At the moment of the project start, I project PIs are 48,3 years old (P project PIs are on average 47,1 years; difference is statistically significant). They are more often in stable positions than stand-alone project PIs. Young researchers use different instruments to cooperate internationally (mobility, individual fellowship programmes, etc.).

E-15. The beneficiaries are satisfied with the international programme portfolio. 40% of the international programme beneficiary respondents (and 43% of the comparison group) state that their demand for international cooperation support is met. 49% state it is partially met (comparison group: 43%). When asked what programme types are missing, there are majorities for both bottom-up multilateral support and specific networking programmes (see above).

E-16. The international programmes at FWF are the only major basic research grants available for international cooperation in Austria. In terms of scope, the projects supported go beyond what the Ministry's Science and Technology agreements are able to fund. In their thematically open/bottom-up orientation, the programmes are also different from the international cooperation funds at EU level (e.g. in the Framework Programmes), through COST, etc. The FWF internationalisation support is therefore complementary with much of what is already on offer.

E-17. Despite the fact that the majority of respondents claims to also cooperate without specific FWF support (84%), the wish for explicit support is clear. International cooperation is possible and widely used in stand-alone projects. 62,5% of FWF stand-alone projects in the comparison group have at least one international partner. However, the intensity of the collaboration, as indicated by the PIs in their reports to FWF, is higher in the international projects. We again consider that the evidence supports the view that the internationalisation programmes of the FWF are appropriate.

E-18. The financial resources allocated to international cooperation, as part of their share in the overall FWF budget (14% in recent years), are higher than in the case of most other councils in the EU. At the same time, the increased number of international programme instruments resulted in decreasing budgets per programme. It was noted that there might be room for consolidation. In light of the demand for additional (multilateral, bottom-up) or substitute (networking support) programme instruments, additional financial resources might be required.

Question 2 - Are the design and the management of the programmes appropriate?

E-19. There is a high level of satisfaction with the FWF processes and support services around I-type projects: the programme design of the IP portfolio can be considered adequate. The various instruments are in demand and although success rates are somewhat low, they are still considered adequate by most, as are the acquisition efforts necessary in the project proposal submission.

E-20. When thinking about the appropriateness of the programme design, it is important to recall what parts of the Austria-based research community are attracted and mobilised by international programmes: The IP mobilise a part of the Austrian research community that goes beyond FWF stand-alone project beneficiaries. The PIs attracted by I projects are highly internationalised also beyond FWF support. 86% of the I project survey respondents state that they have experience with international projects that are not funded by FWF. The causality cannot be clarified here, but we can assume that the international programmes are not internationalising individuals, but are tools to continue to be internationally active. The fact that I project PIs are established scientists (80% with permanent contracts) supports this conclusion.

E-21. One aspect that the current programme design already seems to accomplish is to push or accompany researchers towards geographically new cooperation arrangements. When analysing the survey data, we had asked whether nationality or mobility experiences predetermine international project selection geographically. Apparently, they do not. Our data show that in 65% of the cases, the mobility experience and the country of the I project partner country do NOT correspond (this is, however, also the case in 64% of the comparison group respondents). In 84% of the cases, the nationality and the I project partner country do NOT correspond. Thus, there is additionality in the sense that the international programmes do not simply repeat collaboration patterns inscribed in a research CV.

E-22. As said, the data suggests that a majority of the scientific community wishes for a continuation of the current programme portfolio expanded by bottom-up multilateral as well as networking support. Among the stand-alone project PIs, support instruments for the preparation of international cooperation are also in demand.

E-23. Some survey respondents noted issues with slower processing times or different procedures at partner agencies. While this is largely out of the hands of FWF, it might be worthwhile to push for common standards and timelines (e.g. through lead agency procedures).

E-24. Among the survey respondents, satisfaction with the programme management and the information offers from FWF is high. Punctual qualitative feedback indicates that in some calls, there have been issues with a stringent timeline (e.g. if the processes at the partner agency take longer than in Austria). There are no major issues that concern FWF's management.

E-25. Some consideration might be given to the formulation of country strategies where the FWF's specialist departments could be engaged with at an earlier stage. However, to our understanding (deducting from discussion with the international strategy department), there is early-stage FWF-internal communication between the international strategy department and thematic desk officers on these topics.

Question 3- What are the impacts of the international programmes of FWF?

E-26. To assess the impact of the I programmes, this evaluation considers publication output and citation impact as well as, to the extent possible, sustainability of the collaboration. On average, every I project has reported 4.7 publications to FWF. This is slightly below the average number of publications in P projects: 5.3. However, the difference is not statistically significant. The average publication numbers in I projects vary considerably per programme type: in bilateral joint projects (excluding Lead-Agency projects), for instance, the average number of publications reported is 8.8; it's even higher for EUROCORES and lower for ERA-Nets and Lead Agency projects (team size and start date play a role here).

E-27. There is clear bibliometric evidence that the citation impact of the publications resulting from international programme-supported projects is above the citation impact of publications coming out of stand-alone projects. This result is stable over the various broad areas of science. With some variation among regions, it is also fairly stable geographically. In terms of altmetric impact, we find that there is a substantial number of international programme supported papers with impact in social media. There is a correlation between bibliometric and altmetric impact scores.

E-28. The impact of the I project outputs can also be considered in terms of sustainability (e.g. did the collaboration continue after the I project). This question was not part of the evaluation questions. Also, it is not possible at this point to establish sufficient quantitative evidence for the sustainability of recently started projects. However, we still tried to address the question of sustainability as good as possible. An analysis of publication histories of a sample of two dozens of I project PIs (those with projects starting before 2010 and with at least one mobility experience) suggests that I projects either help to continue existing collaboration patterns or introduce new ones. Moreover, 68% of IP beneficiary survey respondents with projects starting before 2010 stated that they could continue the collaboration beyond the project (29% could partly continue it).

Question 4: Should/could the programmes under discussion be continued, improved or restructured

E-29. Four scenarios were prepared in the study and discussed on two occasions with FWF. The four scenarios examined key dimensions of internationalisation programming that face the FWF in particular (a) the balance between I projects or P projects in the promotion of internationalisation (b) whether to expand country strategies (c) the balance between bottom-up and top down programming and the importance of topic choice and (d) whether to emphasise multi- rather than bi-lateral programmes. The outcome of these discussions led to a further scenario that attempted to combine desired elements.

E-30. It was as a result of this that we propose that the I programme portfolio is continued (with a focus on the lead agency procedure, which reduces programme administration), but complemented

with a new type of I programme supporting networking: a "synthesis network" scheme which would allow Austrian researchers to convene thematic (bottom-up defined) networks of researchers. With the funding coming from Austria, the centre of these networks would be in Austria. The networks would allow for flexible, demand-driven exchange of ideas, preparatory to further substantive research work leading to application for funding from a range of programmes.

Conclusions and Recommendations

E-31. The evidence we have obtained strongly suggests the FWF, in addition to continuing the present portfolio, should continue to push for multilateral, bottom-up schemes building on/expanding lead agency agreements. These can provide additional mechanisms for Austrian science, and Austrian scientists, to engage internationally with research organisations and researchers.

E-32. Our evidence also suggests that the facilitating of cooperation internationally could be achieved with a networking programme designed as a synthesis network. However, such a programme would need to be different from the EUROCORES programme, which was not entirely to the satisfaction of beneficiaries, and from other similar offerings. Such a programme would provide a springboard for Austrian researchers to form partnerships to develop research ideas that would then be taken forward with project funding, probably in multi-lateral research programmes. The criterion of scientific excellence would of course apply here as elsewhere.

E-33. Our work has not given us all the answers and some questions have been raised about which Austrian researchers benefit from the I Projects and the age at which they are successful in doing so. We suggest that more investigation is made of the age-groups which apply for I projects, and the extent to which other programmes – mainly Schrödinger and Meitner – and other funding instruments accessible in Austria support subsequent use of I projects. Another related question for follow-up is the sustainability and evolution of cooperation facilitated by I projects. While we were able to collect some initial evidence, the programme runtime (especially for the higher number of I projects in recent years) is not long enough to draw reliable conclusions. The same goes for the analysis of citation impact (again, the high number of I projects that started recently could not be considered in the analysis because there are no citable publications yet).

E-34. In a broader context, if a further opening of Austria's research landscape is a goal, other programmes such as stand-alone/P projects could also be oriented towards improving on this. Brain circulation activities (Schrödinger and Meitner programmes mainly) could also be considered for some expansion to ensure this objective is supported.

E-35. We recommend – in relation to the issue of the openness of the Austrian scientific system in terms of labour market and brain circulation – further consideration of the extent of internationalisation that is most likely to continuously ensure the high levels of scientific excellence currently achieved.

In particular we recommend an examination of how 'internationalised' scientific institutions could and should become, and what steps would be needed to achieve this. Also, for a systematic change, deploying a broad set of instruments will be necessary.

E-36. FWF should continue to consider country strategies for countries where cooperation would otherwise not work well, owing to lack of research capacity in those countries or limited scientific administrative support. The programme beneficiaries also request programmes with countries where there is cooperation going on (US, etc). FWF needs to think about how to combine this and what they manage to accommodate budget-wise.

2. Introduction I - Our understanding of the background

Scientific knowledge production is increasingly being carried out in international and collaborative settings. Several studies have pointed to the trend towards international cooperation (Science Europe/Elsevier 2013; Royal Society 2011). The share of internationally co-authored journal publications, one way of measuring collaboration, is particularly high in smaller countries like Austria (OECD 2015).

The modes of cooperation are manifold, with some leading to internationally co-authored publications. Scientists cooperate for different reasons in different forms (Beaver 2001; Bozeman/Corley 2004; Laudel 2002). These reasons and forms vary between research fields (small-scale cooperative projects with frequent face-to-face exchange versus big science in physics), career stage or institutional setting. Especially in smaller countries, international cooperation is generally perceived as an opportunity. In complex interdisciplinary and/or novel research fields, it is considered a necessity. It is thus important for funding agencies to understand cooperation requirements and how to best support them.

Other parallel trends add to the relevance of this question: First, policy rationales for collaboration become more comprehensive and broader (Trondal et al. 2003; Georghiou 1998). They can include global challenge related mission orientation as well as science diplomacy motives. This opens up opportunities, but also adds pressure to the science system both at the level of researchers and funders. As the drivers for international cooperation in policy (cf Boekholt et al. 2009) and scientific practice are not necessarily compatible, research funders like FWF need to decide to what extent support to science and basic research can be accommodated with international cooperation requirements. Secondly, resource-related considerations and requirements in novel interdisciplinary fields led to intensified cooperation and coordination at the level of research funding. Research funding is increasingly pooled internationally, e.g. at the European level (cf Reale et al. 2013, Edler 2010). In making the most out of these opportunities, funders have to find a right balance of multilateral, bilateral and unilateral funding, bottom-up and top-down funding as well as networking and project funding. They also have to decide on possibilities for facilitating international cooperation through cross-border funding flows (e.g. in the money follows researcher model) or through lead agency procedures (cf. Science Europe 2014).

With the increasing attention to internationalisation in research practice and funding, the needs for evidence and indicators enabling to measure output, outcome and impact of relevant activities also increased (Edler/Flanagan 2011). We understand the present evaluation as a valuable opportunity and effort by FWF to understand how to support the right kind of international cooperation in an appropriate way and how to balance it in the overall portfolio of the agency (keeping a focus on goals internal to science; also recognizing the separation but interdependence of the goals of research policy and the means whereby they are realized). The present study aims both to collect available evidence informing FWF's decision-making as well as to facilitate an open-minded and open-ended thinking process. In doing so, it should also help to address one of the results of the 2013 Austrian Scientist Survey (iFQ 2014) with FWF supported scientists: the perceived need for more funding opportunities for International Projects and Networks.

Austrian research is strongly interlinked with the international research environment. One indication for this is that the share of international co-publications in Austria's research output has risen beyond 60% in recent years[2]. The international cooperation activities of Austrian researchers take place in a self-organised, bottom-up fashion as well as within EU projects (Horizon 2020, etc). As far as the national support instruments go, FWF is the only funder with substantial competitive support for international cooperation in basic research.

As FWF statistics show, International Project funding has continuously increased, especially since 2013. At the same time, limited budgets require a clear programmatic priority setting. We understand that in light of these trends, there is a need for evidence-based internal programme strategy processes. This is even more the case in view of FWF's need to balance not only available budget, but the own mandate with EU trends (e.g. towards more innovation-driven research) and national research policy. Our understanding of FWF's mandate is that the crucial question is how the variety of instruments serves basic research, not innovation and not research policy. FWF is of course aware of its role in the Austrian innovation system, its foreign science policy and science policy in general. Nevertheless, its mission statement is concerned with:

- supporting the development of Austrian science and basic research
- strengthening Austria's international performance and capabilities
- developing Austria's human resources for science and research
- strengthening the country's attractiveness as a location for high-level scientific activities
- providing scholars with opportunities for cooperation
- emphasising and enhancing the interactive effects of science and research with all other areas of culture, the economy and society

FWF's international programme portfolio is therefore concerned with meeting researchers' needs while also pushing them beyond their 'comfort zone' (towards geographically new cooperation arrangements, for instance) for the benefit of their and Austria's research performance.

[2] data from scimagojr.com, accessed in September 2017

3. Introduction II - the evaluation

FWF has been supporting international cooperation through a number of dedicate instruments since 2003. The portfolio of these international programmes has grown over the years. Questions arose regarding the best possible size and scope of these programmes as well as regarding the balance of top-down vs. bottom-up funding or multilateral vs. bilateral funding. In order to provide evidence for the strategic processes, in 2016, FWF decided to contract our team for an external evaluation of the international programme portfolio. The following evaluation questions had to be addressed:

1. Is the international funding portfolio of FWF appropriate?

- Do FWF's international programmes support internationalisation of science in Austria in the best way?
- How do FWF's international programmes fit into the national and international funding landscape?
- How far do FWF's international programmes support FWF's mission?
- To what extent do FWF's international programmes fit into the entire FWF portfolio?
- Are the financial resources FWF dedicated to international activities adequate?

2. Are the design and the management of the programmes appropriate?

Programme design, e.g.

- Which measures should be taken to improve programme design?
- How can FWF meet this need of the scientific community in the best way (also in light of the results of the 2013 iFQ Survey)?

Processes, e.g.

- Are the evaluation and decision procedures fit for purpose? (E.g. problems resulting from differences in the decision making procedures of partner organisations)
- The effectiveness and efficiency of FWF international programmes, taking into account e.g. call cycles, processing time, success rates, administrative overhead, etc.?
- Which measures should be taken to improve programme management?

3. What are the impacts of the international programmes of FWF?

- Compare the output of FWF International Projects to FWF Stand Alone Projects.
- Are the international activities of FWF suitable to foster high-quality international cooperation of Austrian researchers?
- What impact do the international programmes have on the internationalisation of science in Austria?

4. Should/could the programmes under discussion be continued, improved or restructured?

Please specify pros and cons for your suggestions.

- Is there evidence for continuing the programmes in their present form?
- Is there evidence for terminating the programmes?
- Are there valid arguments for improving or restructuring the programmes?

With this focus and scope, the present evaluation is unique in its kind. To our best knowledge, no other research councils in Europe had commissioned similar evaluation studies focusing explicitly on international cooperation programmes (although some institutional evaluations considered some aspects of international cooperation). The methodology that we proposed to cover this new ground combines quantitative with qualitative methods and includes the construction of a comparison group.

4. Methodology

Approach

In order to address the evaluation questions outlined above, we have designed and implemented a multi-method approach making use of quantitative (scientometrics, descriptive statistics, secondary data from the iFQ survey) and qualitative (document analysis, interviews, survey, focus group) techniques. The quantitative techniques played a larger role towards the beginning of the project. The qualitative techniques were used in the second half of the project for additional data collection and discussion of results of the quantitative analyses.

Here is an overview of the methods and the various evaluation questions they address:

	Methodology						
Evaluation questions	Document analysis	Secondary data	Interviews	Survey	Focus group	Bibliometr/ altmetrics	Comparison group
1. Is the international funding portfolio of FWF appropriate?	√		√	√	√		
2. Are the design and the management of the programmes appropriate?		√	√	√			
3. What are the impacts of the international programmes of FWF?		√		√		√	√
4. Should/could the programmes under discussion be continued, improved or restructured?			√	√	√		

Table 1: Methods and evaluation questions

The comparison group

In order to be able to assess impact and performance aspects of the international programmes, we also designed a *comparison group approach*. Concretely, we apply a quasi-experimental evaluation design for comparing relevant outputs of International Projects and Stand-alone Projects (Austrian researchers can also cooperate internationally within these stand-alone projects with the international partners using their own funding). The comparison group has been constructed using statistical matching techniques. The goal was to select from the set of stand-alone projects a group of matching projects that would be as similar as possible to the treatment group projects with regard to the following variables:

- Start date of the project
- Gender of the PI
- Age of the PI
- Discipline
- Budget of the project

Controlling for these potential intervening variables allows us to isolate, as good as possible, the effect of the relevant independent variable: the presence or absence of explicit international cooperation support. The matching was performed in the programming language R, using the MatchIt package. The algorithm selects for each project in the treatment group a matching project for the comparison group. The goal was to find matches that are as exact as possible along the five variables mentioned. The results of the matching process were:

- For the 600 I projects in the sample, for 534 matching stand-alone projects could be found that comply with the strictest criteria chosen (exact matches at the variables discipline, start year and PI gender; approximate matches regarding the PI age and the budget)
- 20 additional projects could be found with exact matches at discipline and start year
- 37 additional projects could be found with exact matches at discipline
- 7 are matched with start year and PI gender exact, but discipline only approximately matched
- 2 projects remain unmatched

After the matching procedure, we have controlled for the PI names. We have re-matched 7 project matches where the PI of the I project and the matching stand-alone project would have been the same person.

The comparison group is used in the following analytical steps in this evaluation: in the analysis of publication output and impact; and in the survey addressing aspects from researchers' needs via their cooperation behaviour to their assessment of the FWF programme management.

Project data provided by FWF

FWF colleagues provided us with data on the international projects (I-type projects), which include: projects in bilateral programmes, lead agency procedure programmes, EUROCORES and ERA-Nets.

The data structure provides

- basic project data (table A)
- data on Austrian project partners (table B-1)
- data on foreign project partners (table B-2)
- data on the topics the projects cover (table B-3)
- data on the I projects' publication output as reported by the PIs (table B-4)
- data on contracts related to the I projects (table B-5)
- data on the track record of I project PIs (table C)

Data is provided in seven tables, linked by the key "internal_Project_ID". The data structure is as follows:

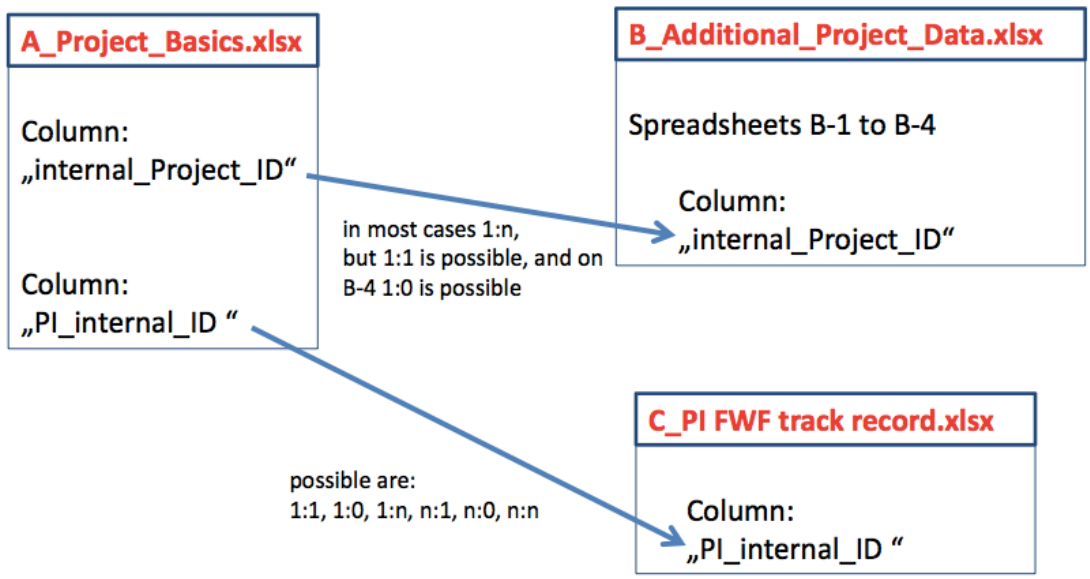

Figure 1: Data structure

FWF provided similar data for the joint seminars and the networks supported in the Research Networking Programme. For the construction of the comparison group and as a general comparative background, FWF also provided information on all stand-alone projects supported during the timeframe of this study. Data on publication output and cooperation partners in stand-alone projects was only provided for the group of matched projects. Furthermore, FWF provided information on the unsuccessful applications to international programmes.

5. Notes on the international programme portfolio and the current state of discussions

Numerous studies have observed that research is increasingly carried out in international and collaborative settings. This trend is observed both on the input (more international funding programmes) and on the output side (more international co-authorship). Internationalisation in research

is a particularly important trend in smaller countries (in Austria, for instance, the share of internationally co-authored journal publications is above 50% by now). There, researchers are more frequently required to reach out to international partners when addressing complex research questions, when using infrastructure, etc. The increasing relevance of international cooperation is not only observed, but policy-makers and funders explicitly support it (for a number of reasons including the idea that global challenges need global solutions, that access to research going on elsewhere is required, etc.).
Funders, in this context, face the challenge of providing the right set of adequately funded support instruments. They have to balance unilateral, bilateral and multilateral schemes, thematically open approaches and top-down topic selection, geographic focus regions and country strategies, etc.

Funders with a high systemic relevance, like FWF, also face challenges of coordinating the institutional mission with external goals defined by national science policy-makers. In the case of FWF, there is no formal obligation to follow national policy priorities (e.g.: the case is different from Switzerland where SNSF receives dedicated funds from a state department for the implementation of international cooperation programmes). At the same time, whatever strategy FWF takes in regard of international cooperation, it will always be systemically relevant in the Austrian context.

FWF's current portfolio of international programmes includes bilateral (joint projects supported through bilateral agreements, lead agency procedures) and multilateral (multilateral DACH projects, ERA-Nets and EUROCORES (discontinued)) instruments. It combines top-down definition of topics in ERA-Nets and some bilateral programmes (usually following a demand from the partner organisation) with thematically open, bottom-up support in most lead agency and bilateral calls as well as stand-alone projects. FWF also supports joint seminars and participated in ESF Research Networking Programmes (discontinued). As per 2017, there is no dedicated support for networking any more. The following figure summarises the programme portfolio.

	Projects	Networks
Bilateral	Bilateral programmes with European and non-European countries	Network support for workshops/seminars
Multilateral	ERA-Nets and ESF EUROCORES	ESF RNP support to meetings (discontinued)
Stand Alone projects and optimized procedures		

Figure 2: FWF's support to international cooperation

Over the period 2003-2015 (date of project funding decision), FWF invested slightly over € 134m in its international programmes. 37% of the funds are in dedicated multilateral instruments (ERA-Nets and EUROCORES), the rest in bilateral or lead agency programmes. DACH as the most important lead agency programme includes both bilateral and (a limited number of) trilateral projects.

6. Descriptive statistics

In the following, we present selected results of the descriptive analyses and discuss possible findings. The goal of this compilation of basic descriptive statistical analyses was to:

- provide relevant background information for the qualitative work in the project, and;
- extract results interesting in their own right, e.g. regarding the track record of I project PIs.

The data processing and analyses have been performed in R. This not only allowed for data exploration, but also ensures reproducibility and modularity of the analyses (project data on other project types, for instance, can be processed using the same scripts). Scripts and output tables are available upon request.

6.1. Project population

The dataset provided by FWF includes a total number of 600 distinct I projects.

.. per programme type

75 of these projects are funded in bilateral programmes, 302 following Lead Agency procedures. 144 are ERA-Net-funded projects and 77 projects have been funded under EUROCORES.

.. by network size

While 400 of the 600 projects have more than one international partner, only 311 projects are multilateral in that they involve partners from at least two different countries. This is the distribution of multilateral projects via programme types:

- Bilateral programmes: 17
- Lead agency procedure: 87
- ERA-Net projects (multilateral by definition): 130
- EUROCORES (multilateral by definition): 76

The sum here is 310. The two projects difference stems from the fact that a few projects cannot be assigned to the programme types. 23% of bilateral programme-funded projects and 30% of Lead Agency projects are multilateral.

To get a better overview on the projects funded, interactive graphics for exploration by topics and programme types were created and made available at the following pages:

- http://bibliometrics.zsi.at/studies/vis/FWF/I/Themen/
- http://bibliometrics.zsi.at/studies/vis/FWF/I/Typen/

6.2. Projects per programme type over time

The development over time shows the increasing number of I projects and a tendency (already expressed in the discussions with FWF) towards lead agency procedures and away from EUROCORES (which is discontinued). The number and share of ERA-Net funded projects have also increased.

The following charts show the number of active projects per year and programme type[3].

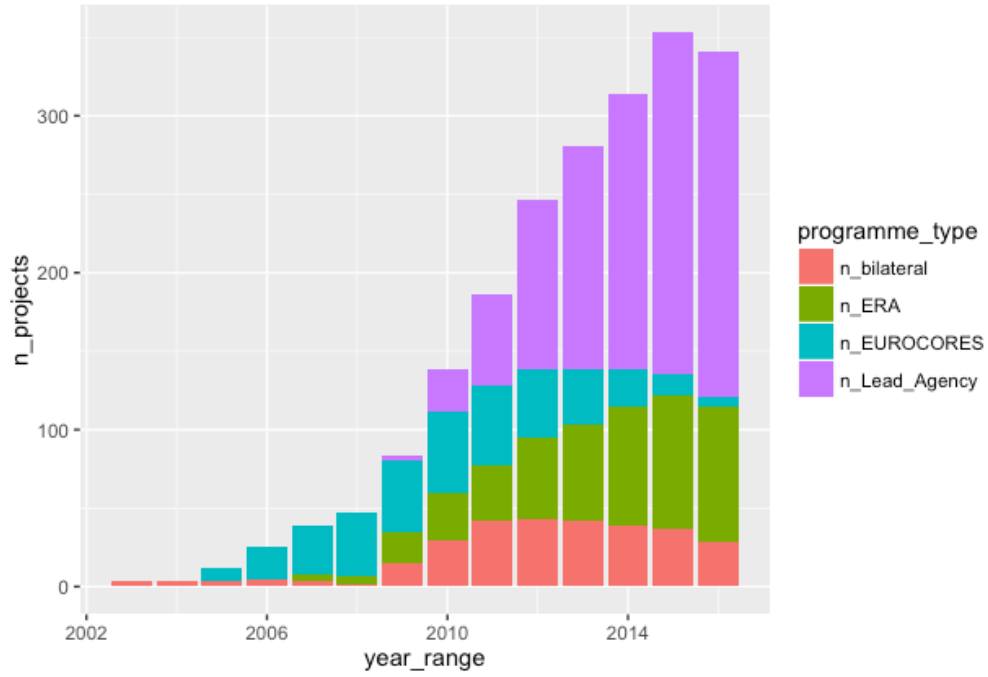

Figure 3: Running projects per year and by programme type – absolute numbers

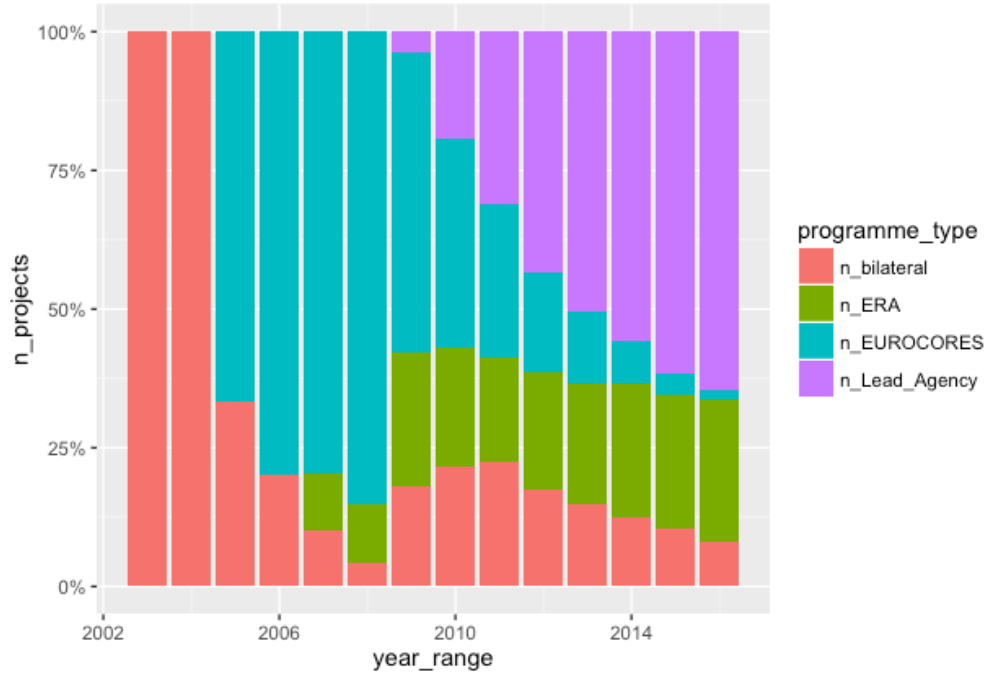

Figure 4: Running projects per year and by programme type - relative

[3] If a project has started in February of a given year, it is counted as "1" in this year. If it ended in February of a year, it is also counted as "1". That is, all years where a given project was active at some point for a given period are counted.

6.3. Programme, call and project budgets

Programme budgets

FWF has invested a total of € 134.26m in Calls and procedures supporting I project. The largest share of this sum was invested through Lead Agency procedures (€ 65.70m, 49.8%; 9 programmes). € 32.96m were invested in ERA-Nets (21 ERA-Nets, 52 Calls), € 18.92m in bilateral programmes (11 programmes) and € 16.68 went into EUROCORES Calls (29 Calls).

Programme budgets per target region (inside/outside Europe)

In order to further clarify the strategic direction the funding in FWF's international programmes, we have compared the funds going into European cooperation vs those supporting cooperation beyond Europe:

- Europeanisation: 60 programmes, 534 projects, € 118.3m
- Internationalisation[4]: 10 programmes, 65 projects, € 15.8m

Call budgets

The largest budgets for the support of I projects come from the DACH Lead Agency process (€ 43.93m over all three lead agencies) as well as from the Lead Agency processes with France (over € 10m for the Calls 2011-2015) and the Czech Republic (€ 3.72m for the two rounds 2014-2015). The largest bilateral funding calls were the ones with Russia (€ 6.12m 2008-2014). Bilateral calls with France prior to the Lead Agency agreement were also among the largest (€ 2.58m 2009-2010). The largest ERA-Net Call was TRANSCAN on cancer prevention (€ 4.58m in four calls), followed by the ERA-Chemistry Calls (€ 3.11m). FWF ERA-Net participations in BioDivERsA (biodiversity), CHIST ERA (ICTs), E-RARE (rare diseases) and HERA (humanities) were also in the order of € 2.5-3m. The largest EUROCORES Call was EuroEEFG on genomics (€ 1.56m).

Project budgets

Each of the 600 I projects has been funded with € 223.763 - on average. Differentiating this by programme type, we see that the average amount is fairly stable. Only bilateral projects tend to receive a slightly higher funding.

Programme type	Average funding per project
Bilateral	€ 248.684
ERA-Net	€ 228.893
EUROCORES	€ 216.610
Lead Agency	€ 216.397

Table 2: Programme types and funding

[4] We understand this as bilateral, lead agency and international/non-thematic ERA-Net calls (like New Indigo) with non-EU countries; EUROCORES is by definition EU-oriented.

6.4. Thematic areas of I projects

According to the ÖFOS[5] classification, the largest thematic areas in I projects are:

OFOS12.Gruppe.3.Steller	Number of projects	N of projects (fract. counts)
106*Biology	188 | 31.92%	129.21 | 21.54%
103*Physics, Astronomy	124 | 21.05%	85.14 | 14.19%
102*Computer Science	87 | 14.77%	45.6 | 7.60%
104*Chemistry	82 | 13.92%	44.65 | 7.44%
301*Medic.-Theor. Sciences, Pharmacy	79 | 13.41%	41.6 | 6.93%
101*Mathematics	68 | 11.54%	40.42 | 6.74%
302*Clinical Medicine	51 | 8.66%	25.62 | 4.27%
105*Geosciences	48 | 8.15%	27.67 | 4.61%
210*Nanotechnology	27 | 4.58%	9.38 | 1.56%
504*Sociology	26 | 4.41%	11.35 | 1.89%
502*Economics	25 | 4.24%	10.58 | 1.76%
202*Electrical Engineering, Electronics, Information Engineering	23 | 3.9%	8.4 | 1.40%

Table 3: I project Thematic Areas

As the ERA-Net and EUROCORES Calls have a top-down thematic focus, it makes sense to have a separate look at bilateral and Lead Agency Calls. The following table shows the most important fields in these two areas.

OFOS12.Gruppe.3.Steller	N of projects Lead Agency	N of projects bilateral	N of projects ERA	N of projects EUROCORES
106*Biology	81 | 26.82%	17 | 22.67%	**63 | 47.37%**	**27 | 35.06%**
103*Physics, Astronomy	71 | 23.51%	**24 | 32%**	14 | 10.53%	15 | 19.48%
102*Computer Sciences	51 | 16.89%	12 | 16%	16 | 12.03%	8 | 10.39%
104*Chemistry	47 | 15.56%	12 | 16%	19 | 14.29%	4 | 5.19%
101*Mathematics	**40 | 13.25%**	**16 | 21.33%**	2 | 1.5%	9 | 11.69%
301*Medical Sciences, Pharmacy	33 | 10.93%	8 | 10.67%	**34 | 25.56%**	4 | 5.19%
105*Geosciences	27 | 8.94%	6 | 8%	7 | 5.26%	7 | 9.09%
302*Clinical Medicine	20 | 6.62%	2 | 2.67%	**28 | 21.05%**	1 | 1.3%
210*Nanotechnology	17 | 5.63%	4 | 5.33%	3 | 2.26%	3 | 3.9%
504*Sociology	13 | 4.3%	2 | 2.67%	3 | 2.26%	**8 | 10.39%**
107*Other Natural Sciences	**12 | 3.97%**	2 | 2.67%	1 | 0.75%	NA
502*Economics	12 | 3.97%	3 | 4%	8 | 6.02%	2 | 2.6%

Table 4: Bilateral and lead agency calls

[5] http://www.statistik.at/KDBWeb/kdb_VersionAuswahl.do?KDBtoken=null&versID=10461&sprache=EN

We see that compared to the general distribution, mathematics and other natural sciences are slightly more prominent in the lead agency procedure and bilateral programmes. 'Physics and astronomy' is the most frequently appearing thematic field in bilateral programme-funded projects.

Medical sciences, pharmacy and clinical medicine are overrepresented in ERA-Net funded projects (there are more ERA-Net funded projects in these areas than there are Lead Agency procedure-funded projects although the total number of ERA-Net funded projects is 133 vs 302 Lead Agency procedure-funded projects). EUROCORES projects show a similar thematic distribution except for the much stronger presence of social science projects (sociology, psychology and political sciences), which were funded under the ECRP Calls.

6.5. PI institutions in I projects

Not surprisingly, the University of Vienna is the institution hosting the highest number of I projects. 102 I projects involved a PI from the University of Vienna (88 projects at Technological University Vienna, 61 at University of Innsbruck). When normalising the participation counts by university budgets, we see that Technological University Vienna, University of Innsbruck and BOKU[6] Vienna have the highest number of projects per budget unit. When we differentiate the institutional participation data by programme type, the results are more varied.

- In the bilateral programme projects, TU Vienna is the institution with the highest number of PIs (24), followed by University of Vienna with only 10. This possibly reflects the fact that there are (relatively) more physics and astronomy projects in the bilateral programmes than in others.
- In ERA-Nets, the University of Vienna (20) and the Medical University of Vienna (19) have so far hosted the highest number of I projects, followed by the University of Innsbruck (11). This fits the thematic focus of ERA-Net I projects on biology, medicine and pharmaceutics (see above).
- In the EUROCORES projects, the University of Salzburg (12) hosted almost as many projects as the University of Vienna (14)
- In the Lead Agency procedure, the ranking is as in the general counts (University of Vienna, TU Vienna, University of Innsbruck), but the ÖAW and the Universities in Graz and Linz hosted more projects than University of Salzburg.

6.6. PIs and track records

As said, the I project population comprises a total of 600 projects. They are coordinated by 496 unique PIs. 408 of these PIs (82.2%) are male, 88 (17.8%) female. The average age of PIs is 52.3 years as per 1.1.2017 (female: 51.0; male: 52.3; Welch test didn't show a statistically significant difference in the means). If we consider the average age at project start, I project PIs are 48.3 years old.

[6] University of Natural Resources and Life Sciences, Vienna

Each PI has an average of 1.21 I projects, but an average of 2.96 FWF-supported projects in general (the median being 2). 36% of PIs have only one (I) project. 64% of PIs have more than one project. Here is the distribution of the number of PIs with 1, 2, etc. projects.

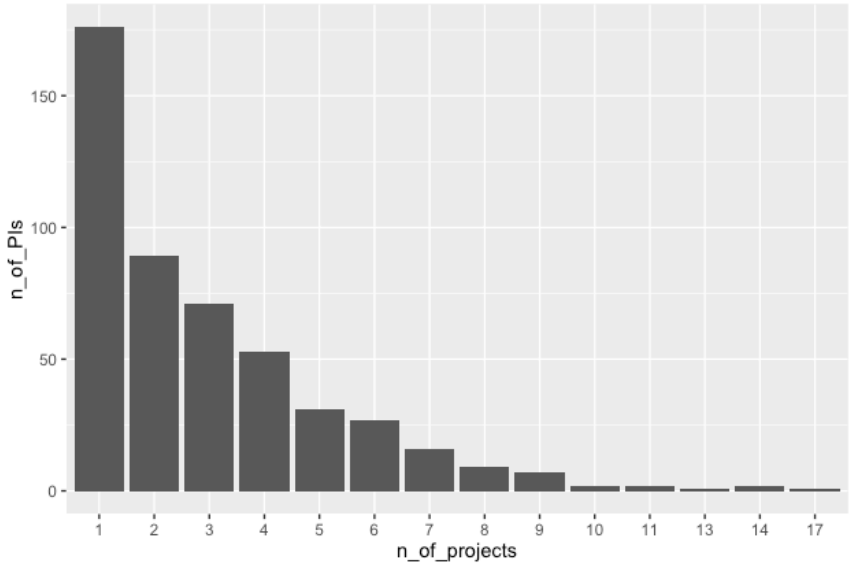

Figure 5: Number of PIs coordinating x projects

We are interested in finding out what kinds of PI acquire I project support. This is a question we can answer with the help of the data on the track record of the PIs (this could be calculated for 487 out of the 496 unique PIs). 19 of the 311 PIs with more than one project have only I projects. 85 of the 311 PIs (17% of the overall population of I project PIs) with more than one project have more than one I project. 292 of the 487 (60%) have at least one non-I project. 252 PIs have a first project that is NOT an I project. This means that of the general population of 487 unique I project PIs, 252 (52%) have a first FWF-supported project that is not an I project. In the case of 59 PIs, the first project is an I project. If we combine this number with the PIs that only have one I project (176), we arrive at the 235 PIs (48% of 487) of PIs who only had I projects (one or several) or who had others but have an I project up front.

Among the 252 PIs that have more than one FWF-supported project and whose first project was not an I project,

- 165 I project PIs had a stand-alone project (P) as their first project
- 17 I project PIs had an 'Spezialforschungsbereit' (F) project as their first project
- 12 I project PIs had a national research network (S) project as their first project
- 10 I project PIs had a translational research programme (L) project as their first project

6.7. Team size and international cooperation

In 76 of the 600 I projects (12.66%), there is another Austrian partner (with a budget share). Partnering with another Austrian institution happens across all programme types and thematic areas.

All I projects by definition have at least one foreign partner. 400 of the 600 projects have more than one foreign partner.
As to the question where the foreign partners are based, there are two distinct ways of counting international collaborations:

- By participation: Each participation is counted, i.e. if a project has 2 German partners, it is counted as 2 German participations
- By project: Each project is counted, i.e. if a project has 2 German partners, it is counted as 1 project with (at least) 1 German partner

The distinction does not change much in terms of the ranking of the most important partner countries, but it's important when interpreting the results. Here is the table with the 15 major international partner countries and the two types of counts:

Country	Number of participations	Involved in n projects
Germany	720	364
France	238	152
Switzerland	137	98
Great Britain	133	95
USA	81	56
Czech Republic	69	40
Spain	68	54
Netherlands	66	51
Italy	62	46
Russia	60	31
Sweden	44	37
Hungary	43	24
Belgium	42	33
Japan	34	16
Finland	31	28

Table 5: Involvement of partner countries

What a comparison of the two different ways of counting collaborations shows us is, for instance, that there are many projects with more than one German partner (there are German partners in 364 projects, but there are 720 German participations). The situation is similar for Japan or Russia. By

contrast, in the case of Great Britain, Spain or Finland, most projects with a partner from these countries have only one partner from these countries.

Apart from these general counts, it makes sense to differentiate the third country participations by programme type: first, because the Lead Agency procedure and bilateral programmes specifically focus individual partner countries; and secondly and relatedly, because ERA-Nets and EUROCORES projects are by definition multilateral.

This is also reflected in the team size with regard to international collaboration: Each I project has an average of 3.47 international collaboration partners.

- Bilateral projects: 2.52 international collaboration partners per project
- Lead Agency projects: 2.94
- ERA-Net projects: 3.87
- EUROCORES projects: 5.76

The EUROCORES projects mobilise the largest consortia of all programme types.

If we compare the partner countries by programme type (we count participations here; see above), we see first of all that the partner distribution reflects the available agreements:

- E.g. in the bilateral programmes, where Russian partners make up 26% of the participations (50 out of 189 participations in total). Japanese partners account for 17% of the participations, followed by Taiwanese, German and French partners (all around 9%). This corresponds to the sizeable bilateral programmes.
- In the Lead Agency projects, German partners make up more than 50% of the participations (the DACH agreement is the largest lead agency agreement budget-wise), followed by French partners (12% of participations) and Swiss partners (10%, also under DACH). Belgian and Hungarian lead agency procedures are also visible in terms of number of participations.
- In ERA-Net projects, German partners account for 29% of the participations (157 out of 557) and France for 17%. Switzerland and other non-EU countries play a minor role.
- In the EUROCORES projects, participations were more evenly spread with 19% from Germany and a stronger role of non-EU countries. France accounts for only 5% of the EUROCORES participations, Great Britain for 14% (which is more than in any other area).

6.8. Project duration

On average, I projects have a runtime of 1272 days (3.48 years). The duration varies only slightly by programme type:

- Bilateral projects: 1.337 days (3.66y)
- Lead Agency procedure projects: 1.218 days (3.34y)
- ERA-Net projects: 1.276 days (3.50y)
- EUROCORES projects: 1.413 days (3.87y)

6.9. Publication output

The full bibliometric analysis of publication output related to I projects was performed by DZHW. It is based on the publication data provided by FWF including additional records identified by the study team through the grant acknowledgements. Results can be found in the chapter on the bibliometrics analysis. Below, we present an introductors overview of average publication output per project based on the basic data initially provided by FWF. The value of this overview lies in the fact that we can differentiate the output by programme type.

On average, every I project has reported 4.72 publications to FWF (all types of publications divided by all projects also those without any publications; the only project excluded were those starting 2016 or later as they could not have produced and reported publications as per spring 2017). The numbers vary considerably by programme type:

- Bilateral projects (excl lead agency): reported an average of 8.41 publications per project
- Lead Agency procedure projects: 3.30 publications per project
- ERA-Net projects: 3.32 publications per project
- EUROCORES projects: 8.92 publications per project

The differences might be caused by team size (EUROCORES projects report a higher number of project partners) or duration (EUROCORES projects have a slightly longer duration). However, the effect of these aspects seems limited. As said, the runtime of EUROCORES is not fundamentally different and bilateral projects (excl lead agency) also have a high number of publications. The more interesting question is whether different disciplinary publication cultures are behind these differences. We have seen that biology/medical/pharma is overrepresented in the ERA-Nets, while physics/astronomy as well as mathematics is overrepresented in non-lead agency bilateral programmes(cf. table 4). So the average publication numbers per programme could be influenced by the thematic distribution of projects in these programmes. The bibliometric source data shows that among the projects that have reported at least one publication, projects in certain disciplines indeed have particularly high numbers of average publications per project: most notably informatics (15.3), informatics (15.1), physics/astronomy (10.6). Projects with a focus on biology (and at least one reported publication) show an average of 6.1 publications per project. This explains to a large degree the low average number of publications in ERA-Net projects, 47% of which are in biology (note that the average number of publications per programme is much lower than the results per discipline as they also include projects that did not report a single publication). It also explains the high average number in bilateral projects (excl lead agency), over 30% of which are in the area of physics and astronomy. The situation for EUROCORES and lead agency are less clear. The high average number of publications in EUROCORES projects runs counter the evidence that 35% of EUROCORES projects are in biology (which would suggest a lower average number of publications). In the lead agency projects, mathematics and physics/astronomy play a stronger role than in ERA-Net or EUROCORES projects. They together make up 37% of the lead agency projects. However, biology is still the strongest single field in lead agency projects. The situation is thus less clear than in the

non-lead agency bilateral projects, which are more clearly dominated by mathematics and physics/astronomy (with the two fields making up over 50% of the projects in this pillar).

6.10. Summary of key findings

Below a summarised list of key findings of the descriptive analysis:

- I projects have an average funding of € 223k and run for 3.5 years.
- They report an average of 4.72 publications.
- They have an average of 3.47 international collaboration partners.
- 9.5% of them also have a second Austrian partner (with a share of the budget).
- Over 80% of I project PIs are male.
- Each PI has an average of 1.21 I projects and an average of 2.96 projects in general (median: 2).
- 4% of I project PIs have more than one project and only I projects. 17% have more than one project and at least two I projects.
- 52% of I project PIs had a prior non-I project before, 34% of I project PIs had a P project before.

6.11. Joint seminars and research networking programmes

Between 2003 and 2015, FWF has supported 57 joint seminars (AJS) and 92 Austrian participations (90 different speakers) in ESF Research Networking Programmes (RNP). The budgets were € 382.187 for the AJS and € 3.27m respectively.

The PI population in joint seminars and research networking programmes is older than in I projects. The average age (as per 1.1.2017) is:

- I project PIs: 52.3 years (48.3 as per project start)
- AJS: 57.8 years
- RNP: 60.0 years

86% of joint seminar PIs and 92% of RNP speakers are male.

Among the institutions of AJS PIs, TU Vienna (14 of the 57 AJS, i.e. 25%), University of Vienna (11) and BOKU Vienna (9) are the most relevant recipients. In the RNPs, the University of Vienna has clearly the highest number of speakers: 30 out of the 92 (33%) RNP speakers are affiliated there. 11 of the speakers are affiliated at TU Vienna, 8 at University of Graz (all others 5 and lower).

Of the 43 unique AJS PIs, 10 also had successfully applied for I projects (20 had tried). 21 also had/have P projects. Among the 10 PIs with AJS and successful I applications, 8 had the seminars prior to the I project in/with the respective country (Japan, Taiwan, Russia…). The majority of PIs, however, have no experience with I projects and did not apply for one. More than half of the joint seminar PIs do not have P project experience, either (in the time window considered in this study). 28% of AJS PIs have neither P project experience nor tried to get an I project.

The thematic distribution of the 57 joint seminars reveals a much stronger relevance of the field of informatics in this project type. Mathematics and electrical engineering are also more strongly represented in AJS projects compared to the relevance in I projects.

OFOS12.Gruppe.3.Steller	% of AJS projects (fractional counts)	% of I projects (fractional counts)
106*Biology	12.6%	21.54%
103*Physics, Astronomy	1.9%	14.19%
102*Computer Science	22.9%	7.60%
104*Chemistry	3.9%	7.44%
301*Medical-Theoretical Sciences, Pharmacy	1.8%	6.93%
101*Mathematics	10.2%	6.74%
…		…
202*Electrical Engin., Electronics, Information Engin.	8.9%	1.40%

Table 6: Thematic distribution of the joint seminars

7. Key findings/comparison with P project population

As indicated above, international cooperation is also possible within stand-alone projects. Austrian researchers can use FWF stand-alone funding to cooperate internationally with any partner who is willing and able to secure own funding for the joint endeavour. In order to assess the relevance of this form of FWF-supported international cooperation, we have received data on the population of funded stand-alone projects in the time period of relevance for this study. This group of P projects helps to assess the parts of the Austria-based scientific community that opt for I project support in light of those supported through FWF stand-alone projects. In this chapter, we use descriptive statistics to characterise the overall population of P projects supported since 2003. The first general statistics can be calculated for the entire population. Statistics on publication output, team size and collaboration partners are calculated for the comparison group only (as we did not have this data for all P projects in the period).

The overall set includes 4230 projects and 2585 individual PIs. Of these 2585 PIs, 229 also have/had successful I projects (602 had applied for an I project).

7.1. PI institutions in P projects

As in the case of the I projects, the institution hosting the highest number of P projects is the University of Vienna (953), followed by TU Wien (395), University of Innsbruck (356), University of Graz (343) and Med Uni Wien (341).

Comparing P projects with I projects, we see that TU Wien is overrepresented in I projects (15% of all I projects, but 9% of P projects are hosted there). University of Innsbruck also hosts a slightly higher share of I projects than P projects (10% of I projects vs 8.4% of P projects). The situation is the same for TU Graz (6% of I projects vs 4.3% of P projects).

In the case of the University of Vienna, the situation is the opposite: 22.5% of all P projects are hosted there, but only 17% of I projects. The same goes for the University of Graz (hosts 8% of P projects, but only 4% of I projects), Med Uni Wien (8% of P projects vs 6.8% of I projects), ÖAW (6.8% vs 3.8%) and Uni Salzburg (4.9% vs 4.2%) also host more P projects than I projects. In the case of BOKU Wien, the shares are similar (5.5% of I projects, 4.5% of P projects).

7.2. Disciplinary distribution of P projects

The disciplinary distribution of P projects compared to I projects (fractional counting)

OFOS12.Gruppe.3.Steller	I project shares (fractional counts)	I project shares (fractional counts; thematically open programmes only)	P project shares (fractional counts)
106*Biology	21.54%	17.67%	15.64%
103*Physics, Astronomy	14.19%	16.58%	8.85%
102*Computer Science	7.60%	8.5%	5.06%
104*Chemistry	7.44%	7.8%	5.35%
301*Medical-Theoretical Sciences, Pharmacy	6.93%	5.6%	10.06%
101*Mathematics	6.74%	9.4%	6.00%
302*Clinical Medicine	4.27%	2.8%	3.79%
105*Geosciences	4.61%	5.1%	3.40%
210*Nanotechnology	1.56%	2.1%	0.92%
504*Soziology	1.89%	2.1%	2.31%
502*Economics	1.76%	1.7%	1.32%
202* Electrical Engineering, Electronics, Information Engineering	1.40%	1.5%	1.46%

Table 7: I project disciplinary distribution

Differences in the two project populations are pronounced in: Physics/Astronomy (more I projects), Medicine/Pharma (more P projects). In addition, 7.6% of P projects, but only 2.0% are in history/archaeology. 5.6% of P projects are in linguistics and literature.

Interestingly, the stronger relevance of physics/astronomy and mathematics in I projects is not due to the programmes with a top-down focus; on the contrary, it is particularly pronounced in thematically open bilateral and lead agency calls.

Obviously, the differences are partly due to the top-down thematic focus of some of the international programmes (ERA-Nets specifically). This is why we also performed a separate analysis comparing disciplinary distribution of P projects with only those I projects in thematically open calls (see table above). The analysis shows the relatively higher relevance of mathematics in bottom-up calls.

7.3. Gender and age of PIs

The gender imbalance in FWF-supported PIs is slightly less in the stand-alone projects: 78.3% of P project PIs are male (I projects: 82.1%). In terms of age, P project PIs are slightly older than I project PIs if we consider both groups as per 1.1.2017. The difference is small (1.8 years), but statistically significant.

- mean age of P project PIs: 54.1 (I projects: 52.3) → difference is significant
- minimum age of P project PIs: 28.6 (I projects: 32.4)
- maximum age of P project PIs: 93.8 (I projects: 78.8)

Interestingly, if we consider the age as per the project start date, I project PIs are older than their P project peers (48.3 years vs 47.1 years; difference is statistically significant).

We also considered age and gender together:

- mean age of female P project PIs as per 1.1.2017: 51.4 (I projects: 51.0)
- mean age of male P project PIs as per 1.1.2017: 54.8 (I projects: 52.6)
- no significant difference between male and female age means

7.4. Project duration, budgets and team sizes

The average **duration** of stand-alone projects is 1311 days, which is slightly longer than I projects (1272 days, as presented in chapter 6.8). The overall amount invested into P projects since 2003 is € 1,039.13m (in 4,230 projects). The average **budget** per P project has been **245,658.10**. Comparison: average project budget in I projects: € **223,762.50** (The Welch-test shows that the differences between the means are significant). We have seen above that there were Austrian **partners involved** in 76 of the 600 I projects (12.66%). In the P project population, this is the case in 10.78% of all cases.

Of the 598 P projects in the comparison group, 374 projects (62.5%) have at least one international partner (all I projects have at least one). 269 (45%) have more than one international partner (in the case of the I projects, this was the case in 400 projects/66.6%). 235 projects (39.3% of all P projects; 63% of those with international partners) are truly multilateral. In the case of I projects, 52% of them were

multilateral. This indicates that PIs manage to organise multilateral projects using basic project support only. They do not necessarily need dedicated support in order to be able to connect multilaterally.

7.5. Publication output

As the following figure shows, most publications report none or few publications:

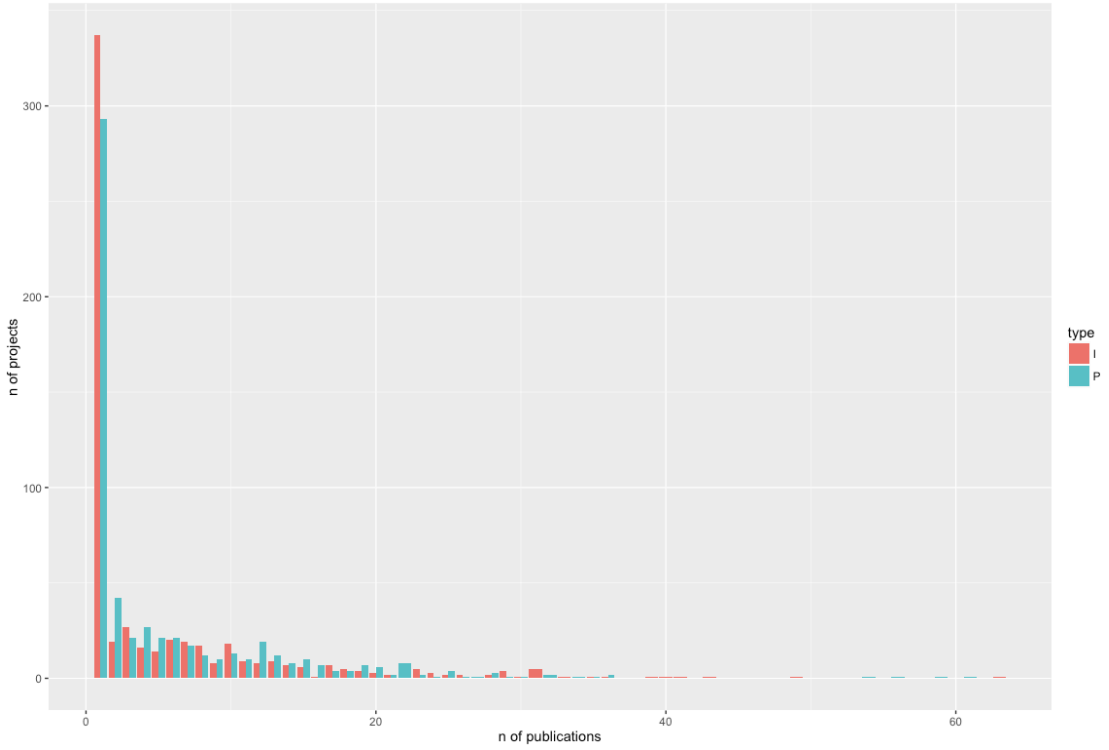

Figure 6: Number of publications (x) and number of projects (y) in I and P projects

The P projects in the comparison group report a slightly higher average number of publications per project: 5.33 “vs” 4.72 publication per project (no significant difference in means!). In the I projects, however, it’s particularly the ERA-Net and the Lead Agency projects that have less publication output. Bilateral projects in the I population have reported an average of 8.42 publications per project.

In order to investigate further whether the start date matters in this context, we extracted the P project matches for the Lead Agency projects according to their start date. We did that to test the hypothesis that the lower publication rate of Lead Agency projects is caused by the fact that they are more recent than other project formats. However, by correcting for the start-date during matching, it can be proven that also in relation to the time any of the projects had for publishing their results, the P projects are more productive than the Lead Agency projects. The resulting average number of publications shows 3.30 publications per project for I Lead Agency projects and 3.90 publications per project for the matched P projects.

7.6. International collaborations

The table below shows the most frequent international collaborations and compares the I and P projects:

Country	Involved in n projects I	% of I projects	Country	Involved in n P projects	% of P projects with int. partners
Germany	364	61%	Germany	162	43%
France	152	25%	**USA**	**126**	**34%**
Switzerland	**98**	**16%**	France	68	18%
Great Britain	95	16%	Great Britain	64	17%
USA	56	9%	Italy	44	12%
Czech Republic	**40**	**7%**	Switzerland	44	12%
Spain	54	9%	**Canada**	**29**	**8%**
Netherlands	51	9%	Netherlands	24	6%
Italy	46	8%	Spain	23	6%
Sweden	37	6%	Japan	17	5%
Russia	31	5%	Russia	14	4%

Table 8: International collaborations compared to I and P projects

If we compare this to the data above (on international partner countries in I projects), we see that the US play a stronger role in "self-organised" international participations in P projects. Partners from the US are in 34% of the P projects with international partners, but only 9% of the I projects. This is largely due to the fact that none (ignoring ERA-Nets with potentially both, US and Austrian participation) of the I programmes addresses cooperation with the US (no bilateral agreement). One conclusion from this data might thus be that there is no bilateral programme needed with the US. However, if we transfer the case of the US to the case of Germany, where Lead Agency projects tend to have higher impact publications, this could also be an argument for the establishment of a trans-Atlantic bilateral programme (programme beneficiaries also called for dedicated programmes with countries like the US). It is hard to predict whether this effect is transferable, though.

Germany-based partners are the most frequently involved in both I and P projects (involved in 43% of the P projects in the comparison group, in 61% of the I projects). Partners from Switzerland are involved in 12% of the P projects, but the bilateral/DACH arrangements seem to be more popular to engage Swiss partners: they are in 16% of the I projects. Partners from France, Great Britain, Italy or the Netherlands are likewise involved both in dedicated I projects and in P projects. Cooperation with Canada is fairly strong in P projects (Canadian partners are involved in 8% of the P projects with international partners (29 projects); but Canada is involved only in 2% of the I projects) – this might also suggest that a bilateral programme is not required (but similar to the USA case discussed above, a dedicated programme might trigger additional high-impact research and publications).

In the case of Russia, Taiwan, China and also India, international projects have led to project co-operation that have not been seen frequently in P projects (only 14 P projects with partners from Russia, 6 with partners from China, 2 with Taiwan and India-based partners).

Instead of P projects, we can also compare the geographic profile of international cooperation support in I projects with the Schrödinger fellowship host countries.

Country	Involved in n projects I	% of I projects	Destination country Schrödinger fellows	% of fellows 2011-2015	% of fellows 2011-2015
Germany	364	61%	**USA**	**109.5**	**42%**
France	152	25%	**Great Britain**	**39.75**	**15%**
Switzerland	**98**	**16%**	Germany	27.5	11%
Great Britain	95	16%	**Canada**	**14**	**5%**
USA	56	9%	Netherlands	11	4%
Czech Republic	**40**	**7%**	Switzerland	11	4%
Spain	54	9%	**Australien**	**10.5**	**4%**
Netherlands	51	9%	Italy	8	3%
Italy	46	8%	France	6	2%
Sweden	37	6%	Spain	3.75	1%
Russia	31	5%	...		

Table 9: Schrödinger fellowship host countries involved in I projects

The following spider chart (logarithmic scale) summarises the information on the geographic distribution of cooperation according to the different programmes.

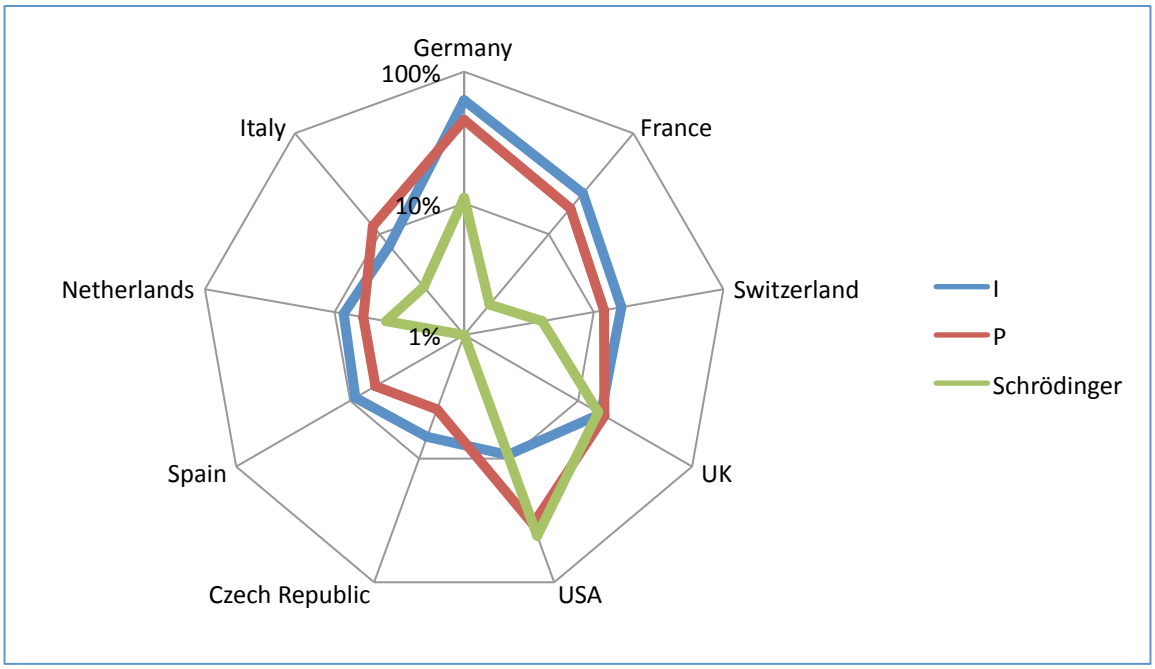

Figure 7: Spider chart: cooperation and destination countries of IP, stand-alone projects and Schrödinger fellowships

The spider chart shows, for instance, that the US is the most important host country for Schrödinger fellows, but is not prominent in I project co-operations. The Czech Republic, Spain or the Netherlands, by comparison, are fairly prominent partner countries in I projects, less so in P projects and much less in Schrödinger fellowships. France is an interesting case as it is a country of importance in project level cooperation in both I and P projects, but with almost no Schrödinger fellows going there. The situation is similar for Switzerland.

8. Re-analysis of iFQ Survey

In 2013, iFQ was commissioned by FWF to conduct a survey with FWF beneficiaries about their profile and opinion regarding the FWF support and performance. Via DZHW we have access to the data collected and could revisit it for the purposes of the present evaluation.

The original survey did not address international cooperation aspects in any detail. It confirmed, however, scientists' need for international cooperation support.

According to our descriptive statistics and survey data, I project applicants are on average slightly younger than stand-alone project PIs (the difference is small, around 1.8 years, but statistically significant). Interestingly, according to survey data at the same time more of them have permanent contracts. This is confirmed by the re-analysis of the iFQ Survey data.

The re-analysis of the survey shows a statistically significant relationship between mobility experience and FWF applicant type (no FWF applications, FWF applications without I, I applications). Austria-based researchers with research stays abroad of a year or longer have a higher propensity to apply for I project support. There is no statistically significant relationship between nationality and the propensity to apply for I project support, i.e. Austrian researchers do not apply for I projects more or less frequently than Austria-based non-Austrian researchers.

There is a statistically significant relationship between the FWF applicant type and the experience with other programmes. I programme applicants also have experience with different types of FWF programmes (more often than their peers in P projects). This result is also reflected in the survey data.

9. Unsuccessful applicants

As a second kind of comparison group, we analysed the set of unsuccessful I applications (and applicants) and compared it with the group of successful I projects and the population of P projects. For the questions to be addressed in this evaluation, the group of unsuccessful applicants to FWF's international programmes is interesting in two regards:

- In addition to the descriptive statistics (see above) and the survey (see below), it helps to shed further light on the question which parts of the Austria-based scientific community are mobilised by the international programmes.
- It also helps to address the question at what point in their careers Austria-based researchers apply for international programme support.

We have retrieved from FWF a list of all unsuccessful applications in the period we investigated (date of board decision 2005-2015, plus the earliest I projects in 2003 and 2004). With the related data on applicants, we could compare this data to the data on successful I projects. Relating the applicant data to the data on stand-alone project PIs, we were also able to show who among the I-applicants has successfully obtained stand-alone project support within the period of study. We did not have data on unsuccessful stand-alone project applications, neither on past stand-alone projects (prior to 2005).

In the period of study, there were 2109 unsuccessful I project applications (2088 in 2005-2015) plus 21 in 2003 and 2004). With 600 successful I projects, this makes an overall success rate for I project applications of 22.3%. The 2609 applications to I programmes (successful and unsuccessful) came from 1622 separate PIs (496 PIs were successful at some point). In order to learn more about these PIs, we analysed the application histories of these PIs. The main results are:

- 1125 applicants had *only negative* results
- 273 had *only positive* results
- 591 applicants had *more than one* application
- 340 applicants had more than one application with *all being unsuccessful*
- 27 had more than one application with *all being successful*

In addition to this closer look at the application profiles of successful and unsuccessful I applicants, we combined information on I applications and P projects. The results are:

- 1020 I applicants (62.9%) do NOT have P projects (i.e. 602 I applicants also have P projects)
- 1983 P applicants (out of 2585, i.e. 76.7%) do NOT have I projects

The majority of I applicants, thus, do NOT have recent experience with stand-alone projects within the period of study (for lack of data, we cannot tell whether they had stand-alone projects before 2005). This suggests that, to a certain extent, the community mobilised through I projects is different.

In order to further explore the potential overlap between the constituency of I and P project PIs, we assessed the experience with P projects for successful and unsuccessful I project PIs separately:

- among the 496 successful I applicants: 46.2% also have at least one P project
- among the 1125 unsuccessful I applicants: 33.2% also have at least one P project

This data shows two things: It confirms that the constituency of I project and P project PIs is somewhat different: more than half of the successful I applicants do NOT have P projects. It shows that the successful I project PIs have a higher probability to also be successful P project PIs. Interestingly, among the 340 I applicants with more than one and only unsuccessful I project proposals, 43.2% also had P projects. So there is a part of P project PIs who manage to acquire P projects but failed more than once in I project applications.

The main finding of the analysis of unsuccessful applications can be summarised as follows: It is not "only" the "usual" successful stand-alone project applicants who apply for (and acquire) I projects. More than half of the successful I project PIs did not have stand-alone projects in the period of study.

10. Analysis of the final reports

FWF's report templates include a number of reporting items that are relevant for the research questions of this evaluation. This includes principle investigators' information on cooperation partners in the project as well as on satisfaction with the administrative processes. FWF has supplied us with the final reports of 255 I projects and 272 P projects. We have analysed these documents with regard to the two dimensions.

Co-operations

FWF Project PIs reports include information on the type of cooperation partners (national, European, international) and the intensity of the cooperation (E1-low, E2-medium, E3-high). The analysis shows:

- a majority of the P projects have cooperation partners (only 11% report no coop. partners)
- among the P projects 77% have European partners, 51% have national partners and 46% have international partners
- among the I projects 84% have European partners, 38% have national partners and 39% have international partners
- Cooperation with European partners is thus more frequent in I projects; cooperation with national and international partners is more frequent in P projects (this reflects, among other things, the programme portfolio of I projects)

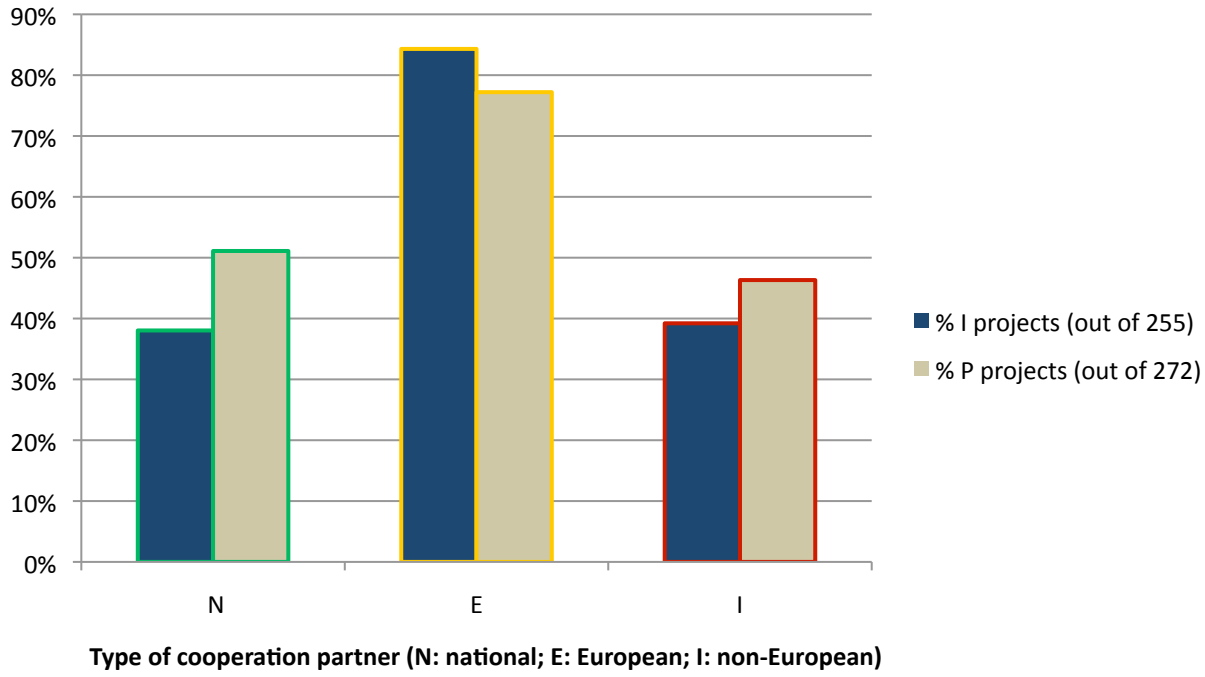

Figure 8: Projects reporting at least one cooperation partner

Regarding the intensity, cooperation in I projects is more frequently of high intensity (E3). This is particularly the case with European or international cooperation partners. 38% of I project co-operations with European partners are reported as high intensity (P projects: 29%); 40% of I project co-operations with international partners are reported as high intensity (I projects: 31%).

Satisfaction

We have analysed the final reports of I projects with regard to the statements on satisfaction with FWF services and processes. We have answers from 139 I projects on this battery of questions. The results show a high overall satisfaction with the performance at FWF. The details can be found in the following figures.

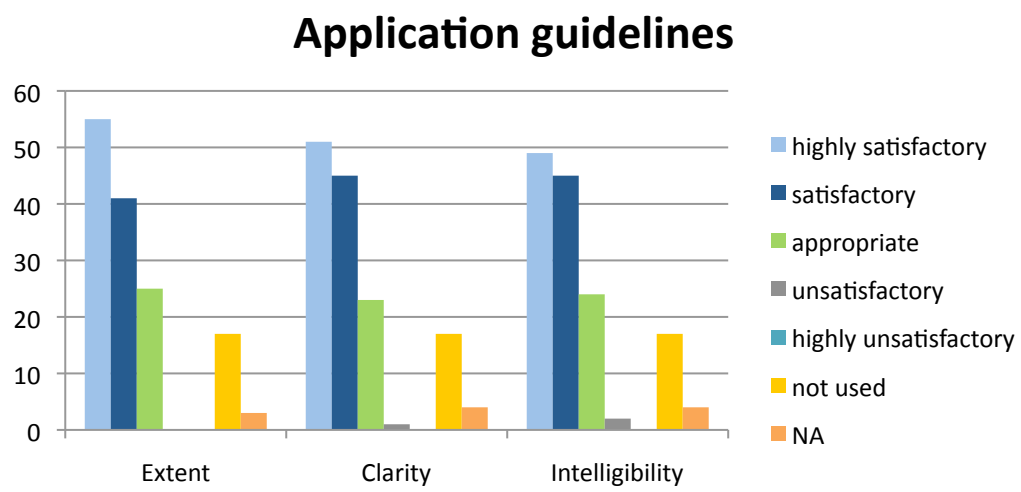

Figure 9: Satisfaction with application guidelines (volume, clarity and intelligibility)

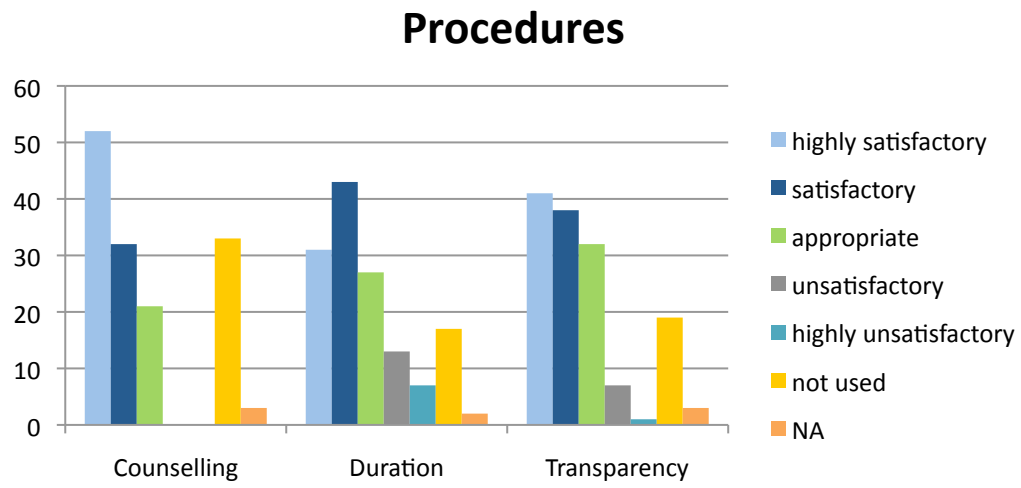

Figure 10: Satisfaction with the process (counselling, duration, transparency)

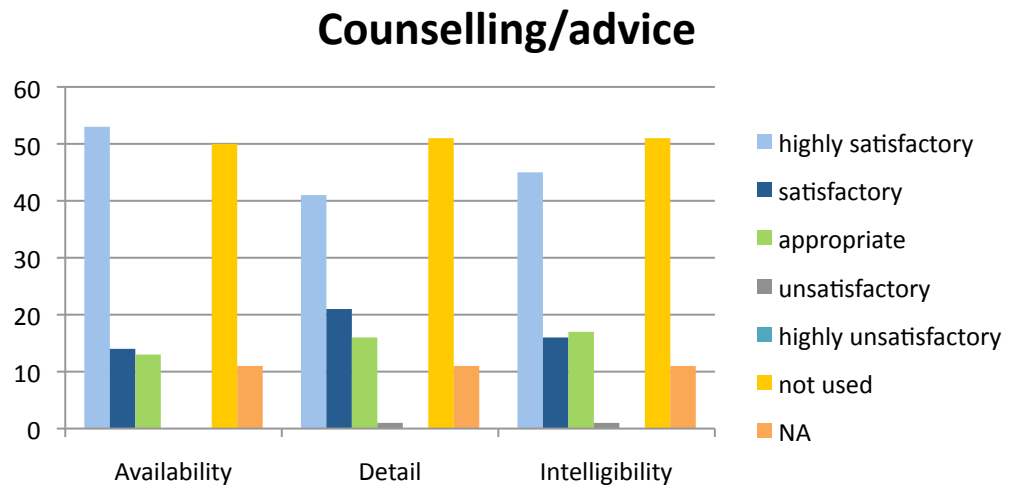

Figure 11: Satisfaction with advice/counselling (availability, elaborateness, intelligibility)

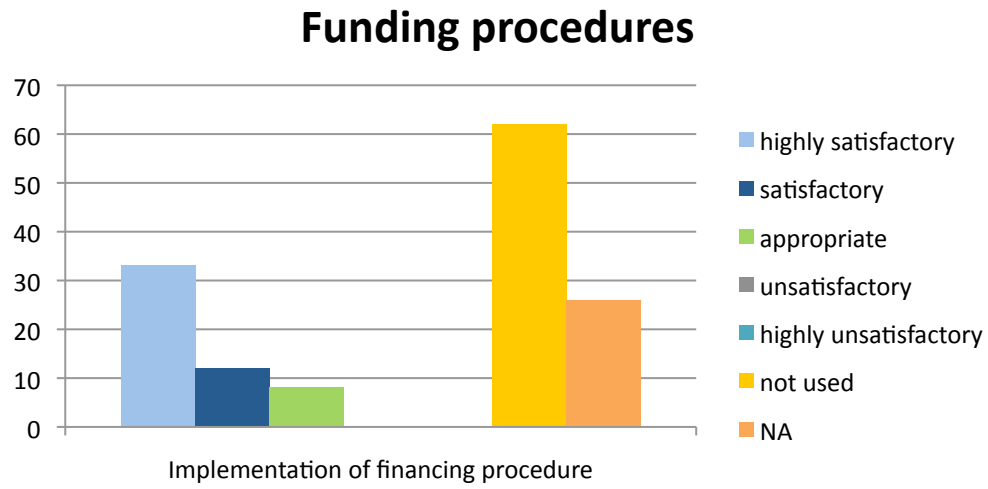

Figure 12: Satisfaction with financing procedure

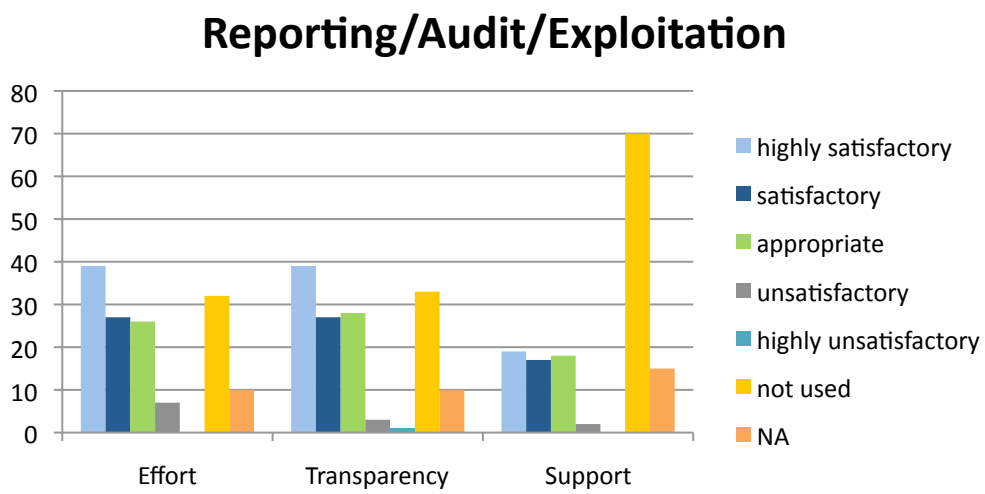

Figure 13: Satisfaction with reporting/audit and assessment/results exploitation

The main findings of the final report analysis are:

- International cooperation is frequent (in fact, it is the norm) in standalone projects.
- National and international (i.e. beyond Europe) cooperation is more frequent in standalone projects than in I projects. Cooperation with European partners is more frequent in I projects. This reflects the programme portfolio.
- The intensity of the collaboration is higher in I project cooperation, especially when it comes to third country international cooperation (both within and beyond Europe).
- Medium to high intensity is, however, still the norm (85% of P project PIs who work with international partners' state that the cooperation intensity is either medium or high).
- There is a high level of satisfaction with the FWF processes and support services around I projects

11. Bibliometric analyses

We chose to include bibliometric analyses in the set of methods for this evaluation for the following reasons:

- Bibliometric analyses of publication data relating to the international projects allows us to further investigate collaboration patterns
- Moreover, the analysis of field-normalised citation rates allows us to get some evidence on the scientific impact of the publications produced in I projects (with the usual limitations of citation counts as an impact measure)
- The construction of a comparison group (of stand-alone/P projects) and a corresponding set of publications allows us to compare the collaboration and impact figures between the two groups

The bibliometric analysis is thus particularly relevant for Evaluation question 3: What are the impacts of the international programmes of FWF? In the following the data set and methodology used are explained. Detailed results of the bibliometric analyse can be found in ANNEX I – Bibliometric analyses | Detailed results.

11.1. Data

The data used for the analysis is the publication output of I and P projects as reported by the grantees to FWF. This data was made available to ZSI. ZSI used its own Web of Science and Scopus-based data on Austrian publication output from previous studies for BMWFW to identify and improve the data received from the FWF (identifying Web of Science IDs, missing DOIs, etc.). ZSI furthermore identified additional records using funding acknowledgement data referring to relevant FWF project IDs. Web of Science IDs and DOIs were forwarded to DZHW. DZHW identified the records for these publications in their bibliometrics database and performed the detailed bibliometric analysis using the Web of Science (WOS) as contained in the in-house data infrastructure of the German Competence Centre for Bibliometrics. Further data cleaning by DZHW involved the deletion of duplicate records and the quality control of Web of Science ID and DOI data.

ZSI submitted 2118 I project publication records to DZHW. With respect to available identifier information, they were distributed as follows:

WoS ID	DOI	number of records
✓	✓	52
✓		1285
	✓	763
		18

Table 10: Records and IDs

Of these, DZHW was able to link 1414 I project publication records to WoS items. As many records only had one identifier and both identifiers were used for linking, it was also found that the original 2118 records contained 142 detectable duplicates. This means that at least 71.5 % of the submitted records were found in the database (1414/[2118-142]). The true figure could be higher because the remaining number of duplicates in the unlinked I project records is unknown.

11.2. Methods

Our analysis distinguishes the performance dimensions of activity, collaboration and scientific impact. All publications published between 2004 and 2014 were taken into account for the output and collaboration analyses. Due to delay between publication and inclusion into the database the publication year 2015 is not fully covered. For output data, all data items in Web of Science (including letters, editorials, etc.) were considered. To facilitate the analysis of publication output across fields of science, we chose to aggregate the subject classification of journals available in Web of Science at the top level of the OECD's Fields of Science classification[7]. The matching table of Web of Science classification to OECD classification is maintained by the producer of Web of Science, Clarivate Analytics. This high-level view of topics in I and P publications serves to illustrate major funding lines.

In order to study the international collaboration activity in I and P funded projects, we calculated the distribution of publications over collaborating countries as obtained from the author affiliation address data of the database records. The same data is used to calculate the share of international co-publications among all publications per analysed group (e.g. Austria, treatment group of all I projects, bilateral projects, multilateral projects and comparison group).

In order to provide this study with information about the reception and use of FWF-funded publications of different funding programmes within the scientific literature, advanced citation impact indicators are calculated and analysed. These impact metrics, based on citation counts, do not claim to directly measure the scientific quality but rather to which degree subsequent research is based on the studied publications.

For the citation analysis a three year citation window was used, thus for example for publications published in 2012, citations received between 2012 and 2014 were counted. The impact analysis covers the period of 2004 to 2012. For the impact analysis, only journal articles and reviews were taken into account. In order to enable comparisons between different funding lines, publications were differentiated depending on whether they were produced in the context of bilaterally or multilaterally funded projects (in accordance with FWF, the assignment of projects to these categories takes into account the programmes, not the number of partners). Furthermore, a differentiation according to the

[7] The labels of the fields are Natural Sciences, Humanities, Engineering and Technology, Social Sciences, Medicine and Health, and Agricultural Sciences, cf. http://www.oecd.org/science/inno/38235147.pdf

origin of collaboration partners was introduced in order to discover differences in impact patterns of projects with difference partner nations. We distinguished between seven country groups.

Country group	**Countries** (that appear in co-publications of the reference sets)
Big three	France, Germany, UK
EU South	Greece, Italy, Malta, Portugal, Spain
Europe CE	Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, FYRO Macedonia, Hungary, Lithuania, Moldova, Poland, Romania, Serbia, Slovakia, Slovenia, Turkey
Small strong	Belgium, Denmark, Finland, Ireland, Israel, Liechtenstein, Luxembourg, Netherlands, Norway, Sweden, Switzerland
Other developed	Australia, Canada, Japan, Korea, Taiwan, USA
Emerging	Argentina, Brazil, China, India, Mexico, Russia, South Africa
Developing	Cameroon, Colombia, Peru

Table 11: Country groups

Furthermore, co-publications with Germany were studied as a special case, this country being the major collaboration partner of Austria. Originally, a comparison of output and impact data with overall Austrian publication performance was intended, but following discussion also with the FWF this idea was discarded as the Austrian output and the FWF-supported output cannot be distinguished adequately. A comparison with all FWF-supported publication output was not possible because of the still limited funding acknowledgement data in Web of Science. Rather, for the purpose of this evaluation, a treatment and a comparison group (with the comparison group constructed by matching techniques) were compared in order to isolate potential funding effects.

Citation impact was assessed with the two indicators mean field-normalised citation rate (MFCR) and share of highly cited papers. In both indicators, citation counts are considered relative to those of other publications in the same field, publication date and document type. This normalisation is necessary to factor out the wide differences in citation count distributions that are the result of disciplines' different sizes, growth, and citation practices and the effects of heterogeneous functions and use of different document types. The MFCR of a set of publications is the mean of the individual publications' field-normalised citation rates. These give the ratio of the observed citation rate of a publication (i.e. its citation count) to the field's expected citation rate, which is the average number of citations of all publications in the field. Hence, MFCR above 1.0 point to average impact that is higher that of the field average. As for the share of highly cited papers, this indicator is constructed as the percentage of publications within a publication set whose citation count equals or exceeds a field specific threshold value of citations counts. In this study we use the threshold of the citations that is necessary for a publication to belong to the 10% most highly cited papers in its reference group.

11.3. Key results

The main findings of the bibliometrics analysis for the present evaluation are as follows.

In terms of output (co-authored papers), the geographical patterns of collaboration are slightly different between the treatment and the comparison group. Canada and the US feature more strongly in the comparison group, while countries like Switzerland, Russia or Japan show more frequently in the treatment group.

The average number of authors for I project publications exceeds that of P publications. While the author count in national-only publications in both group are equal, the international co-publications of I projects have 9.2 authors on average while the international co-publications of P projects (57% of all P project publications) have 7.6 authors on average. One explanation for this is that I projects (especially in programmes like EUROCORES or the ERA-Nets) involve larger networks of partners and, therefore, more co-authors.

Impact figures (both mean field-normalised citation rates and shares of highly-cited papers) are slightly higher for the treatment group than for the comparison group as the following table shows. In order to assess the statistical significance of the difference, we applied the concept of bootstrap intervals (classical tests for independence do not apply as we compare two populations rather than two samples; see annex for details). While the intervals for the field normalised citation rates show some overlap (1.6-2.1 for the treatment group, 1.4-1.7 for the comparison group), we consider the difference to be stable and consistent. There is, however, a high variation of citation counts, which suggests to continue the analysis of impacts in the future (this would anyhow be important as many of the I projects started in recent years for which no citation counts were available at the time of this study).

Impact indicator	Treatment group (I project publications)	Comparison group (P project publications)
highly cited papers (top 10% of reference set, all citations highly cited rated), 2004-2012	23.2%	15.7%
Field normalised citation rate	1.8	1.5

Table 12: Aggregate citation impact indicators

Overall, the citation impact counts show that I programme mobilise a segment of the Austrian research community that is able to produce results of significant quality. Interestingly, the differences in impact citation counts are even more pronounced when isolating the case of Germany (2.0 vs 1.5 in field normalised citation rate). This suggests that while cooperation with Germany is also strong in P projects, the I projects (DACH) produce particularly strong outputs.

The observation of high citation impact is stable over disciplines (although, given the low number of cases, we could only compare in two large areas of sciences: engineering and technology; natural sciences) and country groups (with the exception of publications with emerging country co-authors, which have lower field-normalised citation rates – 1.3; they are, however, still 0.3 points above the international average and are also in the area of field normalised citation rates of Austrian publications in general). The low number of cases and considerable overlap in co-authors from the various regions considered again suggests continued monitoring of citation impact.

For additional and detailed results, please refer to the bibliometrics part in the annex.

12. Altmetrics

In addition to the bibliometrics research, we have added a set of exploratory altmetrics analyses to the present evaluation. We do not understand altmetric impact as the major goal FWF follows in its support. Rather, altmetric impact is a possible desirable (although also potentially an undesirable) consequence of activities taken to promote FWF research outputs. The following steps were taken in our analysis:

- Available altmetrics scores were compiled for a many as possible of the DOIs in the set of I project publications.
- We asked whether there is a correlation between a paper's bibliometrics and altmetrics score.
- We explored papers with high bibliometric citation impact, but low altmetric impact and vice versa. We then discuss possible reasons for divergences in papers' bibliometric and altmetric scores (like publishers' activities and subject categories).

One key result of the analysis is that there is a considerable number of papers with high altmetric impact scores, but also many papers with no altmetric impact/social media citations (over 150 out of 647). There is a weak, but statistically significant correlation between altmetric and bibliometric impact scores in the papers we explored. The general trend of the analysis shows that papers with higher altmetric impact are papers with a higher bibliometric impact and there is a moderately strong correlation. However, there are some papers with high altmetric impact but low bibliometric impact and some which are the reverse. The number of authors, institutions or funding bodies involved does not seem to be responsible for these differences. Rather, it is publishers and subject areas that seem to play a role.

Please refer to the Annex for detailed results.

13. The survey

The beneficiaries of I programme support are an important source of information for this evaluation. We have approached them with an online survey (limesurvey) in order to assess their views on international cooperation, their experiences and assessment of the programme portfolio. In order to maximise the return rate, we have tried to prepare as much information as possible from the other data sources we had. The data provided by FWF, for instance, allowed us to keep the demographics questions we needed to ask to a minimum. The data also allowed us to tailor the survey according to the specific experience of the PI. For instance, different versions of the survey appeared depending on whether a PI was part of the treatment or comparison group. If she/he was part of the comparison group, we differentiated the survey depending on whether or not the PI had international cooperation partners in her/his stand-alone project or not. We also had different versions depending on whether PIs had both I and P project experience, etc. In addition, the survey employed conditional questions in order to show only those questions that are relevant for the specific respondent.

The survey included batteries of questions for the following dimensions:

- Demographics
- Views on international cooperation
- International cooperation experience in an FWF project (if applicable)
- Assessment of the programme management and portfolio
- Sustainability and future needs

Wherever it made sense, we addressed the questions to both the treatment group (I project PIs) and the comparison group respondents in order to be able to contrast the two groups.

We sent out 1054 survey invitations and received 645 full answers. This is a return rate of 62%. The returns by group of survey participants are:

- 367 out of 595 (62%) of the treatment group (I project PIs)
- 278 out of 459 (61%) of the comparison group (P project PIs)

Our key findings from the survey are:

- PIs of I projects are older (this confirms the finding from the descriptive statistics of the PI population) and more established (i.e. more frequently in Prof. positions; 80% have permanent contracts) than their P project counterparts.
- Beneficiaries state that they also cooperate internationally without FWF-support, but still need and benefit from explicit support schemes like the I programmes.

- I project PIs throughout the various programmes state that there was added value in the support obtained (in most programmes, 70% and more stated this). Only in the case of EUROCORES, only 53% stated there was added value.
- Another indication for the additionality of the I programmes is the following fact: In 65% of the cases, the PI's mobility experience and the country of the I project partner country do not correspond. That is, the I programmes allow cooperation with partners in countries independent of PIs' personal background.
- An indication of sustainability: Among the international programme participants, 68% of those with projects starting before 2010 claim that they could continue the collaboration with their partners.
- When asked for their need for cooperation support with specific countries, the majority of respondents point to strong research systems outside Europe (like the USA), within Europe and emerging economies as desired partner countries.
- There is a need for a funding scheme that is both, thematically open and multilateral.
- Multilateral cooperation is considered as requiring more effort, but the effort is considered appropriate given the added value of multilateral forms of cooperation.
- There is a need for networking support schemes.
- A majority of P project PIs also ask for support in the initiation of international cooperation
- Beneficiaries show a high satisfaction with FWF support and programme management. This is independent of PI age.
- The application effort and success rate is acceptable for most. In the case of the success rate, the results are ambiguous, however: 49% consider it low or very low.
- Overall, 84% of I project PIs who responded to the survey would apply again.

A detailed presentation of the analysed survey data is presented in ANNEX III – Survey | Detailed results.

14. The interviews

In order to appropriately address evaluation questions dealing with the appropriateness of the IP portfolio and the programme management, we had proposed a set of semi-structured expert interviews with FWF staff and ministry stakeholders.

In February and March 2017, eight interviews were conducted: 6 interviews with operative, administrative and scientific project officers from all the specialist departments at FWF (Biology and Medical Sciences, Humanities and Social Sciences, Natural and Technical Sciences), one group interview with representatives of the Strategy Department for International Programmes (SDIP) as well as one interview with the person in charge for the FWF at the Austrian Federal Ministry of Science, Research and the Economy.

The first conclusion that we draw from the interviews is that there seem to be no major problems in the programme management within FWF, nor in the relation of FWF to the responsible Ministry contact. The internal processes at FWF seem to be fairly smooth and well rehearsed. Interviewees pointed out that the expansion of the IP portfolio, with a higher number of Calls, can be a challenge (especially when the funding mobilised is relatively low). However, the strategy department is aware of that and also tries to favour substantial long-term agreements over one-off activities with limited budget. The specialist department interviewees acknowledge that programme management processes become easier if Calls with the same partner agencies are repeated regularly.

Also, the general approach towards IP programme design is helpful in this regard: the idea is that international projects work as similarly as possible to stand-alone projects. This limits the administrative burden on the side of FWF as well as the applicants' efforts.

In consideration of this principle, interviewees considered lead agency procedures as particularly efficient (as parts of the administrative burden occur only in one agency). Multilateral arrangements, by contrast, are considered to be more work programme management-wise. Additional efforts can be kept minimal in wherever multilateral arrangements take the form of a grouping of lead agency procedures among similar agencies (like in the case of DACH). If beneficiaries call for more bottom-up multilateral schemes, as we have seen from the survey, grouping lead agency agreements is therefore the most promising way ahead.

Interviewees pointed out that international cooperation works differently in different scientific fields (due to differences in the publishing culture, salience and relevance of international cooperation, etc.). This can pose challenges for programme design. From our analysis, however, it seems that the bottom-up (i.e. thematically open) approach that FWF favours wherever possible seems to be a reasonable solution for this potential problem. FWF provides a framework for cooperation with certain countries and leaves it to the scientific community to decide in what fields cooperation with colleagues in this country is worthwhile.

One challenge for this approach lies in the partner agencies: Often, they favour a top-down (i.e. pre-defined topics) over a bottom-up approach or have a different mandate (e.g. regarding basic vs applied research). While this problem is unlikely to disappear, sharing the experiences with bottom-up lead agency agreements within Europe might push other agencies currently not using this kind of instrument to do so in the future.

This point shows one more finding that was highlighted in the interviews: The international programme portfolio, especially its thematically open/bottom-up elements are unique in the Austrian and, partly, the EU context. There are no other agencies or EU programmes offering support like this.

The detailed data collected in the course of these interviews results answers to the overall evaluation questions can be found in ANNEX IV – Interviews at the FWF | Documentation.

15. Country strategies in international programme portfolios: international comparison

15.1. Initial Observations

It is a truth almost universally acknowledged that *the development and dissemination of scientific knowledge knows no bounds and proceeds more quickly without barriers*: internationalisation is inherent in scientific activity. To learn from the activities of other research councils elsewhere in Europe, a number of interviews were sought with key individuals that would provide evidence to help us answer the research questions outlined in our terms of reference. The central questions for countries and their research supporting agencies is how much internationalisation of science can they support and how should internationalisation be managed? We asked questions and received insights from our interviewees on the following aspects of scientific internationalisation policies and programmes.

- The balance between national and international activity in a national research system.
- What does the internationalisation of science require: we consider this by using a framework which outlines what researchers wish to do, and how research councils support them.
- We then consider the main organisational competences required of research councils to support scientific internationalisation activities.

We present our findings in brief below. We do not quote our interviewees.

15.2. Analysis and Findings

Balance

All countries face the issue of how much to open their programmes internationally. All countries consider that internationalisation is essential to ensure the excellence of knowledge they produce, all countries pursue internationalisation of research but do so to different extents. Larger countries may open more of their main grant awarding programmes to international collaboration than smaller ones although the UK appears an outlier here in limiting this. The UK's very large international presence - and the extent to which UK researchers already work with international organisations - ensures that the UK does not need to engage to the same degree through formalised programmes. France spends around 25% of its research budget through ANR on international cooperation, the Academy of Finland 10% of its basic funding instruments[8] (while international cooperation is possible in 65% of the Academy's spending, 10% or € 14m are spent on explicit international cooperation funding schemes), while FWF's share is around 14%. The extent of internationalisation is closely related to the issue of focusing, see next but one paragraph.

[8] http://www.aka.fi/globalassets/30tiedepoliittinen-toiminta/kv-toiminta/aka_int_policy_background_memo.pdf, p. 38

The focusing of the internationalisation of the research of a country is best seen as taking place at some point on a spectrum with, at one extreme, no control and complete openness of the research on one side, while at the other extreme, the total direction of topic/field, country, and research partner on the other is organised.

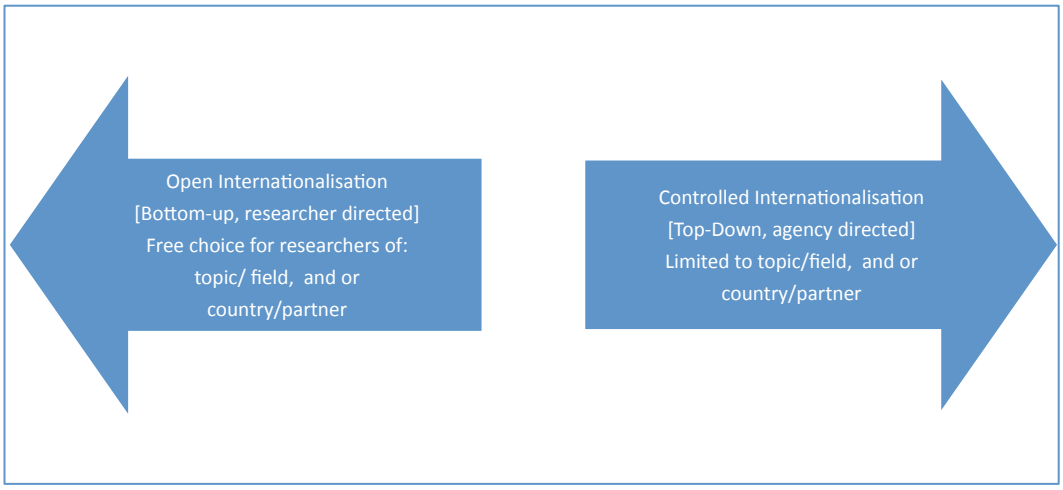

Figure 14 Control Spectrum

On the controlled internationalisation side of the spectrum, a whole range of focusing might take place. Bi- and tri-lateral programmes – negotiated with particular countries of which all our interviewed countries have examples, may include programmes with or without topic prescription. But project calls issued within particular country agreements do not necessarily have to include all countries that are party to the agreement, for example the Framework Programmes of the EU, or ERA-NETs.

A tri-partite subdivision of internationalisation can be observed operating within our countries surveyed. We suggest this is the *research motivation*. We term these types of *research motivation* Types A, B and C.

A. Open – and excellence focused internationalisation where the objective is to work with the best scientists in the world wherever they are.
B. Strategic or thematic research where goals are international as they are in the case of the so-called global challenges or grand challenges – global warming, climate change mitigation, migration – require an international response – problems have international dimensions; this is efficiency and quality justification – critical mass is a justification here; such projects are evaluated against the first type of projects. Such relationships formed at country level are often formalised by MOUs and may have expiry dates set or not.
C. Science diplomacy – here international collaboration takes place to create stronger ties between countries – these ties can be political, social or cultural – as well as scientific (which they are de facto).

All research councils we talked to experienced pressure to operate internationalisation in these ways and to have schemes in place to provide these forms.

Meeting the Needs

Researcher activities, which have an international dimension, and the research councils' responses to them, are listed below in the table. In the left hand column of the table, we consider the needs of researchers and then outline the research council responses. In our final section we list the research council responses, and on the basis of the interviews we have conducted, we identify the key expertise and competences needed for research council action to be perceived to be successful. We underline these observations.

We should note that every type of research council response of the eight main forms listed may have a country focus or not. Whether it does have a location focus (country/region/institution) will depend upon the research motivation (Types A, B or C).

Researchers Activities	**Research Council Responses**
Locating partners with whom to work (identifying capability)	Defraying search costs
Providing opportunities to establish working relationships	Supporting the creation and maintenance of connections
Formulating research proposals	Focusing activities
Submitting research proposals	Proposal review (international peer review)
Conducting research (performance and capability development)	Funding the performance of research (also infrastructure and mobility)
	Project monitoring – formative evaluation
Personal contacts/networking	Supporting mobility
Publication and dissemination	Supporting access to research
Self-evaluation	Evaluation of research – summative evaluation

Table 13: Researcher activities and research council responses

Research Council Priority Expertise and Competence

Defraying search costs

To an extent, modern technology in the form of information and communication technologies are solving the problem of identifying potential research partners. It is only in very rare cases that researchers need research councils to assist them in this area.

Supporting the creation and maintenance of connections

Here research councils have a very important role for play for researchers at all stages of their careers. Support efforts of councils should not be confined to early career researchers only. Circulation is regarded as a highly desirable feature of scientific internationalisation. We refer to circulation ("brain circulation") as home country researchers moving out and returning, and to international researchers

moving in and then back to their respective home country. The smaller the country, the more important is the need for the circulation of home country scientists out and back. The attractiveness of the country and is geographical location is also important. Peripheral countries are concerned that their location discourages circulation into their country from international researchers. A country with a marginal location (Finland) asserts this as a priority area.

Focusing activities

Focusing research where the research motivation is strategic / capacity building or science diplomacy is a very common practice. All councils practice all forms. In all countries there can be pressure to create / focus scientific research for diplomatic reasons. Research councils must anticipate this politically legitimate pressure, but must guard against the risk that at some point low returns to scientific investment may result.

Councils believe that focusing can be the key to the development of capability in certain areas where national strengths are low and where research problems need capabilities drawn from a wide geographical and topic area. Councils need the expertise to conduct and manage focusing processes so that calls define a topic area with a high chance of eliciting relevant high quality research. Field experts take priority in the focusing process, with country choice secondary – and dependent upon topic selection.

Proposal review

All RCs consider international peer review as essential to secure the reputation of their programmes/ initiatives. However, in practice, while lead agency agreements might exist, giving responsibility for peer review to one country in a bi- or multi-lateral programme, verification / auditing processes must exist, with the right for an RC to appeal a decision. RCs need the capacity to challenge decisions made in other countries. In the case of some lead agency agreements, there should not be any circulation of the responsibilities of peer reviewing and evaluation as not all country parties have the capacity to conduct these activities to the necessary standard.

Funding the performance of research (also infrastructure and mobility)

Funding of the direct and indirect costs of research (including infrastructure) is the main activity of councils. The research motivation defines the call. We note that research councils may very occasionally find that research appears to be more cost-effective to off-shore. Councils may avoid the risk of this by requiring other countries to use similar cost-models (salary and other cost measures).

In the current crisis period, councils justify funding research internationally by emphasising to stakeholders and other interested parties that international collaboration is a cost sharing activity that allows research to be attempted that would not otherwise occur.

Project monitoring – formative evaluation

This sensitive issue applies during longer projects where it may be necessary to suspend international partners from participation or modify their role(s). It was not possible in this evaluation to discuss how councils address this issue. This might be an item for future interview-based analysis.

Supporting access to research

Researchers vigorously promote their scientific work through cultural (Mertonian) norms/ strategic (Latourian) citation. Open access further assists with dissemination. However, our discussions with councils did not cover this issue in detail. However, the importance of the English and Chinese languages should not be under-estimated as these are important languages of scientific communication supporting collaboration (in the first instance) and dissemination of research (in the second).

Evaluation of research – summative evaluation

Researchers attend closely to the scientific and other impacts of their research. But Councils may not always extensively monitor the scientific impact of bilateral programmes. Bilateral programmes which result from Type C research motivation may continue to exist even when scientific activity has stalled. Bilateral programmes should be subject to similar evaluation standards.

16. Conclusions with regard to the evaluation questions

In this chapter, we first want to summarise the findings presented above in light of the evaluation questions. The following dimensions will be at the centre of the discussion: additionality, appropriateness, quality, impact, sustainability.

16.1. Is the international funding portfolio of FWF appropriate?

Do FWF's international programmes support internationalisation of science in Austria in the best way?

FWF's international programmes mobilise and, thus, support a segment of the Austria-based research community that is able to produce high-quality output with international colleagues. In this light, we conclude that FWF's international programmes contribute significantly to the internationalisation of science in Austria. At the same time, it was stressed in various discussions in the course of this evaluation that FWF's contribution cannot change systemic issues that easily (e.g. achieve a further international opening of the Austrian research system). Also, the international programmes seem to support a segment of the Austria-based research community that is already well-established. Young researchers use different instruments to cooperation internationally (mobility, individual fellowship programmes, etc.).

The beneficiaries' view of the appropriateness of the portfolio reveals an impression of overall satisfaction with opportunity for fine-tuning. 40% of the international programme beneficiary respondents (and 43% of the comparison group) state that their demand for international cooperation support is met. 49% state it is partially met (comparison group: 43%). When asked what programme types are missing, there are majorities for both bottom-up multilateral support and specific networking programmes (see above).

How do FWF's international programmes fit into the national and international funding landscape?

The international programmes at FWF are the only major basic research grants available for international cooperation in Austria. In terms of scope, the projects supported go beyond what the Austria's Scientific & Technological Cooperation ("WTZ") agreements are able to fund. In the thematically open/bottom-up orientation, the programmes are also different from the international cooperation funds at EU level (e.g. in the Framework Programmes), through COST, etc.

How far do FWF's international programmes support FWF's mission?

The international programmes support FWF's mission of "international orientation". The international programmes can also be seen as supporting other aspects of FWF's mission, e.g. the support of the development of Austrian research (through linking up with international partners) or the strengthening of Austria's attractiveness as a research location.

To what extent do FWF's international programmes fit into the entire FWF portfolio?

Despite the fact that the majority of respondents claims to also cooperate without specific FWF support (84% as stated above), the wish for explicit support is clear. As discussed above, international cooperation is possible and widely used in stand-alone projects. 62.5% of FWF stand-alone projects in the comparison group have at least one international partner. However, the intensity of the collaboration is higher in the international projects (45% consider it highly intensive vs 35% in the comparison group). The analysis of final reports suggests that collaboration in P projects is more frequently of higher intensity when it comes to non-European countries. One reason for this might be that non-European cooperation in P projects often means cooperation with the US, Canada, etc., while in the I projects it often involves Asian countries where one might expect a (still) weaker cooperation intensity. The demand for explicit international cooperation support has also been made clear in the survey. The international programmes, thus, are an important part of the general FWF portfolio, which proves attractive to the research community (as the application numbers show).

The international programmes can also be considered complementary to the individual fellowship programmes (e.g. Schrödinger). The analysis of the geographic networks of cooperation and mobility also shows that I projects serve cooperation with a somewhat different set of countries compared to P projects and Schrödinger mobility).

Are the financial resources FWF dedicated to international activities adequate?

As part of their share in the overall FWF budget (14% in recent years), in the interviews, the financial resources were assessed as higher than in the case of most other councils, although our data suggests that at least in France and Finland the shares are higher (See chapter 15.2). At the same time, the increased number of international programme instruments resulted in decreasing programme budgets. It was noted that a further diversification of budget-wise small I programmes should be avoided.

In light of the demand for additional (multilateral, bottom-up) or substitute (networking support) programme instruments, additional financial resources might be required.

16.2. Are the design and management of the programmes appropriate?

Programme design

Which measures should be taken to improve programme design?

The programme design of the IP portfolio can be considered adequate. The various instruments are in demand. Although success rates are somewhat low, they are still considered adequate by most, as re the acquisition efforts necessary in the project proposal submission.

When thinking about the appropriateness of the programme design, it is important to recall what parts of the Austria-based research community are attracted and mobilised by international programmes: The IP mobilise a part of the Austrian research community that goes beyond FWF stand-alone project beneficiaries. The PIs attracted by I projects are highly internationalised also beyond FWF support. 86% of the I project survey respondents state that they have experience with international projects that are not funded by FWF. 84% state they also cooperate internationally without specific FWF support. The segment of the Austria-based research community that is attracted by IP can be considered, thus, highly internationalised. The causality cannot be clarified here, but we can assume that the international programmes are not internationalising individuals, but are tools to continue to be internationally active. The fact that I project PIs are well established scientists (80% with permanent contracts) supports this conclusion.

Another important finding to keep in mind: 68% of respondents (treatment group) state that their I project cooperation built on past joint work.

One aspect that the current programme design already seems to accomplish is to push or accompany researchers towards geographically new cooperation arrangements. When analysing the survey data, we had asked whether nationality or mobility experiences predetermine international project selection. They do not. Our data show that in 65% of the cases, the mobility experience and the country of the I project partner country do NOT correspond (this is, however, also the case in 64% of the comparison group respondents). In 84% of the cases, the nationality and the I project partner country do NOT correspond. Thus, there is additionality in the sense that the international programmes do not simply repeat collaboration patterns inscribed in a research CV.

How can FWF meet this need of the scientific community in the best way (also in light of the results of the 2013 iFQ Survey)?

As said, the data suggests that a majority of the scientific community wishes for a continuation of the current programme portfolio expanded by bottom-up multilateral as well as networking support. Among the stand-alone project PIs, support instruments for the preparation of international cooperation are also in demand.

Processes

Are the evaluation and decision procedures fit for purpose? (E.g. problems resulting from differences in the decision making procedures of partner organisations)

Some survey respondents noted issues with slower processing times or different procedures at partner agencies. While this is largely out of the hands of FWF, it might be worthwhile to push for common standards and timelines (e.g. through lead agency procedures).

Effectiveness and efficiency of FWF international programmes, taking into account e.g. call cycles, processing time, success rates, administrative overhead, etc.

Beneficiary satisfaction is high in view of all these items. The low success rates are reason for concern for some, but are still considered appropriate by a majority.

Which measures should be taken to improve programme management?

Among the survey respondents, satisfaction with the programme management and the information offers from FWF is high. Punctual qualitative feedback indicates that in some calls, there have been

issues with a stringent timeline (e.g. if the processes at the partner agency take longer than in Austria). There are no major issues that concern FWF's management.

Fine-tuning might be useful with regard to internal decision-making on things like country strategies (bring in the specialist departments at an earlier stage in a suitable way). However, to our understanding, there are FWF-internal forums for early exchange on these topics.

16.3. Are the impacts of the international programmes of FWF the design and management of the programmes appropriate?

Compare the output of FWF International Projects to FWF Stand Alone Projects.

On average, every I project has reported 4.7 publications to FWF. This is slightly below the average number of publications in P projects: 5.3. However, the average publication numbers in I projects vary considerably per programme type: in joint projects (excluding the Lead-Agency projects), for instance, the average number of publications reported is 8.4; it's even higher for EUROCORES and lower for ERA-Nets and Lead Agency projects (team size and start date play a role here).

Additional issues related to quality: The competition for I projects is considerable. In the period there were 2109 unsuccessful I project applications. With 600 successful I projects, this makes an overall success rate for I project applications of 22.1%. The 2609 applications to I programmes (successful and unsuccessful) came from 1622 separate PIs. 1125 applicants had only negative results. 602 I applicants (37.1%) also have P projects. Among the successful I applicants, 46% also have P projects. 1020 I applicants do not have P projects.

Are the international activities of FWF suitable to foster high-quality international cooperation of Austrian researchers?

There is clear bibliometric evidence that the citation impact of the publications resulting from international programme-supported projects is above the impact of publications coming out of stand-alone projects. Over the period of time considered in this study (2004-2012 for the impact data), the mean field-normalised citation rate is 1.8 for publications assigned to I projects and 1.5 for the publications in the comparison group (see annex for an assessment of the statistical significance of this difference). As far as out data goes, the observation of higher citation impacts in I project publications is stable over the broad areas of science. While there were too few cases for a detailed analysis of disciplines, we could confirm that the differences are visible in the natural sciences (1.8 vs 1.5 field-normalised citation impact; 22% vs 15% highly cited) and even more pronounced in engineering and technology (2.0 vs 1.4; 16% vs 4%). For areas like social sciences or medical sciences, there were too few publications for statistically relevant conclusions.

With some variation among regions, the observation of higher citation impact of I project publications is also fairly stable geographically (including with regions like Central and Eastern Europe). The only region with which I project publications obtain lower field normalised citation rates and shares of highly-cited publications is the group of emerging countries (and with this group, the average field normalised citation rate of 1.3 is still above international thresholds). What should be noted, however, is that most publications have co-authors not from one, but from several regions. For instance, publications with co-authors only from developing countries are non-existent and are rare for the case of other regions. It remains thus an open question whether the high citation impacts are a result of excellent collaboration with researchers in regions like Southern Europe or whether the citation impacts are due to the fact that there were often also partners from countries like Germany involved.

In the context of the assessment of the quality and impact of I project outputs, the separate question on the **sustainability** of the interventions was raised. While this question was not part of the original set of evaluation questions, we can address it here to some extent: Methodologically, the question of the sustainability of the international programme interventions is a tricky one. International programmes were expanded in recent years. It is not possible yet to establish evidence for the sustainability of these recently started projects. We have some partly indirect indications for sustainability, however, that also have to do with additionality of the IPs. Concretely, three elements of our analyses contribute to a provisional assessment of sustainability:

First, an analysis of publication histories of a sample of two dozens of I project PIs (those with projects starting before 2010 and with at least one mobility experience) suggests that I projects either help to continue existing collaboration patterns (with co-authors in specific countries, etc.) or introduce new ones. We did not observe discontinuity, i.e. I projects leading to publication activity with co-authors in certain countries that is discontinued after the end of the I project.

Secondly, there is one data item from the survey that helps to assess sustainability: 68% of international programme participant respondents with projects starting before 2010 stated that they could continue the collaboration beyond the project (29% could partly continue it).

Thirdly and finally, we triangulated survey data with basic descriptive statistics to assess additionality (adding somewhat to addressing the question of sustainability). We looked at those I project PIs, who 1) had at least one stay abroad, and 2) who had joint project support (bilateral prog. or lead agency); and asked whether the partner country in an I project corresponds with either the PI's nationality or his/her mobility experience. In 65% of the cases, the PI's mobility experience and the country of the I project partner country do not correspond. This means, that only in 35% of the project cases, a PI might have built on his or her mobility experience in a specific country. For the nationality of the PI, this relation is even weaker: In 84% of the cases (of PIs with non-Austrian nationality), the PI's nationality and the I project partner country do not correspond. This means that it is more likely a PI can follow-up collaboration with partners in a country where she/he has work experience, rather than a personal history.

What impact do the international programmes have on the internationalisation of science in Austria?

In light of the bibliometric results, we can argue that the international programmes manage to connect Austria-based researchers to international colleagues with whom they are then able to produce high-quality scientific output. It would be a matter for further study whether it is the partners, the Austrian researchers, the specific opportunity of the cooperation or simply the network size that triggers these higher impacts.

As stated above, the international programmes are likely to have a limited systemic impact regarding the general cooperation culture of Austria-based researchers (strong cooperation with Germany, etc.) as well as the general degree of openness of the Austrian research labour market.

16.4. Should/could the programmes under discussion be continued, improved or restructured?

- **Is there evidence for continuing the programmes in their present form?**
- **Is there evidence for terminating the programmes?**
- **Are there valid arguments for improving or restructuring the programmes?**

This fourth block of evaluation questions will be addressed in the following section on scenarios for the future of the international programmes at FWF.

17. Scenarios for the future of the international programmes at FWF

17.1. Aims and approach

In the terms of reference for this review of internationalisation programming, FWF outlined four possible scenarios for future development of internationalisation programmes. These four scenarios reflected some of the major strategic choices open to FWF for the future of its international programmes. During the study, the study team has assembled evidence to help FWF consider these scenarios and this evidence was presented at various briefings during the project as well as in the course of an internal event with FWF referees. A summary this internal workshop at the FWF are available in ANNEX IV – Scenario Workshop | Documentation.

At the Focus Group event conducted by Alexander Degelsegger, Isabella Wagner and John Rigby on the 19th June 2017, these scenarios were also presented and discussed with FWF Board members. This section of the report builds on that discussion.

This section of the report refers to each of the four scenarios and for each one, presents an outline – in the form of a general description of the scenario, the rationale for that scenario, the evidence collected during the study relevant to that scenario – and which was then presented at the Focus Group event, the main topics, themes and conclusions discussed at the focus group. Finally, the study team presents its reflections on the conclusions of the focus group and suggests a final synthesis scenario that suggests what FWF might implement to support its internationalisation efforts.

17.2. Scenario 1 - Rethinking I Projects: collaboration via stand-alone projects

In this scenario, FWF continues to operate I projects, but encourages the greater use of stand-alone projects (P projects) for bi-and multi-lateral internationalised research collaboration.

S1 - Rationale

The rationale for encouraging greater use of the stand-alone projects for international collaboration is based on the widely held assumption that the more international the research, the more likely it will be of higher quality. At the same time, it builds on the observation that international cooperation is also possible and practiced within P projects. In this scenario, a limited international programme portfolio results in reduced programme management efforts for international cooperation. In the context of this scenario, Austria-based researchers who wish to have an international dimension to their work may use the stand-alone projects (P projects) while and their out of country partners could use their own funding from other sources, for example, European programmes.

S1 - Evidence of the Study

Evidence from our descriptive statistics, survey results and final report analysis show that international cooperation is common in stand-alone projects (e.g. 62.5% of P projects in the comparison group have international partners; 57% of P projects' final reports state they had international partners) and that researchers also cooperate internationally without FWF support (83% of the survey respondents said so).

At the same time, survey results show that I projects and P projects are used by different kinds of researcher and could be said to be distinctly different forms of programmes. I project grant holders are generally more international in their research, having more experience of international research (e.g. on European programmes for international cooperation), and they are slightly younger and better established in the Austrian research system.

Both programmes are popular. Both I projects and P projects produce high quality outcomes when measured against relevant baselines. I projects have a higher average citation impact and higher shares of highly-cited papers. I projects are popular. This can also be seen in the fact that applicants are interested despite the success rates being lower than in P projects.

The evidence base also suggests that the gender imbalance in programme instrument use is similar to that found with the P projects. Our evidence also noted that amongst treatment and control groups

(users and potential users) there is strong acknowledgement of the value of international collaboration, and a desire for more international work.

A final but important observation from the fieldwork is that those who have used the programmes (the I project PIs) believe more strongly than those who have not used them (the comparison group) that both networking and support activities need further resourcing and support from FWF.

S1 - Focus Group Discussion

It was considered that while the Austrian system is quite international, it is not yet as international as some other systems, for example the Swiss and UK systems are very heavily internationalised in the sense that the staff employed in the research system are non-nationals (Lepori, Seeber, & Bonaccorsi, 2015). This provides a justification to examine the following options: a) the expansion of I projects; b) changing the P projects so that they become more international; or c) introducing further networking activities to grow international research capacity that would have its base in the Austrian system and which would support and develop Austrian research capacity.

The discussion considered whether the expansion of the P projects' international dimension could be enhanced, but this was discounted. The discussion also considered the evidence on I projects. It suggests that the I projects do lead to links with different countries than are made with the P projects, but such differences reflect the country focus of the bi-and multi-lateral agreements FWF negotiated.

This often limits the scope of what can be achieved in I projects in terms of topic and country choice. However, the leverage effect of the I-programmes at an Austrian systems-level is relatively small. It was also noted that access to the I projects by younger researchers should be supported.

S1 - Scenario Assessment

The discussions around this scenario show that there are voices considering the Austrian research community still too little internationalised and/or the Austrian research system too closed (data on this is lacking and inconclusive[9]). There is some expectation that the Austrian system could and should move more towards the Swiss in this respect. If a greater internationalisation of the Austrian research system is a goal (which is not for the study team to assess), a number of ways of encouraging this development can be envisaged. The study team believes that action is possible at two levels: a) at the level of training, development and brain circulation (doctoral, and post-doctoral level including Schrödinger and Meitner Programme dimensions) and b) at the level of research project topic definition and research project funding (international programme formats by agencies like FWF). During the Focus Group event however, there was discussion of a proposal for the second area of activity: a networking initiative.

[9] The FWF-commissioned ifQ survey reports that 27% of the 2900 respondents were not Austrian at birth. In the UK, a recent figure is that 28% of the academic staff in universities are non-UK nationals (https://royalsociety.org/topics-policy/projects/uk-research-and-european-union/role-of-eu-researcher-collaboration-and-mobility/snapshot-of-the-UK-research-workforce/); in Germany, it is around 10% (https://www.bamf.de/SharedDocs/Anlagen/EN/Publikationen/WorkingPapers/wp50-auslaendische-wissenschaftler.html) ; for Switzerland, there is some outdated statistics from Eurostat: In 2006, 44% of the researchers in the higher education sector were not Swiss.

The proposed networking programme aims at researchers who are already well-established. The idea is that the programme helps them to set up international networks of relevant peers. FWF-funding would ensure these networks are anchored in Austria. This would help build capacity in areas in which Austria has strengths already, but where stronger networks would further improve output and capacity. We consider this proposal a sensible one. A number of questions remain to be answered to ensure the proposal's viability, however (distinction to COST schemes, ensure appropriate use of the scheme, etc.).

17.3. Scenario 2 - Expand country strategies

FWF currently has a relatively small number of specific country strategies to underlie both bi- and multi-lateral research funding to support the international collaboration activities of Austrian researchers (while many country links seem to result from opportunities, FWF seems to have an interest, for instance, in supporting collaboration with emerging countries, especially in Asia). Should the number and the scope of such activities be increased with more countries targeted?

S2 - Rationale

Research is inherently international. A research council's country strategies are developed to make possible research activities that bring benefits that are not possible to achieve with the existing portfolio of funding instruments. These strategies have three main aims: a) Open – and excellence focused internationalisation where the objective is to work with the best scientists in the world wherever they are; b) Strategic or thematic research where goals are international as they are in the case of the so-called global challenges or grand challenges – global warming, climate change mitigation, migration – require an international response – problems have international dimensions; this is efficiency and quality justification – critical mass is a justification here; such projects are evaluated against the first type of projects. Such relationships formed at country level are often formalised by MOUs and may have expiry dates set or not. c) Science diplomacy – here international collaboration takes place to create stronger ties between countries – these ties can be political, social or cultural – as well as scientific (which they are de facto). Strategic or thematic research is facilitated through country strategies which identify specific partner country strengths in topic or subject areas and international research is then funded through various mechanisms with those countries.

For any country, these three rationales may all apply, and may even apply simultaneously to a country's scientific relations with a single partner country. Also, over time, as countries' scientific capabilities change – and they may fall as well as rise – these rationales will apply to different degrees. Specific country strategies should be evaluated ex ante on the basis of each and every principle (a: contribution to excellent science; b: capability building, where the rationale is efficiency and quality; c) diplomatic benefits) weighing the potential benefits of each type of collaboration against the costs.

S2 - Evidence of the Study

Our evidence is that country strategies are difficult to develop (because of efforts in programme management, depend on partner country stakeholders) and in principle require a fit between the home country and the international partner, which might not be easy to determine ex ante. It is only after a period of international collaboration that it may be possible to see if a certain bi- or tri-lateral agreement is capable of delivering the outcomes desired. Our evidence suggests that cooperation with certain countries does not work well without explicit country strategies. We also note that country strategies can help to connect with upcoming research communities/countries and help to mobilise stakeholders. This view is also widely discussed in the literature. As Hird and Pfotenhauer (2017) have observed, important and useful structuring effects on a home country can occur from international collaborative research consortium agreements. This has led to initiatives such as the MIT- Portugal Program (MPP) on which they report in their paper.

Further difficulties for this scenario are that management efforts are often high and out of proportion of the end results; also, researchers do not conceive of research collaboration as something depending on political borders; they have collaborators in country x and y and need instruments with flexibility to involve these (as long as the partners manage to get their own funding). This is in effect an argument in favour of further collaboration through the P projects rather than focusing support through IPs.

S2 - Focus Group Discussion

Concern was expressed that increasing country strategies would lead to a higher administrative workload without clear likelihood of benefits in all cases. Furthermore, when operating lead agency agreements, the quality of partner country proposal evaluation processes could not always be guaranteed. Further analysis is required (in a few years' time when the data basis if large enough) to control for the citation impact of publications produced by projects supported under lead agency procedures. It was also noted that some countries' research systems are still relatively weak, and so if the number of projects supported with that country is expanded, the marginal quality will fall more quickly than if a strong scientific county was engaged.

S2 - Scenario Assessment

Expanding country strategies can result in additional programme management workload. There is also a risk of low returns (in terms of scientific impact). At the same time, researchers continue to ask for country programmes (and use them). Our assessment is as follows: In order to avoid depending solely on ad-hoc opportunities, it might make sense to draw up a "strategy of country strategies" clarifying with which countries/agencies (notwithstanding their priorities) FWF wants to support a) high-impact cooperation and/or b) cooperation in general. It can then be assessed whether P projects or I projects are the best vehicle for the researchers. It should also be noted that country-strategies leading to bilateral cooperation programmes are but one option; embedding country strategies into optional multilateral coop options might better meet researchers' needs.

17.4. Scenario 3 - Strict bottom-up thematic approach

When supporting internationalisation of a country's researchers, research councils may specify programmes that give freedom to the scientists to propose research (bottom-up programming) or they may seek to define topics and partners for home country researchers to work with (top-down programming). Bottom-up funding can be targeted to some degree but generally it is awarded on the sole criterion of academic excellence. In this scenario there is a *thematic* bottom-up approach; there are still country strategies and bilateral arrangements, but not thematically i.e. topic defined work.

S3 - Rationale

Councils that seek to promote research excellence may favour this approach. The systemic effects (research capacities, relevant topic areas) of the decisions taken by individual researchers in developing funding applications under the strict bottom-up funding schemes may have to be monitored.

S3 - Evidence of the Study

Our evidence is that researchers who have used I projects (our treatment group) believe that bottom-up multilateral support is not available to the degree that they would like. However, according to the interviews we have conducted, partner agencies push for thematically defined programmes, which can discourage Austrian participation or narrow the scope of such participation to the point that it is costly in scientific terms to collaborate. Evidence from our work in support of this scenario is that thematically open programmes can provide more flexibility for researchers and that bottom up support to excellent research is desirable.

S3 - Focus Group Discussion

While FWF may wish to promote bottom-up research, other country and EU funding bodies are increasingly proposing more top-down programming. This works against the ethos of FWF which is to support mainly bottom-up research, and top-down programme opportunities are not what Austrian researchers expect FWF to provide them with. The discussion considered that FWF's freedom to use bottom-up support depends to a large extent on the priorities of other national research councils and their desire to use top-down programmes.

S3 - Scenario Assessment

This scenario is one of the most challenging to make work for the benefit of Austrian researchers who wish to conduct scientifically excellent research with international partners.

17.5. Scenario 4 - Strengthening multilateral vs bilateral programmes

Most research programmes with an international focus are multi-lateral or bi-lateral. The availability of these instruments often depends more on the possibilities of the governance framework (e.g. in the European context) and the priorities not only of FWF, but of the partner organisation. Also, the current portfolio of multilateral programmes includes only top-down thematic priority setting (e.g. in ERA-Net calls).

S4 - Rationale

Multilateral programmes, which enable engagement with more than one partner (the multi-lateral programmes), provide greater breadth of participation but have greater coordination costs. These programmes (as long as the multilateral arrangement is optional) tend to match the researchers' practices and needs better than bilateral agreements. From a systemic point of view, both bi and multi-lateral programmes are sometimes used to develop capacity, but also to promote international cultural or political ties (science diplomacy; an approach FWF has never taken until now).

S4 - Evidence of the Study

Differences were noted in the actual number of publications per project between bi- and multi-lateral programmes, but our analysis suggests that such differences are attributable to project length and therefore do not provide evidence of differences in the quality of the two forms of programme.

We have some detailed evidence that gives useful background to the views of researchers in the treatment and comparison groups that bear on the differences between multi- and bi-lateral programmes. Firstly, we note that 65% of the I project PI respondents (treatment group) state that multilateral forms or cooperation have a significantly or somewhat higher added value than bilateral forms of cooperation; and while 74% see a higher coordination workload in multilateral projects, 54% consider it is appropriate in light of the added value of multilateral cooperation.

Of those respondents who state that their demand for international cooperation support is not or only partially covered by the current FWF programmes, 60% state that a multilateral, thematically open programme is missing (and 36% consider it highly necessary).

A bottom up and multilateral scheme is a strong differentiation option in light of the H2020 funding (which is multilateral, but top-down). Further evidence against more multilateral programmes is as follows: a) it is not always clear how the partner agencies would fund the joint research, especially in the case of multilateral, bottom-up and thematically open programmes; b) for researchers, a multilateral cooperation setup is ONE attractive option, but it is not the only one and other options should be available (i.e. making multilateral cooperation a requirement of all international cooperation is not the way to go; c) quite a large number of respondents (47% of the I project PIs) wish for additional bilateral programmes; d) the programme management workload is larger in such programmes although adoption of lead agency mode can reduce it.

The, on average, higher citation impacts of publications resulting from multilateral projects also has to do with the higher average number of authors involved. The bibliometric analysis showed that publications in the treatment group have 7.4 authors on average (with a mean field normalised citation rate of 1.8) versus 5.9 in the comparison group (mean FNCR of 1.5). This is not to say that this diminishes the value of multilateral publications. However, it is a factor that has to be kept in mind.

S4 - Focus Group Discussion

The content of the discussion reflected the evidence accumulated during fieldwork to a large degree. It was generally considered that while multi-lateral programmes have more set up and slightly greater operational costs, and may also incur a greater risk of disagreement about proposal quality, they are generally better instruments for geographically unlimited research collaboration than bi-lateral programmes. This is because researchers have their collaborators spread out over a number of countries and their preferred work setup (their pre-existing partnerships, plans, and knowledge) does therefore not reflect the way in which they are asked to work in bilateral arrangement involving geographic priority setting by the funding agency.

S4 - Scenario Assessment

While bi-lateral research agreements have their uses, a higher priority should be placed upon the FWF support to multi-lateral research going beyond available EU schemes. This more easily realises the FWF objectives of encouraging scientifically excellent academic research (which is not oriented along political borders) and encourages researchers to engage with FWF funding programmes.

17.6. The synthesis scenario: strengthening international networking

In this scenario, the I programme portfolio is continued (with a focus on the lead agency procedure, which reduces programme administration), but complemented with a new type of I programme supporting networking: a “synthesis network” scheme which would allow Austrian researchers to convene thematic (bottom-up defined) networks of researchers.

With the funding coming from Austria, the centre of these networks would be in Austria. The networks would allow for flexible, demand-driven exchange of ideas, preparatory to further substantive research work leading to application for funding from a range of programmes. At the same time, FWF continues to push for a multilateral, bottom-up project funding scheme, which could either be a kind of umbrella over several lead agency agreements or a European-wide lead agency-like effort.

Rationale

This scenario supports the international networking of Austria-based research. Austria needs to strengthen its profile internationally. All major scientific science economies – and Austria is one of these – need to do this. By establishing hubs for excellent scientific research, Austria will achieve more inward mobility and a further internationalisation of the Austrian research landscape.

Evidence of the study

In addition to more support for bottom-up multilateral funding, demand for the support for networking was clearly stated in the survey. While much seeding of new scientific ideas takes place in existing research projects (i.e. funded work and prior collaboration), new ideas also come from networking activities which, if successfully designed, can lead to significant research projects. Networking can be cost-effective first-step opportunity to find new ways of working internationally.

Focus group discussion

A new FWF networking programme would have to be clearly distinguished from COST and have clear added value above existing arrangements in terms of (openness) inclusion/exclusion, term of the grant, eligibility for expenditure, and in expectations for scientific outputs, outcomes and impacts.

If infrastructure was required to support the network, Austria should be the partner funding it, thereby ensuring that the centre of the networks is in Austria.

The discussion did not consider that a problem would exist if a network was "only" used to acquire follow-up funding (e.g. through the EU framework programme); such an outcome would still be valuable one in terms of good networking and positioning effect for Austrian research.

Scenario assessment

There is no doubt that the scientific landscape can only be understood as *internationalised*. And while there is increasingly pan-national funding, and increasing internationalisation of research in terms of collaboration and co-lateral funding (where funding for a piece of work comes from other countries funding bodies), national funders remain key players in the landscape. Research funding bodies must adapt to this system by ensuring the attractiveness of their own systems.

The FWF ethos of funding academic excellence can be supported by continuing to operate I project support with an emphasis upon multi-lateral agreements with lead agency procedures. FWF should additionally examine how networking support on a multi-lateral basis can be provided in such a way as to be more effective than what is currently provided through COST.

18. Conclusions and Recommendations

The present evaluation has been carried out between June 2016 and September 2017 with the goal of assessing FWF's international programmes and providing evidence for future strategic programming. We have decided to combine qualitative and quantitative evaluation approaches for the benefit of analytical depth. Concretely, the multi-method approach included:

- descriptive programme statistics (beneficiary demographics, project characteristics, etc.)
- bibliometric and altmetric analyses of international programme-supported projects' publications (output measures, citation impact measures; over topics, time, geographic regions)
- a beneficiary survey (expanding on beneficiary demographics, helping to specify their demands for international cooperation support, addressing issues of programme management, etc)
- secondary data analysis of iFQ survey (Austrian scientists' profile, collaboration propensity, etc)
- an analysis of project reports (providing data on cooperation intensity, beneficiary satisfaction)
- international comparative work (on the question how other councils and questions design programmes and address challenges in international programme management)
- stakeholder interviews as well as a focus group and scenario workshop (with FWF staff).

The scenario workshop was fed with results of the prior analyses. It was oriented towards the clarification of possible and desirable futures for the international programme portfolio.

The scope of an evaluation like this is always limited. Partly, limitations arise out of resource constraints, partly because of data availability[10]. Comparing the situation in Austria with international programme support in other countries, for instance, would have been interesting and valuable. However, there are no comparable evaluations available. The present study is unique in the context of EU research funding.

This is not the only aspect with which the present study breaks new ground. Apart from the multi-method approach as such, another strength and innovative feature of the present evaluation is the use of a comparison group approach. We employed techniques of statistical matching to assign one FWF-supported stand-alone project to each international programme-supported project. Controlling for variables like discipline, start date, etc in the matching allowed us to isolate the different effect of international programme and stand-alone funding as good as possible. The comparison group approach improves the value of particularly the descriptive statistics, the bibliometric analyses and the survey

[10] Regarding the former, an in-depth qualitative analysis of international project impact was clearly out of scope, for instance (if was also not crucial in view of the terms of reference for the evaluation). Regarding the latter, longitudinal analyses were possible only to a limited extent. We clarified typical sequences of beneficiaries' use of certain FWF instruments. By contrast, we have only limited data on the sustainability of the programme interventions; this aspect as well as the evolution of cooperation patterns would have to be monitored and re-assessed in a few years time. The disaggregation of bibliometric data was also limited by data availability. For instance, detailed analyses of output and citation impact per disciplines were not possible simply because there was not enough data points. The number of cases decreases rapidly when the corpus of all publications considered stems from around 600 international projects (around 3000 publications were in the corpus for the group of international programme-supported projects).

(interestingly, with 61% the return rate of comparison group PIs was almost as high as in the group of international programme PIs).

With the multi-method framework and comparison group approach, we were able to address the evaluation questions regarding the appropriateness of FWF's international funding portfolio; the design and management of the programmes; the impacts of the programmes. We also derived recommendations concerning the future of the programmes.

The evidence we collected indicates that the international programme portfolio is not only in demand (despite its competitiveness), but that it also triggers results (in terms of publications) that are comparable to stand-alone projects in terms of outputs (with some variation between international programme formats) and that are, at the time being, even above stand-alone projects in terms of citation impact measures (in general, in major disciplines and over most geographic regions). Programme statistics and bibliometric data suggest that cooperation with some countries mainly works because of international programme support (and triggers a satisfactory amount and quality of research outputs). Even for those countries where cooperation also works without international programme support (in stand-alone projects), like Germany, we find that cooperation with the same countries in international programmes (e.g. via DACH) leads to outputs of higher citation impact.

Survey and final report data show that satisfaction with the programme management is high. FWF-internally, although the increased number of Calls and supported projects challenge programme management, satisfaction with the programmes and processes in general seems high.

This and related evidence leads us to recommend a continuation of the present portfolio with minor adjustments. While country strategies seem useful under certain conditions (e.g. to push Austrian scientists out of their comfort zone and towards cooperating with new players), they have to be closely monitored. For instance, if there would be the opportunity for an explicit programme with countries like the US or Canada, as demanded by the beneficiaries, it would have to be monitored whether this leads to an added value in terms of output and citation impact (like in the case of DACH) compared to support in stand-alone projects like in the case of DACH.

Regardless of the country strategies, too many and diverse Calls with limited funds should be avoided (especially if they are not expected to be offered regularly over a longer period of time). At the same time, the present portfolio might benefit from two additions: Within the possibilities of the European Union context, Austrian researchers would benefit from a flexible, thematically open, multilateral funding scheme that does not require them to find their research interests limited because support is available for a partner in country x, but not in country y. Researchers do not operate in terms of political boundaries. Also, their collaborators move between countries. Researchers collaboration networks are, almost by definition, multilateral. Multilateral schemes (offering multilateral cooperation as an option,

not an obligation) mirror this situation[11]. For FWF and other funding agencies, one option might be to push for an umbrella scheme grouping several lead agency agreements.

The second addition to the portfolio that is worth considering, according to our data, is networking support. Schemes that provided this support are discontinued and also did not entirely match beneficiaries' needs. One option, it seems, would be FWF support to distributed international networks of researchers. The FWF support would anchor these networks in Austria. The programme could improve the linkages of Austrian scientists to the most relevant colleagues abroad. It would provide a springboard for Austrian researchers to form partnerships to develop research ideas that would then be taken forward with project funding, probably in multi-lateral research programmes. The criterion of scientific excellence would of course apply here as elsewhere.

In the broader and more systemic context, if a further increase in the international openness of Austria's research landscape is a goal, other programmes – such as P projects – could also be oriented towards improving on this. Brain circulation activities (Schrödinger and Meitner programmes mainly) could also be considered for some expansion to ensure this objective is supported.

We recommend – in relation to this issue of the openness of the Austrian scientific system – further consideration of what extent of internationalisation is likely to ensure the continued high levels of scientific excellence currently achieved. In particular we recommend an examination of how 'internationalised' scientific institutions could become, and what steps would be needed to achieve this.

Our work has not given us all the answers and it indicates potential directions for future analysis. For instance, some questions have been raised about which Austrian researchers benefit from the I Projects and the age at which they are successful in doing so. Our data shows that I project PIs are older and more established than P project PIs. We suggest that more investigation is made of the age-groups which apply for I projects, the role of the team members vis-à-vis he PI, and the extent to which other programmes – mainly Schrödinger and Meitner – support subsequent use of I projects and other important international funding programme instruments accessible in Austria.

In a similar direction, our work has unearthed pieces of evidence suggesting that I programmes have an additionality in the sense of getting researchers to cooperate with new partners (in countries where they have not spent considerable time themselves) and continuing this cooperation beyond the I project. However, such longitudinal analyses (not least with regard to the citation impact) will have to be repeated in a few years time. Only then will data be available for the large amount of I projects that were launched in the most recent years.

[11] Interestingly, we know that the DACH lead agency agreement allowing for trilateral collaboration between Germany, Switzerland and Austria is only seldom used in a trilateral fashion. Most projects supported under DACH are bilateral. The reason for this would be interesting to study further. One fact might be the dense cooperation and mobility relations between especially Austria and Germany.

ANNEX I – Bibliometric analyses | Detailed results

Publication Output

Overall, sets of 1,471 publications could be identified for the treatment group and 1,483 for the comparison group, respectively. Given that the comparison group was constructed by matching techniques that take into account start date and field, it is not surprising that the annual output counts are similar.

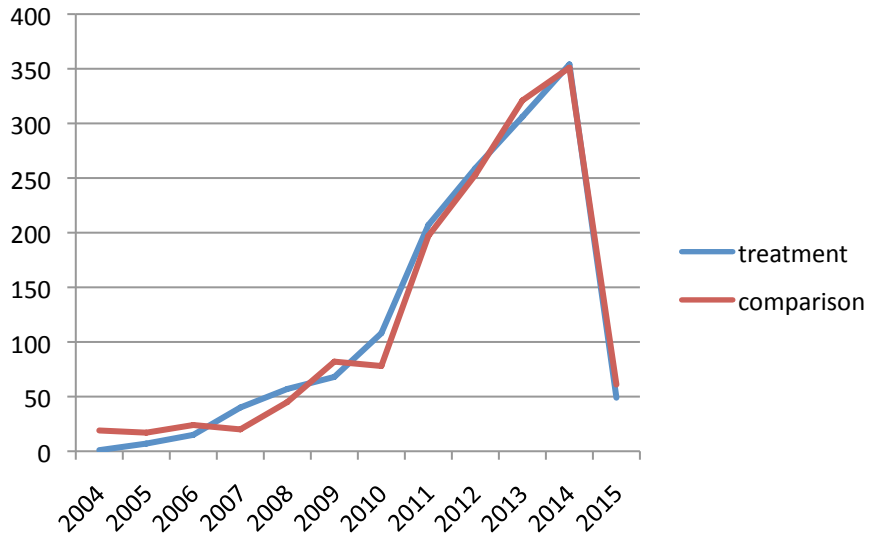

Figure 15: Publications by year - treatment and comparison group

The thematic distribution of publications in the treatment and the comparison group are similar, which is also due to the matching technique. In both groups, 'natural sciences' make up around 73% of the publication output, followed by 'engineering and technology' (around 13%) and 'medicine and health' (around 10%). Compared to the thematic output pattern of Austria in general, 'natural sciences' are overrepresented and 'medicine and health' are underrepresented in our samples

Collaboration

The bibliometric analysis of output patterns suggests a higher internationalisation of the output of projects funded through international programmes. While this does not come as a surprise, it is worthwhile to note given that 62.5% of the comparison group projects also have international partners.

	I (treatment group)	P (comparison group)
Overall	67%	57%
2008	63%	53%
2014	71%	64%

Table 14: Shares of international co-publications

As to the geographical distribution of co-authors in the international co-publications, the major partner countries are similar in the treatment (I) and the comparison (P) group. In I projects, however, co-authors from the US and Canada are present less frequently. Russia, Switzerland and Japan are more visible in I project co-publications. Co-authorship with scientists based in Hungary and the Czech Republic is equally or even more frequent in the comparison group, despite the dedicated co-funding programmes for these countries. It should be added, however, that many of the projects in the programmes with these partner countries have only recently started (and hence did not report publication outputs yet).

Treatment group			**Comparison group**		
Country	**Co-publications**	**Share**	**Country**	**Co-publications**	**Share**
DEU	427	23%	DEU	275	19%
USA	238	13%	USA	229	16%
FRA	145	8%	FRA	124	9%
GBR	143	8%	GBR	107	7%
RUS	114	6%	CAN	79	5%
ITA	79	4%	ITA	79	5%
CHE	79	4%	ESP	60	4%
JPN	78	4%	BEL	56	4%
ESP	78	4%	NLD	53	4%
NLD	73	4%	RUS	51	3%
BEL	56	3%	AUS	51	3%
SWE	55	3%	SWE	46	3%
CAN	52	3%	CHE	43	3%
HUN	43	2%	HUN	41	3%
AUS	40	2%	POL	34	2%
CHN	37	2%	JPN	33	2%
CZE	31	2%	CZE	30	2%

Table 15: Co-publications of I and P projects

We find that the average number of authors for I project publications exceeds that of P publications. The difference results from the higher author count in internationally co-authored papers. In nationally authored or co-authored papers, the average author counts of the groups are nearly equal.

	treatment	**comparison**
National	3.6 (n=261)	3.7 (n=332)
International	9.2 (n=489)	7.6 (n=398)
Total	7.4	5.9

Table 16: Average author counts

Impact

The most relevant contribution of the bibliometrics analysis to the present evaluation is an assessment of the impact of publications linked to I projects (and comparison group projects). Two proxies are used to determine the impact of the sets of publications: mean field-normalised citation rates; and the share of highly cited papers. For both indicators, the treatment group publications show better impact measures. The following tables show the detailed impact measures per group and year (grey colour indicates that the number of publications in the year is below 50 making the values unreliable from a statistical point of view).

Publication year	**Treatment group**	**Comparison group**
2004	2.1	1.7
2005	4.0	1.1
2006	2.5	0.7
2007	1.8	1.6
2008	1.9	1.3
2009	1.5	1.8
2010	2.2	1.6
2011	1.5	1.4
2012	1.6	1.5

Table 17: Mean field-normalised citation rates

Publication year	Treatment group	Comparison group
2004	100.0%	15.8%
2005	52.4%	5.0%
2006	50.0%	6.3%
2007	17.5%	10.0%
2008	25.5%	9.3%
2009	23.0%	18.9%
2010	25.2%	13.4%
2011	21.4%	16.9%
2012	21.3%	18.1%

Table 18: Highly cited papers (top 10% reference set)

What is interesting to note with regard to the shares of highly-cited papers in both I project and P project publications is that it is above national averages of Austria and other countries. According to the European Innovation Scoreboard 2017, 11.7% of Austria's publications are among the top 10% most cited (EU-average: 10.6%; Switzerland, the top-performer in this category: 15.2%). This suggests that FWF-supported publications in general outperform non-FWF-supported publications in the Austrian research system.

Over the entire period of time (2004-2012 for the impact data), the mean field-normalised citation rate is 1.8 for the treatment group and 1.5 for the comparison group. The 95% bootstrap stability intervals[12] of means are 1.6-2.1 and 1.4-1.7, respectively. In the case of the bootstrap interval of the median, there is no overlap, but the intervals are not clearly separated either. The intervals reflect the high variability of citation counts within the groups. However, the difference of 0.3 is still noteworthy.

	Treatment group	Comparison group
Mean of field-normalised citation rates	1.8	1.5
95% bootstrap stability interval of mean	1.6-2.1	1.4-1.7
Median of field-normalised citation rates	1.2	1.0
95% bootstrap stability interval of median	1.0-1.3	0.8-1.0
Publications (2004-2012)	748	727

Table 19: Impact - treatment vs comparison group

[12] Bootstrap intervals make use of resampling with replacement from the analysed data and can be used to inform about the reliability of statistical quantities. This is accomplished by repeated sampling of observations, at each iteration calculating the value in question (i.e. mean). We did 1000 rounds of resampling to compute each interval. The variation found in the distribution of resampling-based values is used to derive bounds that in this particular instance indicate how stable the value is in terms of internal variation. Statistical confidence intervals on the other hand, indicate a region of the probable value in a population, based on a sample. As we do not analyse a sample of FWF publications from I projects but the full population, CIs would merely suggest uncertainty where there is none. Bootstrap intervals, however, show how sensitive the values are to minor, data-driven perturbations.

The differences in impact indicators are stable over disciplines. There are too few publications for a statistical comparison of I and P project publication citation impact in detailed disciplines. What we did was to look at broad areas of science like natural sciences, social sciences, medical sciences, etc. As far as out data goes, the observation of higher citation impacts in I project publications is stable over these broad areas of science. While there were too few cases for a detailed analysis of areas like social sciences, medical sciences or agricultural sciences, we could confirm that the differences are visible in the natural sciences (1.8 vs 1.5 field-normalised citation impact; 22% vs 15% highly cited) and even more pronounced in engineering and technology (2.0 vs 1.4; 16% vs 4%).

We have also controlled for the average number of authors per publication. There is no difference in the number of authors in national-only publications. However, internationally co-authored publications by I projects have a higher average author count (9.2) than the international publications in the comparison group (7.6). In this light, the higher citation counts can be seen as a network effect: Publications with more authors (as is often the case in international co-publications) have higher citation counts. No appreciable difference in impact indicators was found between bilateral and multilateral project papers.

As Germany is Austria's most important collaboration partner, we included a study of co-publications with Germany in particular (due to insufficient numbers of co-authored papers this was not feasible for further countries). The average field-normalised citation rate for I co-publications with Germany-based authors is 2.0, for co-publications in stand-alone projects it is 1.5. The bootstrap intervals, however, are wide as well (due to the variability of citation counts and the small number of cases): 1.6-2.6 and 1.2-1.8. The analysis of the impact values per country group resulted in the illustration of fairly stable impact measures. It has to be added, however, that the co-authorship patterns often span the groups: there are, for instance, few publications with co-authors exclusively working in developing countries, the South of the EU or Central Europe.

		Country group						
		'big three'	EU South	Europe CE	Small strong	Developed	Emerging	Developing
Cooperation including a group	Share of highly cited papers (3 year citation window)	22%	22%	22%	19%	25%	13%	-
	Mean field-normalised citation rate (3 year citation window)	1.8	1.8	1.9	1.8	1.7	1.3	-
	Items	561	173	104	294	141	133	0
Cooperation excl. within a group	Share of highly cited papers (3 year citation window)	21%	-	-	-	24%	13%	-
	Mean field-normalised citation rate (3 year citation window)	1.7	-	-	-	1.6	1.3	-
	Items	196	1	0	8	17	79	0

Table 20: Impact across country groups for the I projects

Please refer to chapter 11 above for a summary of the main findings.

ANNEX II – Altmetrics

Use of Altmetric Data and Bibliometric Data

The study team investigated the use of altmetric data as further (and not as an alternative) means to establishing the impact of papers funded by FWF and to inform the internationalization strategy of the FWF. We also investigated the correlation between the altmetric impact of papers and the bibliometric impact of papers. While the academic literature on altmetrics and evaluation using altmetrics is concerned with an apparent need to account for similarities between the two forms of impact (altmetric and bibliometric), our approach here has been to look at why, if there are differences in impact between the papers, what factors might explain that difference. Such factors might in our view provide a first step in identifying strategies which the FWF might take to enhance the impact of its papers to a wider public audience, rather than the other way around, where papers that have a high wider public impact are of low academic impact.

For information we provide our rank correlation between altmetric score (a percentile) and the field normalised citation rate, which shows a small but significant correlation within the I-papers between the two forms of impact.

Correlations

			Altmetric_Impact	Bibliometric_Impact
Spearman's rho	Altmetric_Impact	Correlation Coefficient	1.000	.231**
		Sig. (2-tailed)	.	.000
		N	580	580
	Bibliometric_Impact	Correlation Coefficient	.231**	1.000
		Sig. (2-tailed)	.000	.
		N	580	586

**. Correlation is significant at the 0.01 level (2-tailed).

Table 21: Correlations almetric and bibliometric impact scores

Overall Social Media Impact – Results and Commentary

Our analysis of the social media impact of I-Programme papers used Digital Science's data. The methodology for measuring altmetric impact is referenced here [https://help.altmetric.com/support/solutions/articles/6000060969-how-is-the-altmetric-attention-score-calculated-]. The methodology applies a weighted score which gives a higher weight to forms of

social media attention which are likely to involve exposure of the item to a greater number of people. This score was then rebased to the journal (i.e. to the other papers in the journal) in which the paper had appeared.

The following chart indicates the percentage scores reached by the papers in the set. These values are the percentile in which the paper scores compared with the papers of the same age in the same journal. The results show that many papers score highly, but many have no social media impact at all. It is premature to make inferences from this analysis and we suggest that more investigation work is done to examine the factors that lie behind the scores. Our view though at this stage is that the social media impact is typical, overall, for all papers measured in these journals in which the I-project papers have been published.

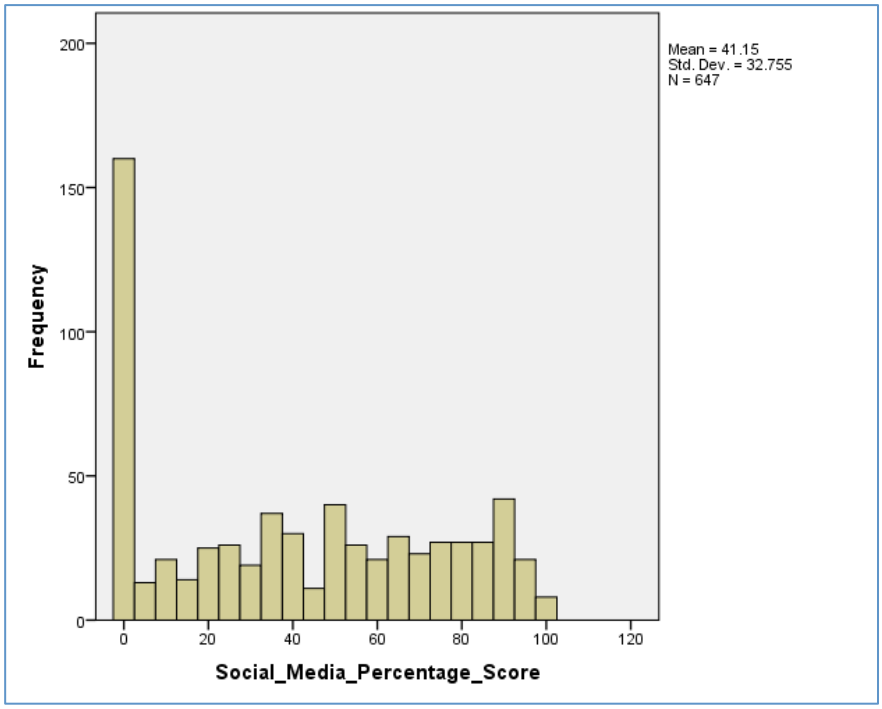

Figure 16: Almetric scores - frequency

Social Media Impact Investigation – Results and Commentary

Our second analysis employed both the altmetric data and bibliometric data. Bibliometric data was obtained from DZHW and analysed. It was sourced from the Web of Knowledge and citation scores were rebased to give the field normalized citation rate (FNCR) for the paper. Our second analysis objective was to relate the information from each source for each paper and observe and account for differences between altmetric impact of papers with a view to providing advice about dissemination of the knowledge and the enhancement of social media impact.

Distributions of papers' altmetric and bibliometric impact scores are both highly skewed with many low values and a small number of high impact papers. To facilitate a simple analysis, papers were then binned into quartiles for each of the measures (altmetric impact and bibliometric impact). There were therefore 16 categories of papers. To illustrate the grouping of the papers, we show by way of example how papers can be allocated to groups by quartile (Figure 17 and Table 23).

In the following bar chart below (figure 17) the x axis shows four groups of papers, by altmetric score by quartile. Within each quartile group there are subdivisions of papers. Each subdivision is a quartile group (quartile 4 is the top quartile in this analysis). The general trend of the analysis shows that papers with higher altmetric impact are papers with a higher bibliometric impact and there is a moderately strong correlation. However, there are some papers with high altmetric impact but low bibliometric impact and some which are the reverse, i.e. which have low altmetric impact but high bibliometric impact. We then undertook analysis on these two sets of papers.

Our objective in carrying out this analysis was to focus on the two sets of papers whose characteristics might suggest the need for change at FWF or on the part of scientists themselves in terms of the promotion of papers. Our primary interest in the analysis was in papers with top quartile bibliometric score and low altmetric score (of which there were 15) and those which have a bottom quartile bibliometric score but a high altmetric score (of which there were 25).

Analysis of the two sets of papers is presented below. We compared the papers in terms of factors which in our view may affect the visibility of published output, not in terms of factors that would explain low scientific visibility.

Set A papers – which we term "Out" papers are those which have the very highest scientific impact but the lowest social media score and are 15 in number. The Set B papers which we term the "In" papers are those which have the highest visibility in social media but the lowest academic visibility. There were 25 of these papers.

The simple differences between the two sets of papers in respect of a number of factors are shown in the following table. We show average values and median values for the count of authors, count of institutions (participating in the research which led to the paper), and count of funding organisations per paper. We might have expected that papers with more authors, or more institutions supporting the research or more funding bodies would tend to lead to papers with higher visibility in social media – because of the fact that more people are involved in such papers and larger numbers involved might lead to more attempts to publicize the papers. However, in our data set, no such relationships can be shown to exist. Differences between these two sets of papers in terms of these three measures (authors, institutions, funding bodies) were examined with a ranks test and no statistically significant differences between the papers were observed.

Other possible explanations for the differences in the social media visibility may lie in the publisher responsible for the papers and the subject categories. These two factors are of course related. Beginning

with the subject category we examined the subject categories present in the In Set of Papers. These papers were in the following subject categories which did not appear in the Out set of papers:

Astronomy & Astrophysics;
Biotechnology & Applied Microbiology
Communication;
Endocrinology & Metabolism;
Genetics & Heredity
Geochemistry & Geophysics;
History & Philosophy of Science
Imaging Science & Photographic Technology
Information Science & Library Science
Life Sciences & Biomedicine - Other Topics;
Marine & Freshwater Biology
Mathematical & Computational Biology
Meteorology & Atmospheric Sciences
Microbiology
Optics
Pharmacology & Pharmacy
Psychology
Remote Sensing;
Research & Experimental Medicine

These are generally medical and applied science and technology areas and natural sciences topic areas (Marine & Freshwater Biology; Meteorology & Atmospheric Sciences).

The role of publishers might also be thought to have an influence as publishers provide different levels of visibility to the papers they publish and they also advise authors on achieving visibility of their work using social media. Our list of the publishers involved shows many similar organisations however.

Measure	Set A Papers – Out Papers	Set B Papers – In Papers
Count of Authors	7.33 Average	6.76
	6 Median	7 Median
Publisher	Amer Chemical Soc	Academic Press Inc Elsevier Science
	Amer Geophysical Union	Academic Press Ltd- Elsevier Science Ltd
	Amer Physical Soc	Amer Chemical Soc
	Elsevier Sci Ltd	Amer Inst Physics
	Elsevier Science Inc	Amer Physical Soc
	Ieee-Inst Electrical Electronics Engineers Inc	Amer Soc Pharmacology Experimental Therapeutics
		Elsevier Sci Ltd
	Inst Arctic Alpine Res	Elsevier Science Bv
	Natl Acad Sciences	Frontiers Research Foundation

	Pergamon-Elsevier Science Ltd Royal Soc Chemistry Wiley-Blackwell [11 Publishers]	Iop Publishing Ltd Natl Acad Sciences Nature Publishing Group Optical Soc Amer Oxford Univ Press Pergamon-Elsevier Science Ltd Sage Publications Ltd Springer Basel Ag Taylor & Francis Ltd Wiley-Blackwell [20 publishers]
Subject Category	Agriculture Biochemistry & Molecular Biology Chemistry Chemistry; Materials Science; Metallurgy & Metallurgical Engineering Computer Science; Engineering Environmental Sciences & Ecology Environmental Sciences & Ecology; Physical Geography Geology Geriatrics & Gerontology; Neurosciences & Neurology Hematology Physics Science & Technology - Other Topics	Astronomy & Astrophysics; Physics Biochemistry & Molecular Biology; Chemistry Biotechnology & Applied Microbiology Chemistry; Science & Technology - Other Topics; Materials Science; Physics Communication; History & Philosophy of Science Computer Science; Information & Library Science Endocrinology & Metabolism; Genetics & Heredity; Research & Experimental Medicine Environmental Sciences & Ecology; Marine & Freshwater Biology Geochemistry & Geophysics; Meteorology & Atmospheric Sciences Hematology Life Sciences & Biomedicine - Other Topics; Mathematical & Computational Biology Microbiology Neurosciences & Neurology Optics Optics; Physics Pharmacology & Pharmacy Physics Psychology Remote Sensing; Imaging Science & Photographic Technology Science & Technology - Other Topics
Count of Institutions	4.8 Average 4 Median	5.3 Average 5 Median
Count of Funding Orgs. Per Paper	5.4 Average 3 Median	3.6 Average 3 Median

Table 22: Characterisation of out and in papers

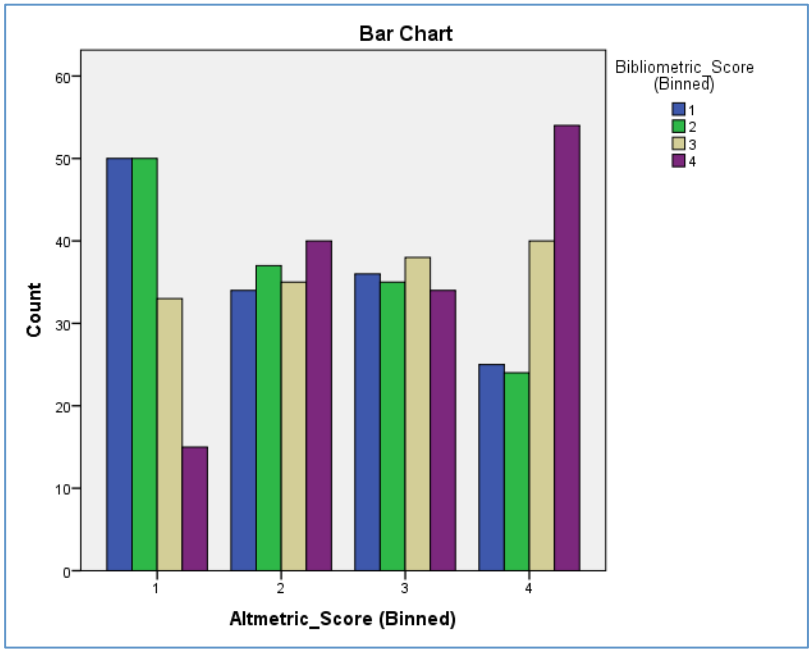

Figure 17: Altmetric and bibliometric scores - quartiles

Altmetric_Score (Binned) * Bibliometric_Score (Binned) Crosstabulation

Count

		Bibliometric_Score (Binned)				Total
		1	2	3	4	
Altmetric_Score (Binned)	1	50	50	33	15 (Set A)	148
	2	34	37	35	40	146
	3	36	35	38	34	143
	4	25 (Set B)	24	40	54	143
Total		145	146	146	143	580

Table 23: Crosstabulation of altmetric and bibliometric scores

Concluding Remarks

Clearly, we have not begun with the assumption nor do we end with the conclusion that altmetric impact is the main objective of FWF activity. Rather, altmetric impact is a possible desirable (although also potentially an undesirable) consequence of activities taken to promote FWF research outputs. Where research of high scientific merit impact (i.e. citations) does not achieve high social media impact, there may be a reason why this is so that FWF cannot control or affect. There may however be steps, which FWF can take either in terms of its own direct activities or in terms of providing advice to authors about how best to promote their work – and the support given to them by FWF. Our recommendation to FWF that it take such a stance is based on very limited data. While we have observed the presence of papers, which have high media impact and low scientific impact and papers which have high scientific impact and low media impact, we have not as yet detected factors that account for these differences and we cannot therefore put forward strong and specific recommendations. Our observations do nevertheless establish that papers with high scientific impact do not automatically receive high social media attention, and that papers of the opposite kind also exist amongst those funded under the I-Programme.

ANNEX III – Survey | Detailed results

Demographics:

- The average age of PIs in the survey is 52.8 for the treatment group (51.6 for I projects only, i.e. joint seminar and RNP PIs are older) and 51.2 years for the comparison group (as per 1.1.2017). The P project PIs in the comparison group match well to the age profile of the treatment group (which confirms the suitability of the matching procedure with regard to this dimension)
- Gender-wise, the respondents are less biased than in the overall population with regard to I projects. 79.2% of I project PI respondents are male. Among the comparison group respondents, 80.6% were male, which is more than in the overall P project population. 100% of the 31 RNP respondents were male. AJS: 78.6% male.
- 70% of the respondent I project PIs are Austrian, 20% from Germany. Among the comparison group respondents, the shares are similar.

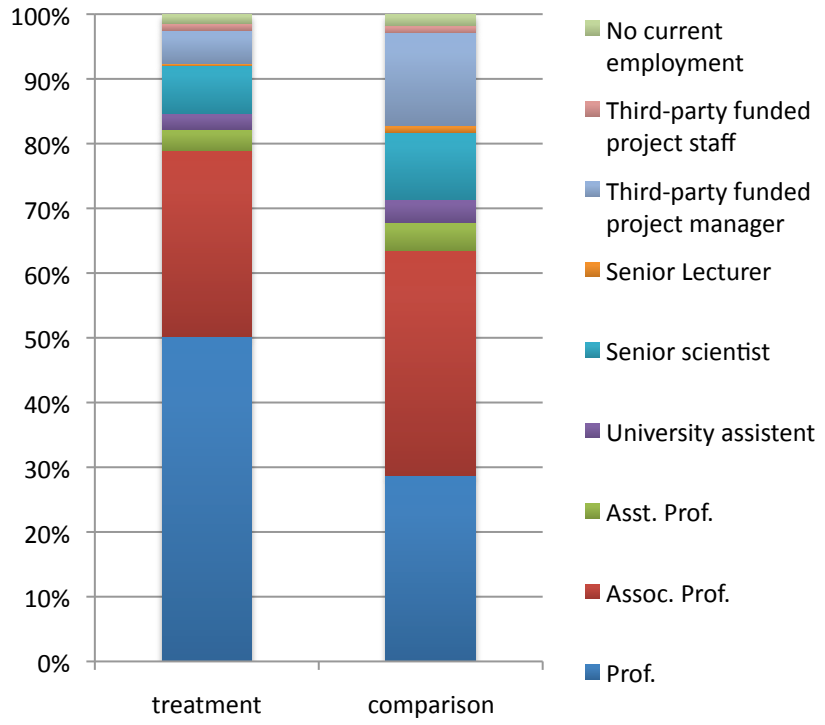

Figure 16: What is your current position?

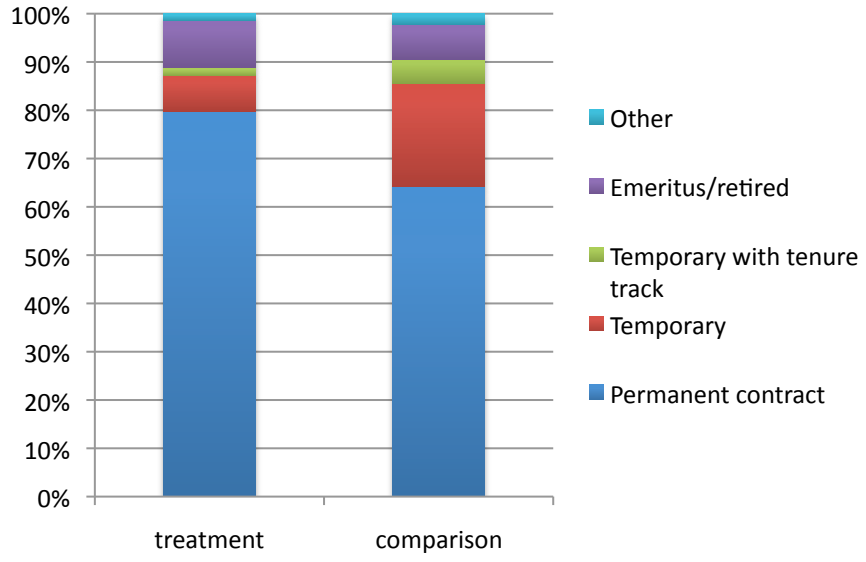

Figure 17: What is your current employment status?

In the treatment group, 86% of respondents claim they have experience with other international projects that are not financed by FWF. 57% of these are in FP7, 36% in COST. In the comparison group, 69% claim they have experience in non-FWF-funded international projects (with 39% in FP7).

We have asked the PIs in the treatment and comparison group about their mobility experiences. 74% of treatment group respondents stated that they had at least one longer (> 6 months) research stay abroad, 47% had more than one. In the comparison group, 67% had at least one, 38% more than one. We also asked respondents to state the location of their research stays.

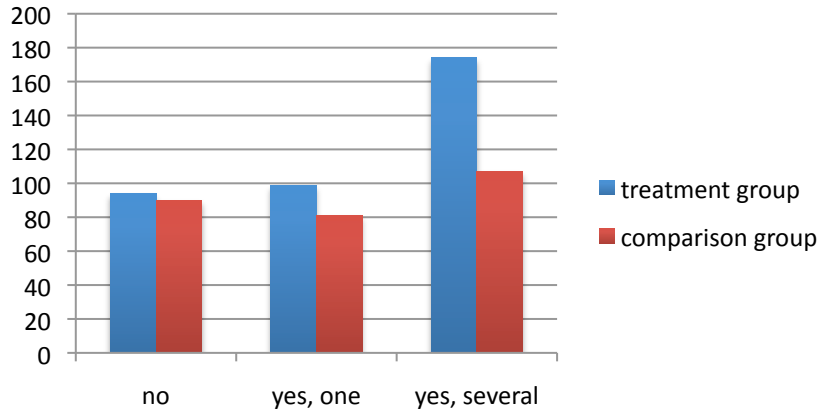

Figure 18: Did you have research stays of 6 months or longer outside of Austria?

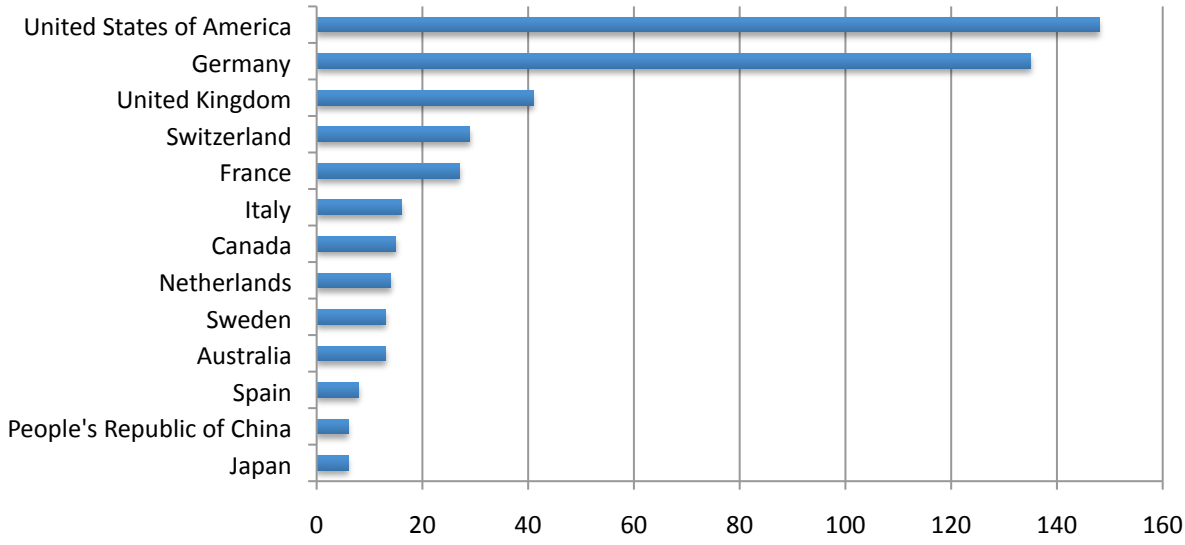

Figure 19: Research stays of I project PIs

The majority of respondents in both the treatment (83%) and the comparison group (81%) claim they also cooperate internationally without FWF support. 65% (in both I and P projects) say they do this independently of any support instruments, 51% (54% of P) say they cooperate in stand-alone projects.

The majority of respondents in the treatment group (52%), but only 28% of the comparison group respondents state that they have been approached by international partners. Differentiating this result according to programme type clarifies that it is mostly in the European-level programmes that Austrian participants are approached by partners (65% in the case of ERA-Nets, 76% in the case of EUROCORES). In the joint programmes (31%) and the lead agency procedures (47%) this figure is below 50%.

68% of the treatment group respondents and 71% of the comparison group respondents state that the collaboration builds on previous collaboration(s).

We also included a battery of questions asking international programme PI respondents (who at some point also had a P project) to compare the acquisition effort (time-wise) and the success rate between standalone projects and international programme projects. 73% consider the time effort for project acquisition appropriate, 18% rather high. 59% consider the success rate appropriate, 23% rather low and 14% low. We have also differentiated these results by programme type.

- Those I project PIs with at least one bilateral joint project (excl Lead Agency): 52% consider the success rate appropriate (30% low, 19% very low); 75% consider the acquisition time effort appropriate (14% high)
- … with at least one ERA-Net: 65% consider the success rate appropriate (24% low); 79% consider the acquisition time effort appropriate (12% high)
- … with at least one Lead Agency project: 57% consider the success rate appropriate (25% low, 14% very low); 70% consider the acquisition time effort appropriate (22% high)
- … with at least one EUROCORES project: 61% consider the success rate appropriate (17% low, 22% very low); 68% consider the acquisition time effort appropriate (21% high)

As to the suitability of the programme portfolio, 40% of international programme participant respondents state that the existing programmes satisfy their demand for support for international cooperation. 61% state that their demand is not or only partially met (partially met: 49%). In the comparison group, 57% state the demand is not or only partially met (partially met: 43%) – a difference not of statistical significance. Thus, the P project PIs are more frequently satisfied with the programme portfolio (43% claim their demand is met vs 40% in the treatment group; these differences are not statistically significant).

In the comparison group, the answers are different depending on whether or not the P project PI has international cooperation partners or not. Those PIs who have no international partners more frequently state that their demand is not or only partially met (65%; partially met: 56%). 52% of the P project PIs with international partners state that their demand is not or only partially met (partially met: 32%). The Chi-square test shows a significant correlation between the groups of P project (national international) and the information on the demand.

When assessing the programme portfolio with regard to missing elements, a majority of respondents in the group of I project PIs (who consider their demand not or only partially met) ask for thematically open, multilateral programmes (59%). An especially large share of those I project PIs (who consider their demand for international cooperation support not or only partially met and) who have EUROCORES (81% of them consider bottom-up multilateral project support missing), joint projects (without Lead Agency) (67%) or ERA-Nets ask for this type of support (64%). Among the lead agency PIs, it is less, but still a majority (52%).

We have observed that international cooperation in P project is frequent. As indicated above, 62.5% of P projects in the comparison group have at least one international partner. One hypothesis that we have pursued in this regard is the expectation that the intensity of collaboration in P projects is lower than in I projects. In the survey, 88% of I project PIs (367 respondents) consider the intensity of the collaboration either intensive or very intensive (very intensive: 45%). In the comparison group of P projects with international partners (136 PI respondents), 71% of the respondents consider the collaboration intensive or very intensive (very intensive: 35%). The U-Test showed that the difference in the distribution of answers is significant.

We have asked I project PIs about the added value of the international programme instruments in light of international cooperation opportunities in stand-alone projects. The following table illustrates the answers to the question which of the programmes have an added value:

Programme experience?	Added value?	Joint projects/lead agency in Europe	Joint projects/lead agency non-European	ERA-Net Calls	EURO-CORES	Joint Seminars
All respondents	**Yes**	71%	47%	25%	9%	11%
All respondents	**No**	29%	53%	75%	91%	89%
Yes	**Yes**	77% (exp. with lead ag. proj.)	69% (exp. with joint projects)	70%	53%	61%
Yes	**No**	23% (exp. with lead ag. proj.)	31% (exp. with joint projects)	30%	47%	39%

Table 20: Added value of international programme instruments[13]

[13] Note: the programme experience for the assessment of programmes with non-European partner countries was taken from joint project PIs only (not lead agency PIs) because the vast majority of lead agency projects are with partners in Europe.

When controlled for programme experience, interestingly the picture changes. Those PIs who have experience with the respective programme acknowledge its added value. The only programme where also the participants are split in their opinion is EUROCORES: only 53% of those PIs who have programme experience state that it has an added value.

Among the international programme participants, 68% of those with projects starting before 2010 claim that they could continue the collaboration with their partners. In addition, 29% state they could partially continue the collaboration. In the comparison group, 60% state they could continue and 33% state they could partially continue.

In the comparison group, only 45% of respondents ask for thematically open, multilateral programmes (59% in the group of I project PIs; see above). There, a majority proposes additional support for the initiation of international cooperation. Especially those P project PIs without international partners ask for initiation support (64% of those). Among the P project PIs with international partners who find their demand for international cooperation support not or only partially met, a majority (53%) asks for additional bilateral programmes, 49% for bottom-up multilateral support.

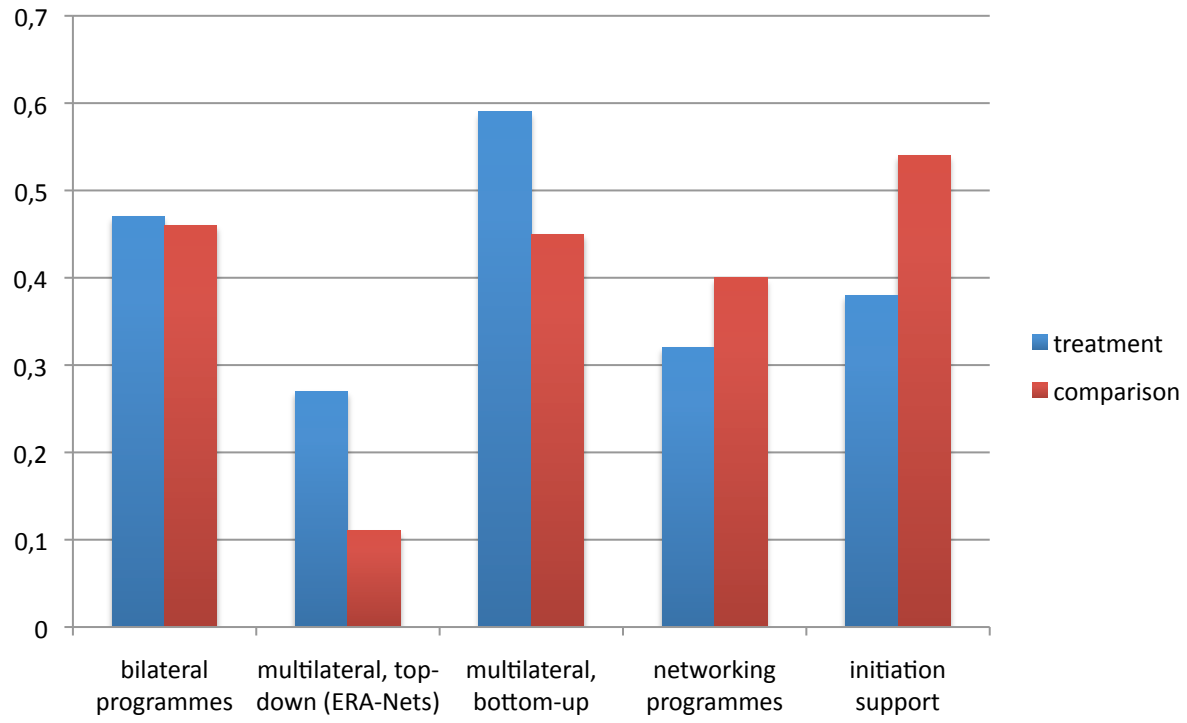

Figure 20: What kind of programme support is missing?

Controlling these relations for programme experience were not considered as useful since it is not clear what kind of programme experience is relevant to assess the need for thematically bottom-up

Conversely, for cooperation within Europe, the experience with lead agency was taken as the relevant condition (as bilateral cooperation within Europe has mostly been via lead agency agreements in the period of our interest).

multilateral programmes. What was possible to do is to control for joint project /lead agency experience and ERA-Net experience:

- Among those with lead agency or joint project experience, 62% ask for more bilateral programmes (vs 47% of the overall population) and 56% for bottom-up multilateral (vs 59% in the overall population).
- Among those with ERA-Net experience, 35% ask for additional top-down multilateral funding (ERA-Net style) – it is thus still a minority.

When asked in which countries/regions cooperation would be important, but is difficult to implement with the currently available instruments, a majority of respondents points to countries with strong research systems – in Europe or beyond.

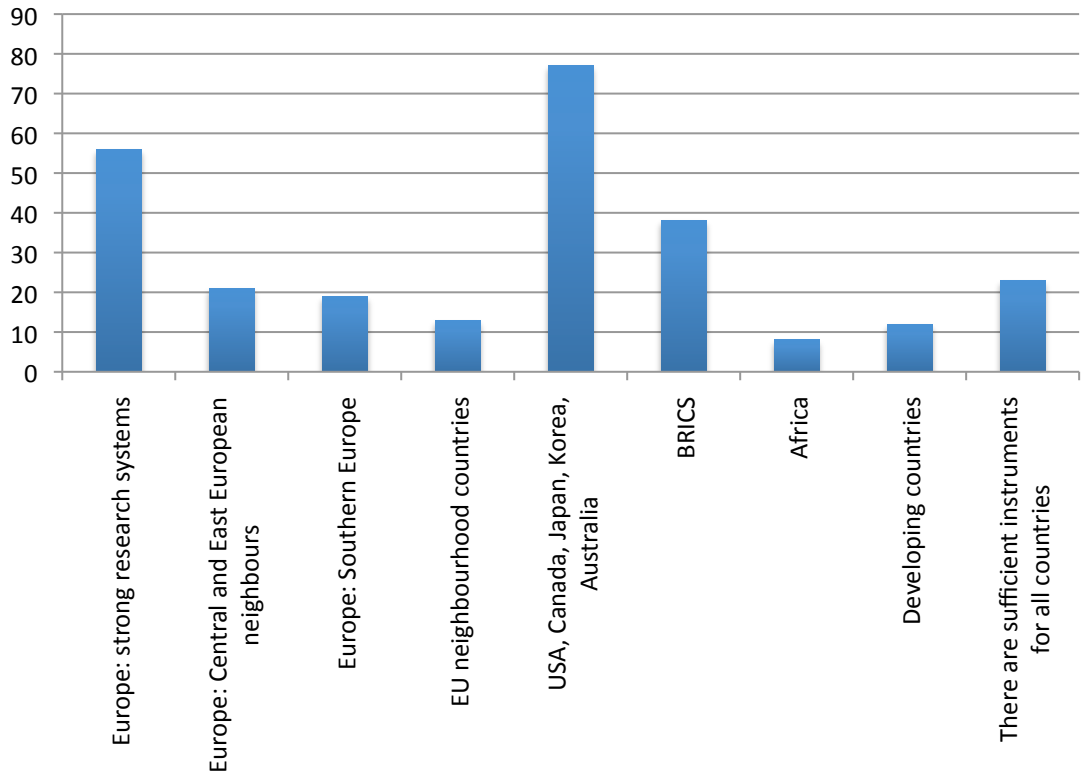

Figure 21: Demand for cooperation with specific countries where current instruments are not sufficient

Although not part of the scope of this evaluation, questions of sustainability (of the cooperations created through I programmes) and additionality (of the I programmes vs other FWF support) are important contextual aspects. The programme portfolio is also too young for a substantial analysis of the sustainability. However, in order to provide some evidence on sustainability and additionality, we looked at those I project PIs, who 1) had at least one stay abroad, and 2) who had joint project support (bilateral

prog. or lead agency); and asked whether the partner country in an I project corresponds with either the PI's nationality or his/her mobility experience. Multilateral schemes like ERA-Nets or EUROCORES were excluded from this analysis. Constellations with multiple partner countries are, on the one hand, too complex to be processed in this context. On the other hand, the direct impact of the various partners in multi-lateral projects on a PI's individual career path can hardly be extrapolated. In the case of DACH, the possibility of trilateral collaboration was assumed, i.e. DACH always counted as Germany AND Switzerland cooperation.

In 65% of the cases, the PI's mobility experience and the country of the I project partner country do not correspond. This means, that in 35% of the project cases, a PI might have built on his or her mobility experience in a specific country. For the nationality of the PI, this relation is even weaker: In 84% of the cases (of PIs with non-Austrian nationality), the PI's nationality and the I project partner country do not correspond. This means that it is more likely a PI can follow-up collaboration with partners in a country where she/he has work experience, rather than a personal history.

The survey results confirmed the data from the final report analysis in the sense of the overall satisfaction with the FWF programme management (information offers, time to contract, etc.). The only item with a slightly more critical appraisal is the success rate. It is considered low or very low by 37% of the I project respondents (still, it is considered appropriate by the majority – 59%).

Overall, 84% of I project PIs who responded to the survey would apply again (ERA-Nets: 91%; Lead Agency: 89%; EUROCORES: 79%; Joint Projects (without Lead Agency): 75%).

Please refer to chapter 12 above for a summary of the main findings.

ANNEX IV – Interviews at the FWF | Documentation

The following is a collection of data resulting from the interviews we carried out. For the methodology and the conclusions we draw, please refer to the appropriate chapter in the main part of this report.

a. Portfolio & context

Is the international funding portfolio of FWF appropriate?

The current portfolio is historically grown and depends on external factors. It is a combination of tools from the EU-context, on the one hand, and others that were (co-)developed bi- or tri-laterally.

<u>How international agreements come into being:</u>

The rationale behind the current international agreements is to enable cooperation where there is demand, rather than stimulating internationalisation strategically. Within Europe the main drivers for

cooperation agreements are: 1) agreements with neighbouring countries are prioritised to ensure synergies with *Austrian research* (=*Forschungsstandort Österreich*) and 2) other EU countries with high performing scientific systems are also prioritised, where possible. Some of the agreements with these countries were initiated by the FWF, some of them by the partner agencies.

Beyond Europe, there are scattered agreements with industrialised nations: Argentina, China, India, Japan, Russia, South Korea and Taiwan. The rationale behind these agreements is, on the one hand, the scientific strength of the research nation and, on the other, the expected development potential of cooperation with Austria. Decisions for new cooperation agreements are taken in a top-down manner by the executive board (*Präsidium*). An internal strategy process within FWF furthermore resulted in the decision to focus on cooperation with Asia.

The two greatest obstacles for new agreements/more active cooperation were described as follows: 1) The partner funding agency's processes do not match the FWF processes. This aspect mainly refers to the fact that FWF funding is, wherever possible, thematically open (bottom-up), which is not the case at many other funding institutions. Other problems relate to the frequency of the funding committee meetings or legal problems: in the case of the NSF (USA), it was not possible to make the funding decisions transparent, which is a prerequisite for the FWF. 2) The partner funding agency's budget is too small to enable the funding of a decent amount of bilateral projects, so the administrative effort does not match the opportunities offered to Austrian researchers.

From the specialist departments there were comments that more transparency and consultation with them would be appreciated when new agreements are made by the Executive Board and the Strategy Department for International Programmes (SDIP).

<u>Differences between the scientific fields:</u>

All interview partners acknowledged that international cooperation works in different ways depending on the scientific field. The project officers in SSH argue that their fields are sometimes under-represented as compared to the natural sciences. They also argued that an agreement with Italy is urgently missing, because there are strong historical and cultural ties in SSH research. Unfortunately Italy does not have a corresponding agency for such an agreement.

In the historical studies and archaeology, where international cooperation is necessary for conducting research, Austrian researchers and their colleagues tap not only into FWF's IPs, but also depend on EU funding. In the humanities, researchers often prefer FWF standalone projects. In the social sciences, researchers sometimes have the problem that they would need to conduct longitudinal studies, but the maximum funding period is only 4 years (for individual projects, but typically only ~ 3 years for IPs; although it is tried to keep 4 wherever feasible).

The ministry interviewee identified two major dimensions for internationalisation within a certain scientific field: top-down vs bottom-up definition; closed vs open and international culture.

top-down	bottom-up
International culture	closed culture

There are logics for stimulating new international cooperation (top-down) as opposed to logics for demand-driven internationalisation support asked for by researchers (bottom-up). While internationalisation with, for instance, India might be researcher-driven in one scientific field, in others cooperation with India might depend more on top-down decisions (if it is not intuitive for the scientific community in the specific field to collaborate with Indian scientists). In general, some scientific fields are inherently international in their culture for knowledge creation and scientific publishing (e.g.: bio-technology research) while other scientific communities tend to have a more closed publishing culture, often in local languages. It is a challenge to find meaningful solutions to enable and support international cooperation for the different fields. Diversity in the international spread of the IP portfolio is thus important to meet the different research fields' demands with regard to international cooperation.

Bilateral vs. multilateral

It was stated, that, from a programme management perspective, bilateral arrangements are more effective for international cooperation than multilateral arrangements (since the latter take more administrative effort while not necessarily leading to better results). We have seen in the survey results that the view from the research community is different here; they value multilateral collaboration. Bibliometrics also have shown that the average citation impact is higher for multilateral publications.

The DACH agreement was named as an exception to the rule of increased administrative efforts of multilateral schemes: due to the aligned administration on the funding agencies' side and cultural closeness on the researchers' side, cooperation works very efficiently. But even within DACH, only 10% of the projects are trilateral. The FWF is flexible to conduct any trilateral construct, but it is not considered as highly demanded. Again, the survey results show that particularly bottom-up support for multilateral collaboration is in demand.

No strong additionality effect was observable at trilateral calls with greater geographical distance as for example in the case of the call with Austria, Hungary and South Korea (there were not many submissions and very few projects funded). Although the ERA-Nets are thematically pre-defined they are considered very useful for multilateral network creation, because they are well established and work very well. It has to be noted, that the FWF has never taken over the secretariat for an ERA-Net. There is no defined strategy after which the FWF decides joining ERA-Nets. The budget does not allow joining all of them.

Since the EUROCORES programme was abandoned (together with the closing of the ESF), a gap for bottom-up multilateral basic research was created. According to the Strategy Department for International Programmes, there are vague considerations all over Europe for re-establishing a similar

mechanism. Alternatively, during the discussion the basic possibility of networking already existing projects, by e.g.: establishing a coordination secretariat or by funding travel or equipment costs, but the FWF does not see itself in such a role.

The interview partner at the ministry was wondering whether it would be worth thinking about international cooperation between the funding agencies themselves as a next phase of multi-lateral science cooperation. TAFTIE already exists as a knowledge base, but already during the creation of the ERC the question arose whether an internationalisation of the agencies all over Europe would make sense. What if one agency decided to launch a call for several countries? How would such a procedure affect the participating researchers, projects and programmes?

Networking tools

The Joint Seminars (JS) play a very marginal role in enabling new networks. They are rather used for setting low-threshold activities, but hardly for developing long-term cooperation. For this purpose, the FWF often refers applicants to the possibilities via the Scientific and Technological Cooperation calls (*Wissenschaftlich-Technische Zusammenarbeit –WTZ*) of the BMWFW (Federal Ministry for Science, Research and Economy).

In contrast to the JS, the RNPs were 4-5 years networking programmes coordinated by the former ESF. These were considered as very useful with the FWF having approximately a participation rate of 80-90%. Although, there is the possibility for networking via the COST Actions, without the RNPs there is still a gap in European networking on basic research level.

How far do FWF's international programmes support FWF's mission?

International cooperation is embedded in the mission of the FWF: "***International orientation****: The FWF is guided by the standards of the international scientific community and actively supports cooperation across national borders*"[14]. The importance of international cooperation is considered as crucial for excellent research that produces internationally citable scientific products, as stated by the Strategy Department for International Programmes. Especially for a small country like Austria, it is important to network internationally.

To what extent do FWF's international programmes fit into the entire FWF portfolio?

The Strategy Department for International Programmes describes the IPs as a "natural [international] extension of the scientific community" of the stand-alone programmes. Particularly through supporting international cooperation in a bottom-up way and oriented towards excellent research, there are no comparable funding tools in Europe (e.g.: in the FP).

[14] FWF (n.d.): FWF Austrian Science Fund. The FWF's Corporate Policy. https://www.fwf.ac.at/en/about-the-fwf/corporate-policy/ . Accessed February 2, 2017.

Are the financial resources FWF dedicated to international cooperation adequate?

The share of the budget for the international programmes has significantly increased within the last decade. 14% of the budget goes to international programmes, plus another 6% on the mobility programmes. With these figures, the FWF seems to have a higher share than all the other agencies Europe-wide, except for the French (ANR), which participates in more ERA-Nets and JPIs. Looking at single calls, the funding partners outside Europe tend to have more budget available than the FWF. Within Europe, apart from Germany and Switzerland, the FWF is usually the agency with higher financial means.

Yet the question of financial resources has to be seen in the context of the scientific quality. FWF will only fund projects with adequate quality, which sometimes is not evaluated as high enough (by FWF staff) in calls with extra-European partners. The FWF does not set limits to specific calls. All projects that meet the quality standards will be funded, which is possible because budgets are shifted flexibly between the different calls, depending on the number of submitted projects and their quality.

b. Management, programme design & processes

Are the design and the management of the programmes appropriate? Which measures should be taken to improve programme design?

The IPs are intended to work as similarly as possible to stand-alone programmes, while respecting the counterpart agencies' specificities. No specific procedures are created for IPs. Particularly in the cases where the Lead Agency Procedure applies, the process is simple. When a bilateral call is created, the Strategy Department for International Programmes establishes and shares guidelines with the Specialist Departments explaining deadlines and the partner agency's specificities.

The Specialist Departments observed that, over the years, the international programme portfolio expanded. This caused increased administrative effort, while in parallel budgets and funding sums tended to decrease. Consequently, the creation of new bilateral agreements was partly seen with scepticism. When creating new bilateral agreements, the wish was expressed by the specialist departments to consult them in advance for better aligning deadlines and procedures.

How can FWF meet the needs of the scientific community in the best way?

Particularly from the Specialist Departments, there were suggestions made to consolidate the portfolio and focus on few countries that traditionally have bilateral calls that are highly demanded. At the same time, the importance of a certain degree of diversity was acknowledged to 1) meet the needs of the different fields. 2) It was also acknowledge that it is easy to repeat and work on already well established cooperation agreements, even if the funding rates are small.

Are the evaluation and decision procedures fit for purpose?

All communication with the international partner agencies is coordinated via the Strategy Department for International Programmes, starting from the conceptualisation of the programme. It is their task to carry the specific international calls to the FWF Board meetings and the decision panels. It is their ambition to design the decision making processes as similarly as possible to the stand-alone projects, so as to create as little additional workload as possible in the specialist departments.

If the partner agency's cycle only foresees few decision meetings per year, the workload at this point increases for the specialist departments (need for aligning timelines). Open calls, on the contrary, enable to handle submissions continually over time, creating fewer peaks.

Overall, it is always attempted to not create any specific procedures for the IPs. Efforts are made to assimilate the IPs processes as closely as possible with those of the standalone projects. To support this, all the international calls come with a guideline document provided by the SIP Department with all the specifications for the international call at stake (deadlines, meetings, documents, etc.). The creation of these guidelines for the IPs was very much appreciated by the specialist departments and highlighted as a good practice.

Effectiveness and efficiency of FWF international programmes (taking into account e.g. call cycles, processing time, success rates, administrative overhead…?

Given that international cooperation is considered highly important, the IPs should not be assessed solely considering their administrative effort. Although the funding rates are lower than for standalone projects (e.g.: with CZ or FR just above 10%) and the funding decisions tend to take longer, it is surprising how high the interest of the Austrian community in the IP calls is. The participation rates and accordingly the demand for IPs are very high.

The Lead Agency Procedure (LAP) is considered as very efficient, because the decision is taken by only one agency and the other(s) accept the decision - It is an independent decision on the basis of the assessment of the documentation and the Lead Agency's preliminary decision. The intention of the others is to follow the Lead Agency as best as possible (because there is trust in the procedures). Behind this is, of course, a lot of mutual trust and certain coordination efforts are necessary. However, the LAP certainly is the success model for international joint funding. Each year, thousands of nominations and expert reviews (*Gutachten*) can be saved only in context of the DACH programmes.

Which measures should be taken to improve programme management?

The LAP should be implemented for as many international programmes as possible to save resources. Other than that, the procedures at FWF already are very efficient and only small details can be adapted occasionally. For these adaptations, there is a task force for the IPs that meets irregularly on the demand of additional regulations.

For better coordination between the Strategy Department for International Programmes and the specialist departments, interviewees informed about previous attempts for better coordination: like the intent of establishing a body (*Gremium*) or dedicated persons as mediators at the interface between the departments. There was no clear vision of what could work in this context to significantly improve processes. After all, every project officer has to understand the IPs to some extent and there are the guidelines provided by the SIP department with specific details on each international call that seem to work very well.

c. Future

Should/could the programmes under discussion be continued, improved or restructured? Is there evidence for continuing the programmes in their present form?

The way science is organised today is inherently international. English is by far the most important language in publication and most scientific communities are set up in a way that makes international cooperation necessary and natural. Therefore, there was no doubt about the importance of the existence of the IPs.

Apart from the fact that there is always room for procedural adaptations to become ever more efficient, the current set of IPs was assessed as functional and satisfying. The most urgent procedural optimisation according to interviewees is the further expansion of the Lead-Agency principle. This principle with only one agency conducting the selection process has already been realised in all bilateral agreements in Europe as well as with the Korean agency. At the moment there are no further bilateral agreements with the potential to be re-organised as a Lead-Agency.

It was widely recommended to keep FWF's ERA-Net participation as high as the budgets possibly allow. Although they are not thematically open, they are the most important and effective multilateral funding tools that currently exists.

Is there evidence for terminating the programmes?

It was acknowledged, that if efforts and demand do not stand in an acceptable relation to each or if a programme does not result in an acceptable funding rate over a longer period of time, it should be in the scope of possibilities to terminate such a programme.

It was observed, that the funding portfolio has been increasing in recent years, which results in a greater diversity of funding schemes, but consequently more scattered budgets. To keep budgets effective it might make sense to consolidate the portfolio again and consider closing down smaller strands again (i.e. in cases described in the above paragraph).

The JS were described as a rather insignificant tool in the funding portfolio, but it was not suggested for closure due to its small cost.

Are there valid arguments for improving or restructuring the programmes?

In the current portfolio, a lack of networking schemes was observed: RNPs and EUROCORES as tools provided by the former ESF are discontinued. To compensate for these, it might make sense to consider the international networking of already running projects.

It could be worthwhile reflecting whether it is legitimate to expect excellent scientists to know the partners they would like to collaborate with and hand in projects, or whether they would need support for network creation by e.g.: strengthening the JS tool. This could be particularly useful when a regional international cooperation strategy is followed (as opposed to a focus on demand-driven internationalisation). It can be questioned, however, whether it should be the FWF's role to conduct such small-scale networking schemes (or rather another agency's role or whether these mechanisms are not already partly covered by other tools, like COST Actions or the WTZs).

ANNEX IV – Scenario Workshop | Documentation

The Scenario Workshop on June 19 2017 took place at the FWF premises with the participation of Uwe von Ahsen, Klement Tockner, Ellen Zechner, Reinhard Belocky, Christoph Bärenreuter, Beatrice Lawal, Klaus Zinöcker, Stephanie Resch of FWF as well as Alexander Degelsegger-Marquéz, Isabella Wagner (both ZSI) and John Rigby (University of Manchester) representing the evaluation consortium.

The workshop was structured as follows: After a **presentation of the data** and results of the evaluation study so far, the four **future scenarios** were presented and additional arguments collected by the participants. In the final phase of the workshop implications of the different scenarios were **discussed** and ideas for future mechanisms addressing these scenarios developed. Below, the major results of the discussions.

a. Idea for a new networking tool

During the discussions, an idea for a new networking tool came up. It was suggested to create something that synthesises on existing networks to an extent of for example 10% of the overall IP portfolio. These synthesis networks should create a nucleus for new projects, have their base in Austria and be set-up for longer time scales than only 3 years (e.g.: 10 years). These networks should be of a tangible nature, for example databases or other infrastructures and be developed in cooperation with partner agencies, where possible. This kind of synthesis networks ideally could follow a bottom-up approach, but doubt was raised if this would be possible.

A pilot project with a budget of couple of 100,000 euros could be invested using and merging existing resources, with a focus on financing the network costs. This can be bottom-up and remain flexible, include every country in the world and therefore cover countries that are not covered by agreements. In such a “global synthesis centre” partners could come in with their own resources, but this does not necessarily have to be the case. Mobility could be one element, but there must be a clear difference between such an approach and the COST networking mechanism.

Austria would be the central partner and remain important nucleus in such a system, attracting international researchers and agencies to join in the long run. As soon as infrastructure is involved, FWF (only or at least mainly) should fund it. The consideration was uttered that we probably cannot involve all countries but maybe only work with pre-defined countries.

To realise that, in a first step, the construction of a multilateral framework around all bilateral lead agency agreements could be established (to limited extent) . This could nicely match with the more networking based logic of the above suggestion. However, the longer time frame in the idea suggested has to be considered and that we must stay flexible with the inclusion of new and more countries than just the ones we already have agreements with.

Currently, there are 9 countries collaborating in a lead agency scheme. I would be interesting to have a joint call with these 9, maybe with Austria in the centre. Such kind of joint programming should be independent, but coordinated and would have an immense visibility.

The specific attractiveness of such a networking project would be that FWF could cover many different research needs and that it would attract people to come to Austria.

Considerations were uttered about the potential effect of such a scheme on the quality of the I projects and the implications if such a capacity would develop in other places (in parallel?). If there are similar networks existing or emerging, they could be complementary or become part of the endeavour.

The vision for such a tool is that if for example there is a team in Romania, one in Brazil and one in Austria, they should be able to team up and join forces with Austria serving as a hub for that. In a pessimistic view (Degelsegger, Rigby) there is the danger of such a tool being misused as a preparatory fund for other proposals or the topics identified might not be very good. A reaction to these concerns was that the approach of FWF always was to trust researchers.

The idea was further developed during the discussions along the four different scenarios in the following. The concept of the "synergy networks" fits into all of the four scenarios presented:

b. Discussion

Scenario 1 – Rethinking the IPs: Apart from enriching the portfolio by a new networking tool, this scenario is not favourable. The IPs are good, we might just need a little less opportunity-driven bilateral programmes.

Scenario 2 – Expanding country strategies: The total amount of Is was lower than the number of Ps. Since the total number of fundable projects is limited, the assumption suggests itself that by increasing high-ranking country cooperation, this might have a positive impact on the quality.
For such an approach, also the Austrian "Beyond Europe strategy" must be considered, which draws on the internationalisation level (or capacity) of the whole system. This would then inhere political decision and such an approach would be a political statement.

The idea of the "*synergy networks*" would connect with this goal.

It is also FWF's task to 'feed the system with new people', who take the chances that we are trying to open up. The question arose whether this has been considered. It was remarked, that 80% of the funding goes into PhD student positions.
In this scenario, the effort would be to expand to regions with partners that do not have as established processes as FWF has. But would that affect the currently good quality? We have to have a look at the specific partner agencies' structures, not only address country groups according to a geographic strategy. It could also be considered to have an evaluation of the existing partner agencies to assess their quality, their ability to learn and whether their processes have an impact on the research quality funded.

Scenario 3 –Strict Bottom-up only approach: There has to be distinguished between bottom-up in the sense of topical openness (bottom-up in the core sense) and bottom-up in the context of collaboration (as opposed to dedicated calls with specific countries). So the same arguments fit for Ps as much as for Is in this regards. The advantage would be the openness for researchers' demands, which still allows priority setting. The disadvantage is that there are always issues on the funding partners' side, particularly beyond Europe (they often have thematic focus areas).

The idea of the "synergy networks" would be thematically AND geographically open and would go beyond this scenario even.

A driver for this scenario would be that both the FWF and the researchers want to work that freely, but the international partners are not as flexible. This situation is expected to even become worse. Thematic funding on the rise and thematic schemes are getting bigger, which is a challenge for a bottom-up oriented organisation like the FWF. They would like to focus just on excellence.

Scenario 4 - multilateral vs. bilateral: This scenario is based on the thinking, that multilateral programmes should be expanded. Most of survey participants want a multilateral bottom-up programme, which currently is not existing. From the survey, we cannot estimate the actual satisfaction with such a potential scheme, therefore difficult to conclude in this context.

The "synergy networks" idea is not easily implemented within a short time, but will tackle all scenarios. It could be realistic within a 2025 horizon. The clear evidence in this study will help creating policy and decisions for framing such an idea – potentially even beyond the FWF.

The fewer other agencies are willing to fund bottom-up research, the more important FWF wants to meet the needs of the research communities. To realise the idea of the "synergy networks", a two-step implementation could be applied: 1) umbrella for lead-agency and 2) inclusion of the networking (infrastructure) element.

Tockner: By installing matching funds we could include complementary funding for other programmes we are not willing to contribute in a different way. We need political will for such an idea and the call is coming from outside; FWF wants to be pro-active and come up with good ideas. However, the FWF has to be careful to not be pulled into something they cannot control anymore. The EU are trying to control the national funds (joint programming etc.) ever more. This is dangerous for the bottom-up idealism at the FWF.

We have to learn from the experiences of other agencies and their IPs. Are there other systematic approaches of considering these issues? Rigby: have another look at literature here in upcoming week. Inevitably, all agencies are working along there strands: supporting science, shaping science, and enacting science diplomacy, but eventually new approaches could fail at partner agencies' limitations.

17. Glossary of Terms

Bi-lateral programme	An international research programme which is organized by two countries to fund research projects
Constituency	Users and direct beneficiaries of a research programme funding instrument
COST	EU funded programme enabling researchers to establish their own interdisciplinary research networks in Europe and beyond
DOI	Digital Object Identifier
ERA-NET	European Research Area Networks – are created when "national and regional authorities identify research programmes they wish to coordinate or open up mutually. The participants in these actions are therefore programme 'owners' (typically ministries or regional authorities defining research programmes) or programme 'managers' (such as research councils or other research funding agencies managing research programmes)." (European Research Area web site: http://ec.europa.eu/research/era/era-net-fp7_en.html, 25/7/2017)
ESF	European Science Foundation
EUROCORES	The European Science Foundation (ESF) (EUROpean COllaborative RESearch) Scheme
FWF	Austrian Science Fund
I Projects or I-type projects	International Programme Funded Research by FWF
iFQ survey	Survey of Researchers conducted by Institut für Forschungsinformation und Qualitätssicherung (Institute for Research Information and Quality Assurance) – for various research bodies – FWF has periodic survey
Joint Projects	Includes FWF's IPs joint projects supported through bilateral agreements AND lead agency procedures, if not stated otherwise.
JOREP	Joint and Open REsearch Programs – an initiative of the European Union DG Research to fund research into research programmes of Member States to identify good and emerging practice
MatchIt	A module available in the R software system for Nonparametric Preprocessing for Parametric Casual Inference
MFCR	<ean field-normalised citation rate – one of a range of normalized citation scores for a publication – being an index which could be aggregated
Multi-lateral programme	An international research programme funding research projects and organized by more than two countries and involving any number of partner countries in a project including as few as two countries
OECD	Organisation for Economic Cooperation and Development
P Projects	Stand-Alone Projects of the Austrian Science Fund
PI	Principal Investigator
R	Statistical Analysis Software Package
SFB	An FWF funded Programme – the Spezialforschungsbereit Programme under which projects can be funded with the following goals: a) Establishment of research networks based on international standards through autonomous research concentration at a single university location and b) Building up of extremely

	productive, tightly interconnected research establishments for long-term and interdisciplinary work on complex research topics
Stand-Alone Projects	Stand-Alone Projects of the Austrian Science Fund
Tri-lateral programme	An international research programme which is organized by three countries to fund research projects
WOS	Web of Science – A citation Index

18. Literature

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