FINAL REPORT

IMPACT ASSESSMENT OF THE FNR FUNDING PROGRAMMES CORE, INTER, ATTRACT AND PEARL

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INTERFACE

Impact assessment of the FNR funding programmes CORE, INTER, ATTRACT and PEARL

Final report

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EXECUTIVE SUMMARY

The Luxembourg National Research Fund is the main funder of research activities in Luxembourg. It commissioned *Interface Policy studies Research Consulting* to evaluate the impact[1] of the agency's four major funding schemes: the project funding programmes CORE and INTER (in the fields of materials and physical sciences) and the person funding instruments ATTRACT and PEARL.[2] The main objective was to evaluate and compare the impact of the four programmes in terms of scientific impact and recognition, training impact, and socio-economic impact and dissemination. The evaluation was based on analysis of documents and data, interviews, and online surveys. The programmes were additionally put to national and international benchmark. A panel of international experts from different fields assessed the evaluation results.

The results of the evaluation are in general positive:

- The funding schemes rely on appropriate and sensible *funding concepts*.
- The funding schemes show *high impact*. They are especially important with regard to *scientific output and recognition*, *visibility*, and *scientific independence*.
- CORE, ATTRACT, and PEARL are of particular importance with regard to *career development* of the funded principal investigators.
- CORE, INTER, and ATTRACT have considerable *training impact*.
- PEARL shows particularly high *socio-economic and dissemination impact*, but there is room for improvement in this kind of impact of CORE and INTER.
- Overarching objectives of the four funding programmes have been achieved. We clearly observe *knowledge transfer* to Luxembourg and an *increase in the visibility* of Luxembourg as an attractive research location.

The following issues should be given further consideration:

- Creation of a funding instrument for *Centres of Excellence* should be envisaged.
- Introduction of a *research award* for Luxembourg should be considered.
- The *sustainability of* PEARL and ATTRACT funding should be discussed.
- Adequate communication accompanying the *application and selection processes* is of utmost importance in the FNR's day-to-day contact with its stakeholders.
- *Low participation of women* in ATTRACT and PEARL gives reason for concern.
- Some changes to the *funding concept of ATTRACT* (external reviews, headhunting aspect) are advisable.

[1] In this study, impact is generally defined as effects of the funding measures on the target groups, i.e. the grantees themselves and their hosts. Four categories of impact are assessed: scientific impact, training impact, socio-economic impact, and personal impact.

[2] CORE is the main FNR project funding programme in five priority domains; INTER provides funding in the framework of bilateral or multilateral collaborations; ATTRACT aims at attracting outstanding researchers with high potential in order to set up a research group in Luxembourg; PEARL aims at attracting established leading researchers in strategically relevant areas.

1 SYNTHESIS AND RECOMMENDATIONS

The evaluation presented in the report at hand was conducted by order of the Luxembourg National Research Fund (*Fonds National de la Recherche*, FNR). The main objective of this evaluation was to assess the impact of the FNR's four most important funding schemes: CORE, INTER, ATTRACT, and PEARL.[3] For CORE and INTER, the evaluation was restricted to the fields of materials and physical sciences (MS) and the period from 2010 to 2015. For ATTRACT and PEARL, the evaluation period is 2008 to 2015.

In this study, impact is generally defined as effects of the funding measures on the target groups, i.e. the grantees themselves and their hosts. The assessment of effects on economy and society was not a priority. Impacts are assessed according to the following categories:

- *Scientific impact:* Scientific output produced by the grantees (e.g. publications in journals, conference contributions, invited talks)
- *Training impact:* Supervision of doctoral students and completed doctoral theses in the research groups of the grantees, heading of research groups
- *Socio-economic impact:* Technology and knowledge transfer achieved by the grantees, grantees' collaboration with industry and other partners, patents, spin-offs, etc.
- *Personal impact:* Career development of the grantees and effects of the funding on the grantees' scientific independence

The assessment is based on the results of different evaluation methods: document and data analysis, qualitative interviews, online surveys, benchmarking, and appraisal of the evaluation results by an international expert panel. The initially planned bibliometric study commissioned by FNR was not available in time and its results could therefore not be used to complete the impact assessment. The following table gives an overview of the methods used to assess the four programmes.

[3] Please note that because of the large numbers of interviews conducted for ATTRACT and PEARL, a lot of qualitative information regarding the concept and implementation of these two funding schemes is available. Therefore, the respective sections are longer for ATTRACT and PEARL than for CORE and INTER.

D 1.1: Overview of evaluation methods

	CORE MS	INTER MS	ATTRACT	PEARL
Document/ data analysis	✓	✓	✓	✓
Interviews* (number)	✓ (2)	-	✓ (19)	✓ (16)
Online survey (population (N, response rate)	✓ (N = 53, 58%)	✓ (N = 42, 55%)	✓ (*Fellows*: N = 12, 100%; *Not retained*: N = 33, 48%)	-
Benchmarking	National International	National	National International	International
Expert appraisal	✓	✓	✓	✓

Source: Interface table. *An additional interview was conducted with Marc Schiltz, Secretary General of the FNR; the interview was on all of the funding schemes evaluated.

In this synthesis, the results of the impact assessment and our recommendations to the FNR are presented. The results are structured by funding programme and the different evaluation subjects examined: (1) concept and implementation of the programme, (2) programme output,[4] (3) impact,[5] (4) overarching objectives and (5) recommendations.

In the course of their appraisal, the experts formulated their own recommendations to the FNR. We have combined our own recommendations and the expert recommendations and present them according to the funding programme they concern. General recommendations and recommendations concerning all of the four programmes are presented in an individual section (cf. section 1.5 below).

1.1 CORE IN MATERIALS AND PHYSICAL SCIENCES

In this section, we summarize the evaluation results concerning the CORE funding scheme in material and physical sciences, draw conclusions, and present our recommendations. The assessment relies on interviews, an online survey conducted with all applicants for CORE MS between 2010 and 2015, and the analysis of FNR documents and data (cf. Table D 1.1). The detailed results are presented in section 4.1 of this report.

Programme description of CORE

With CORE, the FNR funds research projects to strengthen the quality of research in Luxembourg's five priority research domains: (1) innovation in science, (2) sustainable resource management in Luxembourg, (3) new functional and intelligent materials and surfaces and new sensing applications, (4) biomedical and health sciences, and (5) societal challenges for Luxembourg. The standard CORE track is directed at established

4 Programme output means the sum of services of the FNR with respect to the funding programmes: total number of grants awarded, total sum awarded, success rates etc. Impact is the reaction of the target group to these services. This terminology is commonly used in evaluations.

5 As defined above.

Principal Investigators (PIs). With the CORE Junior Track, the FNR fosters the funding of less experienced, early career-stage researchers and provides them with mentors who support them in establishing their independent research lines. The funding of international projects is organized by cooperation agreements between the FNR and funding agencies in Germany, Switzerland, Austria, and Poland (international co-funding within CORE (CORE bilateral); the collaboration with Poland is limited to the CORE domain Innovation in Services). For collaborative projects involving these agencies and where the projects have been submitted to FNR with CORE MS, the FNR is the lead agency. Since 2008, the FNR has funded 235 CORE projects with a total amount of 124 million euros.

Concept and implementation of CORE MS

The concept of CORE MS is appropriate. It is a well-known, important funding scheme in Luxembourg with a good orientation towards its target groups. A particular strength of the concept of CORE is the screening and selection process, which is evaluated very positively by the selection panel members interviewed. Comparing CORE to similar funding schemes abroad, the selection panel members assess the quality of the reviewing process and feedback as even higher. The evaluation further yielded the following positive findings concerning the concept of CORE and its implementation:

- The CORE applicants (with and without CORE funding) participating in our online survey generally evaluate the application process positively or even very positively for some aspects.
- The funding amount for CORE grantees is perceived as adequate or even high compared to similar funding schemes in other countries.
- Concerning the implementation of CORE, the support provided to the grantees by the FNR and the host institutions is very much appreciated.

Room for further consideration and improvement remain with regard to the following aspects:

- The main aim of the CORE programme is to foster projects of highest scientific quality. This is also the principal selection criterion. Therefore, applications in collaboration with industry were often perceived as having lower success rates. In 2015, the FNR reacted to this by introducing a new funding scheme called CORE Public Private Partnerships (PPP) with specific rules and evaluation criteria. A reinforcement of this funding scheme is advisable.
- Regarding the application process, some of the survey respondents criticized its fairness and transparency. This differs from the statement of the selection panel members interviewed, who point out the high quality of the process, and also the results of an evaluation of the CORE selection process conducted by the Western Michigan University in 2015[6]: The evaluation showed that "the CORE selection process is transparent, fair, unbiased and impartial" and that "the FNR's proce-

[6] Coryn, C. L. S., Applegate, E. B., Fiekowsky, E. L., Wilson, L. N., Endres, C. L., & Holley, S. E. (2016). An evaluation of the Luxembourg National Research Fund CORE selection procedure: Final report. Kalamazoo, MI: Western Michigan University.

dure allows the FNR to efficiently, effectively, and systematically select and fund […]". Based on the evaluation results, no conclusion can thus be drawn as to the extent of the transparency and fairness of the CORE application process. Still, it is important to pay attention to this feedback and discuss possible measures to improve the applicants' *perception* of the process.

Programme output of CORE MS

The following table shows a number of indicators concerning the output of the CORE MS funding programme.

D 1.2: Call output CORE MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications (total)	14	13	19	28	21	21	116
Applications with funding	8	5	4	9	7	7	40
Applications without funding	6	8	15	19	14	14	76
Success rate	57%	38%	21%	32%	33%	33%	34%
Funding amount (1000 €)	4,504	2,848	2,034	6,407	3,322	3,918	23,033
Funding amount/project (1000 €)	563	570	509	712	475	560	576

Source: Interface table based on FNR data. Note: Applications without funding include withdrawn applications and applicants not eligible for funding. The amount granted per project depends on the costs structure of the institution.

The number of applications for CORE MS increased from 2012 to 2015. The overall success rate was 34% and remained stable as of 2013.

Female participation in CORE MS in the observed period was low in absolute numbers. However, if we take into account the low number of female researchers working in the field of materials and physical sciences in Luxembourg, the rate of participation of women is satisfactory. What is more, the few female applicants applying to CORE MS have been very successful with their applications.

Impact of CORE MS

The evaluation assesses the impact of the CORE MS funding scheme positively in terms of the scientific output, training, scientific independence, and career development of the grantees as well as in terms of 'deadweight loss'.[7] Impacts in the areas of dissemination and valorization leave room for improvement. These conclusions are drawn based on the following findings:

7 We assume deadweight loss when beneficiaries of a funding measure would have been able to conduct the funded project even without the funding. This means that the same or an equivalent impact would have occurred without the support of the funding measure and that the incentive power of the funding instrument is reduced or even completely lost. We tried to estimate the extent of deadweight loss with the FNR funding measures under evaluation by asking the participants in our online surveys: "Would you have been able to conduct your project without the funding?". Applicants whose applications were not retained were used as a control group. They were asked: "Were you able to conduct your project even when your application for funding was rejected?". High shares of survey respondents answering 'yes' means high deadweight loss and is a negative result, whereas low acquiescence points to low deadweight loss and large incentive power of the funding scheme.

The *external project assessment* of the impact of the 12 CORE MS projects that were completed by 2015 is positive. The assessment was conducted based on the final reports. Overall, most of the projects are assessed to have produced results of reasonable (4 projects) or reasonable to high (4 projects) international impact. The assessment is particularly positive for the aspect of project implementation and positive for scientific impact. Regarding dissemination and valorization of the research results, the assessment is less positive, with some of the projects rated 'fair' (31% on average) or even 'poor' (27% on average).

Our *interviews* and the *online survey* of CORE MS applicants reveal positive effects of CORE on the scientific output and recognition of the funded researchers: The output of the survey respondents with CORE funding is higher than the output of respondents who have never received CORE funding for all aspects examined. For the most important scientific outputs – publications and conference contributions – the differences are particularly striking. Also, the training output of CORE grantees is very high. The share of survey respondents currently heading a research group is also significantly larger than in the group of respondents without CORE funding. The self-assessment of the output of the applicants is positive for both groups.

The online survey further yielded the following results regarding the impact of CORE MS:

- CORE MS funding improves the quantity and quality of scientific output in journals and conference contributions.
- CORE MS is important for visibility and outreach among national and international actors.
- CORE MS is an important factor for scientific independence and is crucial with respect to the career development of the PIs.
- CORE MS shows low deadweight loss.

Overarching objectives of CORE

Based on the results of our online survey, the assessment of some overarching objectives of CORE is positive. The applicants are convinced that CORE contributes to generation of high quality research and new knowledge, advances the careers of the grantees, and boosts the grantees' publication records. A vast majority of the survey respondents also agree that CORE has a positive effect on international visibility and that it supports the training of PhD candidates.

Benchmarking of CORE MS

The international benchmarking for CORE MS with project funding of the Swiss National Science Foundation (SNSF) showed a similar assessment of the significance of the funding for the grantees' career development, scientific independence, and scientific output. SNSF project funding seems to have a somewhat larger impact on publication output than CORE MS. In contrast, CORE shows a significantly smaller assumed and actual deadweight loss than SNSF project funding.

Expert appraisal of CORE MS

The experts agree that the CORE funding scheme is well-designed and that the amount of the grant is comparably high. The experts appreciate the FNR's efforts in creating CORE PPP to foster collaborations with industry.

According to the experts, CORE follows a concept that is comparable to project funding schemes in other countries. They agree that the restriction of the instrument to priority research domains makes sense for a small country like Luxembourg. The CORE application and selection process is also in line with international standards. In the experts' opinion, the level of transparency of the processes is high.

The experts see the CORE funding scheme as one possibility to address the issue of retaining researchers already working in Luxembourg. However, the situation remains critical for disciplines that are not part of the priority domains (e.g. mathematics).

The experts are impressed by the output achieved by the CORE MS grantees and acknowledge the fact that the outputs of the CORE MS applicants are higher for those funded than for the comparison group. They also appreciate that CORE MS seems to have a significant impact on the grantees' career development.

Conclusion and overall assessment of CORE MS

CORE MS is a good and well-endowed funding instrument that is widespread and very much appreciated by the scientific community in Luxembourg. The selection process and the funding amount are based on peer review and in line with international standards. The implementation of the funding scheme by the FNR as well as by the institutions is evaluated very positively. These findings confirm the results of an evaluation[8] of the CORE selection procedure conducted by Western Michigan University in 2015.[9]

The objectives of CORE MS concerning scientific excellence are achieved. The sensible design of the programme and the very good programme management by the FNR are conducive to the remarkable output that the programme has. The impact of CORE MS is clearly visible and significant in terms of scientific output and recognition, training, and career development of the grantees. In addition, CORE MS shows low deadweight loss.

Regarding the concept and implementation of CORE MS, some of the applicants identify room for improvement regarding transparency and fairness of the application process. What also remains disputable is the transfer of knowledge and technology to industry, to the economy, and ultimately to Luxembourg society. This issue is addressed by the introduction of the CORE PPP programme, which the expert team strongly supports.

8 Coryn, C. L. S., Applegate, E. B., Fiekowsky, E. L., Wilson, L. N., Endres, C. L., & Holley, S. E. (2016). An evaluation of the Luxembourg National Research Fund CORE selection procedure: Final report. Kalamazoo, MI: Western Michigan University.

9 The evaluation showed that "the CORE selection process is transparent, fair, unbiased and impartial" and that "the FNR's procedure allows the FNR to efficiently, effectively, and systematically select and fund […]."

Recommendations for CORE MS

We make the following specific recommendation concerning CORE MS:

1 Strengthen knowledge and technology transfer

A present weakness of the CORE MS funding scheme is its ability to exploit its full potential in boosting knowledge and technology transfer and thereby benefitting industry, the economy, and ultimately society. We appreciate the recent efforts of the FNR to strengthen these aspects through the development of the application and selection criteria and the introduction of CORE PPP. We recommend continuation of these efforts. Of course, the FNR should keep funding high quality scientific research projects through CORE MS in parallel.

1.2 INTER IN MATERIALS AND PHYSICAL SCIENCES

In the following, the evaluation results for the INTER funding scheme in materials and physical sciences (INTER MS)[10] are synthesized, and recommendations are presented. Since no interviews were conducted for INTER MS, this section relies on the online survey conducted with all applicants to INTER MS from 2010 to 2015 and the analysis of FNR documents and data (cf. Table D 1.1). The detailed results are presented in section 4.2 of this report.

Programme description of INTER

With the INTER programme, the FNR funds joint research projects of researchers in Luxembourg with foreign research institutions. The prime objective of the programme is to increase the competitiveness and international visibility of Luxembourg public research. The funding is not restricted to specific research fields. From 2006 to 2015, 103 INTER projects in all domains were selected, with total funding of 33.5 million euros.

Concept and implementation of INTER MS

The concept of INTER MS is different from the CORE MS programme. The FNR has entered into a number of cooperation agreements with foreign funding agencies to provide funding opportunities for bilateral projects. For each call, a lead agency responsible for the management of the complete selection process from reception of the applications to the peer review procedure is defined. In most cases the foreign funding agency is the lead agency (and not the FNR).[11] Furthermore, the FNR has joined several international consortia that provide funding opportunities for multilateral projects.

Overall, the survey respondents assessed the application process positively or even very positively on some aspects. This is true for applicants both with and without INTER MS funding. The workload entailed in writing an INTER MS proposal is seen as appropriate, and this is viewed as a particular strength.

[10] Please note that the assessment was restricted to the field of material and physical sciences and that the results might not be generalizable for all domains.

[11] For more information see www.fnr.lu.

Regarding implementation, the applicants highlight the very good support by the FNR and the hosting institutions. Also, the applicants are of the opinion that the FNR does a better job than its partner agencies. Furthermore, the feedback documents from the FNR are also evaluated more positively than the feedback provided by the partner agencies.

Some room for improvement is nevertheless identified: As with CORE MS, transparency and fairness of the application process are criticized by a considerable share of the survey respondents. The wait time for receiving notification of the funding decision is also evaluated rather negatively.

This point of criticism does not address the FNR directly, however, since the application and selection process depends on the foreign partner agency (lead agency). Projects with the FNR as the lead agency have to be submitted to CORE and are treated as CORE projects (CORE bilateral).

Programme output of INTER MS

The following table shows the output of the INTER MS funding programme in the observed time period.

D 1.3: Call output, INTER MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications (total)	11	9	6	44	34	17	121
Applications with funding	1	4	1	6	3	3	18
Applications without funding	10	5	5	38	31	14*	103
Success rate	9%	44%	17%	13%	9%	18%	15%
Funding amount (1000 €)	420	1'653	323	1,688	1,053	990	6,127
Funding amount/project (1000 €)	420	413	323	281	351	330	340

Source: Interface table based on FNR data. Note: Applications without funding include withdrawn applications and applicants not eligible for funding. *With one of the proposals marked as "rejected", the FNR database accounts for funding of 374,000 euros.

There was a significant increase in the number of applications for INTER MS from 2010–2012 to 2013–2015. In recent years, the FNR has enlarged the number of collaborations mainly through new bilateral agreements. The number of successful applications and the respective funding amounts have not developed proportionally. The success rate was very volatile due to the differing and sometimes low acceptance rates of the foreign partner agencies.

As with CORE MS, participation of women in INTER MS is not a problem if we take the low total number of female researchers in materials and physical sciences in Luxembourg into account. Female and male applicants show comparable success rates.

An issue of concern regarding the programme output of INTER MS is the acceptance rates of some of the partner agencies, which are very low. Some agencies generally

have low acceptance rates independent of the fact that projects involve several research partners.

Impact of INTER MS

The assessment of INTER MS is positive regarding impact on scientific output, training, and scientific independence and regarding deadweight loss. Impacts in terms of dissemination and valorization leave room for improvement. This assessment is based on the following findings:

The *external project assessment* of the nine INTER MS projects that were completed by 2015, based on the final reports, is rather positive. Three of the projects are deemed to have produced results of reasonable to high international impact; two projects show results of reasonable impact. However, there are also three projects that in the view of the external assessment show results with no impact to low impact. The assessment is particularly positive for the aspect of project implementation and scientific impact. Even though the majority of the collaborative projects are of a more applied nature, the assessment of dissemination and valorization of the research results is less positive, with most of the projects being rated 'fair'. However, the assessment is somewhat more positive than for the CORE MS projects.

Our *online survey* shows that for most aspects examined, the average output of the survey respondents with INTER MS funding is a lot higher than the output of respondents who have never received INTER MS funding. For the scientific output of publications and conference contributions, the differences are particularly significant. Also, the average training output of the INTER MS grantees is very high and a lot higher than of the survey respondents without INTER MS funding. The share of survey respondents currently heading a research group is also significantly larger than in the control group. The respondents with INTER MS funding assess their output even more positively than those never funded by INTER MS. Further, the following impacts of INTER MS can be identified based on the online survey:

- INTER MS funding improves the quantity and quality of scientific output in journal papers and conference contributions.
- INTER MS shows remarkable effects on the careers of PhD candidates and postdocs in the grantees' groups.
- INTER shows low deadweight loss.

The evaluation yields the following critical results:

- Impacts regarding knowledge and technology transfer are questionable.
- INTER MS seems to be less important than CORE MS regarding scientific independence.
- Also, INTER MS is a less significant instrument than CORE MS for career development of the PIs.

Overarching objectives of INTER

The evaluation of the attainment of two overarching objectives of INTER is very positive. The applicants surveyed confirm that INTER is a suitable instrument for developing new international partnerships and that it gives Luxembourg public research a better profile internationally.

Expert appraisal of INTER MS

The experts agree that the INTER funding scheme is in general well-designed. The INTER application process is hard to assess, because it depends entirely on the lead agency or multilateral consortia (e.g. for Eranets) and the FNR has no possibility whatsoever to influence it. However, the experts are of the opinion that the very low acceptance rates at the FNR's partner agencies are a problem. The acceptance rates of the partner funding agencies are in general on a lower scale. However, bilateral or multilateral projects are neither privileged nor disadvantaged. The experts think that the FNR should address this issue of imbalance between Luxembourg and the partner countries in its communications to potential applicants.

The experts are impressed by the output of the INTER MS grantees and acknowledge the fact that the outputs are higher for those funded than for the comparison group. They appreciate the high training impact of INTER MS.

Conclusion and overall assessment of INTER MS

INTER MS is a well-functioning funding instrument. The implementation of the funding scheme by the FNR and by the host institutions is a particular strength, and the FNR is appreciated when it is the lead agency. This is valid for CORE MS projects (cf. 1.1). INTER MS has high impact regarding its objectives on the individual level (scientific output, training, scientific independence) and on a more general level.

Regarding the concept and implementation of INTER MS, there are some points of criticism. However, they are not directed at the FNR, since the application and selection process is defined by the partner agencies.

As with CORE MS, socio-economic impact and dissemination seem to be on a relatively low level.

From the evaluation results, we do not draw any specific recommendations for INTER MS.

1.3 ATTRACT

In this section, we summarize our findings on the ATTRACT funding scheme and present our recommendations. The assessment is based on interviews conducted with all ATTRACT fellows, two applicants not selected for funding and two standing members of the ATTRACT selection panel, an analysis of FNR documents and data, and an online survey of ATTRACT applicants retained and not retained for funding (cf. table D 1.1). The results are presented in more detail in section 4.3.

Programme description of ATTRACT

The target group of the ATTRACT programme is outstanding young research professionals who are not yet established in Luxembourg. The goal of the programme is to offer postdoctoral researchers the opportunity to develop their research careers at a public-sector research institution in Luxembourg. Applicants can be either 'Starting Investigators' (early-career postdoc researchers) or 'Consolidating Investigators' (experienced postdoc researchers). They need to have proven experience in research and development and demonstrate internationally recognized achievements in their fields of research (i.e. publications, conference contributions, competitive grants, etc.). Between the funding scheme's launch in 2007 and 2015, 12 candidates were granted funding. For five fellows, the ATTRACT funding period has already ended.

Concept and implementation of ATTRACT

The concept of ATTRACT is generally appropriate and suitable to reach the funding scheme's target group. The funding amount is generous, although some of the fellows have the perception that the impact of the granted sum depends on the research discipline and the kind of research conducted.

The funding period of five years is appreciated. It allows for long-term planning, and five years should be a sufficient time period to build up a well-functioning group that can withstand critical evaluation.

Based on the interviews and the expert appraisal, we conclude that the selection procedure for ATTRACT is in line with international standards. The interview partners with and without ATTRACT funding particularly appreciate that they can read the external reviewers' comments in advance and address them in the interviews.

A particular asset concerning the concept of ATTRACT is the built-in tenure track introduced in 2013. This considerably alleviated the lack of sustainability of the funding that was experienced and criticized by the early ATTRACT fellows. The tenure track is also a unique characteristic of ATTRACT compared with similar funding programmes in other countries.

Regarding the implementation of ATTRACT, the support given by the FNR is very much appreciated. The individual coaching provided by the FNR is mentioned as a particular asset of the funding scheme. The collaboration with and integration in the host institutions (units, departments, etc.) are evaluated positively by the fellows in most cases.

Regarding the concept of ATTRACT, the interview partners and survey respondents identify some aspects with room for improvement:

- The quality of the external reviews evaluating ATTRACT applications in the first stage of the selection process seems to vary significantly. Also, the transparency of the application process is assessed negatively by a majority of the survey respondents whose application for ATTRACT was not retained for funding.
- Some of the interview partners suggest allowing second applications.

- In implementation of the programme, the lack of a clear-cut promotion scheme and possibilities of career development are criticized by the fellows employed before 2014 at the University of Luxembourg. ATTRACT fellows employed from the 2014 call benefit from the tenure track and promotion defined in the FNR convention with the institutions.
- The interview partners agree that ATTRACT is at present not known outside Luxembourg and thus has no pull effect on the international market for high quality researchers.

Programme output of ATTRACT

The following table shows the output of the ATTRACT funding programme in the observed time period.

D 1.4: Call output, ATTRACT 2007–2015

Call year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Applications (total)	6	9	4	3	3	5	4	8	6	48
Applications with funding	1	0	2	2	1	2	1	2	1	12
Applications without funding	5	9	2	1	2	3	3	6	5	36
Success rate	17%	0%	50%	67%	33%	40%	25%	25%	17%	25%
Funding amount (1000 €)	846	0	2,558	2,675	1,490	2,999	1,500	3,840	1,500	17,407

Source: Interface table based on FNR data. Note: Applications without funding include the labels 'rejected preproposal' and 'invitation for interview'.

The annual number of applications has not significantly increased since the launch of the funding scheme, but the interview partners observe a clear increase in quality. The success rate with ATTRACT has fluctuated quite a bit and was very high in some years. This may be due to a strict preselection process conducted by the institutions and the FNR, leading to high overall quality of the applications.

The participation of women in ATTRACT (20%) is on a low level compared with similar programmes in Switzerland. Also, it is far from the 40% target recently introduced by the FNR.

There are obvious differences in the success rates of applicants from different research fields. The units within the Faculty of Science, Technology and Communication, especially the physics and materials science unit, have been very successful in winning ATTRACT grants, whereas units in the Faculty of Language and Literature, Humanities,

Arts and Education have submitted a lot of applications for ATTRACT but with little success.

Impact of ATTRACT

The evaluation comes to a very positive conclusion regarding the impact of ATTRACT. This conclusion is drawn based on the following findings:

The *interviews* show that ATTRACT has impacts on the grantees and their careers in a number of ways. The interviewees identify high impact on their scientific independence. Also, they think that ATTRACT has a positive effect on their visibility and outreach. For all fellows, ATTRACT has meant a significant career step. For the more recent ATTRACT fellows, this career development is more sustainable thanks to the tenure track.

The results of the *online surveys* support these assumptions. Regarding the most important scientific outputs, the ATTRACT fellows perform significantly better than the control group without ATTRACT funding. For most of the other outputs, both groups are on a similar aggregate level. If we take a more detailed comparison of individual cases into account, the ATTRACT fellows show a much higher output than comparable researchers without ATTRACT in most cases. This is equally true for scientific output, training output, and socio-economic output. In contrast, the survey respondents without ATTRACT funding are more active in academic services than the ATTRACT fellows.

ATTRACT enables the host institutions to hire more qualified people and build up new research areas. According to the FNR, ATTRACT has also contributed to a change of culture that has taken place in the institutions.

Regarding the impact of ATTRACT, the following points of criticism can be mentioned:

- First, the sustainability of the funding scheme's impact remains unclear to a certain extent. Although a clear-cut career development plan for the ATTRACT fellows has been developed, particularly for those hosted at the University, co-funding beyond the ATTRACT grant for a limited group of high performers could possibly be envisaged, given that costs for infrastructure and staff are high in Luxembourg compared to other countries and difficult to maintain with project funding only.
- ATTRACT seems to be often used for ex-post financing of new hires. This does not affect the impact of the funding scheme in a negative way but might not be the pull effect of the instrument originally intended by the FNR.

Overarching objectives of ATTRACT

ATTRACT is seen as a suitable instrument to generate knowledge transfer to Luxembourg and to boost the visibility of Luxembourg as a research location.

A question remains about the sustainability of these effects. So far, one of the 12 ATTRACT fellows has left Luxembourg, but it is unclear if Luxembourg will be able to retain the excellence brought to Luxembourg research through funding schemes like ATTRACT in the long run.

Benchmarking of ATTRACT

The international benchmarking of ATTRACT with a number of similar programmes in Switzerland, Germany, Austria, and the EU shows that the built-in tenure track with ATTRACT is the one unique characteristic that sets the funding scheme apart from the others and makes it a very attractive, internationally competitive funding scheme. This also secures the sustainability of the impact of ATTRACT, which is an issue often criticized with similar funding schemes abroad. The flexibility in allocating the funds is also comparably high.

Regarding the programme output, the results of the benchmarking support our previous observations:

- The FNR invests impressive amounts in its ATTRACT funding scheme.
- The success rate of ATTRACT is on a high level.
- Female participation has been low compared with similar funding schemes.

The impact of ATTRACT on the grantees' most important scientific output, their scientific independence, and their career development, seems to be of comparable but somewhat smaller significance than the impact of the SNSF funding scheme Ambizione and SNSF professorships. In contrast, the impacts are considered more sustainable for ATTRACT (at least for the more recent grantees) because of the tenure track. Most of the ATTRACT fellows for whom there are comparison cases without ATTRACT funding show better performance than their counterparts regarding scientific output, training output, and socio-economic output.

Expert appraisal of ATTRACT

The experts are impressed that ATTRACT has a tenure track option and point out that this is a major asset of this funding scheme. The experts are convinced that the tenure track contributes largely to high and sustainable outputs and impacts of the ATTRACT fellows. The experts also appreciate that the ATTRACT projects have to pass a strategic merit assessment.

According to the experts, the application process for ATTRACT is in line with international standards. The experts support our recommendation to allow second applications for ATTRACT (see below).

The low participation of women in ATTRACT is a cause for concern and in the experts' view should be tackled by the FNR. The experts are impressed by the high scientific output of the ATTRACT fellows, and they are convinced that the funding programme is of great importance for the grantees and their host institutions.

Conclusion and overall assessment of ATTRACT

Generally speaking, ATTRACT is a very good funding programme. It offers some unique features like the tenure track, the high funding amount, and the individual coaching provided to the grantees. The implementation of the funding scheme by the FNR works very well, and grantees' collaboration with their host institutions is also evaluated positively for the vast majority of cases.

Regarding the impact of the funding scheme, ATTRACT allows for the building up of well-performing research groups and boosts scientific output, scientific independence, and national as well as international visibility on the individual level. It is also an instrument that is very important for the grantees' career development. The host institutions use the instrument for capacity building and securing critical mass. This has led to structural effects of ATTRACT. The overarching objectives of knowledge transfer and gain in visibility for Luxembourg as a research location are also achieved.

Issues calling for further discussion are the sustainability of the funding and the question of saturation of the Luxembourg research system with ATTRACT grantees.

Recommendations for ATTRACT

For ATTRACT, we formulate the following six specific recommendations:

1 Discuss sustainability of ATTRACT funding

The sustainability of ATTRACT funding is questionable. Ensuring that the attracted knowledge is not lost and the level of funding can be maintained is seen as one of the key challenges that the FNR has to face now. We suggest that the FNR discuss this issue together with the Ministry of Higher Education and Research (MESR) and with the research organizations and think about whether further measures are needed to ensure the sustainability of ATTRACT funding.

2 Improve visibility of ATTRACT

At present, the ATTRACT funding scheme is hardly known outside Luxembourg, even though it is undoubtedly a very attractive, competitive, and effective funding instrument for young researchers seeking to conduct their research independently and build up scientific excellence. We suggest that the FNR promote the ATTRACT funding scheme more intensively and take measures to increase its international visibility. These promotional efforts should be targeted to specific outlets such as international journals and conferences or selected universities. We recommend working on this together with the University of Luxembourg and the Public Research Centres (*Centres de Recherche Public*). The particular strengths of ATTRACT should be highlighted in these promotional efforts, i.e. the tenure track, and the individual coaching. Increased visibility would strengthen the pull effect of the funding instrument, which at the moment still leaves room for improvement.

3 Strengthen ATTRACT as a recruitment instrument

Along with the promotional efforts mentioned above, we suggest strengthening ATTRACT as a recruiting instrument. Already today, ATTRACT is actively used by the Luxembourg research institutions to build capacities and finance the hiring of high quality research staff from abroad. This has worked well in the past. We agree that the

University and the Public Research Centres could even intensify the use of ATTRACT as a headhunting instrument. In our view, the pool of ATTRACT applicants not retained for funding is a resource from which the institutions have not benefited enough. The quality of the applications for ATTRACT has increased over the past years and is considered to be remarkable, so that for example in 2016, all of the candidates invited to the interview were deserving of the fellowship. We are convinced that the institutions should make use of this pool of excellent researchers who have already proven their eligibility for ATTRACT funding and are in principle willing to come to Luxembourg. In some cases, applicants for ATTRACT have been recruited by the institutions after they were not retained for funding (in our survey sample, this is the case for 3 out of 16 survey participants).

4 Change the external reviewing process

ATTRACT has a selection process that is in line with international standards and based on peer review. But one difficulty is the commitment of the external reviewers used for the first evaluation of the applications, as the quality of the reviews varies significantly. The FNR has made efforts to improve the expert pool by assessing the quality of external reviews at the end of each call. This has been done systematically since 2016. However, a lot of ATTRACT reviewers are newly selected, given that in most cases, the topics are not yet represented in the existing expert pool. A measure to further improve the process could be the introduction of a one side anonymous ('blind') procedure – as is common in peer review processes. This could also lead to greater consistency. The names of the external reviewers would be revealed to the ATTRACT standing panel members only. Communication of this change of procedure to the applicants could also have a positive effect on their perception of the transparency of the selection process. We recommend leaving the composition and size of the standing panel as is. For the second stage of the selection process, the interview before the selection panel, we recommend better briefing of the external experts (the non-standing panel members) on what ATTRACT is, what their role during the meeting is, what kind of questions they are expected to ask, and who else will be present at the meeting.

5 Monitor and improve participation of women

The participation of women in the ATTRACT funding scheme calls for closer attention. It has been very volatile over the past years, and the overall participation rate is still quite low. The FNR has already acknowledged this problem and has set a new target value for female participation as of 2017, requiring 40% of all candidates proposed in the years 2017–2021 to be women. We strongly support this effort and recommend monitoring compliance with this target value very closely. The target value itself should be regularly reviewed and changed if appropriate. In addition, we suggest that the FNR discuss measures to improve the participation rate of women. The expert team strongly supports this recommendation.

6 Discuss participation of social sciences and humanities

Although the units within the social sciences and humanities have submitted a number of applications, the success rate of the applicants has been low. We observe a better distribution of research fields with similar funding schemes abroad and are convinced that ATTRACT with its concept would be a suitable and very attractive funding instrument also for the social sciences and humanities. We therefore recommend that the

FNR discuss the participation of social sciences and humanities and evaluate the necessity of improving the balance between research fields.

1.4 PEARL

In this section, we summarize the findings of the evaluation concerning the PEARL funding scheme. We then present our recommendations. The assessment is based on interviews conducted with all PEARL grantees, two applicants not selected for funding, two Scientific Advisory Board (SAB) panel chairs, and the analysis of FNR documents and data (cf. table D 1.1). A more detailed description of the results can be found in section 4.4.

Programme description of PEARL

The PEARL programme is directed at public research institutions in Luxembourg and leading research professionals abroad. The goals of the programme are to recruit internationally leading researchers with outstanding track records and thereby to strengthen the research areas that are of strategic importance to Luxembourg. PEARL projects have a lifespan of five years with a financial contribution of between 3 to 4 million euros. From its launch in 2008 to 2015, the PEARL programme funded eight projects; two projects have been completed, and six are still ongoing.

Concept and implementation of PEARL

The concept of the PEARL programme is assessed as sensible and appropriate to reach the stated objectives of the funding scheme. First, the generous funding amount functions as a compensation for researchers' insecurities in connection with the decision to move to Luxembourg. Second, the duration of five years is seen as adequate to be able to establish a research programme and to secure further funding. Third, the flexibility offered is a clear strength of the scheme, as it gives the grantees the freedom to use the resources as they see fit.

Several of the interviewees mention a shift in the concept from a focus on scientific impact to a focus on impact on the host institution and the Luxembourg research environment. The shift towards the 'fit' of the application is seen as favourable in order to meet the main objective of long-term impact and sustainability.

The application process, both the initial reviews in the first stage and the hearings in the second stage, is viewed as professional and transparent. The two stages are seen as favourable, as they allow for a separate assessment of the scientific-technical elements and the fit of the proposal to the funding scheme.

The implementation of the research programmes at the host institutions is also generally positively assessed. Among the PEARL grantees interviewed, most seem to experience positive collaboration with and sufficient support from the host institutions regarding infrastructure and recruitment. The grantees are often involved in internal decision-making processes, transfer of knowledge and methods, the establishment of networks between different research units in and outside of the University. They are also very active in the development of new research projects (particularly with partners

on the EU level and in collaboration with industry). Many hold management positions within the host institutions.

Concerning the concept and implementation of PEARL, the persons interviewed identify some aspects with room for improvement:

- The information provided to the applicant and the host institution after a proposal has been rejected for funding is seen as insufficient.
- The elements of the national strategy are somewhat non-transparent. In future programme descriptions, clear communication of the national strategy in general and in relation to the PEARL programme should be ensured.
- There are a few examples of conflicts between PEARL grantees and the host institutions. These are linked to lack of support, constraints in use of funding, and unclear contractual elements concerning the financial contribution of the host institution.
- Although synergies and collaboration between research institutions in Luxembourg have improved, there is still a need for more cross-collaboration, mainly between the University Faculties and the interdisciplinary centres as well as between research units at the University and the Public Research Centres in Luxembourg.

Programme output of PEARL

The following table shows the output of the PEARL funding programme between 2009 and 2015.

D 1.5: Call output, PEARL 2009–2015

Call year	2009	2010	2011	2012	2013	2014	2015	Total
Applications (total)	2	1	2	2	1	2	3	13
Funded applications	2	1	1	1	1	1	0	7
Applications without funding	0	0	1	1	0	1	3	6
Success rate	100%	100%	50%	50%	100%	50%	0%	54%
Funding amount (1000 €)	8,370	4,600	1,890	5,000	5,000	4,975	0	29,835

Source: Interface table based on FNR data.

The annual number of applications for PEARL has been stable over the years since the first call in 2009. The interview partners observe an increase in the quality of the applications. The success rate of the applications within PEARL is very high, but this may be due to the rigorous preselection of the candidates and the consequential high quality of the applications. In addition, the FNR has several preparatory meetings before submission of the proposal to guide the applicants.

The participation rate of women in PEARL is low. One of the two female applicants was funded. For the 2017 call, a requirement for gender equity in proposal submissions has been introduced. This will require that at least 30% of the candidates to be proposed by the research institutions in the years 2017 to 2021 are female researchers.

With PEARL, the distribution of applications and grants between the different Faculties and the Public Research Centres is more even than with ATTRACT. However, neither the Faculty of Science, Technology and Communication nor the Faculty of Law, Economics and Finance has been successful in attaining a PEARL grant thus far (up to 2015).

Impact of PEARL

Our assessment of the impact of the PEARL funding scheme is in general very positive. This conclusion is based on the findings presented in the following.

Overall, the eight research programmes are given very positive *external assessments* by the Scientific Advisory Boards. Nevertheless, some challenges that may hamper the progress and success of the research programmes are identified. One issue is the level of support for grantees from the host institutions. A second issue is linked to organizational elements in the host institutions, such as unclear career management systems and a lack of a tenure track system, which hinder the recruitment of top researchers to the PEARL research group and the development of a critical mass.

Our *interviews* show that the research programmes have had a substantial impact on the grantees themselves as well as on the host institutions in Luxembourg. Through the programmes, the grantees have been able to build up research groups that have secured scientific output of high quality, development of partnerships, and acquisition of external funding. Many of the PEARL grantees hold management positions at their host institutions and have contributed to professionalization at the leadership level and helped the institutions' continued development into professional research and technology organizations.

So far, the sustainability of these impacts is secured: Most of the eight PEARL grantees interviewed plan to stay in Luxembourg after the funding period. For some of them this entails staying in a managerial position, and others plan a continuation of the research programme through further funding. The conditions offered after the funding period play a central role in the long-term commitment of the grantees. The host institutions generally seem to have a clear strategy linked to further funding of the positions and the research groups.

Overarching objectives of PEARL

The research programmes have had a distinct impact on the international influence and visibility of Luxembourg. Through the generous framework of the funding programme, paired with a high standard of living, an international environment, and a highly developed infrastructure, it has been possible to attract leading researchers to Luxembourg. The choice to focus on specific domains has been favourable, as it has provided the opportunity to focus on strategic research areas and strengthen the reputation of Luxembourg.

Benchmarking of PEARL

The benchmarking of PEARL with a number of similar advanced-career stage funding instruments in Switzerland, Germany, Austria, and the EU showed that the funding amount is the major asset of the PEARL scheme; it sets PEARL apart from other fund-

ing instruments. Also, PEARL grantees have a great deal of flexibility in allocating the funds.

Regarding the programme output, the comparison supports our previous observations. Since the launch of the funding scheme, the total amount awarded with PEARL has been considerable. Also, the average success rate of PEARL is on a high level. In contrast, women's participation rate has been very low.

Regarding the impact of the funding scheme, PEARL's significance is comparable to that of the comparison programmes. It is a crucial funding scheme in terms of advancement of scientific careers, scientific output and recognition, and also socio-economic output and dissemination. In addition, it is particularly important for the host institutions and for Luxembourg as a research location. Sustainability of these effects is an issue that is discussed with PEARL but not with the other funding schemes analysed.

Expert appraisal of PEARL

The experts are impressed by the funding amount offered by the PEARL grant. It is comparable to the DFG Alexander von Humboldt professorship, which is the most highly-endowed research award in Germany. The experts appreciate that PEARL projects need to have a strong strategic fit.

As with ATTRACT, the experts are concerned about the very low female participation in PEARL. They are of the opinion that the FNR should discuss this issue and take measures to improve women's participation.

The experts are impressed by the outstanding performance of the PEARL fellows. They acknowledge the importance that the funding instrument has for the grantees but also for the host institutions and the country as a whole.

Overall assessment of PEARL

PEARL is a very good and successful programme. It is generally assessed positively for concept and implementation by the FNR and the host institutions. The programme and its selection process are viewed as equivalent and competitive with other international funding programmes, such as the prestigious ERC grants.

PEARL clearly advances the fellows on an individual level. It shows impressive scientific impact, has high impact in terms of influence and visibility, and has significant socio-economic impacts. It is also a very important instrument for the host institutions, which use it for capacity building and the building of excellence in priority domains. In that way, PEARL has also shown important structural effects.

However, the stability of the research groups and sustainability of the funding are critical issues. More flexibility and possibly further instruments may be needed to address these.

Recommendations for PEARL

Based on the evaluation results, we formulate the following three specific recommendations for PEARL:

1 Discuss sustainability of PEARL funding

It is unclear whether Luxembourg offers enough incentives to keep the PEARL fellows in the Luxembourg research environment and as such to secure sustainable research groups. We suggest that the FNR together with the MESR and the research institutions develop a medium-term plan on how many PEARL research programmes the Luxembourgish research environment needs and may sustain. The following questions are significant: How many positions should be created by the FNR through the PEARL programme on a medium-term basis in order to fit the strategy of the host institutions and of Luxembourg? How many positions can the host institutions finance on a medium-term basis after the funding through the PEARL programme expires?

2 Develop strategy for programme-overarching use of funding programmes

To secure a critical mass in the research groups, a research base of younger researchers who will evolve into leading scientists needs to be built. We recommend that the FNR develop a strategy for programme-overarching use of the different funding programmes of the FNR. If deemed important and beneficial, the FNR could consider awarding a combination of grants, for example an ATTRACT and a PEARL grant, to one and the same research group.

3 Monitor and improve participation of women

The low participation of women in the PEARL programme calls for closer attention. The FNR has acknowledged this and in response issued a new requirement for gender equity starting from the 2017 call. At least 30% of the candidates proposed by the research institutions in the years 2017 to 2021 should be women. We strongly support this effort and recommend monitoring compliance with this requirement very closely. In addition, we suggest that the FNR discuss measures to improve women's participation in PEARL.

1.5 GENERAL REMARKS AND RECOMMENDATIONS

The evaluation comes to a positive overall assessment of the four programmes of the FNR. We therefore generally recommend the continuation of CORE, INTER, ATTRACT, and PEARL. In addition, the experts made the following three recommendations not targeted to a specific programme but concerning the FNR's programme portfolio or all the programmes under evaluation, respectively. We support these recommendations.

1 Create funding instrument for 'Centres of Excellence'

In general, the experts observe that in the FNR's programme portfolio, coordinated instruments like the DFG's funding of research units (*Forschergruppen*) are missing. The experts agree that given the smallness of the country, there is currently no need for instruments of that kind. However, given that critical mass is a decisive factor in at-

tracting excellent researchers to Luxembourg, there should be a stronger thematic focus in some areas. The experts suggest creating a new funding instrument that allows the establishment of 'centres of excellence'. According to the experts, these centres would function as 'beacons' that improve the international visibility of Luxembourg research and ensure sustainability. The funding instrument could be modelled after similar funding schemes in other countries, such as the DFG Research Centres (*Forschungszentren*) or the SNSF National Centres of Competence (NCCR). The FNR already offers funding of this kind with its National Centre of Excellence in Research (NCER) funding. So far, only one NCER has been created. The results of the evaluation and the expert appraisal suggest the funding of further NCERs in the near future.

2 Implement FNR road shows

Even though the experts do not see evidence of deficiencies in the FNR application processes and the evaluation comes to an overall positive result concerning the application and selection processes of the FNR, the evaluation team and the experts agree that the *perception* of the application process could be improved. The experts suggest implementing FNR 'road shows' at the University and the public research institutions. The FNR should use these shows to present the FNR and its various funding measures and to explain the application and selection process in detail. The road shows would also include Q&A sessions.

3 Introduce a research award

The experts support the evaluation team's recommendation to introduce a research award for Luxembourg. The purpose of the award is to reward outstanding research conducted in the country on the individual level and to increase the visibility of Luxembourg research as a whole. Whereas the FNR programmes function as an incentive, providing researchers with an incentive for doing something in the future ('conduct high quality research'), an award functions as an ex-post reward for laudable achievement in the past ('you have conducted high quality research').

Considering the small size of Luxembourg and its research environment, the experts think that a research award of a medium value, endowed with 500,000 to 1,000,000 euros, would be appropriate. The award could be modelled after a research award of a German federal state, such as the Science Award of Lower Saxony (*Wissenschaftspreis Niedersachsen*). The award would give the awardee freedom to pursue his/her research with full flexibility in the allocation of the award money. The experts stress the importance of extensive PR measures surrounding the launch of the research award, so that the award really functions as a label. Of course, the award could also be set on a higher level and be modelled after awards like the DFG Gottfried Wilhelm Leibnitz Prize or the FWF Wittgenstein Award.

2 INTRODUCTION

The FNR is the main funder of research activities in Luxembourg. Its primary strategic aim is to strengthen the Luxembourg public research system. In its performance contract with the Ministry of Research, the FNR defines the following three strategic objectives for the period 2014–2017[12]:

1. To promote quality and scientific excellence in research
2. To strengthen research engendering an economic and societal impact
3. To strengthen the efficiency and durability of the Luxembourg public research system, to invest in human capital

To attain these objectives, the FNR offers a number of funding instruments. Key funding instruments are the project funding programmes INTER and CORE (objective 1) and the person funding instruments ATTRACT and PEARL (objective 3).

To assess attainment of these objectives, the FNR has agreed on two indicators concerning the funding programmes in question:

- Projects supported by the INTER and CORE programmes generate scientific impact that exceeds the national average.
- The ATTRACT and PEARL grant recipients will contribute a large share to the influence and national and international visibility of Luxembourg research.

In accordance with the performance contract, Interface conducted an impact assessment of the FNR funding programmes CORE, INTER, ATTRACT, and PEARL. For CORE and INTER, the evaluation is limited to the areas of materials and physical sciences (MS), and the evaluation period is 2010–2015.

A more detailed description of the FNR and the four funding programmes evaluated is provided in section 3 below.

2.1 EVALUATION OBJECTIVES AND EVALUATION QUESTIONS

The objectives of the impact assessment of INTER and CORE in the field of materials and physical sciences are as follows:

- Evaluate and compare the impact of INTER and CORE in terms of scientific impact and recognition, training impact, and socio-economic impact and dissemination at national and international benchmark

[12] The performance contract is accessible online at: http://storage.fnr.lu/index.php/s/PTpVlnOq3QiGZF1.

- Assess the impact of INTER and CORE with a special focus on gender differences. This second objective could not be assessed explicitly, since the study was restricted to the field of materials and physical sciences and the number of women active in this field in Luxembourg (and thus also the number of female participants in our surveys) is very small.

The objectives of the impact assessment of ATTRACT and PEARL are as follows:

- Compare and evaluate the impact of ATTRACT and PEARL in terms of scientific impact, international influence and visibility, institutional impact, training impact, socio-economic impact and dissemination, and personal development of the candidates at national and international benchmark

In addition, the evaluation results will undergo an expert appraisal. For this, a panel consisting of three international experts in different research disciplines was put together. The panel, together with the impact assessment team, will draw conclusions regarding attainment of the objectives defined in the performance contract and the corresponding performance indicators. The experts will also comment on recommendations formulated by Interface.

2.2 METHODOLOGY

We used quantitative and qualitative methods for the impact assessment of the funding programmes. The methods are presented in the following.

2.2.1 DOCUMENT AND DATA ANALYSIS

Available documents and data were analysed for all of the four funding programmes. These included project proposals and CVs of the applicants/grantees, annual and final project reports of the funded projects and Principle investigators (PIs), PEARL SAB reports, and other FNR documents and data.

2.2.2 QUALITATIVE INTERVIEWS AND ONLINE SURVEYS

In total 37 interviews were conducted, either face-to-face or by telephone, with (representatives of) the following groups:

D 2.1: Overview of the interviews

Target group	Number
FNR	
Secretary General of the FNR	1
FNR CORE selection panel	2
FNR ATTRACT selection panel	2
FNR PEARL selection panel	2
ATTRACT	
ATTRACT fellows	12
ATTRACT applicants whose applications were not retained	2
ATTRACT host institution management	3*
PEARL	
PEARL fellows	8
PEARL applicants whose applications were not retained	2
PEARL Scientific Advisory Board (SAB) members	2
PEARL host institution management	2*

Source: Interface. *One of the hosts interviewed hosts both ATTRACT and PEARL fellows.

Interview guides were used to structure the interviews. The interviews were evaluated using methods of qualitative analysis.

2.2.3 ONLINE SURVEYS

Four online surveys were conducted to obtain quantitative results on the views of the funding schemes' target groups:

- The first online survey addressed all applicants for ATTRACT from 2007–2015 whose applications were not retained; 33 persons were contacted in total.
- The second online survey addressed all applicants for FNR CORE MS funding in the field of materials and physical sciences from 2010–2015, whether successful or not; 53 persons were contacted.
- The third online survey was sent to all applicants for FNR INTER MS funding in the field of materials and physical sciences from 2010–2015, whether successful or not; 42 persons were contacted.
- The fourth online survey was conducted with ATTRACT fellows; all 12 former and current fellows were contacted.

The surveys of CORE MS, INTER MS, and ATTRACT applicants were launched on 22 August 2016 and were left open for participation for four weeks each. After two weeks, a reminder was sent to all invitees who had not yet completed the online questionnaire. The survey of the ATTRACT fellows was started on 17 October 2016[13] and

[13] It was originally planned to gather quantitative information regarding the ATTRACT fellows' output through the interviews and analysis of additional documents and data. Because the quality of the information gathered in this way was too low, it was decided to conduct an online survey of all former and current ATTRACT fellows in addition to the qualitative interviews already conducted. This explains the later start of this online survey.

was left open for participation for two weeks. No online surveys were conducted with PEARL fellows and hosts because of the small size of the two groups. For those groups and the group of ATTRACT fellows, in-depth information was gathered using qualitative interviews. Some key figures for the four online surveys are presented in the following.

Key variables

Table D 2.2 shows the survey samples and overall response rates of the online surveys.

D 2.2: Key figures on the online surveys

Study group	Sample	Valid responses	Response rate
ATTRACT fellows	12	12	100%
ATTRACT applicants not retained*	33	16	48%
CORE applicants**	53	31	58%
INTER applicants**	42	23	55%

Source: Interface, online surveys with ATTRACT fellows, ATTRACT applicants not retained, CORE and INTER applicants.

Note: *Applicants between 2007–2015. **In material and physical sciences from 2010–2015.

The response rates for the surveys (except for the survey of ATTRACT fellows) leaves room for improvement, in particular taking into account that the surveys were left open for participation for a long time, a reminder message was distributed, and the FNR is in general quite close to its grantees and appreciated by them. However, considering the good representation of key variables in the survey samples, we think that the survey results allow for convincing analyses. Of course, absolute numbers remain – particularly for ATTRACT – very small.

The quality of representation of the survey samples can also be measured looking at the distribution of some key variables. For CORE and INTER, we do not dispose of variables that we can use to compare the survey sample to the population because of the different time periods concerned. The population comprises all CORE MS and INTER MS applicants from 2010 to 2015. In the surveys, we asked survey respondents if they had *ever* received CORE and INTER funding and if *any* of their applications for CORE and INTER had not been retained for funding, respectively. Regarding gender distribution, the survey samples represent the population of all CORE and INTER MS applicants very well. For both surveys, there is even a slight overrepresentation of female applicants who responded.

2.2.4 BENCHMARKING

In addition to the interviews and online surveys, a national and international benchmarking was carried out for the four programmes under evaluation. The results can be found in section 5 below.

2.2.5 EXPERT APPRAISAL

A panel of international experts in different fields was asked to assess the evaluation results and the recommendations to the FNR. Also, the expert team drew conclusions

regarding the attainment of the objectives defined in the performance contract and the corresponding performance indicators.

The international expert panel was composed of the following three members:

- Colette Rolland, professor of information sciences at Panthéon Sorbonne University – Paris I, France
- Anita Rauch, professor of medical genetics and director of the Institute of Medical Genetics at the University of Zurich, Switzerland
- Jürgen Mlynek, professor of physics at the Humboldt-Universität Berlin, former president of the Helmholtz Association of German Research Centres, Germany

The expert appraisal was based on a synopsis of an interim report containing the evaluation results and some interim recommendations and on a half-day workshop that took place in October 2016 in Zurich. The workshop, which was organized and moderated by Interface, consisted in a presentation of the evaluation results, feedback and questions by the experts, a discussion with representatives of the FNR, and the formulation of recommendations to the FNR by the experts and Interface.

3 THE FNR AND ITS PROGRAMMES

In the following section, information about the FNR and its four most relevant funding programmes (CORE, INTER, ATTRACT, and PEARL) is presented.

3.1 THE LUXEMBOURG NATIONAL RESEARCH FUND

The FNR is the main funder of research activities in Luxembourg. The FNR invests public funds and private donations in research projects in various branches of science and the humanities, with an emphasis on selected core strategic areas. Furthermore, activities to strengthen the link between science and society and to raise awareness for research are supported and coordinated. The FNR also advises the Luxembourg government on research policy and strategy. The FNR's primary strategic aim is to strengthen the Luxembourg public research system generally, with a particular focus on a few key areas of excellence that will further develop international visibility and a leading scientific reputation.

To achieve this, the FNR offers over ten different funding instruments,[14] covering a broad spectrum of funding opportunities. Three types of funding can be distinguished:

- Person funding, such as ATTRACT and PEARL
- Project funding, such as CORE and INTER
- Programme funding: The FNR offers funding for National Centres of Excellence in Research (NCER). So far, one such centre has been funded, the National Centre of Excellence in Research on Parkinson's Disease (NCER-PD). The NCER-PD functions as a pilot.

The FNR invested over 400 million euros in research activities and the promotion of scientific culture from 2007 to 2015. Table D 3.1 presents an overview of the total annual FNR expenditures in that time period.

D 3.1: FNR funding, 2008–2017

	Performance contract period 2008–2010	Performance contract period 2011–2013	Performance contract period 2014–2017 (planned)
FNR funding (in million euros)	141.2	173.8	248

Source: FNR, Annual Report 2015.

The FNR's key funding instruments in pursuing the strategic objectives of the performance contract (cf. section 2 above) are the CORE and INTER programme (in particular for objective 1) and the ATTRACT and PEARL programmes (in particular for ob-

[14] Information on the FNR funding instruments is accessible online at: https://www.fnr.lu/.

jective 3). From 2010 to 2015, the FNR invested 189 million euros to support over 330 projects with these four instruments.

The FNR selection process is based on peer review, which comprises written reviews by international experts and panel meetings. Depending on the programme, the selection process may comprise interviews with the applicants and their host institutions during the panel meetings.

With INTER, the selection procedure depends on the foreign lead agency and thus varies.

3.2 CORE IN MATERIALS AND PHYSICAL SCIENCES

CORE is a multi-annual thematic research programme and is the central programme of the FNR. The prime objective of CORE is to strengthen the scientific quality of Luxembourg's public research in the country's priority research domains. In the eyes of the FNR, high quality research capacities form the essential pool of knowledge and expertise from which social, environmental, and economic impact emanate. CORE projects should directly contribute to the strengthening of the research competences in the priority fields and be of international competitiveness. CORE aspires to create strategic national resources and increased visibility in the international research community. CORE is open for proposals on an annual basis.

Objectives

The CORE programme should contribute to the:

- Funding of high quality scientific research, leading to the generation of new knowledge and scientific publications in the leading international peer-reviewed outlets of the respective fields
- Development of a strong research basis in Luxembourg which can be exploited for sustainable long-term socio-economic and environmental benefits
- Advancement of the research group or institution in view of international visibility and critical mass
- Training of doctoral students and advancement of the involved researchers in general

Table D 3.2 lists the CORE domains and the corresponding thematic research priorities for 2016 and 2015, respectively.

D 3.2: CORE domains, 2016

CORE domains 2016	Thematic research priorities
Innovation in Services	Information Security and Trust Management
	Business Service Design
	Development and Performance of the Financial Systems
	Telecommunication and Multimedia
Sustainable Resource Management in Luxembourg	Water Resources under Change
	Sustainable Management and Valorisation of Bioresources
	Sustainable Building and Bioenergy
	Spatial and Urban Development
New Functional and Intelligent Materials and Surfaces and New Sensing Applications	New Functional and Intelligent Materials and Surfaces
Biomedical and Health Sciences	Regenerative Medicine in Age-related Diseases
	Translational Biomedical Research
	Public Health
Societal Challenges for Luxembourg	Social and Economic Cohesion
	Education and Learning
	Identities, Diversity and Interaction

Source: FNR.

Programme history

The evolution of the CORE funding programme since its launch in 2008 can be summarized as follows:

2008

- Launch of the CORE Programme: Prior to CORE, there were individual thematic programmes with individual programme budgets.
- As a result of the Foresight exercise conducted in 2006, a set of possible future priorities for public research in Luxembourg is identified with important impacts on the economy, society, and the environment: Six priority domains are defined as a result.
- Overhead costs are eligible.

2010

- Mini Foresight exercise in biomedical sciences: The description of two subdomains under the biomedical sciences is modified: 'Translational Biomedical Research' and 'Public Health'.
- Introduction of CORE Junior Track:
    - The FNR considers that supporting young, promising principal investigators (PIs) at the start of their independent careers is of benefit for the national innovation system. CORE Junior Track with special project specificities provides an opportunity for non-established PIs to obtain their own funding and start their independent careers.

2012

- The two domains 'Labour Market' (LM) and 'Identities' (ID) are merged into one domain, 'Societal Challenges for Luxembourg' (SC).
- Introduction of the international co-funding through collaborations with the DFG in Germany, SNSF in Switzerland, or FWF in Austria: bilateral applications, for which FNR is the lead agency

2013

- The domain 'Sustainable Resources in Luxembourg' (SR) is rearranged by a mini Foresight exercise. It is reshaped in order to contribute to the development of critical mass and scientific quality.
- Biomedical sciences: Subdomain 'Translational Biomedical Research' is updated.
- International cofounding is extended: Cooperation agreement with the 'European Molecular Biology Laboratory' (EMBL): Bilateral applications have to be submitted through the CORE programme. The FNR is the lead agency.

2014

- After consultation of the CORE expert panel and in order to optimize efforts in the institutions and at FNR, the application procedure is changed from a two-stage application process to a one-stage application process.
- PIs must hold a doctoral degree at submission deadline.
- Reinforcement of impact considerations in the application (scientific dissemination strategy, potential stakeholder invovlement, strategy for exploitation, outreach activities).
- National Centre for Research and Development (NCBR), Poland: POLLUX-Innovation in Services was handled within the INTER scheme in 2012 and 2013. As of 2014, it is incorporated into CORE.

2015

- Eligibility of applicant research institutions is extended after new FNR law.

3.3 INTER IN MATERIALS AND PHYSICAL SCIENCES

The INTER programme is the FNR's instrument to provide co-funding for international research collaborations between scientists in Luxembourg and abroad. INTER has ongoing deadlines, as it serves as an umbrella for research collaborations between scientists in Luxembourg and other researchers across the world.

Objectives

The objective of the INTER programme is to develop new (and foster existing) international partnerships. The programme aims to facilitate participation in international initiatives for cooperative funding of projects with partners in several countries.

Only proposals of excellent scientific quality will be funded, and all proposals submitted within the INTER programme must demonstrate the added value of the cooperation between Luxembourg-based scientists and researchers abroad.

The INTER programme supports joint research in bilateral and multilateral projects.

The FNR lead agency has agreements with 17 different foreign partners to support bilateral projects between researchers based in Luxembourg and abroad. These agreements make it possible for Luxembourg-based researchers to conduct bilateral research projects with researchers based in ten different countries. They normally run for three years and are renewable.

Joint research projects will be evaluated by one agency only (lead-agency agreement). For bilateral projects with the DFG, the FWF, and the SNSF, whether the FNR or the foreign funding agency is the lead agency is determined by where the main research effort is accomplished. For all other bilateral projects, the foreign funding agency is generally the lead agency.

Bilateral projects where the FNR is the lead agency must comply with the rules of the CORE programme.

Bilateral projects with the following partner agencies can be submitted in the domain of materials and physical sciences:

D 3.3: Partner agencies, INTER MS projects

Agency	Year of agreement with FNR	Lead agency	Projects submitted (funded) 2010–2015*
Belgium			
FWO	2009	FWO	7 (1)
FNRS	2015	FNRS	4 (1)
Germany			
DFG	2009	Both; if FNR, then within the CORE domain	8 (4)
Austria			
FWF	2011	Both; if FNR, then within the CORE domain	0 (0)
Switzerland			
SNSF	2010	Both; if FNR, then within the CORE domain	9 (1)
USA			
NSF	2003	NSF and FNR in early calls; now NSF	6 (1)
Great Britain			
RCUK	2014	RCUK → EPSRC	0 (0)
France			
ANR	2013	ANR	22 (2)
CNRS	2006	CNRS, but joint evaluation and equal project budget for both research partners	0 (0)
Norway			
RCN	2015 (first call deadline 2016)	RCN	0 (0)

Source: FNR.

Note: *CORE bilateral projects not included.

The FNR participates in more than eight international research networks offering multilateral research opportunities with over 35 countries for researchers based in Luxembourg. These include Joint Programme Initiatives (JPI) as well as European Research Area (ERA) networks. Within the following networks, multilateral projects can be submitted in the domain of materials sciences (Table D 3.4):

D 3.4: Networks, CORE MS

Network	Year consortium was signed	Projects submitted (funded) 2010–2015
MATERA (materials science and engineering), FNR is a member of the ERA-NET	2006–2011	8 (3)
MNT (micro- and nanotechnologies), FNR participated in the calls	2009–2011	1 (0)
MANUNET (manufacturing), FNR participated in the calls	2011–2014	6 (0)
MERA-Net (materials science and engineering), FNR is a member of the ERA-NET	2012–2015	46 (5)
EUROSTARS	2013	1 (0)

Source: FNR.

3.4 ATTRACT

The ATTRACT programme aims to support the research institutions in Luxembourg so as to expand their competencies in strategic research areas by attracting outstanding young researchers with high potential to Luxembourg. The programme is designed for researchers not yet established in Luxembourg who have two to eight years of postdoc experience. It offers them the opportunity to set up their own research group within one of the Luxembourg research institutions' focus areas. Research proposals must be submitted jointly by the candidate and the host institution. Proposals selected for ATTRACT funding have a lifespan of five years, and the financial contribution by FNR can be up to 1.5 million euros for Starting Investigators (or 2 million euros for Consolidating Investigators). Following a successful final evaluation, the applicant moves to the next career stage and obtains tenure (if not already the case) and promotion. ATTRACT is open for proposals on an annual basis.

Objectives

- Recruitment of researchers who demonstrate high potential
- Strengthening research areas of strategic importance to Luxembourg

Programme history

The evolution of the ATTRACT funding programme since its launch in 2007 can be summarized as follows:

2007 (first ATTRACT call)

- Launch of the first ATTRACT call, aligned to the former European Young Investigators Awards managed by the ESF (later resulting in the EU ERC grants)
- Maximum budget: 1 million euros per proposal; exceptionally 1.5 million euros, maximum amount for equipment: 0.2 million euros
- No tenure track

- Bottom-up approach: Candidates apply jointly with Luxembourg host institutions in one of their priority domains (very broad list, no strategic merit assessment).
- Overhead costs are eligible.

2010

- Extension of eligibility period in case of career breaks, such as maternity leave
- Budget: Maximum 1.5 million euros (max. 0.2 million euros for equipment)

2012

- Several candidates (i.e. more than 2) can be retained for funding, provided they are judged to be equivalent.
- The financial contribution for equipment is no longer restricted to 200,000 euros.
- Relocation assistance and financial support for relocation are provided by FNR.

2013

- Differentiation between 'starting investigator' and 'consolidating investigator'; maximum budget remains the same for the two categories
- Mandatory tenure or tenure track
- Strategic Merit Assessment (SMA): Fit with strategy of institution required

2014

- Modification of eligibility: Applicants employed by the host institution for less than a year at the date of the full proposal deadline are eligible
- Modification of grant maxima: Starting investigator 1.75 million euros, consolidating investigator 2.5 million euros

2015

- In addition to the tenure track, a career progression is introduced at the end of the ATTRACT grant, based on pre-defined target indicators and a qualitative assessment in the presence of external evaluators
- Modification of grant maxima: Starting investigator 1.5 million euros, consolidating investigator 2 million euros
- No overhead paid to host institution (co-funding requirement)

2017

- Introduction of a minimum quota of 40% of female applications by participating host institutions for the period 2017–2021

3.5 PEARL

The PEARL programme is a key instrument of the FNR in its strategy to strengthen Luxembourg's research environment by investing in human resources, institutional development, and capacity building in priority research domains.

Objectives

The main objective of the PEARL programme is to attract leading researchers who will develop research programmes in areas of strategic importance to Luxembourg with the potential to generate long-term impact. PEARL candidates should be leaders in the field, innovative and creative, and possess an outstanding track record that will strengthen Luxembourg's position in the international world of R&D.

Increased emphasis has been put on the assessment of PEARL proposals in light of their contribution to the development of a given priority area for Luxembourg through a strategic merit assessment. The FNR will gauge the extent to which the candidate will contribute to strengthening the particular research field. Proposals will need to show how the candidate's research activities will integrate into the institution's strategy and create synergistic effects with the existing research fabric with a view to multiplying scientific impact and attaining high international recognition in the field. The FNR will look at the past and present achievements within the particular research field in Luxembourg as well as the past and future investments of the institution within this domain.

Programme history

The evolution of the PEARL funding programme since its launch in 2008 can be summarized as follows:

2009

At the start of the programme, the maximum grant amount is 5 million euros, and the projects have a life span of five years. There is no call deadline; the programme is managed by open calls.

2014

After five years of experience, several changes are introduced:

- Introduction of the strategic merit assessment (SMA) to better align with the institutions' objectives
- Single deadline for operations and competition issues
- The PEARL budget reduced from 5 million to 3 million euros, respectively 4 million euros, for projects requiring substantial experimentation and instrumentation
- Requirement for a minimum investment of the host institutions: the salary of the position and a starting package of regular professors and senior researchers

2017

- Clarification on the level of the SMA criteria
- Requirement for gender equity in proposal submissions
- Earmarking of one PEARL grant for a joint position of Luxembourg research institutions

4 EVALUATION RESULTS

This section presents the results of the document and data analysis, the interviews (for CORE, ATTRACT, and PEARL), and the online surveys (for CORE, INTER, and ATTRACT) for each of the four funding programmes individually. The assessment yielded findings concerning the programmes' concept and implementation of the programmes by the FNR and the hosting institutions, the output of the programmes and the target groups, the impacts that the programmes have for grantees and their host institutions, and the attainment of some overarching goals that the FNR pursues with the programmes.

4.1 CORE MS

This section presents the evaluation results for the FNR CORE funding scheme in the field of materials and physical sciences for the period 2010 to 2015. For each objective, we present the results of interviews with two CORE selection panel members, an interview with an FNR representative, and the results of an online survey of all applicants for CORE MS from 2010 to 2015. In some cases, the results are complemented by an analysis of FNR documents or data.

4.1.1 CONCEPT AND IMPLEMENTATION

Results regarding the concept and activities of the CORE funding scheme are presented in the following.

The selection panel members interviewed agree that CORE is based on an adequate concept. They point out the high quality of the screening and selection process. They explain that because of the smaller research environment and the subsequent lower number of applications, reviewers can dedicate more time to each proposal and give more detailed feedback than is the case with funding agencies in other countries. They are also convinced that the funding amount is adequate and even high compared to similar funding schemes abroad. The funding scheme is seen as suitable to reach the target group. It is well-known and widespread in the Luxembourg research community.

One interview partner points out that a difficulty with the concept of CORE is that applications in collaboration with industrial partners were often not retained because of the strong focus of the selection panel on scientific quality. The FNR reacted to this by introducing the CORE PPP (CORE Public Private Partnerships).

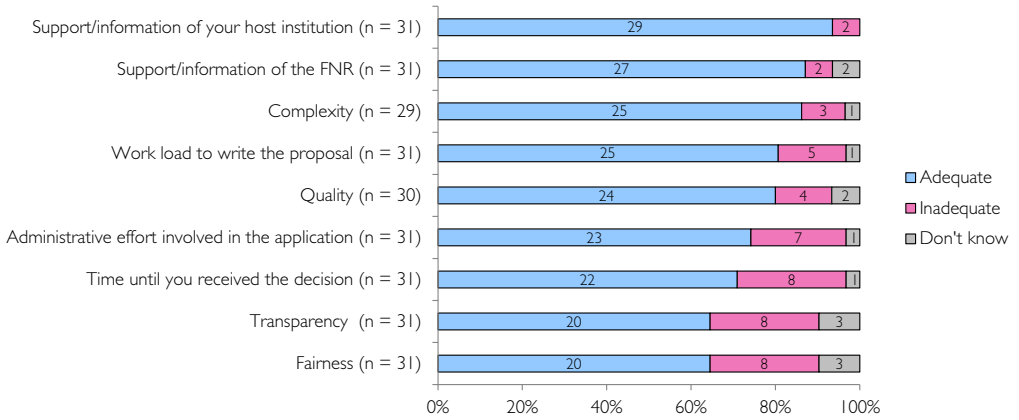
Some feedback concerning the CORE Junior Track comes from a survey respondent, who is of the opinion that these grants are a very good idea, since they give young researchers a chance to be PIs, which according to the respondent is a determinant when seeking a permanent position after the grant. However, it is the survey respondent's impression that the FNR and the institutions could do more to support these researchers in becoming established in Luxembourg. The respondent suggests that the

FNR could follow the development of the CORE Junior PIs and offer continuity after the grant to some of them.

Application process

In the online survey, CORE applicants with and without CORE funding were asked to assess a number of aspects of the application process. The responses are shown in figure D 4.1.

D 4.1: Applicants' assessment of application process, CORE



Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.

All aspects are evaluated positively by more than half of the respondent group. The support and information from the host institution and also from the FNR are particularly appreciated. In contrast, transparency and fairness of the application process as well as the wait time for receiving notification of the funding decision from the FNR are evaluated critically by slightly over 25% of the respondents. The responses of the five respondents who never received a CORE grant account for a large share of the negative assessments, especially regarding the administrative effort required for the application (assessed as 'inadequate' by 80%), the workload entailed in writing the proposal (rated 'inappropriate' by 60%), and fairness (rated 'inadequate' by 60%). However, there are no significant differences between the two groups in their assessment of the transparency of the process. Time until the decision notification was received is even assessed more positively by the group of applicants whose applications were not retained.

A few of the survey respondents explained their answers to this question in more detail (unfortunately, none of them is one of the five respondents who never received CORE funding). One respondent suggests ending the system where there is one particular date when proposals may be submitted. According to the respondent, this takes away the flexibility to apply for funding when a good project idea arises or when a good candidate for a postdoc or PhD comes along. Also, the respondent says, studies have shown that specific submission dates lead to a higher number of proposals being submitted of worse than average quality.

The survey respondents were further asked to assess the usefulness of the feedback documents provided by the FNR; 87% of the 31 respondents find these documents useful, and 13% do not. Of the five respondents who never had CORE funding, three (60%) find the documents useful, and two (40%) do not.

The CORE selection process was specifically evaluated by the Western Michigan University in 2015.[15] That evaluation showed that "the CORE selection process is transparent, fair, unbiased and impartial" and that "the FNR's procedure allows the FNR to efficiently, effectively, and systematically select and fund [...]". In that evaluation, PIs from all priority domains were included. The sample size was therefore larger.

4.1.2 PROGRAMME OUTPUT

This section presents the results concerning the programme output of CORE. Number of applications and female participation in the programme are shown for the time period observed.

Table D 4.2 shows the output of the CORE funding programme in the field of materials and physical sciences for the evaluation period 2010–2015. The number of CORE applications (total, funded, and not retained) and the corresponding funding amounts awarded are presented.

D 4.2: Call output CORE MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications (total)	14	13	19	28	21	21	116
Applications with funding	8	5	4	9	7	7	40
Applications without funding	6	8	15	19	14	14	76
Success rate	57%	38%	21%	32%	33%	33%	34%
Funding amount (1000 €)	4,504	2,848	2,034	6,407	3,322	3,918	23,033
Funding amount/project (1000 €)	563	570	509	712	475	560	576

Source: Interface table based on FNR data.

Note: Applications without funding include also withdrawn applications and applicants not eligible for funding. The amount granted per project depends on the costs structure of the institution.

From 2010 to 2015, 108 applications for CORE funding in MS were submitted to the FNR. The overall success rate was 34%, ranging from 21% in 2013 to 57% in 2010. The success rate was stable as of 2013. We observe a clear increase in submitted applications from 2013 on. The largest number of applications was submitted and funded in 2013. There are two explanations for this outlier: First, overhead costs were capped as of 2014. Second, the merger of the Public Research Centres Gabriel Lippmann and Henri Tudor led to a large number of applications. Researchers at both institutions filed applications separately. As of the 2014 call, their applications were coordinated. In total, the FNR invested over 23 million euros in CORE grants in the observed field and period.

[15] Coryn, C. L. S., Applegate, E. B., Fiekowsky, E. L., Wilson, L. N., Endres, C. L., & Holley, S. E. (2016). An evaluation of the Luxembourg National Research Fund CORE selection procedure: Final report. Kalamazoo, MI: Western Michigan University.

Table D 4.3 shows some key figures for female CORE MS applicants.

D 4.3: Female participants, CORE MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications of female candidates	3	2	1	2	2	3	13
Share of total number of applications	21%	15%	5%	7%	10%	14%	11%
Applications of female candidates with funding	1	2	0	1	1	3	8
Female success rate	33%	100%	0%	50%	50%	100%	62%

Source: Interface table based on FNR data.

Of the total of 116 applications for CORE in the observed field and period, only 13 applications (11%) were submitted by women. Eight of these applications (62%) resulted in funding. The numbers show that female researchers submit a small number of CORE MS applications but that the few applications submitted are very successful and more successful than applications submitted by men. The underrepresentation of female applicants may be due to the restriction of the analysis to the research field of materials and physical sciences. In this field, as in the whole STEM (Science, Technology, Engineering and Mathematics) sector, we typically observe low female participation from an early stage in (higher) education onwards.

4.1.3 IMPACT

This section reports on the impact of CORE. We first present the external assessment of the 12 CORE MS projects that are already completed. We then summarize the feedback from the CORE MS panel members interviewed on impact. We then show the results of our survey of CORE applicants.[16] There, we distinguish between scientific impact and recognition, training impact, and socio-economic impact and dissemination.

External assessment

Every completed CORE project is evaluated remotely by external experts. The evaluation assesses: (1) project implementation (fulfilment of initial project objectives, application of state-of-the-art and adequate methodology, resource efficiency, advancement of young researcher's career); (2) the scientific impact of the project (contribution to international state-of-the-art, international visibility of PI group after project, quality of scientific publications); and (3) dissemination and valorization of the research results (exploitation of intellectual property generated, dissemination of research results among wider public, implication of potential research users, intended valorization of results after project). In addition, an overall assessment of the project is made based on a quantitative rating according to four categories (excellent, good, fair, and poor). If the reviewers do not agree on the assessment, it is possible to give ratings that are in between categories. The overall assessment draws a conclusion regarding the project's

[16] Of course, the survey results have to be interpreted very cautiously. First of all, the analysis does not distinguish between the different CORE call years or between research fields. Second, the group sizes differ, and the group of survey respondents without CORE funding is very small. Also, these scientific outputs are the result of a number of reasons, and the explanatory power of the FNR CORE funding (or the absence of it, respectively) is unclear.

impact. Accordingly, a project can have 'no impact', 'results with low impact at international level', 'results of reasonable international impact', or 'results of high international impact'. Again, ratings between categories are possible.[17]

Table D 4.4 shows the assessment of the 12 CORE MS projects terminated by 2015.

D 4.4: External panel assessment of completed CORE MS projects (n = 12)

	Poor	Poor – Fair	Fair	Fair – Good	Good	Good – Excellent	Excellent
Project implementation							
Fulfilment of initial project objectives	-	-	2	1	2	-	7
Application of state-of-the-art and adequate methodology	-	-	-	1	4	1	6
Resource efficiency	1	-	2	-	3	1	5
Advancement of young researcher's career	2	-	-	-	5	1	4
Total project implementation	3	-	4	2	14	3	22
Scientific impact							
Contribution to international state-of-the-art	-	-	2	1	7	1	1
International visibility of PI / group after project	1	-	2	1	5	2	1
Quality of scientific publications	-	-	1	2	5	4	-
Total scientific impact	1	-	5	4	17	7	2
Dissemination and valorization of the research results							
Exploitation of intellectual property generated	4	-	4	-	3	-	1
Dissemination of research results among wider public	3	-	3	2	3	-	1
Implication of potential research users	3	1	5	-	3	-	-
Intended valorization of results after project	3	-	3	-	6	-	-
Total dissemination and valorization of the research results	13	1	15	2	15	-	2

Source: Interface table based on FNR documents.

Although the assessment of project implementation is excellent or good for the majority of the projects and the general assessment of the scientific impact is good, the projects seem to be rather weak in terms of dissemination and valorization of the research results. There are even a considerable number of projects rated 'poor' on the dissemination/valorization dimension. This confirms feedback from the panel members interviewed and supports the efforts of the FNR to strengthen this aspect by launching the CORE PPP programme.

[17] In the original assessments, these "between-ratings" are not labelled. We labelled them to make the assessment more comprehensible.

Table D 4.5 shows the overall assessment of the 12 CORE MS projects terminated by 2015.

D 4.5: Overall external panel assessment of completed CORE MS projects (n = 12)

Overall assessment	
Results of high international impact	1
Results of reasonable to high international impact	4
Results of reasonable international impact	4
Results with low impact at international level	1
Results with no to low international impact	1
No impact	1

Source: Interface table based on FNR documents.

The overall assessment of the projects is positive for most cases. Most projects are rated as having results with 'reasonable international impact' or 'reasonable to high impact'. Only one of the 12 projects did not have any impact according to the external assessment. This confirms the positive feedback on the CORE projects drawn from the other sources of information.

Interview results

The CORE panel members interviewed are convinced that CORE has the potential to have impact with regard to research dissemination and, ultimately, impact on the economy. However, as one of the panel members points out, this is not the case at the present time, because dissemination priorities were contributions at international conferences and publications. The valorization of research results in the sense of technology transfer for innovation, with patents or even spin-offs, is not yet a common concept, the panel member states.

Both members of the selection panel interviewed suggest introducing national awards to intensify the impact of CORE. This could raise public awareness, introduce more competition, and stimulate ambitions.

The selection panel members interviewed agree that the most significant outcome of CORE has been the increase in competitiveness and visibility of Luxembourg research in general. High quality researchers are attracted to Luxembourg through other FNR funding schemes. They use CORE to conduct high quality research and, through that, draw attention to Luxembourg as a research location. Still, as one of the interviewees points out, room for improvement in impact remains.

Scientific impact and recognition

This section turns to the scientific impact and recognition of CORE. First, Table D 4.6 shows a comparison of the self-declared scientific output of survey respondents who received CORE funding (n = 26) and of respondents who never received CORE funding (n = 5). Survey respondents with CORE funding were additionally asked to estimate the share of their scientific output that was related to their CORE grant.

D 4.6: Scientific output of applicants with and without CORE funding (n = 31)

Output indicator	Output with CORE (related to CORE)	Output without CORE
Scientific output		
Number of published journal articles	24 (10)	13
Conference contributions	23 (12)	11
Invited talks	15 (6)	8
New international project collaborations	8 (3)	4
International grants earned	6 (1)	1
International grants earned	6 (1)	1
National grants earned	5 (4)	1
Published books/monographs	2 (2)	1
Scientific prizes won	2 (1)	1
Published policy reports	0 (0)	0

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.

Since the range of responses is very broad for most of the output indicators, we used medians[18] instead of means and took into account only answers of respondents who state that a certain output is relevant in their research discipline.

In general, the highest average numbers are observed with publications in journals, contributions to international conferences, and invited talks. This is true for both the group with and without CORE funding. Comparing the two groups, the table shows that the total average scientific output of the survey respondents with CORE funding is higher than of the survey respondents without CORE funding for all indicators (two outputs were not realized by either group). The biggest differences can also be found with the two most important scientific outputs.

Applicants who received CORE funding were then asked about the same dimensions of scientific impact and recognition to estimate the effect of their CORE funding. Table D 4.7 shows the results.

[18] The median is the value separating the higher half of a data sample from the lower half. The advantage of the median compared to the mean is that it is robust to outliers, and thus may give a better idea of a "typical" value.

D 4.7: Grantees' assessment of scientific impact and recognition related to CORE funding (n = 26)

My CORE project grant/my CORE project grants …				
	Accurate	Inaccurate	Don't know	Not relevant
Scientific impact and recognition				
… increased the number of my scientific publications	20 (77%)	1 (4%)	4 (15%)	1 (4%)
… enabled new international collaborations	20 (77%)	3 (12%)	2 (8%)	1 (4%)
… increased my visibility among national actors	19 (73%)	2 (8%)	3 (12%)	2 (8%)
… increased the number of my conference contributions	19 (73%)	3 (12%)	3 (12%)	1 (4%)
... improved the quality of my scientific publications	16 (62%)	5 (19%)	4 (15%)	1 (4%)
… improved the quality of my conference contributions*	15 (60%)	4 (16%)	5 (20%)	1 (4%)
… facilitated follow-up research projects*	12 (48%)	5 (20%)	7 (28%)	1 (4%)
… led to more invited talks	12 (46%)	7 (27%)	6 (23%)	1 (4%)
… led to successful applications for further competitive funding	10 (39%)	7 (27%)	8 (31%)	1 (4%)
… led to scientific prizes	4 (15%)	14 (54%)	7 (27%)	1 (4%)

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.
Note: *With quality of conference contributions; follow-up research projects: n = 25.

According to the survey respondents, the most important effects of CORE are scientific impacts: CORE enables new international collaborations and increases the number of scientific publications, the number of contributions to international conferences, and visibility among national actors. This supports the observations of the panel members interviewed, who agreed that CORE has an impact on (international) visibility and outputs like publications or conference contributions. It confirms also the information that the survey respondents gave on their scientific output related to their CORE funding.

CORE grantees were additionally asked how relevant CORE was for their scientific independence; 89% think CORE is very relevant (50%) or relevant (39%). Eighteen of the 23 survey respondents (78%) also confirm that the CORE grant(s) had a significant influence on their further career. This shows that CORE is an important instrument also regarding career development of PIs.

Training impact

This section reports on the training impact of CORE. First, the training output of the survey respondents who had CORE funding (n = 26) and who never received CORE funding (n = 5) is shown in Table D 4.8. Respondents with CORE funding were addi-

tionally asked to estimate the share of their training output which was related to their CORE grant.

D 4.8: Training output of CORE applicants with and without CORE funding (n = 31)

Output indicator	Output with CORE (related to CORE)	Output without CORE
Training output		
Doctoral theses completed in PI's group	8 (5)*	1
Doctoral students supervised by PI	6 (5)	2

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015. Note: *The average number of doctoral theses completed can be higher than the average number of doctoral students supervised, because with the median, the number of '0' answers is not relevant. If we take the mean, the result is 3 for both the number of doctoral students supervised and the number of doctoral theses completed.

The table shows that the CORE grantees in our survey sample have a very high average training output and that it is much higher than the average training output of applicants without CORE funding.

CORE applicants with CORE funding were then asked to estimate the effect of their CORE funding for the same dimensions. The following table shows the results.

D 4.9: Grantees' assessment of training impact of CORE funding (n = 26)

My CORE project grant/my CORE project grants …				
	Accurate	Inaccurate	Don't know	Not relevant
Training impact				
… increased the number of completed doctorates in my group	16 (62%)	5 (19%)	4 (15%)	1 (4%)
… had a positive impact on the career(s) of the PhD students and/or the postdoc(s) in my group*	12 (48%)	4 (16%)	8 (32%)	1 (4%)

Source: Interface, online survey of CORE applicants in material and physical sciences 2010–2015. Note: *With impact on careers of PhD/post docs: n = 25.

As Table D 4.9 shows, training impacts are identified by around 50% of the survey respondents. The positive effect of CORE on the careers of PhD candidates and postdocs seems to be a lot smaller than the training impact of INTER (see section 4.2.3 below).

In relation to training output, we also asked if the CORE applicants are currently heading their own research group, how many members the groups have, what the total budget of their groups was in 2015, and what kind of funding their budget consists of.

Eleven of the 26, or 42%, of the survey respondents who received CORE funding are currently heading a research group. None of the five survey respondents that never received CORE funding are among them.

The research groups of the survey respondents range in size from 3 to 14 members, including the respondent PIs. Taking only scientific personnel into account, group sizes range from 2 to 10 people. Nine of the 11 respondents currently heading a research group stated the budget of their groups in 2015: The budgets range from 100,000 to 1 million euros. In five cases, FNR funding accounts for 50% or an even higher percentage of the budget. In one case, the FNR funded the total 2015 budget and in one case, 90% of the budget.

Of the 11 survey respondents currently heading a research group, 3 (27%) are women. Compared with the total share of female respondents (13%), this share is very high. One of these research groups is among the smallest groups and had a rather low budget in 2015. The other two groups are not smaller or less comfortably endowed than the other groups of the survey respondents.

Socio-economic impact and dissemination

Table D 4.10 shows a comparison of the transfer output of the survey respondents with and without CORE funding. Respondents with CORE funding additionally estimated the share of their transfer output in relation to their CORE grant.

D 4.10: Socio-economic output and dissemination of CORE applicants with and without CORE funding (n = 31)

Output indicator	Output with CORE (related to CORE)	Output without CORE
Socio-economic output and dissemination		
Number of collaborations with industry/other partners realized	5 (3)	1
New national project collaborations	4 (3)	1
Patents filed	4 (3)	0
Spin-offs initiated	0 (0)	0

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.

With socio-economic output and dissemination we observe that again, the output of applicants with CORE funding is significantly higher than of applicants without CORE funding. The latter group shows a particularly low average output in terms of collaborations with industry or other partners and new national project collaborations and no output in the form of patents. In both groups, no spin-offs were initiated.

Again, successful CORE grant applicants were asked to estimate the importance of their CORE grant(s) in terms of socio-economic impact and dissemination. Table D 4.11 shows their responses.

D 4.11: Grantees' assessment of socio-economic impact and dissemination of CORE funding (n = 26)

My CORE project grant/my CORE project grants …				
	Accurate	Inaccurate	Don't know	Not relevant
Socio-economic impact and dissemination				
… helped my public outreach activities	15 (58%)	5 (19%)	4 (15%)	2 (8%)
… contributed to technology and knowledge transfer to my group	13 (50%)	7 (27%)	4 (15%)	2 (8%)
… facilitated collaboration with industrial and/or other partners*	10 (40%)	8 (32%)	5 (20%)	2 (8%)
… increased the number of my patents and/or patent applications	5 (20%)	11 (44%)	6 (24%)	3 (12%)
… enabled me to fund/contribute to the funding of spin-offs*	0 (0%)	14 (56%)	6 (24%)	5 (20%)

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.
Note: *With collaboration with industrial and other partners and spin-offs: n = 25.

The impacts in the category of socio-economic impacts and dissemination are again the lowest impacts as assessed by the survey respondents: the funding of spin-offs (0%) and patents (20%). However, these outputs are not among the main objectives of the CORE MS funding scheme. However, CORE grants help with public outreach activities (58%), contributed to technology and knowledge transfer to the group (50%), and facilitated collaboration with industry and other partners (40%). With spin-offs and also patents, the share of respondents stating that those impacts are not relevant in their discipline is, as one would expect, quite high (20% for spin-offs, 12% for patents). The numbers show that the grantees' assessment of transfer impacts of CORE is in general more positive than the assessment by the selection panel members interviewed.

Overall productivity

CORE applicants were asked in the online survey how they rate their overall productivity given their career stage. Of the 25[19] respondents with CORE funding, 80% rate their output as high (72%) or very high (8%). Sixteen per cent rate their output as moderate, and 1 respondent (4%) thinks his/her output is low. Of the 5 respondents without CORE funding, 3 persons (75%) rate their output as high and 1 person (25%) as moderate.

Assessment of deadweight

We asked the CORE grantees if they would have been able to conduct their research project without the grant. Their responses are shown in Table D 4.12.

[19] One person did not answer this question.

D 4.12: Assumed realization of project without CORE funding (n = 26)

Could your research project(s) have been carried out without the CORE project grants?	Number (%)
Yes	5 (19%)
No	21 (81%)

Source: Interface, online survey with CORE applicants in materials and physical sciences 2010–2015.
Note: Only the survey participants who had at least one CORE grant were asked this question.

The vast majority of the group of grantees do not think they would have been able to conduct their projects without CORE.

The survey respondents who did not receive CORE funding were asked if they were still able to conduct their envisaged projects. Their responses are shown in Table D 4.13.

D 4.13: Consequences of CORE MS application not being approved for funding (n = 22)

Were you still able to conduct the research project for which you submitted the application?	Number (%)
Yes	1 (5%)
Yes, but to a smaller extent	7 (32%)
No	14 (64%)

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.
Note: Only the 17 survey respondents who had at least one application for CORE funding that was not retained were asked this question.

The majority of the respondents who had at least one application for CORE funding that was not retained could not conduct the envisaged project as a consequence of not receiving the grant. Although 38% say they were still able to conduct the project, most of them had to downsize.

4.1.4 ATTAINMENT OF OVERARCHING OBJECTIVES

We asked the participants in the online survey how they rate the achievement of six overarching goals that the FNR pursues with its CORE funding scheme. Table D 4.14 shows the survey results.

D 4.14: Attainment of overarching objectives of CORE (percentage of persons answering 'accurate' or 'very accurate', n = 28)

How do you rate the following statements with regard to the goals attained through the CORE funding scheme of the FNR?	Number (%)
CORE leads to the generation of new knowledge through funding of high quality scientific research.	27 (96%)
CORE advances the careers of involved researchers in general.	26 (93%)
CORE leads to scientific publications in the leading international peer-reviewed outlets of the respective fields.	25 (89%)
Through CORE, research groups and institutions are advanced in view of international visibility and critical mass.	23 (82%)
CORE supports the training of doctoral students.	23 (82%)
CORE helps develop a strong and sustainable research basis in Luxembourg.	22 (79%)

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015.

The results show that CORE is generally assessed very positively by the survey respondents regarding the six overarching goals for the funding instrument. The evaluation corresponds also to the assessment of impact on the individual level. There, generation of new knowledge and personal advancement measured in publications and conference contributions as well as international collaborations, national visibility, and completion of doctoral theses were confirmed as being particularly important impacts of CORE.

4.2 INTER MS

This section presents the evaluation results for the FNR INTER funding scheme in the field of materials and physical sciences for the period 2010 to 2015. For each objective, we present the results of an online survey of all applicants for INTER in said fields of research from 2010 to 2015. This research period does not cover all of the INTER MS applicants. In some cases, the results are complemented by an analysis of FNR documents or data.

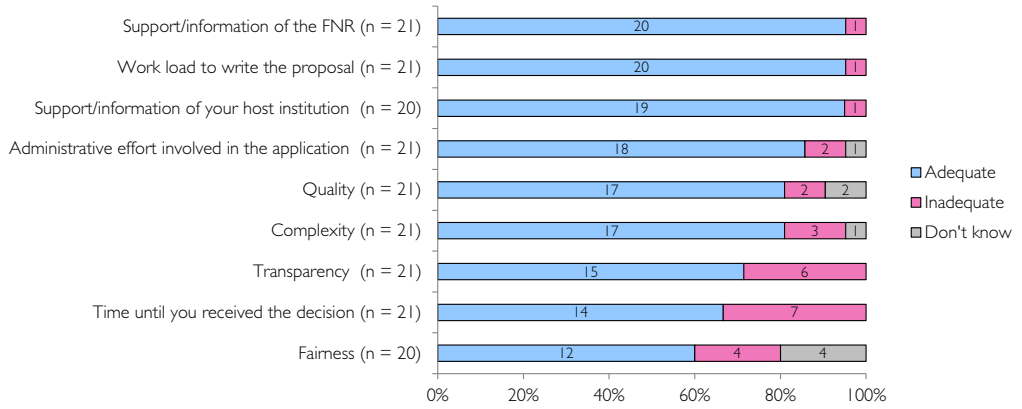
4.2.1 CONCEPT AND IMPLEMENTATION

Results regarding the concept and the activities in relation to the INTER funding scheme are presented in the following.

Application process

In the online survey, INTER applicants with and without INTER funding were asked to assess a number of aspects of the application process. Their responses are shown in the following figure. It should be noted that with INTER, the application process depends entirely on the foreign lead agency and the FNR has no means to influence this process. The assessments shown in Figure D 4.15 thus concern the processes of the various partner agencies of the FNR.

D 4.15: Applicants' assessment of application process, INTER



Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

Most of these aspects concern the processes at the partner agencies of the FNR and thus cannot be interpreted. However, the support and information received from the FNR is again evaluated very positively. We also see that transparency and wait time to receive notification of the funding decision is viewed critically by some of the respondents, so it seems to be a remark made generally rather than a specific weakness of the FNR application processes. One survey respondent who has experience with various partner agencies explains that the assessment depends on which partner agency, and that whenever he/she experienced difficulties, they were not caused by the FNR but by the partner agency. The six survey respondents who never received an INTER grant generally evaluated the different aspects of the application process a little less positively than the respondents with INTER funding but not on the aspects assessed most critically. These are assessed even more positively by the applicants who did not receive INTER funding.

The survey respondents were further asked to qualify the usefulness of the feedback documents provided by the FNR. Fifteen of the 21 respondents (71%) find these documents useful, and 6 (21%) do not. All of the six respondents who never had INTER funding find the documents useful. Again, one respondent points out that this depends on the partner agency and on which agency takes the lead. If the FNR does not function as the lead agency, the feedback is not provided by the FNR.

4.2.2 PROGRAMME OUTPUT

This section reports the results concerning the programme output of INTER. The number of applications and the participation of women in the programme are shown for the time period observed.

Table D 4.16 shows the output of the INTER funding programme in the field of materials and physical sciences for the evaluation period 2010–2015. The number of INTER applications (total, funded, and not retained) and the corresponding funding amounts awarded are presented.

D 4.16: Call output, INTER MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications (total)	11	9	6	44	34	17	121
Applications with funding	1	4	1	6	3	3	18
Applications without funding	10	5	5	38	31	14*	103
Success rate	9%	44%	17%	13%	9%	18%	15%
Funding amount (1000 €)	420	1,653	323	1,688	1,053	990	6,127
Funding amount/project (1000 €)	420	413	323	281	351	330	340

Source: Interface table based on FNR data.

Note: Applications without funding also include withdrawn applications and applicants not eligible for funding. *With one of the proposals marked as 'rejected', the FNR database accounts for funding of 374,000 euros.

From 2010 to 2015, 121 applications for INTER funding in MS were submitted to the FNR. The overall success rate was 15%, ranging from 9% in 2010 and 2014 to 44% in 2011. The success rate fluctuated quite a bit in the observed period. The increase in applications as of 2013 is even more evident than with the CORE funding scheme. Funding amounts also remained on a high level from 2013 on. The largest number of applications was submitted and funded in 2013. In total, the FNR invested over 6 million euros in INTER grants in the observed field and period.

Table D 4.17 shows some key figures for female INTER MS applicants.

D 4.17: Female participants, INTER MS

Call year	2010	2011	2012	2013	2014	2015	Total
Applications of female candidates	4	1	0	5	3	2	15
Share of total number of applications	36%	11%	0%	11%	9%	12%	12%
Applications of female candidates with funding	1	1	0	1	1	0	4
Female success rate	25%	100%	-	20%	33%	0%	27%

Source: Interface table based on FNR data.

Of the total 121 applications for INTER in the observed field and period, only 15 applications (12%) were submitted by women. Four of these applications (27%) resulted in funding. The numbers show that female researchers in MS submit a small number of CORE applications with average success. However, the applications are more successful than the applications submitted by men.

4.2.3 IMPACT

This section reports our findings concerning the impacts of INTER. We first summarize the external assessment of the final reports of the nine INTER MS projects already completed. We then show the results of our survey of INTER applicants.[20] There, we distinguish between scientific impact and recognition, training impact, and socio-economic impact and dissemination.

External assessment

Every completed INTER project is evaluated remotely by external experts. The evaluation assesses: (1) project implementation (fulfilment of initial project objectives, application of state-of-the-art and adequate methodology, resource efficiency, advancement of young researcher's career); (2) the scientific impact of the project (contribution to international state-of-the-art, international visibility of PI group after project, quality of scientific publications); and (3) dissemination and valorization of the research results (exploitation of intellectual property generated, dissemination of research results among wider public, implication of potential research users, intended valorization of results after project). In addition, an overall assessment of the project is made based on a quantitative rating with four rating categories (excellent, good, fair, and poor). If the reviewers do not agree on the assessment, it is possible to give ratings that are between categories. The overall assessment draws a conclusion regarding the project's impact. Accordingly, a project can have 'no impact', 'results with low impact at international level', 'results of reasonable international impact', or 'results of high international impact'. Again, ratings between categories are possible.[21]

Table D 4.18 shows the assessment of the nine INTER MS projects that were completed by 2015.

[20] Of course, these survey results have to be interpreted very cautiously. First of all, the analysis distinguishes neither between the different INTER call years nor between research fields. Second, the group sizes differ and the group of survey respondents without INTER funding is very small. Also, these scientific outputs are the result of a number of reasons, and the explanatory power of the FNR INTER funding (or the absence of it, respectively) is unclear.

[21] In the original assessments, these 'between-ratings' are not labelled. We labelled them to make the assessment more comprehensible.

D 4.18: External panel assessment of completed INTER MS projects (n = 9)

	Poor	Poor – Fair	Fair	Fair – Good	Good	Good – Excellent	Excellent
Project implementation							
Fulfilment of initial project objectives	-	-	1	-	5	1	2
Application of state-of-the-art and adequate methodology	-	-	-	-	3	1	5
Resource efficiency	-	-	2	-	4	-	3
Advancement of young researcher's career	1	-	1	4	1	1	1
Total project implementation	1	-	4	4	13	3	11
Scientific impact							
Contribution to international state-of-the-art	-	-	2	2	4	-	1
International visibility of PI / group after project	1	-	2	1	4	1	-
Quality of scientific publications*	-	-	2	-	5	1	-
Total scientific impact	1	-	6	3	13	2	1
Dissemination and valorization of the research results							
Exploitation of intellectual property generated	2	-	3	-	3	1	-
Dissemination of research results among wider public	3	-	1	-	4	-	1
Implication of potential research users	2	-	4	-	1	1	1
Intended valorization of results after project	-	-	5	-	3	1	-
Total dissemination and valorization of the research results	7	-	13	-	11	3	1

Source: Interface table based on FNR documents. *For one project, the assessment of the quality of scientific publications is missing, because no such publications have been produced.

As with CORE, the assessment of project implementation is 'good' or even 'excellent' for the majority of the projects. The evaluation of scientific impact is also comparable: Most of the projects are rated as having good scientific impact. The aspects of dissemination and valorization of the research results are rated less positively: The majority of the projects are rated 'fair', and here again, a number of projects are rated 'poor' on dissemination and valorization. However, the overall assessment of this category is somewhat more positive than with the CORE MS projects.

Table D 4.5 shows the overall assessment of the 12 CORE MS projects that were completed by 2015.

D 4.19: Overall external panel assessment of completed INTER MS projects (n = 9)

Overall assessment	
Results of high international impact	-
Results of reasonable to high international impact	3
Results of reasonable international impact	2
Results with no to low international impact	3
Results with low impact at international level	1
No impact	-

Source: Interface table based on FNR documents.

The overall assessment of the projects is variable. Five of the nine projects are considered to have 'reasonable' or 'reasonable to high' international impact. In contrast, four projects are considered to have 'low' or 'no to low' impact. This is a less positive overall assessment than we observed with the completed CORE MS projects.

Scientific impact and recognition

This section turns to the evaluation results regarding scientific impact and recognition. Table D 4.20 shows a comparison of the self-declared scientific output of survey respondents who received INTER funding (n = 16) and of respondents who never received INTER funding (n = 6). Survey respondents with INTER funding were additionally asked to estimate the share of their output that was related to their INTER grant.

D 4.20: Scientific output and recognition of applicants with and without INTER funding (n = 22)

Output indicator	With INTER (related to INTER)	Without INTER
Scientific output and recognition		
Number of published journal articles	33 (3)	23
Conferences contributions	25 (6)	12
Invited talks	16 (7)	5
New international project collaborations	9 (6)	1
National grants earned	7 (4)	3
International grants earned	4 (3)	1
Scientific prizes won	3 (2)	0
Published books/monographs	2 (1)	2
Published policy reports	0 (0)	1

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

Since the range of responses is very broad for most of the output indicators, we used medians[22] instead of means and took into account only answers of respondents who state that a certain output is relevant in their research discipline.

In general, the highest average numbers can be observed for publications in journals, contributions at international conferences, and invited talks. This is true for both the group with and the group without INTER funding. Comparing the two groups, the table shows that the total average scientific output of survey respondents with INTER funding is higher than that of survey respondents without INTER funding for all indicators of scientific output. The biggest differences between the two groups can also be found with scientific output, particularly new international collaborations.

Survey respondents with INTER funding were asked about the same dimensions of scientific impact and recognition to estimate the effect of their INTER funding. Table D 4.21 shows the results.

D 4.21: Grantees' assessment of scientific impact and recognition related to INTER funding (n = 16)

My INTER project grant/my INTER project grants …				
	Accurate	Inaccurate	Don't know	Not relevant
Scientific impact and recognition				
… increased the number of my scientific publications	15 (94%)	0 (0%)	1 (6%)	0 (0%)
… increased the number of my conference contributions	12 (75%)	3 (19%)	1 (6%)	0 (0%)
… enabled new international collaborations	12 (75%)	3 (19%)	1 (6%)	0 (0%)
… improved the quality of my conference contributions	11 (73%)	4 (27%)	0 (0%)	0 (0%)
… facilitated follow-up research projects	11 (69%)	3 (19%)	2 (13%)	0 (0%)
… improved quality of scientific publications	10 (67%)	5 (33%)	0 (0%)	0 (0%)
… increased my visibility among national actors	9 (56%)	4 (25%)	3 (19%)	0 (0%)
… led to more invited talks	8 (53%)	5 (33%)	2 (13%)	0 (0%)
… led to successful applications for further competitive funding	8 (53%)	5 (33%)	2 (13%)	0 (0%)
… led to scientific prizes	2 (14%)	7 (50%)	4 (29%)	1 (7%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

According to the survey respondents, the most important effects of INTER are scientific in nature: The survey respondents confirm that INTER increases the number of

22 The median is the value separating the higher half of a data sample from the lower half. The advantage of the median compared to the mean is that it is robust to outliers and thus may give a better idea of a 'typical' value.

their scientific publications and contributions at international conferences and enables new international collaborations. This confirms that the information the survey respondents gave about their scientific output related to their INTER funding.

For scientific impact, the INTER grantees were asked how relevant INTER was for their scientific independence. Thirteen grantees (81%) are of the opinion that INTER is very relevant (4 grantees) or relevant (9 grantees).

Seven of the 16 grantees (44%) think that the INTER grant(s) has/have a significant influence on their further career. This shows that the funding instrument INTER is less important for career development of the PI than the other funding schemes evaluated, but it helps improve scientific output at a given career stage and influences training impact by boosting the careers of PhD candidates and postdocs.

Training impact

This section reports on the training impact of INTER. Table D 4.22 shows the training output of the survey respondents with and without INTER funding. Respondents with INTER funding were additionally asked to estimate the share of their training output that was related to their INTER grant.

D 4.22: Training output of applicants with and without INTER funding (n = 22)

Output indicator	With INTER (related to INTER)	Without INTER
Training output		
Doctoral students supervised	7 (4)	2
Doctoral theses completed	6 (3)	3

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

The table shows that again, applicants with INTER funding show much higher numbers than applicants without INTER funding, both for doctoral students supervised and doctoral theses completed under their supervision.

Applicants for INTER who received INTER funding were then asked to estimate the effect of their INTER funding regarding training impact. Table D 4.23 shows the results.

D 4.23: Grantees' assessment of training impact related to INTER funding (n = 16)

My INTER project grant(s) …	Accurate	Inaccurate	Don't know	Not relevant
Training impact				
… had a positive impact on the career(s) of PhD student(s)/postdoc(s) in my group	14 (88%)	0 (0%)	1 (6%)	1 (6%)
… increased the number of completed doctorates in my group	8 (53%)	6 (40%)	1 (7%)	0 (0%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

The results show that training impact is relevant: INTER has a positive effect on the careers of PhD candidates and postdocs in the PIs' groups. The share of survey respondents confirming this effect is a lot higher than with CORE and ATTRACT. The effect on completed doctorates is disputed, with 6 of the 16 respondents disagreeing with this effect.

Regarding training impact, we asked if the INTER applicants are currently heading their own research group, how many members the groups have, what the total budget of their groups was in 2015, and what kind of funding their budget consists of. Eleven of the 16 respondents (69%) who received INTER funding are currently heading a research group. Of the five survey respondents who never received INTER funding, only one currently heads a research group.

The research groups of the survey respondents range in size from 7 to 17 members including the respondent PIs. Taking only scientific personnel into account, group sizes range from 6 to 14 people. Ten of the 12 respondents currently heading a research group stated the budget of their group in 2015: The budgets range from 50,000 to 2 million euros.[23] In six cases, FNR funding accounts for 50% or an even higher percentage of the budget. In one case, the FNR funded 90% of the total 2015 budget and in one case, 80% of the budget.

Of the 12 survey respondents heading a research group, 2 (17%) are women. Compared to the total share of female survey respondents (17%), there is no underrepresentation regarding heading a research group. Group sizes and budgets are rather on the lower end of the distribution.

Socio-economic impact and dissemination

Table D 4.24 shows a comparison of the socio-economic output and dissemination of the survey respondents with and without INTER funding. Respondents with INTER funding additionally estimated the share of their transfer output related to their grant.

[23] Excluding one person, who stated that the 2015 budget of his/her group was '0'.

D 4.24: Socio-economic output and dissemination of INTER applicants with and without INTER funding (n = 22)

Output indicator	With INTER (related to INTER)	Without INTER
Socio-economic output and dissemination		
New national project collaborations	6 (2)	7
Collaborations with industry/other partners realized	5 (3)	4
Patents filed	5 (2)	2
Spin-offs initiated	1 (0)	0

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

The survey respondents with INTER funding achieve higher output than the respondents without INTER funding. However, the differences are generally smaller than with the other output categories (scientific output and training output). For new national project collaborations, the respondents without INTER funding show an even higher number than the grantees.

Again, the respondents with INTER funding were asked to estimate the significance of their INTER grant(s) in terms of socio-economic impact and dissemination. Table D 4.25 shows the results.

D 4.25: Grantees' assessment of socio-economic impact and dissemination of INTER funding (n = 16)

My INTER project grant(s) …				
	Accurate	Inaccurate	Don't know	Not relevant
Socio-economic impact and dissemination				
… contributed to technology and knowledge transfer to my group	10 (63%)	3 (19%)	0 (0%)	3 (19%)
… facilitated collaboration with industrial and/or other partners	10 (63%)	3 (19%)	0 (0%)	3 (19%)
… helped my public outreach activities	7 (44%)	6 (38%)	2 (23%)	1 (6%)
… increased the number of patents and/or patent applications	4 (25%)	7 (44%)	2 (13%)	3 (19%)
… enabled me to fund/contribute to the funding of spin-offs	0 (0%)	10 (67%)	0 (0%)	5 (33%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

Again, the socio-economic impacts are among the impacts that the survey respondents confirm the least: With spin-offs and patents, the share of respondents stating that these impacts are not relevant in their discipline is, as one would expect, quite high (33% for spin-offs, 19% for patents), although these outputs are encouraged by some

INTER calls. Apart from the shortcomings mentioned above, INTER grants support public outreach activities (44%), contribute to technology and knowledge transfer to the group (63%), and facilitate collaboration with industry and other partners (63%).

Overall productivity

INTER applicants were asked in the online survey how they rate their overall productivity given their career stage. Of the 15 respondents with INTER funding, 14 (93%) rate their output as high (10 grantees) or very high (4 grantees). One respondent (7%) rates his/her output as moderate. None of the respondents perceive their output as low or very low. Of the 5 respondents without INTER funding who answered this question, 3 (60%) perceive their output as high, and 2 (40%) say their output is moderate.

Assessment of deadweight

We asked the INTER grantees if they would have been able to conduct their research project without the grant. Their responses are presented in Table D 4.26.

D 4.26: Realization of project without INTER funding (n = 16)

Could your research project(s) have been carried out without the INTER project grants?	Number (%)
Yes	4 (25%)
No	12 (75%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.
Note: Only the survey participants who had at least one INTER grant were asked this question.

The vast majority of the group of grantees do not think they would have been able to conduct their projects without INTER. However, the assumed deadweight loss is bigger than with CORE.

The survey respondents whose applications for INTER funding were not approved for funding were asked if they were still able to conduct their envisaged projects. Table D 4.27 shows their responses.

D 4.27: Consequences of INTER MS application not being approved for funding (n = 14)

Were you still able to conduct the research project for which you submitted the application?	Number (%)
Yes	1 (7%)
Yes, but to a smaller extent	3 (21%)
No	10 (71%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.
Note: Only the 15 survey participants who had at least one INTER application that was not approved for funding were asked this question.

The majority of the respondents who had at least one INTER application that was not approved for funding could not conduct the envisaged project as a consequence of not receiving the grant. Four people (28%) say they were still able to conduct the project,

but with the exception of one respondent, all of them had to downsize. This actually points to a lower deadweight loss than we observe with CORE.

4.2.4 ATTAINMENT OF OVERARCHING OBJECTIVES

We asked the online survey respondents how they rate the achievement of two overarching goals that the FNR pursues with its INTER funding scheme. Table D 4.28 shows the survey results.

D 4.28: Attainment of overarching objectives INTER (percentage of persons answering 'accurate' or 'very accurate', n = 21)

How do you rate the following statements with regard to the goals attained through the INTER funding scheme of the FNR?	Number (%)
INTER is a suitable instrument for developing new international partnerships	19 (91%)
INTER gives Luxembourg public research a higher profile in the international context	18 (86%)

Source: Interface, online survey of INTER applicants in materials and physical sciences 2010–2015.

The results show that INTER is assessed very positively by the survey respondents regarding the two overarching goals mentioned. The first overarching goal corresponds to the assessment of the impact on the individual level, which was identified by 75% of the respondents and is confirmed by the actual output that the INTER grantees have achieved in this respect, which is significantly higher than in the group of applicants for INTER who did not receive INTER funding.

4.3 ATTRACT

This section reports the evaluation results for ATTRACT. For each objective, we present the results of the interviews with the 12 ATTRACT fellows, two applicants whose applications to ATTRACT were not approved for funding by the FNR, two hosts of ATTRACT fellows, two standing members of the ATTRACT selection panel, and the results of an online survey of all applicants for ATTRACT not approved for funding from 2007 to 2015. In some cases, the results are complemented by an analysis of FNR documents or data. Please note that due to the large number of in-depth interviews conducted on the ATTRACT funding scheme, we were able to gather a lot of qualitative information about the funding scheme's concept and implementation. The respective sections are therefore longer than with CORE and INTER.

4.3.1 CONCEPT AND IMPLEMENTATION

The experts and fellows interviewed are of the opinion that ATTRACT, as it is today, is based on a sensible concept. The main disadvantage mentioned by the interviewees – the lack of a tenure track – was corrected by the FNR with the introduction in 2013 of a mandatory tenure or tenure track demanded of the host institutions. The tenure track is seen as the unique feature of ATTRACT that clearly sets this funding scheme apart from similar grants in neighbouring countries. In that, it is perceived to fill a void between the two types of positions mainly available: non-permanent postdoc positions and (rare) permanent full professorships. As the interviewees point out, the tenure

track is especially important in the Luxembourg research environment, because the labour law does not allow hiring on temporary contracts for a term of more than five years.

Compared to similar funding schemes in other countries, the number of applications is very low (48 applications from 2007 to 2015, compared with over 1,000 applications to the SNSF Ambizione programme in six years or around 700 applications to the DFG Emmy Noether programme in five years). On the one hand, this might be due to the low awareness of the funding scheme outside Luxembourg (results concerning this topic are presented below). Another possible reason is suggested by one of the panel members: He says that since the application requires a lot of commitment and work on the part of the candidates and since the candidates need a clear vision and have to coordinate with a host, they might self-select. An effect of this is that – as both the panel members and the FNR representative state – the quality of the applications for ATTRACT is generally high and has even increased over the years.

Awareness of ATTRACT

In the interviews, the fellows and the applicants whose applications were not retained were asked how they learned about ATTRACT. The results show that in many cases the funding scheme does not work as a clear independent incentive to come to Luxembourg. One fellow describes the situation as follows:

> "In terms of international visibility, it (ATTRACT) is not on the map. […] I have never been approached at any conference by anybody who was interested in ATTRACT. I think it is known to people with some kind of connection to Luxembourg. You have to also see it in the light of the fact that Luxembourg is nowhere. There have been certain very positive developments […]. We are not lacking the instruments to recruit really good people. But we just don't have the visibility".

Usually, the hosts seek out high-quality researchers, invite them to Luxembourg, and offer them a position at their institution. They then suggest applying for ATTRACT. In one case, the person was even already working at his/her designated host institution when he/she applied for an ATTRACT grant, but his/her application was not approved. This researcher argues that he/she had the feeling that the recommendation of his/her host institution to apply for ATTRACT was made based entirely on opportunity. This might not be problematic, as the objectives of ATTRACT are still achieved, but it does not seem to be exactly what the FNR intended. One interviewee says that this enables a host to undermine the strategy of the University by specifically recruiting researchers that are to their liking. One reason why the recruitment process works this way might be that ATTRACT – as the interview partners unanimously say – is not known outside Luxembourg. Within the country, however, it is a well-known, prestigious grant. The fellows seem to actively promote ATTRACT whenever they are outside Luxembourg, and they say that once people learn about the funding scheme, they are amazed by its extent and quality.

The fellows judge the need for more intensive promotion of ATTRACT by the FNR ambiguously. Some fellows are of the opinion that there should be more advertise-

ments, for example in important science publications. Others do not see a need to make the funding scheme more known and state that similar national funding schemes in other European countries are equally unknown. One of the panel members thinks that the number of applications should not be increased – which is likely to happen if promotion is intensified – if the number of grants is not increased as well. He wishes that more people could be funded through ATTRACT.

As the online survey with applicants for ATTRACT whose applications were not retained shows, the applicants' most important reasons for applying to ATTRACT were the option of developing their own research focuses and the possibility to set up their own research group. The development of their own research focuses was even assessed as 'very significant' by almost 90% of the survey respondents. The attractiveness of the funding scheme was also an important reason for applying. Obviously, the reputation of the funding scheme does not precede it, the reputation being the least significant reason why the respondents applied to ATTRACT. This confirms the interview results regarding awareness of the funding scheme. Interestingly, half of the respondent group answered that the option of going to or returning to Luxembourg was a significant reason. This argues somewhat against the assumption that Luxembourg is not yet on the map as an attractive research location.

Participation criteria and application process

The ATTRACT participation criteria as they are today are seen as clear and in line with international standards. The grantees but also the applicants whose applications were not approved for funding have found the application process to be well organized, professional, fair, and transparent. Interviewees who applied for similar funding schemes in other countries point to this as a particular asset of the application process to ATTRACT:

> "I had been in the final round for an Emmy Noether grant. There, I did not have access to the reviews at any time during the application process. I very much appreciated this with the FNR".

The workload entailed in writing the application was also appropriate, according to the vast majority of the fellows and applicants. All interviewees appreciate greatly the possibility to directly address in the course of their interviews the criticisms or questions raised.

Two fellows say that the reviews of their proposals differed remarkably:

> "It was interesting to see how the same proposal can get ratings from excellent to very bad. I got everything".

One of the fellows has the impression that the outcome of the interview depended largely on the external expert invited to the panel. Discrepancy between the reviews was also addressed by the standing panel members interviewed.

The fellows as well as the applicants interviewed are very happy with the information and counselling that they received from the FNR during the application process. One

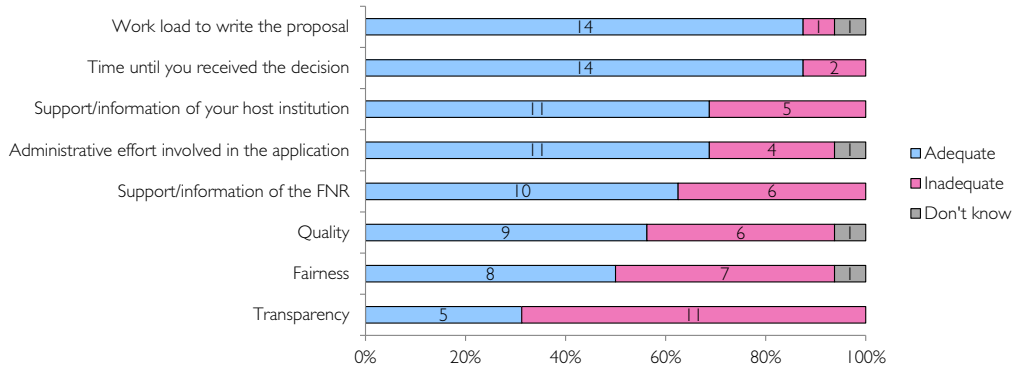
of the fellows emphasizes the extensive support in writing the application received from his designated host unit at the University of Luxembourg and its research facilitators.

A difficulty described in relation to the application process is that the panel is composed of experts who are usually not experts in the applicants' research fields. One interviewee says that although he/she thinks the FNR is doing a great job putting together the panel of experienced researchers, he/she felt some of the experts were not really interested in his/her proposal during the interview, simply because they were not at all familiar with the subject.

According to the panel members interviewed, another problem is that the panel relies heavily on the external referees, but their quality is very variable. The FNR is currently trying to improve the database of its external referees to resolve this issue. The panel members are of the opinion that another measure could be to reveal the names of the referees to the standing panel members. This would bring the procedure close to the refereeing practice at most journals. Also, one of the panel members says that the external experts are sometimes rather unprepared in terms of knowing what is expected of them by the FNR. He thinks that there should be a better briefing about what ATTRACT is and what the experts' role is, what kind of questions they are expected to ask, and who else will be present at the meeting. This preparation should be more formalized than it is today. This second issue is supported by the statement of one of the applicants not selected for ATTRACT funding. The applicant says he/she was unaware of the composition of the panel and the panel members' engagements and confidentiality agreements and hence did not know what could be disclosed in the course of the interview.

In the online survey, the respondents whose applications were not retained for funding were asked to assess a number of aspects concerning the application process. Their responses are shown in Figure D 4.29.

D 4.29: Assessment of ATTRACT application process by applicants not retained (n = 16)



Source: Interface, online survey of ATTRACT applicants whose applications were not retained.

For all aspects except one, more than half of the respondent group gives positive feedback concerning adequacy/appropriateness. The appropriateness of the workload entailed in writing the proposal and the wait time until the funding decision is communicated to the candidates are appreciated by the respondents. Surprisingly, the transparency of the application process is evaluated quite critically: Eleven of 16 respondents find this aspect inadequate, independent of the year in which they applied for ATTRACT funding. This contradicts the general opinion of the fellows but also the applicants not approved for funding interviewed: They found the application process particularly transparent, also compared to the application processes for other grants in their experience. Of course, one has to take into account that the rejection of an application such as that to ATTRACT can cause frustration and lead an applicant to doubt the fairness and transparency of the process. This is also a general difficulty observed with peer review processes.

Five survey respondents explain their negative answers in more detail, but only one of the clarifications concerns the transparency of the application process. This respondent is of the opinion that "reviewers should be screened for potential conflicts of interest" and that "it would have been fairer to get the comments of the reviewers and their identities at least two weeks in advance of the panel meeting because it takes time to carefully consider their remarks […]".

The online survey also asked the respondents whose applications were not retained for funding to assess the usefulness of the feedback provided by the FNR. Ten of the 16 respondents did not find the comments of the FNR useful. Some of them explained their response. Their criticism is that the "feedback was too generic and did not clearly explain the motives behind the final decision" and that it was "very superficial and lacked any objectivity".

Funding amount and duration

The funding amount has been changed over the years, but the majority of the ATTRACT fellows interviewed say that the extent of the grant is good and sufficient for attaining the objectives linked with an ATTRACT fellowship – building up an independent research group and starting a project. Not only the extent of the grant but also the flexibility in allocating the resources that comes with it is pointed out as a particular advantage of ATTRACT. However, the interview results show that what a sum of 2 to 2.5 million euros enables a scientist to do clearly depends on the research discipline and the kind of research. For a scientist working mainly in theoretical or basic research or in a less cost-intensive field, the amount granted is high and allows the building up of a large research group (group sizes for current ATTRACT fellows range from 2 to 15 members), but it can be rather restrictive for a scientist working in applied research or in a more cost-intensive research field with high expenditure for infrastructure, equipment, etc. In this context, the lack of a dedicated fund for equipment in Luxembourg is criticized by some of the ATTRACT fellows who need such equipment. The contrasting statements of two fellows illustrate this:

> "It's a fantastic amount, a very generous grant. I say this as a theorist of course".

> "Even though the budget seems quite large, it only enables me to finance half a position of a technical assistant and two doctoral students. The other means are contributed by the institute. Given that you are expected to build up a group relatively fast, and taking the personnel costs in Luxembourg into account, I was shocked at the restrictions".

The panel members and the hosts interviewed agree that the funding amount is adequate and works as an attractive starting package that Luxembourg can offer to high quality researchers from abroad.

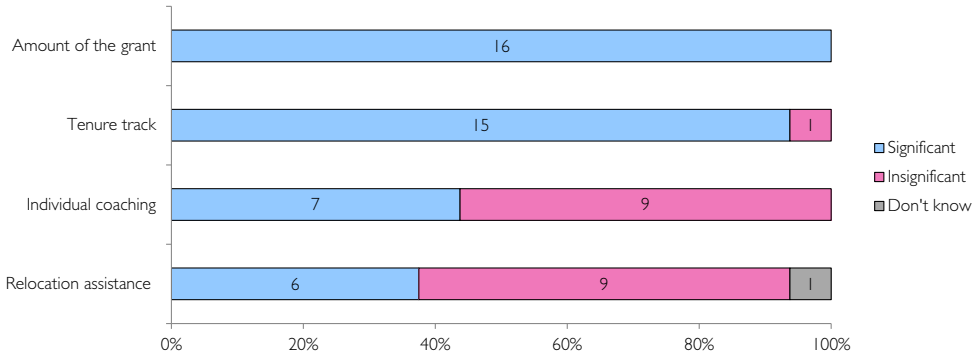
Compared to similar funding programmes in Europe (e.g. DFG Emmy Noether programme, FWF START programme), the annual funding amount is high. Compared to similar funding schemes in Switzerland (SNSF Ambizione and SNSF professorships), where salary costs are on a similar level, ATTRACT grants for Starting Investigators and grants for Consolidating Investigators are both higher than Ambizione; SNSF professorships are on the same funding level as ATTRACT Consolidating Investigator grants.

The interviewees agree that the funding period of five years is adequate and comparable to international standards. A few of the ATTRACT fellows think that it could be longer. One fellow states that this is not a particular problem of the ATTRACT grant but of how research funding is executed today in general. According to this fellow, there is a lack of an actual long-term perspective with funding instruments everywhere.

Looking at similar funding schemes abroad, five to six years is the duration for most other schemes. Some of the programmes (e.g. SNSF professorships, DFG Emmy Noether programme) allow for prolongation of the funding period.

In the survey, we asked the applicants about the importance of some specificities of ATTRACT. Figure D 4.30 shows the results.

D 4.30: Importance of specificities of ATTRACT for applicants not retained



Source: Interface, online survey of ATTRACT applicants whose applications were not retained.

Clearly, the extent of the grant and the tenure track are the specific features that are the most valued by applicants who participated in the survey. All of the respondents assessed the amount of the grant as significant, and for 50% it was even 'very signifi-

cant'. The individual coaching and the relocation assistance are of less importance, with over 50% of the respondents finding these factors insignificant.

Support from the FNR

The ATTRACT fellows interviewed were very happy with the information and counselling that they received from the FNR during the funding period. The fellows agree that the FNR is very responsive, helpful, and flexible. They particularly appreciate that the FNR tries to stay close to its grantees and encourages networking and collaborating among the fellows. The annual meeting for current and former ATTRACT fellows is commended. Some of the fellows mention the coaching that comes with an ATTRACT grant as a special advantage of the funding scheme. The coaching is perceived as very helpful. One of the fellows argues that it is mainly the research unit at the University of Luxembourg and not the FNR that supports him/her.

Collaboration with host

The majority of the (former) ATTRACT fellows assess their collaboration with their direct hosts very positively. In two cases the collaboration was problematic. In both cases, lack of independence granted to the fellow by the host institution or the direct hosts was the main reason for disagreement. Both fellows agree that the FNR was very helpful in their difficult situations.

Whereas the collaboration with the host units or departments is appreciated, criticism is raised concerning the collaboration with the University as a host institution. The points of criticism are manifold. The main problem mentioned by the interview partners is again the lack of a clear scheme for promotion. One respondent feels that the human resource department had the decisive power over recruitment and budget of his/her research group. Another fellow says that the University does not have a good library. He/she also says that the University hires top professors but does not provide lab space or adequate infrastructure.

Support from the hosts

The overall assessment of the support that grantees receive from their ATTRACT host institutions is positive. The grantees feel that they are supported adequately in terms of both infrastructure and additional funding provided by the host unit. Again, the lack of a dedicated fund for equipment is mentioned as a possible problem in some research fields.

All former and current ATTRACT fellows were able to recruit PhD candidates and postdocs for their research projects. Depending on the field of research, the interviewees state that it is difficult to find (good) scientific personnel in Luxembourg and that they were forced to recruit people from outside. The group sizes and number of group members funded by the ATTRACT grant differ, ranging from 2 to 15 people. This also reflects the cost intensity of the different research fields or kinds of research, although it should be noted that some of the fellows are still in the phase of building up their groups.

Integration in the host institution

The results indicate good integration of the ATTRACT fellows in their host institutions. A number of fellows interviewed point out that they are also integrated in administrative processes, which allows them to help shape decisions. They are of the opinion that this is a special advantage of the University of Luxembourg because it is a young university and still shapeable to some extent.

Involvement in teaching activities

All of the former and current ATTRACT fellows were/are involved in teaching activities. ATTRACT does not come with a teaching obligation, but the fellows agree that they feel their host institutions implicitly expect them to teach. In some cases, the fellows claim to have (had) quite a heavy teaching load, especially at the beginning of their grant period. Nevertheless, most of the fellows appreciate the opportunity to acquire teaching experience, which is seen as vital for any academic career. The fellows in small departments or units particularly agree that the teaching load should be distributed among all academic staff. Because of the nature of the research carried out at the Public Research Centres, the teaching load for fellows employed there is somewhat lower than for the fellows employed at the University.

Potential for improvement

The interviews yield a number of suggestions on how the FNR could improve the concept of ATTRACT.

- A point of criticism regarding the concept of ATTRACT is brought up by the applicants whose applications were not retained and one of the panel members interviewed: They are of the opinion that the funding scheme's regulations should allow for second applications. Since the quality of the applications seems to be high, the pool of applicants not selected for funding is a resource of eligible candidates that should – according to the interviewees – be put into use. They think that candidates should be allowed to revise their applications based on the external reviews and reapply.
- Two of the fellows interviewed are of the opinion that the FNR should promote the ATTRACT funding scheme more, for example by placing more advertisements in journals. One fellow says that the halo around ATTRACT still has to improve, although locally ATTRACT is already regarded as prestigious. One of the panel members interviewed supports this but thinks that ATTRACT should only be promoted further if the number of grants awarded is increased accordingly.

In the online survey, the ATTRACT applicants with applications that were not retained also mentioned some room for improvement. Most of their comments concern the concept of the ATTRACT funding scheme.

A suggestion supported by several respondents is to improve the pool of external reviewers.

4.3.2 PROGRAMME OUTPUT

This section reports the results concerning the programme output of ATTRACT. First, the number of applications for ATTRACT since the launch of the funding scheme is shown. Second, we analyse female participation and the participation of the different Faculties of the University of Luxembourg in the programme.

Table D 4.31 shows the output of the ATTRACT funding programme since its launch in 2007. The number of ATTRACT applications (total, funded, and not retained) and the corresponding funding amounts awarded are presented.

D 4.31: Call output, ATTRACT 2007–2015

Call year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Applications (total)	6	9	4	3	3	5	4	8	6	48
Applications with funding	1	0	2	2	1	2	1	2	1	12
Applications without funding	5	9	2	1	2	3	3	6	5	36
Success rate	17%	0%	50%	67%	33%	40%	25%	25%	17%	25%
Funding amount (1000 €)	846	0	2,558	2,675	1,490	2,999	1,500	3,840	1,500	17,407

Source: Interface table based on FNR data.

Note: Applications without funding also include 'rejected preproposal' and 'invitation for interview'.

Forty-eight applications for ATTRACT funding were submitted to the FNR from 2007 to 2015. The overall success rate was 25%, ranging from 0% in 2008 to 67% in 2010. Except for peaks in 2008 and 2014, the number of applications has been stable over the years. In total, the FNR has invested 17.4 million euros in ATTRACT grants in the observed period.

Table D 4.32 shows some key figures for female ATTRACT applicants.

D 4.32: Female participants, ATTRACT

Call year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Applications of female candidates	1	2	0	0	1	2	0	1	3	10
Share of total number of applications	17%	22%	0%	0%	33%	40%	0%	13%	50%	21%
Applications of female candidates with funding	0	0	0	0	0	1	0	0	1	2
Female success rate	0%	0%	-	-	0%	50%	-	0%	33%	20%

Source: Interface table based on FNR data.

Of the total 48 applications to ATTRACT, 10 applications (21%) were submitted by women. Two of these applications (20%) resulted in funding. Compared to similar funding schemes abroad, ATTRACT has fluctuating female participation and success rates. Since the success rate was higher than 0% in only two years, it is difficult to compare. The average success rate of 20% is rather low (e.g. 34% average female success rate for the SNSF Ambizione programme, 28% for the SNSF professorships). The overall participation rate of 21% is rather low compared to similar funding schemes (e.g. for Ambizione, the target value of 35% female participation has been reached in five of six years since its launch in 2007). Also, it is far from the targeted rate of 40%, which has been set as of 2017. The usual explanations for low participation of women do not seem to apply for ATTRACT. The Luxembourg research environment is not a limiting factor, since the instrument targets excellent researchers *outside* the country. Also, Luxembourg's job market for research does not seem to be disadvantageous for women.

We analysed the dissemination of proposals and accepted proposals for the different faculties of the University of Luxembourg and the Public Research Centres. The number of applications for ATTRACT funding and success rates vary greatly between Faculties of the University of Luxemburg. The most applications were submitted from the Faculty of Language and Literature, Humanities, Arts and Education but with little success (2 of 11 applications resulted in funding). The Luxembourg Centre for Systems Biology and the Faculty of Science, Technology and Communication have also been quite active in applying for ATTRACT funding, in both cases – but particularly in the case of the Faculty of Science, Technology and Communication – with considerable success (the Physics and Materials Science Research Unit within the Faculty hosts 4 of the 12 former and current ATTRACT fellows).

4.3.3 IMPACT

This section reports the results on the impacts of ATTRACT. Since there is an external assessment based on final reports for only three of the ATTRACT fellows (and one of them only qualitative), we did not evaluate that assessment here. We summarize the results of the interviews with the 12 ATTRACT fellows concerning the impact of their ATTRACT funding and the results of our online surveys with former and current ATTRACT fellows and applicants for ATTRACT funding whose applications were not

retained. There, we distinguish between scientific impact and recognition, training impact, and socio-economic impact and dissemination.

Interview results

The ATTRACT fellows see a number of ways in which ATTRACT has had/has an impact on them and their scientific careers. Most importantly, the funding gave them scientific independence and made it possible for them to independently head their own research groups. The fellows point out that the flexibility of the grant is particularly conducive to this impact. For example, one fellow explains that due to the flexibility, he/she could invite people that he/she was interested in collaborating with without any difficulties. Some of the fellows also point out the long-term perspective with ATTRACT. One grantee summarizes the impact of ATTRACT as follows:

> "It is an enormously important vehicle for young aspiring scientists to get a foot on the ground. The investment is exactly what is needed to start a lab and start it at a level where you want it to start as somebody who wants to excel and do well. It is a very important tool".

The second most important effect that ATTRACT has according to the interviewees is that the grant changes the way one is perceived in the scientific community. The interviewees are of the opinion that the high standing that ATTRACT has in Luxembourg boosts the recognition and visibility of its fellows and their research groups, ultimately putting their host institutions and Luxembourg as a whole on the map. As one of the fellows interviewed puts it:

> "It enabled me to join a community I couldn't join before. I started my own career, got my own name".

The fellows clearly perceive this boost in visibility, for example because they receive a lot of unsolicited applications of high quality. One fellow illustrates this effect by saying that his/her colleagues were astonished when he/she announced that he/she was going to Luxembourg to work. But the group's reputation has since grown considerably, so that most of the good people in his/her field of research apply to his/her group first.

Some of the fellows also observe that they are invited to more conferences and invited to give more talks. The fellows see this as an effect of their ATTRACT funding. The impact regarding publication, patents, spin-offs, and industrial collaborations is not as clearly and unanimously identified by the interviewees. Some fellows see (indirect) positive effects on their publications. A number of fellows state that ATTRACT has had an impact on their success in obtaining further grants, not only from the FNR but also on the European level. The former ATTRACT grantee who recently won an ERC grant says that ATTRACT was conductive to obtaining this grant.

The applicants to ATTRACT whose applications were not retained for funding were asked what effect this has for them and their careers. The two persons interviewed do not think that the rejection has had a major influence on their careers. One interviewee mentions that everything is proceeding a bit slower because he/she did not get an AT-

TRACT grant. Also, teaching takes up a lot of time in his/her current position. The financial possibilities that he/she has now are also of a different calibre, and he/she has a shorter-term perspective compared to ATTRACT. However, he/she is happy with his/her current position. The other applicant interviewed who did not succeed in winning an ATTRACT grant does not think the rejection has had an impact on his/her career. He/she says that he/she was hired to Luxembourg on a specific mission and that ATTRACT was seen as an opportunity to accelerate the development. He/she was hired before applying to ATTRACT and says the hiring had nothing to do with the application.

Scientific impact and recognition

This section reports the evaluation results regarding scientific impact and recognition of ATTRACT. Table D 4.33 shows a comparison of the scientific output of the ATTRACT fellows participating in our online survey (n = 12) and the applicants for ATTRACT whose applications were not retained for funding. Survey respondents with ATTRACT funding were additionally asked to estimate the share of their output that was related to their ATTRACT grant.

D 4.33: Scientific output and recognition of ATTRACT applicants with (n = 12) and without ATTRACT funding (n = 27)

Output indicator	With ATTRACT (related to ATTRACT)	Without ATTRACT
Scientific output and recognition		
Number of published journal articles	39 (22)	16
Conferences contributions	35 (24)	20
Invited talks	20 (14)	15
New international project collaborations	9 (9)	9
National grants earned	6 (5)	5
International grants earned	3 (4)	5
Published policy reports	3 (2)	3
Scientific prizes won	2 (3)	7
Published books/monographs	2 (2)	5

Source: Interface, online surveys of ATTRACT applicants with and without ATTRACT funding.

Since the range of responses is very broad for most of the output indicators, we used medians instead of means[24] and took into account only answers of respondents who state that a certain output is relevant in their research discipline.

Again, for both groups of respondents the highest output is found for the scientific indicators. However, the order of the different indicators is not the same. The two most important scientific outputs are publications and conference contributions. Unlike all the other groups answering this question, the ATTRACT applicants whose applications were not retained for funding show the highest number of conference contributions. The output of the ATTRACT fellows is a lot higher than that of the

[24] The median is the value separating the higher half of a data sample from the lower half. The advantage of the median compared to the mean is that it is robust to outliers and thus may give a better idea of a 'typical' value.

applicants with applications for ATTRACT that were not retained for funding but only for the two most important scientific outputs. For most of the other outputs, the respondents without ATTRACT funding even show higher output than the ATTRACT grantees.

The number of conference contributions is comparable to the CORE and INTER grantees participating in our surveys. The number of published journal articles is clearly lower than the respective output of the responding CORE and INTER grantees and INTER applicants without funding but higher than of the responding CORE applicants without funding.

The ATTRACT fellows were asked about the same dimensions of scientific impact and recognition to estimate the effect of their ATTRACT funding. Table D 4.34 shows the results.

D 4.34: Assessment of scientific impact and recognition of ATTRACT funding (n = 12)

My ATTRACT grant …				
	Accurate	Inaccurate	Don't know	Not relevant
Scientific impact and recognition				
… increased the number of my conference contributions	11 (92%)	0 (0%)	1 (8%)	0 (0%)
… increased my visibility among national actors	11 (92%)	0 (0%)	0 (0%)	1 (8%)
… increased the number of my scientific publications	9 (75%)	0 (0%)	3 (25%)	0 (0%)
… improved the quality of my scientific publications	9 (75%)	3 (25%)	0 (0%)	0 (0%)
… improved the quality of my conference contributions	9 (75%)	1 (8%)	2 (17%)	0 (0%)
… enabled new international collaborations	8 (67%)	3 (25%)	1 (8%)	0 (0%)
… led to more invited talks	8 (67%)	3 (25%)	1 (8%)	0 (0%)
… facilitated follow-up research projects	8 (67%)	3 (25%)	1 (8%)	0 (0%)
… led to successful applications for further competitive funding	8 (67%)	2 (17%)	2 (17%)	0 (0%)
… led to scientific prizes	4 (33%)	6 (50%)	2 (17%)	0 (0%)

Source: Interface, online survey of ATTRACT fellows 2007–2014.

As with CORE and INTER, the most important impacts of ATTRACT are scientific impacts. Respondents stress in particular effects on the number of conference contributions and visibility among national actors. The impact of this funding scheme on national visibility seems to be a lot more important than with CORE or INTER. This is also the case for invitations to give talks and successful applications for further fund-

ing. These findings are in accordance with the results of our interviews with the ATTRACT fellows.

An important question regarding the impact of individual funding on young researchers is if the funding has a positive effect on the researchers' careers. Both the ATTRACT grantees and the applicants for ATTRACT whose applications were not approved for funding were asked about their position at the time of their application and their current position.

For the ATTRACT grantees, a distinction has to be made between grantees whose funding period has already ended and grantees whose funding period is still ongoing. Also, there are clear differences regarding career development between the 'old' and the 'new' fellows because of the recent introduction of the tenure track. For most of the new fellows, being awarded an ATTRACT grant has already meant a career step to associate professorships with tenure track or tenure. One fellow applied from outside of academia. Only one fellow was already in an assistant professor position, and it even had a tenure track. For the seven fellows who had ATTRACT funding before the introduction of the tenure track, ATTRACT did not necessarily lead to the same kind of career step, since their position during their ATTRACT funding period was not always clear. Most of these former fellows were also in non-tenured postdoc positions at the time that they applied for ATTRACT. Two fellows worked as scientific collaborators. One fellow had completed a habilitation (postdoctoral qualification) but was not yet working as a professor.

In the online survey, the applicants whose applications were not approved for funding provided information on their positions at the time of their application and their current positions. The survey results show that 9 of the 16 applicants participating in the survey have moved to a higher career level since applying for ATTRACT funding. Two respondents have even attained full professorships. Half of the group has permanent positions. For 5 applicants, their positions remain on the same level. However, 3 of them submitted their applications in recent calls. Only one respondent has dropped to a lower position. Only 3 of the 16 survey respondents are currently working in Luxembourg despite their unsuccessful application for ATTRACT. At least in one case, the person applied for ATTRACT funding after being hired to come to Luxembourg.

Comparing the group of applicants without ATTRACT funding to the ATTRACT fellows, it is remarkable that in the first group, the share of people already in professor positions at the time of the application is significantly higher than in the fellows' group. This difference is not explained by differences in age or career stage of the researchers in the two groups, since these are similar. An explanation might be that the applicant's position at the time applying is taken into account in the evaluation of the applications and that applicants already in professor positions are less likely to be selected for ATTRACT funding. ATTRACT clearly boosts career development, but we also observe career steps with the applicants without ATTRACT funding. This can mean that the ATTRACT fellows would have been able to 'make it' without ATTRACT or it can be an effect of the selection criteria.

Training impact

This section reports on the training impact of ATTRACT. Table D 4.35 shows the training output of the survey respondents with and without ATTRACT funding. Respondents with ATTRACT funding were additionally asked to estimate the share of their training output which was related to their ATTRACT grant.

D 4.35: Training output and recognition of ATTRACT applicants with (n = 12) and without ATTRACT funding (n = 27)

Output indicator	With ATTRACT (related to ATTRACT)	Without ATTRACT
Training output		
Doctoral students supervised	8 (7)	8
Doctoral theses completed	3 (4)	4

Source: Interface, online surveys of ATTRACT applicants with and without ATTRACT funding.

The survey respondents whose applications for ATTRACT funding were not retained for funding show a higher average training output than the ATTRACT fellows participating in our survey. In general, the training output is at a comparable level with CORE and INTER grantees.

Again, the ATTRACT fellows were asked to assess the impact of their grant regarding these indicators. Table D 4.36 shows the results.

D 4.36: Assessment of training impact of ATTRACT funding (n = 12)

My ATTRACT grant …				
	Accurate	Inaccurate	Don't know	Not relevant
Training impact				
… increased the number of completed doctorates in my group	8 (67%)	2 (17%)	2 (17%)	0 (0%)
… had a positive impact on the career(s) of the PhD candidates and/or the postdoc(s) in my group	6 (50%)	3 (25%)	3 (25%)	0 (0%)

Source: Interface, online survey of ATTRACT fellows 2007–2014.

Fifty to seventy per cent of the survey respondents identify training impacts of their ATTRACT grant. The assessment is very similar to that of the CORE funding scheme (see section 4.1.3 above). ATTRACT and CORE seem to have a positive impact on the career of PhD candidates and postdocs in a minority of the cases, whereas for INTER, almost 90% of the survey respondents confirm this effect (see section 4.2.3 above).

Regarding management of people, we know that all of the former and current ATTRACT fellows are currently heading research groups ranging in size from 2 to 15

members. The applicants whose applications were not retained manage between 2 and 40 people.

ATTRACT fellows and applicants whose applications were not approved for funding were asked about their activities in a number of academic services. Table D 4.37 shows the number and shares of survey respondents involved in the academic services included in the questionnaire.

D 4.37: Activities in academic services of ATTRACT applicants with (n = 12) and without ATTRACT funding (n = 27)

	With ATTRACT	Without ATTRACT
Reviewing activities (e.g. articles, proposals)	12 (100%)	16 (100%)
Organization of conferences	8 (67%)	12 (75%)
International selection committees (e.g. expert panels)	9 (75%)	11 (69%)
Editorial activities (e.g. journals, books)	8 (67%)	13 (81%)
Professional scientific associations	8 (67%)	11 (69%)

Source: Interface, online surveys of ATTRACT applicants with and without ATTRACT funding.

The most widespread activity in academic services are reviewing activities, in which all of the ATTRACT fellows and all of the survey respondents without ATTRACT funding are involved. The ATTRACT fellows are generally less active in academic services than the survey respondents without ATTRACT funding. This is particularly the case for editorial activities.

Twelve (75%) of the ATTRACT applicants who were not approved for funding and participated in the survey are involved in the management of a department or research unit. With the former and current ATTRACT fellows, this is the case for 5 of the 12 persons (46%). Nine (former) fellows (75%) are currently involved in the organization of a doctoral programme. Of the 16 applicants without ATTRACT funding who participated in the survey, 8 (50%) are involved in the organization of a doctoral programme.

Socio-economic impact and dissemination

Table D 4.38 shows a comparison of the socio-economic output and dissemination of the survey respondents with and without an ATTRACT grant. Respondents with ATTRACT funding additionally estimated the share of their transfer output related to their grant.

D 4.38: Socio-economic impact and dissemination of ATTRACT applicants with (n = 12) and without ATTRACT funding (n = 27)

Output indicator	With ATTRACT (related to ATTRACT)	Without ATTRACT
Socio-economic output and dissemination		
New national project collaborations	2 (1)	5
Collaborations with industry/partners realized	4 (3)	4
Patents filed	1 (1)	1
Spin-offs initiated	2 (1)	5

Source: Interface, online surveys of ATTRACT applicants with and without ATTRACT funding.

Among the survey respondents, the socio-economic output and dissemination of the ATTRACT fellows is considerably lower than that applicants who did not receive an ATTRACT grant. This is a surprising result that cannot be explained by differences in the two groups (such as year of application or research discipline). The socio-economic output and dissemination is also lower than the same output of the CORE and INTER grantees. This can possibly be explained by the restriction of the CORE and INTER analyses to the field of materials and physical sciences, where such outputs are more common.

Again, the ATTRACT fellows were asked to estimate the significance of their ATTRACT grant in terms of socio-economic impact and dissemination. Table D 4.39 shows the results.

D 4.39: Assessment of socio-economic impact and dissemination of ATTRACT funding (n = 12)

My ATTRACT grant …				
	Accurate	Inaccurate	Don't know	Not relevant
Socio-economic impact and dissemination				
… contributed to technology and knowledge transfer to my group	6 (50%)	2 (17%)	1 (8%)	3 (25%)
… helped my public outreach activities	6 (50%)	3 (25%)	2 (17%)	1 (8%)
… facilitated collaboration with industrial and/or other partners	5 (42%)	3 (25%)	4 (33%)	0 (0%)
… increased number of patents and/or patent applications	3 (25%)	2 (17%)	1 (8%)	6 (54%)
… enabled me to fund/contribute to the funding of spin-offs	0 (0%)	4 (33%)	2 (17%)	6 (50%)

Source: Interface, online survey of ATTRACT fellows 2007–2014.

The impacts in the category of socio-economic impacts and dissemination are again the impacts that are the least confirmed by the survey respondents: funding of spin-offs

(0%) and patents (25%). With spin-offs and patents, the share of survey respondents stating that these impacts are not relevant in their discipline is, as one would expect, very high (more than half of the group of the survey respondents). The effects in this category are observed by even fewer grantees than it is the case for CORE and INTER. This may be due to the fact that the analysis of ATTRACT was not restricted to a certain field of research where this kind of output and thus impact is more common.

Overall productivity

In the online surveys ATTRACT applicants (with and without ATTRACT funding) were asked how they rate their overall productivity given their career stage. Of the 12 respondents with ATTRACT funding, 5 rate their output as high and 5 as very high. Two respondents consider their output to be moderate. None of the respondents perceive their output as low or very low. Of the 16 respondents without ATTRACT funding, 3 perceive their output as very high, 9 think their output is high, and 4 consider their output moderate.

Assessment of deadweight effect

We asked the ATTRACT fellows if they would have been able to conduct their research project without the grant (e.g. by finding alternative funding, pursuing the project as part of traditional assistant positions, etc.). The interview results are ambiguous. Of the 12 ATTRACT fellows interviewed, 5 (47%) say they would not have been able to conduct their projects without this grant. Two fellows (17%) think it would have been possible with funding from other sources. The remaining 5 fellows (47%) assume that they would have had to downsize their projects without an ATTRACT grant or another grant of the same size. As one of them illustrates it:

> "I would definitely not have had the same possibilities. This grant is something special. […] There is nothing comparable in Germany or Switzerland".

The two interviewees whose applications for ATTRACT were not approved for funding by the FNR both say that they were able to pursue their envisaged projects but not to the same extent and not as quickly as planned.

In the online survey, ATTRACT candidates whose applications were not approved for funding were first asked if they were employed by their host institutions even though their applications were not approved for funding by the FNR. This was the case for 4 of the 16 respondents. They were then asked if they were still able to conduct their envisaged research project even without ATTRACT funding. Table D 4.40 shows their responses.

D 4.40: Consequences of the project not being approved for funding (n = 16)

Were you still able to conduct the research project for which you submitted the application? (n = 16)	Number (%)
Yes	4 (25%)
Yes, but to a smaller extent	5 (31%)
No	7 (44%)

Source: Interface, online survey of ATTRACT applicants whose applications were not retained.

About half of the group that participated in the online survey was not able to proceed with their envisaged project when their application for ATTRACT funding was not approved for funding; the other half could still conduct their project. Four respondents even state that they were able to conduct their projects to the same extent without ATTRACT funding. The 9 respondents saying they could still conduct their projects were asked how they secured funding. Of the 3 respondents answering this question, 2 started collaborations with private or industry partners, and 1 used a number of different grants from international and European funding partners as well as the University of Luxembourg to realize his/her project. One applicant tried to do as much as possible using bachelor's and master's students for gathering data.

The ATTRACT applicants not successful in obtaining an ATTRACT grant were asked in the online survey if they faced further consequences because their application for ATTRACT was not approved for funding by the FNR. Fourteen of the 16 survey respondents affirm this. Three of them state that due to not obtaining the grant, they did not go to Luxembourg. One respondent chose to investigate less controversial research questions. One person was discouraged and uncertain for a while whether to pursue a scientific career at all. One respondent says that having an ATTRACT application that is not approved for funding by the FNR comes with a certain stigma (if one is still going to work in Luxembourg). Another respondent says that it caused a significant rupture in his/her career development and that it took him/him three years to recover from this failure. One person states that it took him/her longer to get the professorship position that he/she has now. Only one respondent sees a positive effect, saying that his/her application not being approved for funding helped him/her grow professionally.

Institutional impact

The ATTRACT fellows illustrate the various benefits that they bring to their host units or institutions as follows:

- Many of the fellows say that they have been able to establish novel fields of research at their host institutions with the help of their ATTRACT funding.
- They also argue that their involvement in teaching is beneficial to their hosts.
- The contribution of the fellows in the host institutions' administrative work is mentioned as a further benefit of the fellows to the host institutions.
- A number of fellows state that they help promote their host institution but also Luxembourg as a site for research by going to conferences, giving talks, etc. abroad. They also say that they tell colleagues about ATTRACT and in that way increase awareness of this funding scheme in other countries.

One of the fellows summarizes his/her benefit as follows:

> "So the main benefit I think is having people that are recognized as experts internationally in the house. These people bring top level PhD candidates and postdocs from abroad; this creates a very high level scientific environment locally, which has an impact ultimately on the education that is going on in the department, and is creating a high level academic culture in the University".

The representatives of the host institutions interviewed add that the ATTRACT fellows help build the reputation of the host unit through their high-level publications. ATTRACT allows the host units to recruit the best candidates. One host argues that without the kind of starting package that ATTRACT offers, these best candidates would not come to Luxembourg, and without a long-term perspective, these researchers would not stay after their ATTRACT funding ends. For some units, the interview partners say, ATTRACT is also important for capacity building.

4.3.4 ATTAINMENT OF OVERARCHING OBJECTIVES

This section describes the results of the interviews on the attainment of some overarching objectives that the FNR has set for its ATTRACT funding scheme. The interviewees were asked whether they think that ATTRACT: (1) is suitable to generate knowledge transfer to Luxembourg, and (2) helps to boost the international influence and visibility of Luxembourg research. These overarching objectives were not discussed with the applicants whose applications were not approved for funding and not included in the respective online survey.

Knowledge transfer

With the exception of one fellow, all interviewees are of the opinion that ATTRACT is a suitable instrument to generate knowledge transfer to Luxembourg. They confirm that ATTRACT is indeed interesting enough to attract people that would otherwise not consider coming to Luxembourg. This is true for most of the fellows themselves, who would not be in Luxembourg if it were not for ATTRACT. But they also observed this when building up their research groups. Some of the interviewees also point out that the presence of the other ATTRACT fellows causes new and interesting possibilities for collaboration. However, according to the fellows interviewed, there are big question marks concerning how to retain this knowledge. A fellow who does not find ATTRACT to be a suitable instrument for knowledge transfer puts it this way:

> "You're building up a group and once the group leader leaves, the knowledge is gone".

It should be noted that so far, only 1 of 12 ATTRACT fellows has left Luxembourg. The other fellows are all in tenured or permanent positions and are planning to stay in Luxembourg for now.

International influence and visibility

A vast majority of the fellows interviewed agree that ATTRACT helps to boost Luxembourg's visibility and "put it on the map" of high quality research. The fellows think that this is mainly attained because with ATTRACT they are invited to more conferences and are invited to give more talks, through which their research, their institution, and Luxembourg research in general become visible. The same effect is achieved through international collaborations that the fellows are able to establish or through invitations to join consortia to apply for grants, partly also with the help of ATTRACT.

The increase in visibility according to the interview partners also goes back to the fact that ATTRACT is awarded to excellent researchers who would otherwise not come to

Luxembourg. As they are known internationally and contacted by their colleagues from outside Luxembourg, Luxembourg itself gains visibility. As one of the fellows puts it:

> "If well-performing researchers are hired to [come to] Luxembourg and this gets noted in publications and at conferences, Luxembourg appears on the map".

One fellow suggests strengthening this effect by organizing big conferences in Luxembourg.

Criticism is raised regarding the lack of sustainability of ATTRACT funding, which according to the interview partners puts the funding scheme's potential to achieve these overarching goals at risk. Two points are mentioned in this connection:

- Even though the problem has been partially solved by the introduction of a tenure track, some uncertainties regarding the long-term career perspective of the (former) ATTRACT fellows remain. According to some of the fellows, there is still no clear career development path. This is not due to the FNR; the problem lies mostly on the side of the institution. ATTRACT fellows hosted at the University of Luxembourg say that there is virtually no internal promotion scheme for any position there. The 'old' ATTRACT fellows say that they are happy that they were given the possibility to move to associate professorships (which, according to them, was also thanks to the efforts of the FNR) but that they now feel 'trapped' in this position. At the Public Research Centres, this is even more obvious, since they cannot award professorships and have to fall back on adjunct professorships from universities (outside Luxembourg). One of the fellows interviewed argues that the University of Luxembourg is not very interested in offering the (former) ATTRACT fellows at the Public Research Centres such positions.
- The level of research achieved with ATTRACT funding cannot be kept up after the funding period ends. Some of the fellows state that large-scale follow-up funding should be provided by the FNR so that the research capacities built under the ATTRACT funding scheme can be sustained and the research groups can continue their work. PEARL would be a suitable follow-up instrument, but former ATTRACT fellows are not eligible for PEARL because they are already working in Luxembourg. The only option for a former ATTRACT fellow to gain funding of a similar extent is to apply for an ERC grant or another large, consortium-driven (European) funding instrument. This is a criticism that not only concerns the concept of the funding scheme but also addresses a problem that can potentially threaten the impact at both the individual and superordinate levels. One of the fellows suggests that the FNR require that the long-term career plan that the institutions have to provide should include not only the fellow's own post but also corresponding research funds. Without research funds being secured after the ATTRACT period, the fellow says, there is the danger of high-level researchers leaving Luxembourg for better options abroad. One of the interview partners summarizes the current situation as follows:

  > "I think the FNR has done a fantastic job in attracting good people to Luxembourg. There is a significant pool of good scientists now in Luxembourg thanks to

the FNR's effort. Some of the people, however, will end their funding, and the question is what they will do next. There should be an instrument for these people".

In relation to this, the termination of the AFR funding scheme is criticized. One of the fellows says:

"With AFR postdocs in place I could have survived. But with that having disappeared, this is really a problem. It's very dangerous to have no funding schemes in this country for postdocs outside the priorities."

4.3.5 STRUCTURAL EFFECTS

ATTRACT clearly has developed structural effects since its launch in 2007. It has been used for capacity building by the host institutions. The Physics and Materials Science Research Unit at the University of Luxembourg has shown particular success in making use of the funding instrument in that sense. Four of the 10 professors within that unit are former or current ATTRACT fellows. One of the ATTRACT awardees of 2016 will be hosted by the Physics and Materials Science Research Unit. This success in building capacities is particularly noteworthy, since physics is not a priority area of the University. Further structural effects of ATTRACT can be observed at the Luxembourg Centre for Systems Biomedicine at the University of Luxembourg. There, 3 of the 15 PIs are former or current ATTRACT fellows. The director of the Luxembourg Centre for Systems Biomedicine has specifically used ATTRACT to build up excellence in the field.

4.4 PEARL

This section presents the evaluation results for the PEARL funding programme. For each objective, we present the results of the interviews with the eight PEARL fellows, two applicants whose applications for PEARL were not approved for founding by the FNR, two hosts of PEARL fellows, two members of the PEARL selection panel, and two members of a Scientific Advisory Board. In some cases, the results are complemented by an analysis of documents provided by the FNR. Please note that due to the large number of in-depth interviews conducted on the PEARL funding scheme, we were able to gather a lot of qualitative information about the concept and implementation of the funding scheme. The respective sections are therefore longer than with CORE and INTER.

4.4.1 CONCEPT AND IMPLEMENTATION

In the opinion of the interview partners, the PEARL funding programme is based on a sensible concept. The amount, the period of funding, and the built-in flexibility are seen as key elements to reach the stated objectives. First, given that the research environment in Luxembourg is still relatively young and in a developmental phase, the generous amount of funding is seen as compensation for the insecurities of deciding to move to Luxembourg. Considering the high position of the grantees in the international research community, representatives of the host institutions are of the opinion that they would not have been able to attract these individuals with a normal professorship

at the University. Second, the duration of five years is seen as adequate to be able to establish a research programme and to secure further funding. Third, the flexibility offered is seen as a clear strength of the scheme, giving the grantees the freedom to use the resources as they see fit. A member of one of the scientific advisory boards stated the following:

> "Luxembourg has a very challenging job. There was no University 15 years ago. With a goal to be an international leading player in particular chosen fields, you need very convincing financial arguments in order to make it work. […] Compared to foreign players, the amount of funding that has been allocated for the output is on the generous side. But on the other hand, we are working with a system that needs to establish itself. This always requires additional efforts".

Both the grantees and the candidates whose proposals were not retained for funding state similar reasons for deciding to apply. Their motivations largely coincide with the objectives of the PEARL programme and include aspects linked to Luxembourg in general and to the host institution in particular. Regarding Luxembourg, its geographical location and the possibility of both private and public funding were deemed attractive. Regarding host institutions, the international visibility of the host institution, the possibilities within the institution to bridge fundamental research with applied research and to collaborate with industry and to hold professorial positions at University of Luxembourg were seen as important elements when deciding to apply for funding through the PEARL programme.

Given that the programme offers a five-year grant, continued funding after the programme period is a central issue for the host institutions and the grantees. In this connection, the PEARL programme is to some extent viewed as a stepping stone for further funding. This can be seen in several of the existing research programmes, in which the grantees and their research groups have plans to apply for or have already been granted national funding through the CORE, PRIDE, and INTER programmes of the FNR as well as international funding through the European Research Council (ERC) and the EU.

Overall, the PEARL programme is given a positive assessment as a funding instrument. The programme is viewed as equivalent and competitive to other international funding programmes like the highly ranked ERC grants. However, the instrument is little known internationally, and the FNR thus relies on the host institutions to inform potential candidates about the funding opportunity. This seems to be working, as many of the grantees confirm that they were approached by and learned about the programme from representatives of the management at the host institution. The host institutions focus on proactive work, contacting international researchers of high calibre who fit the strategic profile of the institution and the country.

Adaptations to the PEARL concept

The experts, host, and grantees underline that the main objective of the PEARL funding programme is to attract the *right* people in chosen domains in order to build up research programmes and to secure in the long term sustainable and internationally visible research groups. In this context, several of the persons interviewed addressed a

shift in the funding scheme, from a focus on the scientific impact of the research programmes to a focus on the impact on the host institution and the Luxembourg research environment. The persons interviewed see it as paramount that the recruitment of PEARL grantees is in line with a clearly defined strategy. The shift towards the 'fit' of the application is seen as favourable in order to meet the main objective of long-term impact and sustainability.

In 2014, the PEARL budget was reduced from 5 million to 3 million euros, respectively 4 million euros for projects requiring substantial experimentation and instrumentation. One grantee views this reduction as disadvantageous, as it may lead to less qualified applications. It should be noted that the reduction is compensated by a higher financial contribution required from the host institution. The absolute funding amount has therefore not gone down. Furthermore, some of the PEARL fellows were able to obtain so much external funding that the FNR had to extend the PEARL funding period so that the funds could be used up.

Since the launch of the funding scheme in 2008, both the experts and the grantees interviewed identify a shift from fundamental to applied research in the Luxembourg research institutions. Some of the persons interviewed request a more conscious take on this shift on the national level, as illustrated in the following statement by a PEARL grantee:

> "I see it as a gradual transition from fundamental research towards application-driven research, and even to some extent one step further to consultancy-like activities. This flow of research, transitioning from fundamental work to making it work in companies, is not made explicit in the discussions at the national level. […] Some stakeholders are not willing to or not ready for that kind of discussion. If this was clearer, it would be easier to position the roles of the University and the institutes and to mix fundamental research with more applied research".

At the same time, the research institutions in Luxembourg are relatively young and therefore still in a developmental phase. Due to growing pains connected with these features, there has been a strengthened emphasis on the managerial skills of the grantees in the PEARL programme, where the chosen candidates should display both strong research and managerial skills. This is exemplified through the fact that many of the grantees hold strategic positions at their respective host institution and thus combine a research position with managerial responsibilities.

Application process

The PEARL programme foresees two evaluation stages for the review process following submission of a proposal:

- In the first stage, the proposal is reviewed according to a strategic merit assessment (SMA). In the assessment, the selection panel evaluates elements such as the appropriateness of the candidate in light of the objectives of the PEARL programme, the alignment of the proposal with the national research and development strategy and the strategy of the host institution, and the commitment of the host institution. Representatives of the host institution are invited to present the

proposal in front of the SMA panel. If accepted, the proposal goes on to the second stage.

- In the second stage, the proposal undergoes scientific evaluation by at least three international experts, who review the excellence of the researcher, the scientific quality and innovativeness of the proposal, and the expected impact. After the written reviews, an interview session with representatives of the host institutions, the candidate, the international experts, and the selection panel is held. Here, the proposal is presented, and questions and comments from the written expert panel reviews are addressed. Based on the two stages, a funding decision is made and communicated to the applicants.

The two-stage process is seen as favourable, as it allows for separate assessment of the scientific-technical elements and the fit, or alignment, of the proposal. The experts interviewed list the three elements as beneficial to the process. First, the fact that very few applications have not been retained after reaching the second stage illustrates the robustness of the process. Second, through the continuous engagement of the selection panel members, consistency in the use of the selection criteria is secured. Third, the use of external experts in the selection panel brings independent views into the process.

The interviewed candidates view the application process, both the initial reviews in the first stage and the hearings in the second stage, as professional and transparent. The high quality of the international experts responsible for the scientific reviews is appreciated. When compared, the statements from the candidates indicate that the application process has become more professionalized since the start of the PEARL programme in 2008.

Four points of criticism and issues are raised in the interviews:

- A first point concerns the rejection of applications. According to the FNR, the candidates receive a full panel report. However, candidates and host institutions whose applications were not retained feel that they were given insufficient information on the reasons for the rejection. They say that considering the candidate's and the host institution's investments in the application process, clear and comprehensive feedback from the FNR should be provided. Furthermore, in the views of the persons interviewed, the possibility to discuss the unsuccessful application with representatives of the FNR could have been beneficial.
- A second criticism is the communication of the national research strategy. The fit, or alignment, with the national strategy of Luxembourg is listed as a key criterion in the review of the proposals. To some persons involved, the elements of the national strategy are somewhat non-transparent. In future programme descriptions, one should secure clear communication of the national strategy in general and in relation to the PEARL programme.
- A third issue involves the possibility for host institutions to hand in a proposal where the candidate is still to be recruited. These proposals are evaluated on their strategic merit together with regular candidates in the first stage of the application process. If the proposal is retained, representatives of the FNR and the host insti-

tution form a joint recruitment panel, and the PEARL position is openly advertised. Although the fit of the candidate is a central element in the recruitment process, to some persons involved, it is unclear to what extent the FNR should allow for discrepancy between the proposal presented by the host institution and the chosen candidate.

- A fourth and last issue concerns gender equity. Some of the persons interviewed address the lack of female researchers in their research domains. Of the eight PEARL proposals accepted in the period 2009–2016, only one PEARL grant was given to a female researcher (as a joint project with a male researcher). In the 2017 call, the FNR addresses the gender gap in leading academic and research positions and requires that at least 30% of the candidates to be proposed by the research institutions in the years 2017 to 2021 are female researchers. One of the persons interviewed is of the opinion that gender equity should be targeted through incentives instead of constraints. For example, the FNR could consider giving female applicants in fields where women are underrepresented an extra grant.

Collaboration with host institution

Most of the eight PEARL grantees interviewed seem to experience positive collaboration with and sufficient support from their host institutions. The grantees are often highly involved in internal decision-making processes, and many hold management positions within the host institutions. They see these positions as giving them an ability to affect both policies and processes within the host institutions. Despite their privileged position, the grantees seldom experience jealousy within the institutions. One of the PEARL grantee views his role as follows:

> "From the start, I clearly had a different status than the other researchers. I had a PEARL, a large project, and the confirmation of quality that goes with that; I was also professor. This gave [me] a different status separate from the organization of structure. In terms of leadership, a lot of people were looking towards me. My impact has been more in terms of leadership than having a formal role. I also communicated this internally; I don't care too much about what's on my business card, I care about what we can get done. This allows me to avoid unnecessary political games in terms of organizational structure and to free the organization to some extent. You manage to establish informal networks within the organization that gives you informal power".

The grantees overall seem to be given sufficient support from the host institutions in the form of infrastructure and staff. To a large extent the grantees have been able to build up the needed infrastructure and recruit the needed personnel for their research programmes. In the recruitment processes, their reputation as leading researchers and the salary models and infrastructure made available through the funding seem to facilitate the processes. At the same time, some grantees have experienced difficulties when recruiting, partly due to Luxembourg's lack of international visibility and reputation in certain research domains. Within one of the research programmes, there have been challenges linked to institutional red tape hampering the allocation of infrastructure and personnel.

According to the PEARL programme description, the grantee should have the necessary freedom to use the budget in order to conduct research according to the set objectives. However, there are examples of attempts by the host institution to control the use of the PEARL funding. Another identified challenge is the contract between the FNR, the grantee, and the host institution. According to the programme description, the financial contribution to a PEARL research programme should be a joint undertaking by the FNR and the host institution. In one of the research programmes, the contribution of the host institution was not sufficiently regulated in the contract. As a consequence, the research programme has less funding at disposal than planned.

According to persons interviewed, synergies between the research institutions of Luxembourg are a central aspect in the national research strategy. A development in the collaboration between the research entities in Luxembourg can be identified, as grantees give examples of past difficulties in the collaboration with research units and the University, whereas current collaboration is largely positively assessed. Although collaboration has improved, some grantees still see the need for more cross-collaboration, mainly between the University Faculties and the interdisciplinary centres. For many of the grantees interviewed, integration into the University of Luxembourg stands out as a central aspect, both for PEARL grantees in the research units and interdisciplinary centres of the University and in other research institutions. Teaching activities, involvement in doctoral schools, or professorial faculty positions could enhance the collaboration in the research environment and lay the foundation for further employment after the funding period.

4.4.2 PROGRAMME OUTPUT

This section reports on the programme output of PEARL. First, the number of applications for PEARL since the launch of the funding scheme is shown. Second, we analyse female participation and the participation of the different Faculties of the University of Luxembourg in the programme.

Table D 4.41 gives an overview of the number of PEARL proposals (total, funded, and not retained) and the corresponding funding amounts awarded since the first PEARL call in 2009.

D 4.41: Call output, PEARL 2009–2015

Call year	2009	2010	2011	2012	2013	2014	2015	Total
Applications (total)	2	1	2	2	1	2	3	13
Funded applications	2	1	1	1	1	1	0	7
Applications without funding	0	0	1	1	0	1	3	6
Success rate	100%	100%	50%	50%	100%	50%	0%	54%
Funding amount (1000 €)	8,370	4,600	1,890	5,000	5,000	4,975	0	29,835

Source: Interface table based on FNR data.

Thirteen applications for PEARL funding were submitted to the FNR from 2009 to 2015. The overall success rate was 54%, ranging from 0% in 2015 to 100% in 2009, 2010, and 2013. This high success rate is not caused by a feeble selection procedure

but by the rigorous preselection of candidates by the host institutions. The number of applications has been stable over the years at between one and three applications. In total, the FNR has invested almost 30 million euros in PEARL grants in the observed period.

Table D 4.42 shows some key figures for female PEARL applicants.

D 4.42: Female participants, PEARL

Call year	2009	2010	2011	2012	2013	2014	2015	Total
Applications of female candidates	0	0	1*	1	0	0	0	2
Share of total number of applications	0%	0%	50%	50%	0%	0%	0%	15%
Applications of female candidates with funding	0	0	1*	0	0	0	0	1*
Female success rate	-	-	100%	0%	-	-	-	50%

Source: Interface table based on FNR data.

Note: *Joint proposal by a female and a male candidate.

Of the 13 applications for PEARL, 2 applications (15%) were submitted by women. One[25] of these applications (50%) resulted in funding. Compared with the SNSF Ambizione funding scheme and SNSF professorships but also with ERC grants, PEARL has a low female participation rate. The female success rate is difficult to evaluate, since there have been no applications by women for most years. The overall success rate of 50% is of course very high. For the 2017 call, a requirement for gender equity in proposal submissions will be introduced.

The distribution of applications and grants between the different faculties and the Public Research Centres is more even with PEARL than with ATTRACT. However, neither the Faculty of Science, Technology and Communication nor the Faculty of Law, Economics and Finance has been successful in obtaining a PEARL grant so far (up to 2015). The former CRPs Henri Tudor and Gabriel Lippmann (today: LIST) and the Interdisciplinary Centre for Security, Reliability and Trust at the University of Luxembourg have been the most successful in obtaining PEARL grants in the observed time period.

4.4.3 IMPACT

This section reports on the impact of PEARL. We first show the external Scientific Advisory Board (SAB) assessment of the eight PEARL projects (for the ongoing projects, we analysed the latest SAB reports). We then summarize the results of the interviews with the PEARL fellows on the impact (scientific impact and recognition, training impact, and socio-economic impact and dissemination) of PEARL funding. No online survey was conducted for the PEARL programme.

25 It resulted in a shared PEARL chair with a male researcher.

External assessment

Each research programme within the PEARL funding scheme is accompanied by a Scientific Advisory Board (SAB) that helps steer the programme and on a yearly basis reports on the progress of the programme to the FNR. Following annual site visits and meetings, the members of the boards deliver report on the development and results of the individual research programmes. In the following, the newest reports from eight research programmes awarded funding in the calls from 2009–2014 are summarized. For one research programme, the final report is available.

Overall, the eight research programmes are given very positive assessments by the SABs. The experts note impressive progress, with successful recruitments of highly skilled researchers and the development of state-of-the-art facilities, including internationally high-level standard laboratories. Many of the research programmes have also been successful in acquiring external funding. The research programmes demonstrate high impact and innovative publications, models, and methods with clear impact on industry and society. Some of the research programmes have outstanding performance in research, publications, and collaborations and enjoy a leading role in the international research environment. The programmes have not only secured increased international recognition for the research groups and host institutions, but also increased the reputation of Luxembourg in general. The work of the PEARL grantees is assessed as impressive, both on a scientific and a managerial level.

Despite these very positive assessments, the SABs identify challenges and issues that may hamper the progress and success of the research programmes. One issue addressed in several research programmes is the level of support from the host institutions. According to some SABs, the host institutions do not use the individual PEARL programmes to their full potential. Examples thereof are a lack of financial support to secure the sustainability of the groups after the five-year funding period and the creation of barriers to external collaboration. In other host institutions, a lack of academic culture and multiple changes in strategic orientation create challenges for the PEARL grantees. A second issue is linked to organizational elements in the host institutions, such as unclear career management systems and a lack of tenure track system, which hinders recruitment of top researchers and development of a critical mass. Further, the lack of supervision rights for some PEARL grantees and their researchers hampers the training of PhD candidates. A third issue addressed in some research programmes is an overly broad research focus and agenda, which may pose a challenge in terms of ensuring coherence and output of high impact.

A recurrent recommendation from the SABs is to secure the sustainability of the research programmes beyond the period of funding through the PEARL scheme. Among other things, this entails securing financial support from the host institution and external sources, increasing the number of PhD candidates and postdoctoral researchers, and creating permanent positions for key researchers, thus laying the foundation for a critical mass. A second, often mentioned recommendation is to increase interaction with industry and collaborations, especially on a local level. Third, several of the research programmes are recommended to generate intellectual property (IP), including patents and spin-offs. In this context, the SABs recommend securing support from the technology transfer officers. The host institutions play a central role in all of these

recommendations, as they greatly affect the conditions of the research programmes. As such, the host institutions are encouraged by the SABs to ensure adequate support, both during and after the funding period.

Scientific impact and recognition

The PEARL programme has (had) significant impact on the research and careers of the grantees. The funding scheme plays a particularly important role in boosting scientific output and recognition:

- First, the grantees are of the opinion that the amount and duration of the funding has made it possible for them to engage in and concentrate on long-term research and develop large-scale and large-range tools and methodologies. Since there are few to no teaching obligations, the funding scheme is especially effective in this sense.
- Second, the programme has had an impact on the visibility of the grantees in the international research community, predominantly due to the development of leading research groups and new domains but also through dissemination activity.

Training impact

Most of the grantees have few to no teaching obligations regulated in their contracts during the funding period. In the research programmes, more emphasis is placed on the scientific and institutional impact than on the training impact. The experts underline that the training burden should not have a negative impact on the grantees' research. However, teaching and counselling are seen as both a recruitment strategy and a collaboration potential with the University. There is a clear awareness among the experts and the grantees that for PhD candidates, exposure to an international competitive research group may have an influence on the formation of younger researchers of high quality and may as such secure a critical mass in the respective domain. Several of the grantees plan to teach at the University of Luxembourg either during or after the funding period. However, it is not seen as necessary to regulate teaching obligations in all contracts within the PEARL programme: Instead, it should be internally discussed between the grantee and the host institution.

Socio-economic impact

Although an assessment of the socio-economic impact of the PEARL programme may be premature, as to date, only two grantees have completed their individual programmes, the indications are positive. Most grantees have been able to initiate collaborations and knowledge transfer with industry and other national partners, and patents and prototypes are being developed. Especially some host institutions seem to have built up extensive collaborations with industry partners. A further *future* socio-economic impact is identified in the training of young researchers who may offer significant contributions to national and international industry. One of the experts notes that the PEARL programme can be used to demonstrate the value of research to the broader public:

> "We try to keep the candidates connected to general public. We have to keep in mind that the money comes from taxpayers and that there's no strong tradition of

> research in Luxembourg. It very recently changed into a banking and service community. We have to bring people to understand that research is not spending money because we have a lot of money but is an investment for the future. These PEARL candidates are the examples people are looking at. Publications cannot be enough, as they are for a selective community. The research has to be translated and explained".

At the same time, persons within the PEARL programme warn against overly ambitious objectives concerning socio-economic impact. First, it is underlined that one cannot expect the same impact elements from all research programmes, as the objectives and the dissemination plans vary. Second, the impact on society, the economy, and industry seems to be dependent on the support offered by the host institution. In one of the research programmes, the host institution did not welcome external collaboration, which hampered the potential socio-economic impact of the programme concerned.

Assessment of deadweight effect

We asked the PEARL grantees whether they would have been able to conduct their research project without the funding from the FNR (e.g. through alternative funding, pursuing the project as part of traditional assistant positions, etc.). Most of the grantees are of the clear opinion that they would not have been able to focus on a project of this size and extent without the PEARL grant. One of the grantees stresses that he would not have been able to combine a managerial and a research role in a normal position. Others are of the opinion that it would have been difficult to build up the same amount of collaboration with industry and public partners.

Institutional impact

The institutional impact of the PEARL funding programme is assessed as substantial. Especially some of the individual PEARL programmes have led to outputs and impact far beyond the expectations of the host institutions. The experts, the representatives of the host institutions, and the PEARL grantees identify different ways in which the institutions benefit from the individual PEARL programmes: A first identified element is the development of research fields and domains through recruitment of highly qualified researchers and increased international visibility through dissemination activities. Through the funding programme, the institutions are able to quickly ramp up research groups and activities. A second impact is seen within funding, as some grantees have been able to acquire a substantial amount of external competitive funding, nationally as well as internationally. A third element is found in collaboration. Through their contacts with national and international industry, research institutes, and public institutions, the PEARL grantees have strengthened the host institutions' collaborations with external partners. To some extent, they have also reinforced the collaboration with or within the University of Luxembourg.

Much of the impact of the PEARL funding programme may be viewed as 'soft' impact, for example bringing together disciplines, improving the management of an institution, or connecting the host institution with other research and industry actors. Here, the flexibility within the PEARL programme is seen as valuable in order to be able to adapt the research programmes to the needs of the host institution. This impact is dif-

ficult to measure, however, and may often only become visible through evaluation of the entire host institution.

A central 'soft' impact seems to be found at the managerial and cultural level. Many of the PEARL grantees hold management positions as directors and heads of departments or centres at their host institutions. The PEARL grantees have contributed to professionalization at the leadership level and to further development of the host institutions into professional research and technology organizations. In this context, the experts and PEARL grantees identify an institutional maturation process, where the grantees have been able to create awareness and develop a scientific research mentality within the institutions. Some see the managerial and cultural impact as an unintended side-effect of the PEARL funding programme, as this was to a lesser extent a focus in the earlier years of the programme. One of the grantees explains the cultural influence in the following way:

> "The PEARL programmes at the University have strong impact in terms of consciousness of what scientific competition is in this country. It changes at large the normal way of doing things at the University; it changes to an extent the culture of what scientific life is".

Although clear institutional impact can be identified, there are critical voices concerning the sustainability of the impact. The developed research fundaments are seen as insecure, as they depend on relatively small groups of people. The large number of temporary contracts at the University of Luxembourg seems to reinforce the insecurity. The long-term institutional impact thus depends on the commitment of the PEARL grantees and the formation of sustainable research groups. Furthermore, some fear that the PEARL grantees may be overburdened by demands at both the managerial and research level and that the host institutions may become too dependent on one person, as exemplified by the following statement from a member of an SAB:

> "If you overburden a manager with too many tasks, there are risks of all kinds. Also as a system, you become too dependent on the individual input on how the system should work. We need lighthouses in order to establish good visibility for Luxembourg. On the other hand, you also need a living ecosystem long term".

An important connected question for both experts and grantees is the extent to which the grantees should be followed up throughout the funding period – by both the FNR and the host institution. Through the SABs implemented by the FNR, the individual programmes are assessed on a yearly basis on the use of the funding and the execution of the proposal. The grantees are to a great extent satisfied with the support offered by the SAB and view the members as colleagues and mentors with whom they may discuss challenges. Concerning the follow-up from the host institution, there is a tendency that the grantees at the University of Luxembourg feel more supported by the centre or research unit than by the central offices of the University.

Of the eight PEARL grantees interviewed, most are planning to stay in Luxembourg after the funding period. For some, this entails keeping the managerial position, while others plan a continuation of the research programme through further funding. Others

view the option of staying in Luxembourg as conditional. As leading researchers in their domains, the grantees are contacted by other research and educational institutions on a regular basis with offers of positions. As such, the conditions offered after the funding period may play a central role in the long-term commitment of the grantees. One grantee would only choose to stay if the research group is able to secure the critical mass and the sustainability needed. Another grantee views it as important that the University of Luxembourg develop an understanding of itself as a top-level university.

The host institutions generally seem to have a clear strategy that is linked to further funding of the grantee's position, mainly through further external funding of the research groups. Despite this, the host institutions as well as the grantees are conscious of the potential risks if a research group does not secure further funding, as this will have consequences for the sustainability of the groups and thereby for the impact (see also section 4.4.4 below).

4.4.4 ATTAINMENT OF OVERARCHING OBJECTIVES

This section focuses on the attainment of the overarching objectives that the FNR has set for its PEARL funding scheme. These elements were not discussed with the candidates whose applications were not approved for funding.

There is a clear agreement among most of the experts, the representatives of host institutions, and the grantees that the research programmes funded by PEARL have distinct impact on the international influence and visibility of Luxembourg. Through the generous framework of the funding programme, paired with Luxembourg's high standard of living, international environment, and highly-developed infrastructure, it has been possible to attract leading researchers to the country. The choice to focus on specific domains has been favourable, as it has provided the opportunity to concentrate on strategic research areas and strengthen the reputation of Luxembourg within a selection of domains instead of pursuing the development of a generalist research environment. This, in turn, has made Luxembourg more attractive to foreign staff and PhD candidates and has increased the credibility of the institutions. That being said, some of the grantees interviewed see continued potential in the positioning of Luxembourg internationally, as it is still not the first choice for many PhD candidates or postdoctoral researchers. According to one grantee, this would require an integrated and coordinated public relations effort between the Luxembourg research institutions and the University.

Despite the multiple impact areas identified, the persons interviewed stress that although the PEARL programme lays the foundation for impact, the actual results are dependent on other factors. One of the grantees notes:

> "PEARL is a necessary condition to bring people of a certain calibre to Luxembourg. But it is not a sufficient condition for the PEARL grantee to have an impact. It all depends on what the PEARL recipient does once he is there".

According to the experts, the host institution representatives, and the grantees, the potential to generate long-term impact, as stated in the programme description, is dependent on a number of factors:

- First, to secure institutional and socio-economic impact, it is not sufficient to bring outstanding researchers to Luxembourg. It is seen as important that the PEARL funding programme continue to differentiate itself from a normal hiring process at a university or research institution. In this context, the grantees should be outstanding managers as well as outstanding researchers and should more strategically be employed in leadership positions. The research programmes within the funding scheme should focus on creating capacity and should entail clear objectives regarding impact. Here, one of the representatives of a host institution suggests implementing a stronger focus on key performance indicators in the research programmes. Further, the contribution within the institutional setting and to the Luxembourg research environment should be a central basis when assessing the 'fit' of the candidate. However, the objectives of the PEARL programme should be flexible and should allow for a continuous assessment of the concept and priorities of the PEARL programme, so as to meet the changing needs of the research institutions in Luxembourg.
- Second, to secure a critical mass, one needs to secure a research base of younger researchers who will evolve into leading scientists. To secure this base of younger researchers, the PEARL programme should be utilized in combination with the ATTRACT programme. This would entail programme-overarching strategic use of the different funding programmes of the FNR. As examples from the research programmes illustrate, combined use of the different funding schemes already exists.
- Third, to secure long-term commitment and as such long-term impact for Luxembourg, there should be a focus on the embedment and integration of the grantees in the host institutions specifically and the Luxembourg research environment as a whole. During the funding period, the grantee should be able to operate independently and should be offered a framework for scientific work through the needed infrastructure and recruitment as well as through a professional research culture. After the funding period, a goal should be to keep the grantee in Luxembourg. Some grantees state that there should be a contractual element stating the clear dual financial commitment of the FNR and the host institution, both during and after the funding period. In this context, one grantee underlines that host institutions within the University may have more possibilities to hire the grantee after the funding period than the Public Research Centres. Dual positions at a Public Research Centre and at the University of Luxembourg during the funding period may therefore be favourable for the integration of the grantee, both during the research programme and afterwards.
- Fourth and last, a number of the persons interviewed stress the need for a change in the mindset in Luxembourg, from the identity of a start-up to a top-level place for research, as illustrated by the following statement from a PEARL grantee:

> "The PEARL programme puts top level people in the University and creates excellent capacity within the University. It is only going to work if the University evolves in the necessary way in order to take advantage of that [...] It's all about migrating from a very voluntarist effort "let's make this work" that happened over the last twelve years to a serious, energetic and ambitious attempt of being a top-level international University [...]".

4.4.5 STRUCTURAL EFFECTS

As for ATTRACT, structural effects can also be identified for the PEARL programme. PEARL is a very important instrument in building up areas of excellence. The effects are particularly evident at the two interdisciplinary centres of the University of Luxembourg, the Centre for Security, Reliability and Trust and the Luxembourg Centre for Systems Biomedicine. The Centre for Security, Reliability and Trust currently hosts two PEARL fellows. One PEARL fellow is hosted by the Luxembourg Centre for Systems Biomedicine.

5 BENCHMARKING

This section presents the findings of a national and international benchmarking of the four FNR programmes under evaluation. For the national benchmarking of CORE, INTER, and ATTRACT, we used our online surveys and compared applicants with and without funding. The results of these analyses can be found in the respective sections on the impact of the three programmes (see sections 4.1.3, 4.2.3, and 4.3.3 above). For PEARL, no national benchmarking was conducted due to the lack of available data at the PI level.

The results of the international benchmarking for CORE, ATTRACT, and PEARL are presented in the following. For INTER, no international benchmarking was conducted.

- For CORE MS, we used data from an online survey conducted by order of the SNSF: The survey was conducted with 372 recipients of SNSF project funding from 2008 to 2013 in the course of the evaluation of the SNSF Ambizione funding scheme. We compared the results of this online survey to the results of our online survey of CORE MS applicants.
- For ATTRACT and PEARL, the international benchmarking is based on analysis of various documents and online sources. ATTRACT was compared to the SNSF Ambizione programme, the FWF START programme, the DFG Emmy Noether programme, and the ERC Starting Grants based on a number of documents and recently conducted evaluations of these programmes. In addition, results of online surveys of Ambizione grantees[26] and SNSF professors[27] were compared to the results of our online survey of the ATTRACT fellows. We further used a comparison between similar cases of ATTRACT fellows and applicants not approved for funding as part of the international benchmarking for ATTRACT. This is reasonable, because most of the ATTRACT applicants were not in Luxembourg at the time of their application and did not come to Luxembourg after their application was not approved for funding. PEARL was compared to the SNSF professorship programme, the FWF Wittgenstein Preis, the DFG Alexander von Humboldt professorship, and the ERC Advanced Grants.

5.1 INTERNATIONAL BENCHMARKING OF CORE

For the benchmarking of CORE, data was available to us from an online survey of grantees of project funding from the SNSF that allows us to benchmark the programme regarding a number of impacts. We compare the results of the two online surveys in the following.

[26] This survey was part of the evaluation of the SNSF Ambizione programme conducted by Interface in 2013/2014. The report can be found online at: http://www.snf.ch/SiteCollectionDocuments/Web-News/ambizione_evaluationsbericht_e.pdf

[27] This survey was part of an evaluation of the SNSF professorship programme conducted by Interface in 2015. The report can be found online at: http://www.snf.ch/SiteCollectionDocuments/Web-News/news_280515_bericht_snf_foerderungsprofessuren.pdf

In both surveys, the participants assessed the effect of their funding on the number and quality of their scientific publications. Table D 5.1 shows the results.

D 5.1: Effect of CORE MS funding/SNSF project funding on scientific publications

My grant …	FNR CORE MS	SNSF project funding
… increased the number of my scientific publications	77%	80%
… improved the quality of my scientific publications	62%	73%

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015; Interface, online survey of researchers with SNSF project funding 2008–2013.

The table shows that for both number and quality of scientific publications, a larger share of the survey participants with SNSF project funding identified an impact than was the case with the CORE grantees.

In both surveys, the respondents were asked how the funding contributed to their scientific independence. With CORE, 89% of the respondents find that the contribution of CORE is 'relevant' (39%) or even 'very relevant' (50%) for their scientific independence. With SNSF project funding, 73% thought that the contribution of the funding to their scientific independence was large, and 15% identified the contribution as small. If we assume that 'relevant' and 'small contribution' (as opposed to no contribution) mean the same thing, the assessment of the two groups is very similar.

Table D 5.2 shows the groups' assessments of the impact of the funding on their further career.

D 5.2: Effect of funding on further career

	FNR CORE MS	SNSF project funding
Did/does the funding have a substantial influence on your further career? (% answering 'yes')	78%	81%

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015; Interface, online survey of researchers with SNSF project funding 2008–2013.

The table shows that again, the survey respondents with CORE MS funding and the survey respondents with SNSF project funding reported similar assessments of the effect of the funding on their further career.

The deadweight loss was also analysed for both funding schemes. We asked the survey respondents with CORE or SNSF project funding if they would have been able to conduct their project without the funding. Table D 5.3 shows their responses.

D 5.3: Assumed realization of project without CORE MS/SNSF project funding

	FNR CORE MS	SNSF project funding
Could your research project(s) have been carried out without the grant? (% answering 'yes'	19	25

Source: Interface, online survey of CORE applicants in materials and physical sciences 2010–2015; Interface, online survey of researchers with SNSF project funding 2008–2013.

One fifth of the CORE MS grantees and one fourth of the beneficiaries of SNSF project funding think that they would have been able to realize their projects without the funding. CORE MS shows a slightly smaller assumed deadweight loss than SNSF project funding.

5.2 INTERNATIONAL BENCHMARKING OF ATTRACT

The benchmarking for ATTRACT was conducted regarding the funding scheme's concept and implementation and also the funding schemes' impacts.

Table D 5.4 first shows a comparison of a selection of key figures for ATTRACT and the comparison programmes.

D 5.4: Key figures, ATTRACT and comparison programmes

	ATTRACT	Ambizione	Emmy Noether Programme	START	Starting Grants
Country	Luxembourg	Switzerland	Germany	Austria	EU
Funding agency	FNR	SNSF	DFG	FWF	ERC
Year of launch	2007	2007	1999	1996	2007
Amount of grant (MEUR)	1.5-2	max. 0.73	-*	0.8-1.2	max. 1.5
Duration of grant (years)	5	4	5	6	max. 5

Source: FNR, SNSF, DFG, FWF, ERC.[28]

Note: *No upper limit, but the salary requirements following the *Tarifvertrag im Öffentlichen Dienst* (TV-L 15) apply.

The table shows that the funding amount is the highest for the ATTRACT scheme, especially when taking the Consolidator Investigator into account. It might be that the

[28] FNR: ATTRACT Programme Description, available at: http://storage.fnr.lu/index.php/s/mKQyJtjcn265jKc/download
SNSF: Regulations on Ambizione grants (Ambizione Regulations) 2016, available at: http://www.snf.ch/SiteCollectionDocuments/ambizione_reglement_e.pdf
DFG: Emmy Noether Programme Guidelines 2016, available at: http://www.dfg.de/formulare/50_02/50_02_en.pdf
FWF: Short description of the START programme online at: https://www.fwf.ac.at/en/research-funding/fwf-programmes/start-programme/
ERC: Short description of the ERC starting grants online at: https://erc.europa.eu/funding-and-grants/funding-schemes/starting-grants

eligible costs in the different countries vary substantially. The duration of the scheme is in line with international standards.

5.2.1 CONCEPT AND IMPLEMENTATION

This section presents the benchmarking results for a number of aspects concerning the concept and implementation of ATTRACT and the comparison programmes.

Target groups

The target groups of the five funding schemes analysed are similar: They address young postdocs willing to conduct their own research project and to lead a research group at a host institution. What is special with ATTRACT and Ambizione is that the funding schemes target researchers not established in Luxembourg or Switzerland, respectively. For ATTRACT, the requirements in this regard have been relaxed somewhat: Applicants are allowed to have been employed in Luxembourg for up to one year prior to their application.

Participation requirements

The requirements concerning previous education of the applicants are again similar for the five funding schemes. ATTRACT, the FWF START programme, and ERC Starting Grants target postdocs with two to eight (seven for the ERC grants) years of postdoctoral research experience. For Ambizione and the Emmy Noether programme, it is up to four years. These two programmes additionally require international research experience. The funding instruments differ in further participation requirements. As stated above, applicants for ATTRACT and Ambizione are required to be outside the respective countries when they apply. The SNSF additionally appreciates national mobility (if a grantee has worked in Switzerland before applying to Ambizione, the Ambizione project should be conducted at a different institution in Switzerland). Of course, that kind of requirement would not make sense in Luxembourg. The DFG also demands international experience and national mobility: With the Emmy Noether programme, foreign grantees must commit to staying in Germany after their grant period ends. The FWF requires applicants to have already acquired competitive third-party funds independently after their doctorate so that they are eligible for START funding.

With funding schemes like ATTRACT, it is usually possible to apply twice if the first application is not approved for funding. For example, the SNSF funding schemes Ambizione and SNSF professorships and the DFG Emmy Noether programme allow one resubmission of the proposal. The FWF START programme is even open for more than two submissions of a proposal, but applicants are blocked for 12 months after the third unsuccessful submission of a proposal. With the ERC Starting Grants, resubmission is also possible. If an applicant gets to a certain stage with his/her first application, he/she can apply again in the subsequent call. Otherwise, the applicant has to wait for one or two years, respectively. With ATTRACT, only one submission of a proposal is possible at the moment.

Unique characteristics of the funding schemes' concepts

Each of the programmes analysed has its own unique characteristics:

- ATTRACT clearly sets itself apart from the other funding schemes by offering a tenure track option. Further special assets are the individual coaching and the relocation assistance. Also, ATTRACT grantees are allowed to allocate the funds quite flexibly.
- Ambizione is an important instrument to win back researchers from Switzerland who are currently working abroad. Also, the selection process strongly values individual assessment, for example concerning limited international mobility due to family reasons.
- With the Emmy Noether programme, there is first of all no limitation of the number of research groups. The programme works on an open call with continuous acceptance of applications. Like Ambizione, the programme is used to win back German researchers who are working abroad. There is an interim appraisal after three years, deciding if the funding period will be extended by another two years.
- A unique characteristic in the concept of the FWF START programme is that since the introduction of the ERC Starting Grant, START applicants are obliged to apply for an ERC grant in parallel. If both the START and the ERC grant applications are successful, the project is funded by the ERC grant.
- For the ERC Starting Grant, its reputation seems to be the characteristic that sets it apart from the other funding schemes analysed. In contrast to the other four instruments, which are all on a national level and are hardly known outside of the respective countries, the ERC grants are well known and considered to be prestigious funding opportunities.

5.2.2 PROGRAMME OUTPUT

Table D 5.5 shows the programme output of ATTRACT and the comparison programmes.

D 5.5: Call output, ATTRACT and comparison programmes

	ATTRACT	Ambizione	Emmy Noether Programme	START	ERC Starting
Number of grants awarded	12 (07–15)	435 (08–15)	63 (2015)	52 (09–15)	349 (2015)
Total amount awarded (MEUR)	17.4 (07–15)	32.2 (2015)	80.6 (2015)	39.9 (09–15)	430 (2015)
Average success rate (%)	25 (07–15)	25 (08–16)	~20	11 (09–15)	10 (07–16)
Female participation (%)	21 (07–15)	37 (08–16)	29 (11–14)	24 (09–15)	30* (2014)
Female success rate (%)	20 (07–15)	23 (08–16)	?	14 (09–15)	11 (2014)

Source: FNR, SNSF, DFG, FWF, ERC.[29]

Note: *For Starting Grants *and* Consolidating Consolidator Grants.

The table shows that the total number of awarded ATTRACT grants and, accordingly, also the total amount awarded are much lower than for the other funding instruments. Of course, these absolute numbers reflect the size of the countries of the different funding agencies. Taking the size of the countries and scientific communities into account, the FNR actually invests impressive amounts in its ATTRACT funding scheme. The success rate of ATTRACT is quite high. On the other hand, female participation has been comparably low. Compared to the other funding programmes, female applicants show considerable success in winning ATTRACT grants.

5.2.3 IMPACT

Findings on the impact of ATTRACT and the comparison programmes are presented in the following. First, we show the results of a comparison of similar cases of ATTRACT fellows and ATTRACT applicants not selected for funding. We then present a

[29] FNR grant database.
SNSF Statistics 2015, accessible online at: http://www.snf.ch/SiteCollectionDocuments/statistiken_vollversion_en.pdf
Ambizione summary of grants 2008-2016, accessible online at:
http://www.snf.ch/SiteCollectionDocuments/ambizione_zusammenfassung_zusprachen_e.pdf
Jahresbericht der Deutschen Forschungsgemeinschaft 2015, accessible online at:
http://www.dfg.de/download/pdf/dfg_im_profil/geschaeftsstelle/publikationen/dfg_jb2015.pdf
DFG Chancengleichheits-Monitoring 2014, accessible online at:
http://www.dfg.de/download/pdf/foerderung/grundlagen_dfg_foerderung/chancengleichheit/chancengleichheits_monitoring_2016.pdf
Emmy Noether Programme online FAQ, accessible online at:
http://www.dfg.de/en/research_funding/programmes/individual/emmy_noether/faq_emmy_noether/index.htm
FWF funding statistics: Funding programmes 2009-2015, accessible online at:
https://zenodo.org/record/57015/files/Funding_Programmes_2009-2015.xlsx
ERC annual report 2015, accessible online at: https://erc.europa.eu/sites/default/files/publication/files/erc_annual_report_2015.pdf
ERC gender statistics 2014, accessible online at:
https://erc.europa.eu/sites/default/files/document/file/Gender_statistics_April_2014.pdf

quantitative comparison between some of the impacts of ATTRACT and the SNSF Ambizione programme and SNSF professorships.

Since ATTRACT addresses researchers in all disciplines and a variety of disciplines is represented in the group of survey respondents, the numbers might be subject to a bias caused by differences in disciplines. Also, the numbers shown in the impact section (see section 4.3.3 above) do not take the year of the ATTRACT application into account. The very general findings can be nuanced by applying a matching approach: Cases similar in research field, host institution, and year of application for both groups (ATTRACT applicants not selected for funding and ATTRACT fellows) are extracted from the survey data and their output is compared. For seven ATTRACT fellows, there are suitable comparison cases that make such a comparison reasonable. The results can be described as follows:

- For the first case, the ATTRACT fellow clearly had higher training output since his/her application for ATTRACT. Also, he/she had more conference contributions (twice the number of conference contributions than the applicant whose application was not approved) and gave more scientific talks. He/she also earned more national and international grants. As for journal publications, the researcher without ATTRACT funding had a slightly higher output. The researcher without ATTRACT funding further performed significantly better than the ATTRACT fellow regarding national and international project collaborations.
- In the second case, the ATTRACT fellow equally shows much better performance than his/her counterpart for all of the outputs relevant in the respective research discipline except for obtaining international grants. The differences are particularly striking for training output, journal articles, conference contributions, international project collaboration, and capture of national grants. The socio-economic output and dissemination of the ATTRACT fellow is also very high.
- For the third case, there are two applicants for ATTRACT not selected for funding that we can compare to an ATTRACT fellow. Again, the ATTRACT fellow shows much higher scientific output than the two researchers without ATTRACT funding. In contrast, his/her training output is fairly low and slightly lower than the training output of the comparison cases.
- In case number four, the ATTRACT fellow states that there is only one output relevant in his/her discipline: publications in scientific journals. Comparing this output, the fellow performs much better than the researcher without ATTRACT funding, with twice as many publications in the respective time period.
- The fifth case is an example of a case where the applicant whose application was not approved for funding has higher output than the ATTRACT fellow for most of the relevant indicators. The differences are particularly large with journal articles and training output.
- Case number six is again a case that confirms the impact of ATTRACT. The ATTRACT fellow performed much better than the researcher without ATTRACT funding, with four times as many journal publications and conference contribu-

tions, six times as many invited talks, higher training output, and more success in grant capture.

- The seventh and last case is quite the opposite. The applicant not approved for funding shows much higher output in conference contributions and invited talks, more project collaborations, and better grant capture than the ATTRACT fellow.

The results of a quantitative comparison between some of the impacts of ATTRACT and the two SNSF programmes Ambizione and SNSF professorships are shown in the following. This comparison relies on the online survey of ATTRACT fellows, an online survey of Ambizione grantees, and an online survey of SNSF professors. Please note that the group sizes differ significantly for the three surveys (but also the three populations).

Again, the respondents in all three surveys assessed the effect of their funding on the number and quality of their scientific publications. Table D 5.6 shows the results.

D 5.6: Effect of funding through ATTRACT/Ambizione/SNSF professorships on scientific publications

My grant …	FNR ATTRACT (n = 12)	SNSF Ambizione (n = 208)	SNSF professorships (n = 363)
… increased the number of my scientific publications	75%	81%	91%
… improved the quality of my scientific publications	75%	70%	78%

Source: Interface, online survey of ATTRACT fellows 2007–2015; Interface, online survey of Ambizione grantees 2008–2013; Interface, online survey of SNSF professors 2000–2013.

In the three surveys, the survey respondents were asked how the funding contributed to their scientific independence. All of the ATTRACT fellows participating in the survey find that the ATTRACT grant is relevant (25%) or very relevant (75%). With Ambizione, 88% think that the contribution of the funding to their scientific independence was large, and 6% identified the contribution as small. Of the SNSF professors participating in our survey, 85% find that the funding contributes largely to their scientific independence and 6% think that the contribution is small. If we assume 'relevant' and 'small contribution' (as opposed to no contribution) mean the same, the recipients of SNSF funding assessed the contribution of the funding to their scientific independence as more significant than the ATTRACT grantees. In contrast, all ATTRACT fellows think ATTRACT is important for their scientific independence, whereas both for Ambizione and the SNSF professorships there are survey respondents who do not see any contribution at all.

In addition to this quantitative comparison of ATTRACT and two SNSF programmes, we can draw information on impacts from several recently conducted evaluations of

Ambizione,[30] the Emmy Noether programme,[31] the START programme,[32] and the ERC Starting Grants. The evaluations describe the impacts of the programmes as follows:

- All of the five programmes show significant impact with regard to scientific independence and the career development of the grantees.
- Ambizione is particularly important concerning scientific independence.
- Thanks to the Emmy Noether programme, the grantees experience better working conditions and better chances for full professor appointments than without the funding.
- The START programme shows a positive effect on scientific performance and enables new and unconventional research fields to be tested; all of the grantees stay in the research system (the majority at an Austrian institution), and the grant is often considered to be the decisive reason for staying in Austria.
- With the ERC Starting Grants, there is evidence that movement up the career ladder is a direct result of a successful application. For many researchers, Starting Grants serve as an official confirmation of their scientific status and help them to advance in their professional career. The majority of grantees intend to stay at their host institutions after the funding ends.

However, this impact is threatened by the lack of a tenure track for all of the funding schemes except ATTRACT. Brain drain can be a consequence. Also, the evaluations show that for some of the funding instruments, the career development of the recipients does not necessarily differ from that of the researchers without funding (START programme and ERC Starting Grants). For the ERC Starting Grants, the evaluation shows that compared to their peers at the same career level, both successful and unsuccessful applicants report very high levels of scientific independence at the time of their application. This may suggest that the Starting Grant serves as an instrument to supplement pre-existing scientific independence with financial autonomy. Also, the Starting Grant is rarely used to enable mobility. Most researchers stay in the same country where they lived when applying. For Ambizione, our evaluation showed that the impacts found are not particularly attributable to the Ambizione funding scheme but exist equally for the SNSF project funding scheme. For ATTRACT, the same observation can be made but not for all impacts analysed. With regard to visibility on a national level or number of conference contributions, ATTRACT is much more significant than CORE or INTER. On the other hand, some effects seem to be stronger for CORE than for ATTRACT, such as an increase in the number of publications or new international collaborations.

30 Balthasar, Andreas; Iselin, Milena (2014): Evaluation of the Swiss National Science Foundation's Ambizione Funding Scheme. Final Report, Interface Policy studies Research Consulting, Lucerne. The report is available online at: http://www.snf.ch/SiteCollectionDocuments/Web-News/ambizione_evaluationsbericht_e.pdf

31 Böhmer, Susan; Hornbostel, Stefan; Meuser, Michael (2008): Postdocs in Deutschland: Evaluation des Emmy Noether Pro-gramms. iFQ Working Paper No. 3, May 2008. Available online at: www.forschungsinfo.de/publikationen/download/working_paper_3_2008.pdf

32 Seus, Sarah, Heckl, Eva, Bührer, Susanne (2016). Evaluation of the START Programme and the Wittgenstein Award. Final Report. Available online at: https://zenodo.org/record/50610/files/Eval-START-Witt_final_report.pdf

5.3 INTERNATIONAL BENCHMARKING OF PEARL

The benchmarking for PEARL also focused on the funding scheme's concept and implementation and the funding scheme's impacts.

Table D 5.7 first shows a comparison of a selection of key figures for PEARL and the comparison programmes.

D 5.7: Key figures, PEARL and comparison programmes

	PEARL	SNSF Professorships	Heisenberg professorship	Wittgenstein-Award	Advanced Grants
Country	Luxembourg	Switzerland	Germany	Austria	EU
Funding agency	FNR	SNSF	DFG	FWF	ERC
Year of launch	2008	1999	2005	1996	2008
Amount of grant (MEUR)	3-4	1.46	-*	max. 1.5	max. 2.5
Duration of grant (years)	5	4+2	3+2	5	5

Source: FNR, SNSF, DFG, FWF, ERC.[33]

Note: *Depending on amount being financed by the institution after funding ends, negotiated between the applicant and the host institution.

Again, funding amount is by far the highest for the PEARL scheme. It might be that the eligible costs in the different countries vary substantially. The duration of the scheme is in line with international standards.

5.3.1 CONCEPT AND IMPLEMENTATION

In the following, we present the benchmarking results for a number of aspects concerning the concept and implementation of PEARL and the comparison programmes.

Target groups

Except for the SNSF professorships, the target groups for the advanced career stage instruments analysed are similar. The funding schemes target established and internationally recognized researchers (PEARL), researchers fulfilling all the requirements for tenured professorships (Heisenberg professorship), outstanding researchers who have already produced exceptional scientific work and who occupy a prominent place in the international research community (Wittgenstein Award), or leaders in their respective

[33] FNR: FNR PEARL programme description, available at: http://storage.fnr.lu/index.php/s/tVHBKTXy5xHnEdR/download
SNSF: Regulations on SNSF professorships 2008, available at: http://www.snf.ch/SiteCollectionDocuments/fp_reglement_e.pdf
DFG: Presentation on the Heisenberg Professorship, available at: http://www.dfg.de/download/pdf/foerderung/programme/heisenberg/vortrag_heisenberg_professur_en.pdf
DFG: Module description 2011, available at: http://www.dfg.de/formulare/52_09/52_09_en.pdf
FWF: Short description of the Wittgenstein Award, available at: https://www.fwf.ac.at/en/research-funding/fwf-programmes/wittgenstein-award/
ERC: Short description of the ERC Advanced Grants, available at: https://erc.europa.eu/funding-and-grants/funding-schemes/advanced-grants

field(s) of research with significant achievement in the last ten years (ERC Advanced Grants). The SNSF professorship is on a somewhat lower academic level. It addresses senior postdocs intending to pursue an academic career and wishing to establish their own research group to realize a research project.

Participation requirements

Whereas there are no participation requirements for the Wittgenstein Award or the ERC Advanced Grants except for those mentioned above, the Heisenberg professorship requires a habilitation or equivalent. To be eligible for an SNSF professorship, candidates need at least two to nine years research experience after the doctorate, a degree from an institution in Switzerland, or at least two years' activity at a Swiss institution by the submission deadline, and a research stay of several years at a research institution that is not identical with the institution where the doctorate was obtained, thereof at least one year abroad.

Unique characteristics of the funding schemes' concepts

Again, unique characteristics can be highlighted out for each of the programmes analysed:

- PEARL is unique in its funding amount, which is exceptionally high. Also, grantees are very flexible in allocating the funds.
- There is no tenure track built in with this funding scheme.
- With the Heisenberg professorship, the requirements regarding formalization of the proposal are very low. Applicants whose proposals are not approved for a Heisenberg professorship can apply for a Heisenberg fellowship.
- The Wittgenstein Award is a special funding scheme; researchers cannot apply for it but are nominated and selected by an FWF jury. As with PEARL, the recipients are granted practically complete flexibility in the use of the grant.
- In contrast to the other funding schemes analysed, the ERC Advanced Grants have no specific eligibility criteria regarding academic requirements.

5.3.2 PROGRAMME OUTPUT

Table D 5.8 shows the programme output of PEARL and the comparison programmes.

D 5.8: Programme output, PEARL and comparison programmes

	PEARL	SNSF professorships	Heisenberg professorships	Wittgenstein Award	Advanced Grants
Number of grants awarded	8 (09–15)	40 (2015)	25 (2015)	10 (09–15)	302 (2015)
Total amount awarded (MEUR)	32.3 (09–15)	68.9 (2015)	7.6 (2015)	14.8 (09–15)	647 (2016)
Average success rate (%)	54 (09–15)	19 (09–15)	80* (06–10)	7 (09–15)	13 (08–15)
Female participation (%)	15 (09–15)	30 (09–15)	27 (08–14)	25 (09–15)	15 (08–13)
Female success rate (%)	50 (09–15)	16 (2015)	?	7.6 (09–15)	6 (2014)

Source: FNR, SNSF, DFG, FWF, ERC.[34]

Note: *This exceptionally high success rate is partly due to the fact that recipients of a Heisenberg fellowship are given the possibility to convert their stipend into a Heisenberg professorship. Even when these cases are excluded, the success rate was at 71% from 2008–2014.

The table shows that the total number of awarded PEARL grants is lower than for the other funding instruments. Still, the total amount awarded is considerable due to the exceptional size of the grant. The average success rate and also the female success rate of PEARL are high. This might be due to the fact that the FNR invests a lot of time in upfront consultation meetings with the applicant and the institutions. Only the Heisenberg professorship programme shows higher success rates. Female participation has been very low. The SNSF professorships have a comparably high female participation.

[34] FNR grant database.
SNSF Statistics 2015, accessible online at: http://www.snf.ch/SiteCollectionDocuments/statistiken_vollversion_en.pdf
DFG: Jahresbericht der Deutschen Forschungsgemeinschaft 2015, accessible online at:
http://www.dfg.de/download/pdf/dfg_im_profil/geschaeftsstelle/publikationen/dfg_jb2015.pdf
DFG Chancengleichheits-Monitoring 2014, accessible online at:
http://www.dfg.de/download/pdf/foerderung/grundlagen_dfg_foerderung/chancengleichheit/chancengleichheits_monitoring_2016.pdf
FWF funding statistics: Funding programmes 2009-2015, accessible online at:
https://zenodo.org/record/57015/files/Funding_Programmes_2009-2015.xlsx
ERC annual report 2015, accessible online at: https://erc.europa.eu/sites/default/files/publication/files/erc_annual_report_2015.pdf
ERC gender statistics 2014, accessible online at:
https://erc.europa.eu/sites/default/files/document/file/Gender_statistics_April_2014.pdf

5.3.3 IMPACT

Findings on the impact of PEARL and the comparison programmes are presented in the following. The comparison is based on information from recently conducted evaluations of the SNSF professorships[35] and the Wittgenstein Award.[36] There is no information available concerning the Heisenberg professorships and the ERC Advanced Grants.

The evaluations describe the impacts of the programmes as follows:

With the outstanding size of the grants, PEARL and the FWF Wittgenstein Award first and foremost give outstanding researchers a maximum level of freedom and flexibility in their research. They boost the grantees' careers and have significant impacts on the grantees' scientific outputs and recognition. These funding instruments are not only very effective on the individual level but also have proven to be significant for the promotion of Luxembourg and Austria as research locations. For the Wittgenstein Award, the evaluation sees no evidence of these impacts not being sustainable. With PEARL the sustainability of the level of funding is an issue raised by the interview partners.

The SNSF professorships rely on a slightly different concept and have a different target group than PEARL and the Wittgenstein Award. Nevertheless, the impact of the programme is impressive. The funding boosts the grantees' scientific independence and is conducive to obtaining permanent professorship positions. The lack of a tenure track is criticized with the SNSF professorship, but this does not actually manifest as a problem, since almost all of the former SNSF professors find permanent positions after their funding period ends.

PEARL and the SNSF professorships are funding schemes that also develop significant institutional impacts.

35 Balthasar, Andreas; Iselin, Milena (2014): Surveys on the professorships of the Swiss National Science Foundation. Report, Interface Policy studies Research Consulting, Lucerne. Available at: http://www.snf.ch/SiteCollectionDocuments/Web-News/news_280515_bericht_snf_foerderungsprofessuren.pdf

36 Seus, Sarah, Heckl, Eva, Bührer, Susanne (2016). Evaluation of the START Programme and the Wittgenstein Award. Final Report. Available at: https://zenodo.org/record/50610/files/Eval-START-Witt_final_report.pdf

6 EXPERT APPRAISAL

This section presents the expert appraisal of the evaluation results reported in section 4 above.[37]

The section is divided into two parts: The first part discusses the expert team's observations gathered during the evaluation process. It focuses on a general assessment, the concept and implementation, the output, and the impact of the programmes under evaluation.

The second part presents the expert team's recommendations for further development of existing strengths and overcoming observed weaknesses.

6.1 RESULTS OF THE EXPERT APPRAISAL

The results of the expert appraisal are presented in the following. The section starts with a general assessment and then presents the experts' findings on the funding schemes' concept and implementation, output, and impact.

6.1.1 GENERAL ASSESSMENT

The experts give very positive general feedback on the funding schemes under evaluation. They are impressed that a country of the size of Luxembourg invests so much in the development of its research, and they are convinced that this investment generally translates into considerate impact, not only on the individual but also on the aggregate level.

The experts agree that the schemes are well-designed, with some unique features like the size of the grants (CORE, ATTRACT, and especially PEARL) or the tenure track option with ATTRACT. The experts are also impressed by the selection procedures of the FNR, which not only withstand international comparison but also grant an exceptional degree of transparency. They see that the FNR invests significant resources in the organization of a state-of-the-art selection process. The implementation of the funding schemes by the FNR also seems to be very good in general.

The experts generally support the strategy of focusing on a number of priority areas, given Luxembourg's size. This is seen as conducive to building a critical mass and achieving considerable outputs and impacts.

The experts appreciate the various impacts that the funding schemes have for the grantees' career development and also for Luxembourg research as a whole. They confirm that the FNR contributes largely to the visibility and perception of Luxembourg research in the international scientific community.

[37] The benchmarking of the four FNR programmes was not yet concluded at the time of the expert appraisal.

6.1.2 CONCEPT AND IMPLEMENTATION

This section summarizes the experts' findings regarding the concept and implementation of the four funding schemes under evaluation.

Funding concept

Generally speaking, the experts agree that the funding concepts of all four funding programmes evaluated are sensible and suitable for reaching the target groups.

CORE follows a concept that is comparable to project funding schemes in other countries. Funding amounts are also on a comparable or even higher level. The restriction of the instrument to priority areas is a particularity which at first sight caused the experts some concern. However, given the smallness of the country and its research environment, the experts agree that it makes sense to focus on a certain range of topics. Also, the experts acknowledge that the priority areas are quite wide and leave sufficient room for interpretation.

The experts see the CORE funding scheme as one possible way address the issue of retaining researchers already working in Luxembourg. CORE could be an attractive funding opportunity after the funding period of ATTRACT or PEARL ends. Since CORE has no funding maxima and is only restricted by the overall funding budget for the five priority areas, this is in principle already possible today. However, the situation remains critical for the disciplines that are not part of the priority domains (e.g. mathematics).

Concerning the funding concept of *ATTRACT*, the experts point out that the tenure track is a major asset of this funding scheme and sets the funding scheme apart from similar schemes in other countries (e.g. the DFG Emmy Noether Programme or the SNSF Ambizione Programme). Of the funding schemes targeting this career stage known to the experts, not one has a built-in tenure track option. The experts appreciate that the ATTRACT projects have to pass a strategic merit assessment, which was introduced recently. They are convinced that the tenure track contributes largely to high and sustainable outputs and impacts of the (former) ATTRACT fellows, because this system requires long-term career planning and provides long-term support for career development.

Concerning the FNR's *PEARL* programme, the experts are impressed by the amount of the PEARL grant. It is comparable to the DFG Alexander von Humboldt professorship, which is the most highly-endowed research award in Germany. The experts appreciate that PEARL projects need to have a strong strategic fit.

Application process

Application processes for CORE, ATTRACT, and PEARL are in line with international standards. The experts do not see evidence of weaknesses in the selection procedures applied by the FNR. They appreciate that the selection follows a two-stage process with remote reviews and panel meetings and that all bodies are composed of international experts. The experts agree that the FNR puts a lot of effort into the recruitment of these experts and in the organization of the selection process. The experts are impressed that the applicants receive the full reviews of their proposals. They consider

this a high level of transparency. Still, they support the idea of further improving the communication measures accompanying an application.

For INTER, the application process is hard to assess, because it depends entirely on the lead agency (for bilateral projects) and the FNR has no possibility whatsoever to influence it.

CORE currently has one submission deadline per year. According to the experts, there is no need for open calls and the FNR's argument that they want to be able to compare applications to ensure quality is understandable, but two call deadlines every year would allow for more flexibility and would correspond to the procedure in other countries.

The experts are in favour of allowing second applications to ATTRACT. More than two applications should not be permitted.

6.1.3 OUTPUT

The output of the funding programmes under evaluation is in general appreciated by the experts.

Concerning INTER, the experts state that the very low acceptance rates at the FNR's partner agencies (e.g. ANR in France) is a problem. The experts are of the opinion that the FNR should address this issue of imbalance between Luxembourg and the partner countries in its communications. The FNR should call INTER applicants' attention to the fact that there is a considerable risk of not getting funded if they apply with a foreign lead agency.

The low female participation in ATTRACT and PEARL is a cause for concern, and in the experts' view, it should be tackled by the FNR. Quota for applications from female researchers, special recruiting programmes for outstanding female scientists, the share of female members of selection panels, and dual career couples are issues discussed in relation to the gender issue. The experts formulate a recommendation on this issue (see section 6.3.1 below). For CORE and INTER, the rate of female applicants seems low, but taking the total number of female researchers in the respective fields into account, it is satisfactory. Of course, the total number of female researchers in materials and physical sciences in Luxembourg is very low.

The experts are impressed by the output of the CORE, INTER, ATTRACT, and PEARL grantees. They acknowledge the fact that the outputs are higher for those funded than for their comparison groups (CORE and INTER) and value the positive self-assessment by the ATTRACT and PEARL fellows.

The experts ask themselves if the domains need to be even narrower for the purpose of building up critical mass. According to the experts, critical mass is an important factor in attracting excellent people to the country, leading to higher outputs and impact in certain areas and improving the outreach of Luxembourg research internationally. The experts suggest creating a new funding instrument that allows the building up of 'centres of excellence'. According to the experts, these centres would function as 'beacons',

improving the international visibility of Luxembourg research and ensuring sustainability. The funding instrument could be modelled after similar funding schemes in other countries, for example the DFG Research Centres (*Forschungszentren*) or the National Centres of Competence (NCCR) of the SNSF.

6.1.4 IMPACT

The experts find the impacts that the FNR's funding programmes have for the grantees and the hosts convincing. They particularly appreciate the effects of all four funding measures on the grantees' career development. This impact is supported by elements of the funding schemes' concepts: the comparably large extent of the grants, the tenure track built in with ATTRACT, etc. The experts also approve of the low deadweight loss observed and confirm that it is low also in comparison with similar programmes in other countries. They agree that the low deadweight loss is a positive effect of the rigorous selection procedure implemented by the FNR.

Given that the impact in the area of knowledge and technology transfer to the industry and ultimately also to society could still be improved, the experts appreciate the FNR's efforts in creating CORE PPP to foster collaborations with industry. They also find it appropriate to use a particular funding scheme with a particular budget for this purpose and to separate it from the regular project funding through CORE. They stress, however, that having an instrument like CORE PPP should not mean that projects funded through the conventional CORE track should not produce outputs like patents or spin-offs.

The evaluation showed that ATTRACT is often used for ex-post financing of new hires instead of having a pull-effect on potential applicants per se. This is due to the fact that although the funding scheme is well-known and prestigious within the country, it is hardly known outside Luxembourg. The experts are of the opinion that this 'headhunting' aspect of ATTRACT should even be strengthened, and they agree that efforts to promote ATTRACT should be intensified, for example through advertisement in journals or advertising the funding scheme at international conferences.

The sustainability of the funding through ATTRACT and PEARL and the degree of saturation of the Luxembourg research environment were discussed as a critical issues. Although the experts do not see a problem of saturation right now (they agree, for example, that one to two PEARL fellows per year can be sustained), they support the idea of reflecting upon the question of sustainability of the funding. The experts' view in terms of sustainability is not unanimous, however. Two of the experts clearly see the difficulty for Luxembourg to be able to sustain the level of funding through ATTRACT and PEARL. The third expert does not think sustainability is an issue at the moment ("don't fix what isn't broken").

6.2 RECOMMENDATIONS TO THE FNR

This section presents the experts' recommendations to the FNR. The experts make three general recommendations, one recommendation that concerns both ATTRACT and PEARL, and two recommendations concerning ATTRACT.

6.2.1 GENERAL RECOMMENDATIONS

The experts make the following three general recommendations:

1 Create funding instrument for 'Centres of Excellence'

In general, the experts observe that in the FNR's programme portfolio, coordinated instruments like the funding of research units of the DFG (*Forschergruppen*) are missing. The experts agree that given the smallness of the country, there is currently no need for such instruments. However, given that critical mass is a decisive factor in attracting excellent researchers to Luxembourg, there should be a stronger thematic focus in some areas. The experts suggest creating a new funding instrument that allows the build-up of 'centres of excellence'. According to the experts, these centres would function as 'beacons', improving the international visibility of Luxembourg research and ensuring sustainability. The funding instrument could be modelled after similar funding schemes in other countries, for example the DFG Research Centres (*Forschungszentren*) or the National Centres of Competence (NCCR) of the SNSF.

2 Implement FNR road shows

Even though the experts do not see evidence of deficiencies in the FNR application processes, they agree that the *perception* of the application process could be improved. They suggest implementing FNR 'road shows' at the University and the public research institutions. The FNR should use these shows to present itself and its various funding measures and to explain the application and selection process in detail. The road shows would also include Q&A sessions.

3 Introduce a medium-scale research award

The experts support the evaluation team's recommendation to introduce a research award for Luxembourg. The purpose of the award is to reward outstanding research conducted in the country on the individual level and to increase the visibility of Luxembourg research as a whole. Considering the smallness of Luxembourg and its research environment, the experts think that a medium-scale research award, endowed with 500,000 to 1,000,000 euros, would be appropriate. The award could be modelled after a research award of a German federal state, such as the Science Award of Lower Saxony (*Wissenschaftspreis Niedersachsen*). The award would give the awardee freedom to pursue his/her research with full flexibility in the allocation of the award money. The experts stress the importance of extensive PR measures surrounding the launch of the research award, so that the award really functions as a label.

6.3 RECOMMENDATIONS CONCERNING INDIVIDUAL FUNDING SCHEMES

6.3.1 ATTRACT AND PEARL

The experts make the following recommendation concerning ATTRACT and PEARL:

1 Improve female participation

The experts are convinced that female participation in the ATTRACT and PEARL programmes should be improved. They suggest that the FNR look at models of other funding agencies abroad and decide which measures could be implemented in Luxem-

bourg. The experts fully support the FNR's introduction of a quota for ATTRACT (40% applications of female researchers as of 2017) and PEARL (30% of the candidates proposed by the research institutions in the years 2017 to 2021 should be female) and strongly recommend enforcing compliance with these values. Compliance with the target values should be treated as a prerequisite for FNR funding: If a target value is not met, the process should be stopped and proactive recruitment of female applications should be initiated. The share of female members in reviewer pools and selection panels should also be monitored and adapted in case of imbalances. Furthermore, the experts suggest implementing measures to improve conditions for dual career couples and spousal hiring, respectively.

6.3.2 ATTRACT

For ATTRACT, the experts make the following two recommendations:

1 Allow second applications

In line with common international procedures for similar funding schemes, the experts support the suggestion to allow second applications for ATTRACT. The number of applications should be limited to two.

2 Strengthen ATTRACT as a recruiting instrument

Already today, ATTRACT is actively used by the Luxembourg research institutions to build capacities and finance the hiring of high quality research staff from abroad. Even though the result is positive (international top researchers have been attracted to Luxembourg, and so far, only one of them has left the country), the pull effect of the funding scheme does not work exactly as intended by the FNR. The experts thus suggest strengthening ATTRACT as a recruiting instrument and officially making it a 'headhunting' scheme as is already the case for PEARL. Efforts to promote the funding scheme, such as through advertisement in journals or at international conferences, should be simultaneously intensified.

ANNEX

A1 QUESTIONNAIRES FOR THE ONLINE SURVEYS

A1.1 CORE MS APPLICANTS 2010–2015

Dear participant

We highly appreciate your willingness to participate in our survey concerning the Luxembourg National Research Fund's CORE funding scheme. You have been asked to participate because you applied for one or more CORE grants in the field of Materials and Physical sciences between 2010 and 2015.

It should take you approximately 20 minutes to complete the survey. Please select the answers that best reflect your personal opinion. Some open-ended questions have been included to allow for more detailed answers. You can browse backward and forward through the questionnaire by clicking on the arrows at the bottom of each page.

Your responses will be kept strictly confidential and your name will not be attached to any of the survey results.

If you have questions concerning the survey, or if you experience technical problems, please email or call Milena Iselin at Interface (iselin@interface-politikstudien.ch; +41 41 226 04 10).

Thank you very much for your valued collaboration.

Where not indicated otherwise, the questions are related to the period 2010-2015. Please answer the questions in relation to your function as Principal Investigator.

Have you ever received funding through the FNR's CORE funding scheme?

- ❍ Yes
- ❍ No

How many CORE grants have you received so far?

_____

How many of your CORE grants were CORE Junior Track grants?

_____

In which year did you receive your first CORE grant?

In which year did you receive your second CORE grant?

In which year did you receive your third CORE grant?

In which year did you receive your fourth CORE grant?

In which year did you receive your fifth CORE grant?

Have any of your applications for CORE funding been rejected?

- Yes
- No

How many of your applications for CORE have been rejected in total?

_____

If you have ever applied for a CORE Junior Track, how many of your CORE Junior applications have been rejected?

In which year was your first application for CORE funding rejected?

In which year was your second application for CORE funding rejected?

In which year was your third application for CORE funding rejected?

In which year was your fourth application for CORE funding rejected?

In which year was your fifth application for CORE funding rejected?

In which year was your sixth application for CORE funding rejected?

Are you sure you've never applied for an FNR CORE grant?

- Yes (you will be directed to the end of the questionnaire)
- No (please go back to the start of the questionnaire)

The following question concerns your situation at the time you submitted your (first) application for a CORE grant.

How can your position be best described at the time you submitted your (first) application for CORE project funding between 2010 and 2015?

- Full professor

- ❍ Associate professor
- ❍ Assistant professor
- ❍ Scientific collaborator
- ❍ Lecturer
- ❍ Assistant
- ❍ Postdoc
- ❍ Other position, namely: _____
- ❍ I was not working.

Was this position ...?

- ❍ ... tenured
- ❍ ... with tenure track
- ❍ ... non tenured

In which country was your main job at the time you submitted your first application for CORE funding in the period 2010–2015?

- ❍ In Luxembourg
- ❍ In another country

At what kind of institution were you working when you submitted your first application for CORE funding in the period 2010–2015?

- ❍ University
- ❍ Public research organisation
- ❍ Private sector research
- ❍ Administration/NPO
- ❍ Other workplace

In which year did you start working in Luxembourg?

- ❍ In the year: _____
- ❍ I have never worked in Luxembourg.

The following questions are about the application process for a CORE project grant.

How do you evaluate the application process for CORE project funding in terms of the following criteria?

	Very adequate	Adequate	Inadequate	Very inadequate	Don't know
Fairness	❍	❍	❍	❍	❍
Transparency	❍	❍	❍	❍	❍
Work load to write the proposal	❍	❍	❍	❍	❍
Administrative effort involved in the application	❍	❍	❍	❍	❍
Complexity	❍	❍	❍	❍	❍
Quality	❍	❍	❍	❍	❍
Time until you received the decision	❍	❍	❍	❍	❍
Support/information of the FNR	❍	❍	❍	❍	❍
Support/information of your host institution	❍	❍	❍	❍	❍

Additional comments on your answers:

Were the feedback documents provided by the FNR regarding your application(s) for CORE funding useful to you?

❍ Yes
❍ No

Additional comments on your answer:

We would like to know how you estimate the impacts of your CORE project grant(s) and the consequences of the rejection of your application(s) for CORE.

We would like to know how you estimate the impacts of your CORE project grant(s).

We would like to know how you estimate the impacts of the rejection of your application(s) for CORE.

Please tick what is applicable to you with regard to the following statements.

My CORE project grant(s) has/have ...

	Very accurate	Accurate	Inaccurate	Completely inaccurate	Don't know	Not relevant in my field of research
... increased the number of my scientific publications	❍	❍	❍	❍	❍	❍
... improved the quality of my scientific publications	❍	❍	❍	❍	❍	❍
... increased the number of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... improved the quality of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... facilitated follow-up research projects	❍	❍	❍	❍	❍	❍
... led to scientific prizes	❍	❍	❍	❍	❍	❍
... led to more invitations to talks	❍	❍	❍	❍	❍	❍
... enabled me to start new international collaborations	❍	❍	❍	❍	❍	❍
... led to successful applications for further competitive funding	❍	❍	❍	❍	❍	❍
... increased the number of completed doctorates in my group	❍	❍	❍	❍	❍	❍
... had a positive impact on the career(s) of the PhD student(s) and/or Post Doc(s) in my group	❍	❍	❍	❍	❍	❍
... increased my number of patents and/or patent applications	❍	❍	❍	❍	❍	❍
... enabled me to fund/contribute to the funding of spin-offs	❍	❍	❍	❍	❍	❍
... contributed to technology and knowledge transfer to my group	❍	❍	❍	❍	❍	❍
... facilitated collaboration with industrial and/or other partners	❍	❍	❍	❍	❍	❍
... helped my public outreach activities	❍	❍	❍	❍	❍	❍
... increased my visibility among national actors	❍	❍	❍	❍	❍	❍

How relevant was the contribution of your CORE project grant(s) to your scientific independence?

- ❍ Very relevant
- ❍ Relevant
- ❍ Irrelevant
- ❍ Very irrelevant
- ❍ Don't know

Did/does the CORE project grant(s) have a substantial influence on your further career?

- ❍ Yes, namely: _____
- ❍ No

Could your research project(s) have been carried out without the CORE project grant(s)?

- ❍ Yes
- ❍ No

After the rejection(s) of your application(s) for CORE, were you still able to conduct the research project(s) for which you submitted the application?

- ❍ Yes, to the same extent
- ❍ Yes, but to a smaller extent
- ❍ No

How did you secure funding?

Did the rejection of your application(s) for CORE have further consequences for you and your career?

The following questions concern your current career situation.

Are you still working at the same institution as you were at the time of your (first) application for CORE 2010-2015?

- ❍ Yes
- ❍ No
- ❍ I'm not currently working.

Where is your current job?

- ❍ In Luxembourg
- ❍ In another country

At what kind of institution is your current job?

- ❍ University
- ❍ Public research organisation
- ❍ Private sector research
- ❍ Administration/NPO
- ❍ Other institution

Please describe your current position.

- ❍ Full professor
- ❍ Associate professor
- ❍ Assistant professor
- ❍ Scientific collaborator
- ❍ Lecturer
- ❍ Assistant
- ❍ Postdoc
- ❍ Other position, namely: _____

Is this position...?

- ❍ ...tenured
- ❍ ...with tenure track
- ❍ ...non tenured

Are you currently leading your own research group?

- ❍ Yes
- ❍ No

How many members does your own research group currently have?

_____ PhD students
_____ Postdocs
_____ Other personnel (assistants, technicians etc.)

Have you received (as PI) any other funding by the FNR or other funding institutions between 2010 and 2015? (multiple answers possible)

- ❑ Yes, FNR funding
- ❑ Yes, other Luxembourg institutional funding
- ❑ Yes, competitive third party funding (i.e.H2020)
- ❑ Yes, contract research
- ❑ Yes, other funding, namely: _____
- ❑ No

What kind of FNR funding have you received?

- ❑ PEARL
- ❑ ATTRACT
- ❑ INTER
- ❑ AFR (as supervisor)
- ❑ Other FNR funding

What was approximately the total annual budget of your research group (in EUR) in 2015?

Which percentage of your budget is (approximately) financed by:

_____ The FNR
_____ Other competitive funding (i.e.H2020…)
_____ Contract research
_____ Institutional basic funding
_____ Other funding

The following questions concern your scientific output for your time of employment in Luxembourg during the period 2010-2015 in total and in relation to your CORE funding. If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.

If you have not produced a particular output, please indicate this by filling in "0". If an output indicator is not relevant in your discipline, please leave the field empty.

Since you've started working in Luxembourg, how many …

	Total number	Number related to CORE funding (< total number)
… journal articles have you published?		
… Books/monographs have you published?		
Policy reports have you published?		
… doctoral students have you supervised?		
… doctoral students have successfully completed their doctoral thesis under your supervision?		
… conferences have you contributed to (as a speaker, panellist etc.)?		
… scientific prizes have you won?		
… talks have you been invited to?		
… new international project collaborations have you realised?		
… new national project collaborations have you realised?		
... international competitive grants have you earned?		
… national competitive grants have you earned?		
… patents have you filed?		
… spin-offs have you initiated?		
… collaborations with industrial or other partners have you realised?		

The following questions concern your scientific output for your time of employment in Luxembourg during the period 2010-2015. If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.

If you have not produced a particular output, please indicate this by filling in "0". If an output indicator is not relevant in your discipline, please leave the field empty.

Since you've started working in Luxembourg, how many …

… journal articles have you published?	
… Books/monographs have you published?	
Policy reports have you published?	
… doctoral students have you supervised?	
… doctoral students have successfully completed their doctoral thesis under your supervision?	
… conferences have you contributed to (as a speaker, panellist etc.)?	
… scientific prizes have you won?	
… talks have you been invited to?	
… new international project collaborations have you realised?	
… new national project collaborations have you realised?	
... international competitive grants have you earned?	
… national competitive grants have you earned?	
… patents have you filed?	
… spin-offs have you initiated?	
… collaborations with industrial or other partners have you realised?	

Given your career stage (and what is typical for your research area) how do you rate your overall productivity?

- ❍ Very high
- ❍ High
- ❍ Moderate
- ❍ Low
- ❍ Very low

Please describe your activity in academic services. Are you active in …

	Yes	No	Not relevant in my discipline/field of research
… professional scientific associations	❍	❍	❍
… international selection committees (e.g. expert panels)	❍	❍	❍
… reviewing activities (e.g. articles, proposals)	❍	❍	❍
… editorial activities (e.g. journals, books)	❍	❍	❍
… organisation of conferences	❍	❍	❍

With the CORE funding scheme, the FNR aims to achieve various overarching goals. We would like to know your views with regard to the attainment of these goals.

How do you rate the following statements regarding the overarching goals of the FNR's CORE funding scheme?

	Very accurate	Accurate	Inaccurate	Completely inaccurate	No assessment possible
CORE generates new knowledge through funding of high quality scientific research.	❍	❍	❍	❍	❍
CORE leads to scientific publications in the leading international peer-reviewed outlets of the respective fields.	❍	❍	❍	❍	❍
CORE helps to develop a strong and sustainable research basis in Luxembourg.	❍	❍	❍	❍	❍
Through CORE, research groups and institutions are advanced in view of international visibility and critical mass.	❍	❍	❍	❍	❍
CORE supports the training of doctoral students.	❍	❍	❍	❍	❍
CORE advances the careers of involved researchers in general.	❍	❍	❍	❍	❍

We would like to terminate this survey by asking you to give us feedback on potential for improvement with regard to the CORE funding scheme.

From your experience, do you see such potential for improvement? Please explain.

You have now reached the end of our questionnaire. Have you answered all the questions? If so, move to the next page to save your answers. Please note that you will not be able to return to the questionnaire from there.

A1.2 INTER MS APPLICANTS 2010–2015

Dear participant

We highly appreciate your willingness to participate in our survey concerning the Luxembourg National Research Fund's INTER funding scheme. You have been asked to participate because you applied for one or more INTER grants in the field of Materials and Physical sciences between 2010 and 2015.

It should take you approximately 20 minutes to complete the survey. Please select the answers that best reflect your personal opinion. Some open-ended questions have been included to allow for more detailed answers. You can browse backward and forward through the questionnaire by clicking on the arrows at the bottom of each page.

Your responses will be kept strictly confidential and your name will not be attached to any of the survey results.

If you have questions concerning the survey, or if you experience technical problems, please email or call Milena Iselin at Interface (iselin@interface-politikstudien.ch; +41 41 226 04 10).

Thank you very much for your valued collaboration.

Where not indicated otherwise, the questions are related to the period 2010-2015. Please answer the questions in relation to your function as Principal Investigator.

Have you ever received funding through the FNR's INTER funding scheme?

- ❍ Yes
- ❍ No

How many INTER grants have you received so far?

_____

In which year did you receive your first INTER grant?

In which year did you receive your second INTER grant?

In which year did you receive your third INTER grant?

Have any of your applications for INTER funding been rejected?

- ❍ Yes
- ❍ No

How many of your applications for INTER have been rejected in total?

_____

In which year was your first application for INTER funding rejected?

In which year was your second application for INTER funding rejected?

In which year was your third application for INTER funding rejected?

In which year was your fourth application for INTER funding rejected?

In which year was your fifth application for INTER funding rejected?

In which year was your sixth application for INTER funding rejected?

In which year was your seventh application for INTER funding rejected?

In which year was your eighth application for INTER funding rejected?

In which year was your ninth application for INTER funding rejected?

In which year was your tenth application for INTER funding rejected?

Are you sure you've never applied for an FNR INTER grant?

- ❍ Yes (you will be directed to the end of the questionnaire)
- ❍ No (please go back to the start of the questionnaire)

The following question concerns your situation at the time you submitted your (first) application for an INTER grant.

How can your position be best described at the time you submitted your (first) application for INTER project funding in the period 2010-2015?

- ❍ Full professor
- ❍ Associate professor
- ❍ Assistant professor
- ❍ Scientific collaborator
- ❍ Lecturer
- ❍ Assistant
- ❍ Postdoc
- ❍ Other position, namely: _____
- ❍ I was not working.

Was this position...?

- ❍ ...tenured
- ❍ ...with tenure track
- ❍ ...non tenured

In which country was your main job at the time you submitted your first application for INTER funding in the period 2010-2015?

- ❍ In Luxembourg
- ❍ In another country

At what kind of institution were you working when you submitted your first application for INTER funding in the period 2010-2015?

- ❍ University
- ❍ Public research organisation
- ❍ Private sector research
- ❍ Administration/NPO
- ❍ Other workplace

In which year did you start working in Luxembourg?

❍ In the year: _____
❍ I have never worked in Luxembourg.

The following questions are about the application process for an INTER project grant.

How do you evaluate the application process for INTER project funding in terms of the following criteria?

	Very adequate	Adequate	Inadequate	Very inadequate	Don't know
Fairness	❍	❍	❍	❍	❍
Transparency	❍	❍	❍	❍	❍
Work load to write the proposal	❍	❍	❍	❍	❍
Administrative effort involved in the application	❍	❍	❍	❍	❍
Complexity	❍	❍	❍	❍	❍
Quality	❍	❍	❍	❍	❍
Time until you received the decision	❍	❍	❍	❍	❍
Support/information of the FNR	❍	❍	❍	❍	❍
Support/information of your host institution	❍	❍	❍	❍	❍

Additional comments on your answers:

Were the feedback documents provided by the FNR regarding your application(s) for INTER funding useful to you?

❍ Yes
❍ No

Additional comments on your answer:

We would like to know how you estimate the impacts of your INTER project grant(s) and the consequences of the rejection of your application(s) for INTER.

We would like to know how you estimate the impacts of your INTER project grant(s).

We would like to know how you estimate the impacts of the rejection of your application(s) for INTER.

Please tick what is applicable to you with regard to the following statements.

My INTER project grant(s) has/have ...

	Very accurate	Accurate	Inaccurate	Completely inaccurate	Don't know	Not relevant in my field of research
... increased the number of my scientific publications	❍	❍	❍	❍	❍	❍
... improved the quality of my scientific publications	❍	❍	❍	❍	❍	❍
... increased the number of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... improved the quality of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... facilitated follow-up research projects	❍	❍	❍	❍	❍	❍
... led to scientific prizes	❍	❍	❍	❍	❍	❍
... led to more invitations to talks	❍	❍	❍	❍	❍	❍
... enabled me to start new international collaborations	❍	❍	❍	❍	❍	❍
... led to successful applications for further competitive funding	❍	❍	❍	❍	❍	❍
... increased the number of completed doctorates in my group	❍	❍	❍	❍	❍	❍
... had a positive impact on the career(s) of the PhD student(s) and/or Post Doc(s) in my group	❍	❍	❍	❍	❍	❍
... increased my number of patents and/or patent applications	❍	❍	❍	❍	❍	❍
... enabled me to fund/contribute to the funding of	❍	❍	❍	❍	❍	❍

	Very accurate	Accurate	Inaccurate	Completely inaccurate	Don't know	Not relevant in my field of research
spin-offs						
... contributed to technology and knowledge transfer to my group	❍	❍	❍	❍	❍	❍
... facilitated collaboration with industrial and/or other partners	❍	❍	❍	❍	❍	❍
... helped my public outreach activities	❍	❍	❍	❍	❍	❍
... increased my visibility among national actors	❍	❍	❍	❍	❍	❍

How relevant was the contribution of your INTER project grant(s) for your scientific independence?

❍ Very relevant
❍ Relevant
❍ Irrelevant
❍ Very irrelevant
❍ Don't know

Did/does the INTER project grant(s) have a substantial influence on your further career?

Did/does the INTER project grant(s) have a substantial influence on your further career?

❍ Yes, namely: _____
❍ No

Could your research project(s) have been carried out without the INTER project grant(s)?

- ❍ Yes
- ❍ No

After the rejection(s) of your application(s) for INTER, were you still able to conduct the research project(s) for which you submitted the application?

- ❍ Yes, to the same extent
- ❍ Yes, but to a smaller extent
- ❍ No

How did you secure funding?

Did the rejection of your application(s) for INTER have further consequences for you and your career?

- ❍ Yes, namely: _____
- ❍ No

The following questions concern your current career situation.

Are you still working at the same institution as you were at the time of your (first) application for INTER between 2010 and 2015?

- ❍ Yes
- ❍ No
- ❍ I'm not currently working.

Where is your current job?

- ❍ In Luxembourg
- ❍ In another country

At what kind of institution is your current job?

- ❍ University
- ❍ Public research organisation
- ❍ Private sector research
- ❍ Administration/NPO
- ❍ Other institution

Please describe your current position.

- ❍ Full professor
- ❍ Associate professor
- ❍ Assistant professor
- ❍ Scientific collaborator
- ❍ Lecturer
- ❍ Assistant
- ❍ Postdoc
- ❍ Other position, namely: _____

Is this position...?

- ❍ ... tenured
- ❍ ... with tenure track
- ❍ ... non tenured

Are you currently leading your own research group?

- ❍ Yes
- ❍ No

How many members does your own research group currently have?

_____ PhD students
_____ Postdocs
_____ Other personnel (assistants, technicians etc.)

Have you received (as PI) any other funding by the FNR or other funding institutions between 2010 and 2015? (multiple answers possible)

- ❑ Yes, FNR funding
- ❑ Yes, other Luxembourg institutional funding
- ❑ Yes, competitive third party funding (i.e.H2020)
- ❑ Yes, contract research
- ❑ Other, namely: _____
- ❑ No

What kind of FNR funding have you received?

- ❑ PEARL
- ❑ ATTRACT
- ❑ INTER
- ❑ AFR (as supervisor)
- ❑ Other FNR funding

What was approximately the total annual budget of your research group (in EUR) in 2015?

Which percentage of your budget is (approximately) financed by:

_____ The FNR
_____ Other competitive funding (i.e.H2020…)
_____ Contract research
_____ Institutional basic funding
_____ Other funding

The following questions concern your scientific output for your time of employment in Luxembourg during the period 2010-2015 in total and in relation to your INTER funding. If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.

If you have not produced a particular output, please indicate this by filling in "0". If an output indicator is not relevant in your discipline, please leave the field empty.

Since you've started working in Luxembourg, how many …

	Total number	Number related to INTER funding (< total number)
… journal articles have you published?		
… Books/monographs have you published?		
Policy reports have you published?		
… doctoral students have you supervised?		
… doctoral students have successfully completed their doctoral thesis under your supervision?		
… conferences have you contributed to (as a speaker, panellist etc.)?		
… scientific prizes have you won?		
… talks have you been invited to?		
… new international project collaborations have you realised?		
… new national project collaborations have you realised?		
... international competitive grants have you earned?		
… national competitive grants have you earned?		
… patents have you filed?		
… spin-offs have you initiated?		
… collaborations with industrial or other partners have you realised?		

The following questions concern your scientific output for your time of employment in Luxembourg during the period 2010-2015. If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.

If you have not produced a particular output, please indicate this by filling in "0". If an output indicator is not relevant in your discipline, please leave the field empty.

Since you've started working in Luxembourg, how many…

	Total number
… journal articles have you published?	
… Books/monographs have you published?	
Policy reports have you published?	
… doctoral students have you supervised?	
… doctoral students have successfully completed their doctoral thesis under your supervision?	
… conferences have you contributed to (as a speaker, panellist etc.)?	
… scientific prizes have you won?	
… talks have you been invited to?	
… new international project collaborations have you realised?	
… new national project collaborations have you realised?	
... international competitive grants have you earned?	
… national competitive grants have you earned?	
… patents have you filed?	
… spin-offs have you initiated?	
… collaborations with industrial or other partners have you realised?	

Given your career stage (and what is typical for your research area) how do you rate your overall productivity?

- ❍ Very high
- ❍ High
- ❍ Moderate
- ❍ Low
- ❍ Very low

Please describe your activity in academic services.

Are you active in …

	Yes	No	Not relevant in my discipline/field of research
… professional scientific associations	❍	❍	❍
… international selection committees (e.g. expert panels)	❍	❍	❍
… reviewing activities (e.g. articles, proposals)	❍	❍	❍
… editorial activities (e.g. journals, books)	❍	❍	❍
… organisation of conferences	❍	❍	❍

With the INTER funding scheme, the FNR aims to achieve various overarching goals. We would like to know your views with regard to the attainment of these goals.

How do you rate the following statements regarding the overarching goals of the FNR's INTER funding scheme?

	Very accurate	Accurate	Inaccurate	Completely inaccurate	No assessment possible
INTER is a suitable instrument for developing new international partnerships.	❍	❍	❍	❍	❍
INTER gives Luxembourg's public research a higher profile in the international context.	❍	❍	❍	❍	❍

We would like to terminate this survey by asking you to give us feedback on potential for improvement with regard to the INTER funding scheme.

From your experience, do you see such potential for improvement? Please explain.

You have now reached the end of our questionnaire. Have you answered all the questions? If so, move to the next page to save your answers. Please note that you will not be able to return to the questionnaire from there.

A1.3 ATTRACT APPLICANTS NOT RETAINED 2007–2015

Dear participant

We highly appreciate your willingness to participate in our survey concerning the Luxembourg National Research Fund's ATTRACT funding scheme. You have been asked to participate because you applied for an ATTRACT grant between 2007 and 2015.

It should take you approximately 15 minutes to complete the survey. Please select the answers that best reflect your personal opinion. Some open-ended questions have been included to allow for more detailed answers. You can browse backward and forward through the questionnaire by clicking on the arrows at the bottom of each page.

Your responses will be kept strictly confidential and your name will not be attached to any of the survey results.

If you have questions concerning the survey, or if you experience technical problems, please email or call Milena Iselin at Interface (iselin@interface-politikstudien.ch; +41 41 226 04 10).

Thank you very much for your valued collaboration.

The following questions concern your personal background to your application for an FNR ATTRACT grant.

In which year did you submit your application for an FNR ATTRACT grant?

- ❍ 2007
- ❍ 2008
- ❍ 2009
- ❍ 2010
- ❍ 2011
- ❍ 2012
- ❍ 2013
- ❍ 2014
- ❍ 2015

How significant were the following motives for your ATTRACT application?

	Very significant	Significant	Insignificant	Completely insignificant	Don't know
Option of going to/returning to Luxembourg	❍	❍	❍	❍	❍
Option of developing own research focuses	❍	❍	❍	❍	❍
Possibility to set up own research group	❍	❍	❍	❍	❍
Option of studying new research questions	❍	❍	❍	❍	❍
Reputation of the ATTRACT scheme	❍	❍	❍	❍	❍
Attractiveness of the ATTRACT scheme	❍	❍	❍	❍	❍
Reputation of the hosting institution/unit/research group	❍	❍	❍	❍	❍
Family/personal reasons	❍	❍	❍	❍	❍

Were there other significant reasons for your ATTRACT application?

How do you rate the importance of the following specificities of the ATTRACT funding scheme?

	Very significant	Significant	Insignificant	Completely insignificant	Don't know
Level of funding	❍	❍	❍	❍	❍
Tenure track	❍	❍	❍	❍	❍
Individual coaching	❍	❍	❍	❍	❍
Relocation assistance	❍	❍	❍	❍	❍

Additional comments on your answers:

Why did you choose your envisaged host institute (or your department, unit, lab, team, etc.)? (multiple answers possible)

- ❑ Reputation of the host institute
- ❑ Reputation of scientists at the host institute
- ❑ Importance of the host institute in my research field
- ❑ Existing links to the host institute
- ❑ Infrastructure of the host institute
- ❑ Employment conditions at the host institute
- ❑ Other/further reasons, namely: _____

Were the feedback documents provided by the FNR regarding your application useful to you?

- ❍ Yes
- ❍ No

Additional comments on your answer:

How do you evaluate the application process for ATTRACT in terms of the following criteria?

	Very adequate	Adequate	Inadequate	Very inadequate	Don't know
Fairness	❍	❍	❍	❍	❍
Transparency	❍	❍	❍	❍	❍
Work load to write the proposal	❍	❍	❍	❍	❍
Administrative effort involved in	❍	❍	❍	❍	❍

	Very adequate	Adequate	Inadequate	Very inadequate	Don't know
the application					
Complexity	❍	❍	❍	❍	❍
Quality	❍	❍	❍	❍	❍
Time until you received the decision	❍	❍	❍	❍	❍
Support/information of the FNR	❍	❍	❍	❍	❍
Support/information of your host institution	❍	❍	❍	❍	❍

Additional comments on your answers:

The following questions are about your situation at the time of your application for ATTRACT

Where were you working when you submitted your ATTRACT application?

❍ University
❍ Public research organisation
❍ Private sector research
❍ Administration/NPO
❍ Other workplace
❍ I was not working.

How can your position be best described at the time you submitted your application for ATTRACT?

❍ Full professor
❍ Associate professor
❍ Assistant professor
❍ Lecturer
❍ Assistant
❍ Postdoc
❍ Scientific collaborator
❍ Other position, namely: _____

Was this position ...?

- ❍ ... tenured
- ❍ ... with tenure track
- ❍ ... non tenured

Your application for ATTRACT was not retained by the FNR. The following questions concern the effects this has had on you and your career.

At which stage was your ATTRACT application not retained?

- ❍ Before the interview
- ❍ After the interview

After your application for ATTRACT was not retained, were you employed at your envisaged ATTRACT host institute thanks to funding from other sources?

- ❍ Yes
- ❍ No

Were you still able to conduct the research project for which you submitted the ATTRACT application?

- ❍ Yes, to the same extent
- ❍ Yes, but to a smaller extent
- ❍ No

How did you secure funding?

Did you receive any other grant after your ATTRACT application was rejected? (multiple answers possible)

- ❑ Yes, FNR funding
- ❑ Other Luxembourg institutional funding
- ❑ Yes, competitive third party funding (i.e. Horizon 2020)
- ❑ Funding from my former host institution
- ❑ No

What kind of FNR funding did you receive?

- ❑ CORE
- ❑ INTER
- ❑ PEARL
- ❑ AFR
- ❑ Other FNR funding

Did the rejection of your application have further consequences for you and your career?

- ❍ No
- ❍ Yes, namely: _____

The following questions are about your career situation today.

In which country is your current main job?

- ❍ In Luxembourg
- ❍ In another country
- ❍ I am not currently working.

Are you currently mainly working as a researcher?

- ❍ Yes
- ❍ No

In what kind of institution is your current main job?

- ❍ University
- ❍ Public research organisation
- ❍ Private sector research
- ❍ Administration/NPO
- ❍ Other workplace

How can your current position be best described?

- ❍ Full professor
- ❍ Associate professor
- ❍ Assistant professor
- ❍ Scientific collaborator
- ❍ Lecturer
- ❍ Assistant
- ❍ Postdoc
- ❍ Other position, namely: _____

Is this position ...?

- ❍ ... tenured
- ❍ ... with tenure track
- ❍ ... non tenured

How many people do you currently manage?

Are you involved in the management of a department or research unit at your institution?

- ❍ Yes
- ❍ No

Are you involved in the organisation of a doctoral programme?

- ❍ Yes
- ❍ No

Have you been active in research since your application for ATTRACT was not retained?

- ❍ Yes
- ❍ No

The following question concerns your scientific output. Please indicate which of the following outputs are relevant in your field of research. (Multiple answers possible)

- ❑ Journal articles
- ❑ Books/monographs
- ❑ Policy reports
- ❑ Supervision of doctoral students
- ❑ Conference contributions
- ❑ Scientific prizes
- ❑ Scientific talks
- ❑ International project collaborations
- ❑ National project collaborations
- ❑ International competitive grants
- ❑ National competitive grants
- ❑ Patents
- ❑ Spin-offs
- ❑ Collaborations with industrial or other partners

The following question concerns your scientific output since your application for ATTRACT was not retained by the FNR. If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.

If you have not produced a particular output, please indicate this by filling in "0".

Since your application for ATTRACT, how many …

… journal articles have you published?	
… Books/monographs have you published?	
Policy reports have you published?	
… doctoral students have you supervised?	
… doctoral students have successfully completed their doctoral thesis under your supervision?	
… conferences have you contributed to (as a speaker, panellist etc.)?	
… scientific prizes have you won?	
… talks have you been invited to?	
… new international project collaborations have you realised?	
… new national project collaborations have you realised?	

... international competitive grants have you earned?	
... national competitive grants have you earned?	
... patents have you filed?	
... spin-offs have you initiated?	
... collaborations with industrial or other partners have you realised?	

Given your career stage (and what is typical for your research area) how do you rate your overall productivity?

- ❍ Very high
- ❍ High
- ❍ Moderate
- ❍ Low
- ❍ Very low

Please describe your activity in academic services. Are you active in ...

	Yes	No	Not relevant in my discipline/field of research
... professional scientific associations	❍	❍	❍
... international selection committees (e.g. expert panels)	❍	❍	❍
... reviewing activities (e.g. articles, proposals)	❍	❍	❍
... editorial activities (e.g. journals, books)	❍	❍	❍
... organisation of conferences	❍	❍	❍

We would like to terminate this survey by asking you to give us feedback on potential for improvement with regard to the ATTRACT funding scheme.

From your experience, do you see such potential for improvement? Please explain.

You have now reached the end of our questionnaire. Have you answered all the questions? If so, move to the next page to save your answers. Please note that you will not be able to return to the questionnaire from there.

A1.4 ATTRACT FELLOWS 2007–2015

Dear participant

We highly appreciate your willingness to participate in our survey concerning the FNR's ATTRACT funding scheme.

It should take you 10 minutes to complete the survey. Please select the answers that best reflect your personal opinion. You can browse backward and forward through the questionnaire by clicking on the arrows at the bottom of each page.

Your responses will be kept strictly confidential and your name will not be attached to any of the survey results.

If you have questions concerning the survey, or if you experience technical problems, please email or call Milena Iselin at Interface (iselin@interface-politikstudien.ch; +41 41 226 04 10).

Thank you very much for your valued collaboration.

Please indicate which of the following outputs are relevant in your field of research. (Multiple answers possible)

- ❑ Journal articles
- ❑ Books/monographs
- ❑ Policy reports
- ❑ Supervision of doctoral students
- ❑ Conference contributions
- ❑ Scientific prizes
- ❑ Scientific talks
- ❑ International project collaborations
- ❑ National project collaborations
- ❑ International competitive grants
- ❑ National competitive grants
- ❑ Patents
- ❑ Spin-offs
- ❑ Collaborations with industrial or other partners

The following questions concern your scientific output from the start of your ATTRACT funding until today. Please indicate your total output and your output in relation to your ATTRACT funding.

If you don't know the exact figure, please make an estimate. Please indicate published output only, not work in progress or submitted for publication.If you have not produced a particular output, please indicate this by filling in "0".

Since the start of your ATTRACT funding period, how many …

	Total number	Number related to ATTRACT (< total number)
… journal articles have you published?		
… Books/monographs have you published?		
Policy reports have you published?		
… doctoral students have you supervised?		
… doctoral students have successfully completed their doctoral thesis under your supervision?		
… conferences have you contributed to (as a speaker, panellist etc.)?		
… scientific prizes have you won?		
… talks have you been invited to?		
… new international project collaborations have you realised?		
… new national project collaborations have you realised?		
...international competitive grants have you earned?		
… national competitive grants have you earned?		
… patents have you filed?		
… spin-offs have you initiated?		
… collaborations with industrial or other partners have you realised?		

Given your career stage (and what is typical for your research area) how do you rate your overall productivity?

- ❍ Very high
- ❍ High
- ❍ Moderate
- ❍ Low
- ❍ Very low

Please describe your activity in academic services. Are you active in …

	Yes	No	Not relevant in my discipline/field of research
… professional scientific associations	❍	❍	❍
… international selection committees (e.g. expert panels)	❍	❍	❍
… reviewing activities (e.g. articles, proposals)	❍	❍	❍
… editorial activities (e.g. journals, books)	❍	❍	❍
… organisation of conferences	❍	❍	❍

Are you currently active in international committees, boards or scientific associations dealing with topics related to research?

- ❍ Yes
- ❍ No

In which role/roles?

Are you involved in the management of a department or research unit at your institution?

- ❍ Yes
- ❍ No

Are you involved in the organisation of a doctoral programme?

- ❍ Yes
- ❍ No

We would like to know how you estimate the impact of your ATTRACT grant.

Please tick what is applicable to you with regard to the following statements.

My ATTRACT grant has ...

	Very accurate	Accurate	Inaccurate	Completely inaccurate	Don't know	Not relevant in my field of research
... increased the number of my scientific publications	❍	❍	❍	❍	❍	❍
... improved the quality of my scientific publications	❍	❍	❍	❍	❍	❍
... increased the number of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... improved the quality of my contributions in international conferences	❍	❍	❍	❍	❍	❍
... facilitated follow-up research projects	❍	❍	❍	❍	❍	❍
... led to scientific prizes	❍	❍	❍	❍	❍	❍
... led to more invitations to talks	❍	❍	❍	❍	❍	❍
... enabled me to start new international collaborations	❍	❍	❍	❍	❍	❍
... led to successful applications for further competitive funding	❍	❍	❍	❍	❍	❍
... increased the number of completed doctorates in my group	❍	❍	❍	❍	❍	❍
... had a positive impact on the career(s) of the PhD student(s) and/or Post Doc(s) in my group	❍	❍	❍	❍	❍	❍
... increased my number of patents and/or patent applications	❍	❍	❍	❍	❍	❍
... enabled me to fund/contribute to the funding of spin-offs	❍	❍	❍	❍	❍	❍
... contributed to technology and knowledge transfer to my group	❍	❍	❍	❍	❍	❍
... facilitated collaboration with industrial and/or other partners	❍	❍	❍	❍	❍	❍
... helped my public outreach activities	❍	❍	❍	❍	❍	❍
... increased my visibility among national actors	❍	❍	❍	❍	❍	❍

How relevant is/was the contribution of your ATTRACT grant to your scientific independence?

- ❍ Very relevant
- ❍ Relevant
- ❍ Irrelevant
- ❍ Very irrelevant
- ❍ Don't know

You have now reached the end of our questionnaire. Have you answered all the questions? If so, move to the next page to save your answers. Please note that you will not be able to return to the questionnaire from there. Thank you very much!

Luxembourg National
Research Fund

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