

# **SYNTHESIS REPORT** **IMPACT ASSESSMENT** **OF THE FNR FUNDING** **PROGRAMMES CORE,** **INTER, ATTRACT AND** **PEARL**

**INTERFACE**  
**POLITIKSTUDIEN FORSCHUNG BERATUNG**

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

Synthesis 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<sup>1</sup> 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.<sup>2</sup> 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.

<sup>1</sup> 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.

<sup>2</sup> 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.

## I SYNTHESIS AND RECOMMENDATIONS

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The evaluation presented in the synthesis 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.<sup>3</sup> 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.

<sup>3</sup> 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%)	✓ ( <i>Fellows</i> : N = 12, 100%; <i>Not retained</i> : 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,<sup>4</sup> (3) impact,<sup>5</sup> (4) overarching objectives and (5) recommendations. A full version of the final report containing the evaluation results in more detail is available and can be requested of the FNR.

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 the full version of the final 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

<sup>4</sup> 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.

<sup>5</sup> As defined above.

surfaces and new sensing applications, (4) biomedical and health sciences, and (5) societal challenges for Luxembourg. The standard CORE track is directed at established 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<sup>6</sup>: 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 [...]”. 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’.<sup>7</sup> Impacts in the areas of dissem-

<sup>6</sup> 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.

<sup>7</sup> 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?”.

ination and valorization leave room for improvement. These conclusions are drawn based on the following findings:

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.

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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.

### 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<sup>8</sup> of the CORE selection procedure conducted by Western Michigan University in 2015.<sup>9</sup>

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.

<sup>8</sup> 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.

<sup>9</sup> 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 [...]."

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.

#### Recommendations for CORE MS

We make the following specific recommendation concerning CORE MS:

##### I 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)<sup>10</sup> 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 the full version of the final 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

<sup>10</sup> 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.

agency is the lead agency (and not the FNR).<sup>11</sup> 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.

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

<sup>11</sup> For more information see [www.fnr.lu](http://www.fnr.lu).

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 post-docs 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

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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 the full version of the final report.

#### 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 the full version of the final report.

### 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 funding 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, AT-

TRACT, 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 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 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.

