Iceland Liechtenstein Norway grants

Norway grants

NCBR
Narodowe Centrum Badań i Rozwoju

Contractors:

EGO, LB&E

Evaluation of „Applied Research" Programme – final report

Authors:

Anna Borowczak
Tomasz Klimczak
Marta Mackiewicz
Adam Miller (coordinator)
Zuzanna Popis
Korneliusz Pylak

List of abbreviations

Abbreviation	Extension
EC	European Commission
EEA	European Economic Area
Environmental Policy	National Environmental Policy 2030
EU	European Union
FWD	Bilateral Cooperation Fund
IP	Intellectual Property
IT	Internet technology
KPO	National Recovery and Resilience Plan
KSRR	National Strategy for Regional Development 2030
NABS 2007	Nomenclature for the analysis and comparison of scientific programmes and budgets
NCBR	National Centre for Research and Development
NFM	Norwegian Financial Mechanism
NCN	National Science Centre
OP SG	Operational Programme Smarth Growth
PC	Programme Committee
PEP 2020	Poland's Energy Policy until 2040
Productivity strategy	Productivity Strategy 2030
R&D	Research and development
RCN	Research Council Norway
SGS	Small Grant Scheme
SME	Small and medium enterprises
SRG	Strategy for Responsible Growth (to 2020 with an outlook to 2030)
SRKL2030	Human Capital Development Strategy 2030
SRKS2030	Social Capital Development Strategy 2030
SRT2030	Sustainable Transport Development Strategy 2030
SZRWRiR	Strategy for sustainable rural, agricultural and fisheries development 2030
TRL	Technology readiness levels
ZSU2030	Integrated Skills Strategy 2030

SUMMARY

INTRODUCTION (PURPOSE OF THE STUDY)

The main objective of the study was to assess the progress of the — Norwegian Financial Mechanism (NFM) and European Economic Area (EEA) Financial Mechanism (EEA FM) "Applied Research" Programme so as to ascertain that the objectives of the Programme are being effectively met. The specific objectives of the study were as follows: 1) Assessment of the feasibility of achieving the intended effects of the "Applied Research" Programme, 2) Evaluation of the NFM and EEA FM "Applied Research" Programme participants' activeness in the transition from basic to applied research and of the further possibilities for practical use of the results of projects implemented under the Programme, 3) Evaluation of the appropriateness of the Programme's implementation and management system.

The study covered all calls, namely: POLNOR, POLNOR CCS, IdeaLab and SGS. Number of applications submitted in these calls amounted to 434 while the number of funded projects was 81.

STUDY METHODOLOGY

The study was carried out using a wide range of research methods including: desk research analysis, 66 surveys with beneficiaries, 169 surveys with unsuccessful applicants, interviews with: Principal Investigators (12), business entities participating in the projects (5), NCBR representatives (2), expert panel with members of the Programme Committee, 2 case studies covering research programmes in Romania and Lithuania and a recommendation workshop with NCBR representatives.

MAIN CONCLUSION OF THE STUDY

Implementation of the "Applied Research" Programme to date indicates that its expected results of *enhanced performance of Polish applied research* and *enhanced collaboration between beneficiary and donor state entities involved in the Programme* will be achieved. Thanks to the Programme, dozens of partnerships have been established with Norwegian entities, fostering mutual exchange of knowledge and experience. Supported projects are strongly pro-business oriented and there is a high potential that their results will be implemented. The terms and conditions for submitting and implementing projects are characterized by a high level of tailoring to the needs of scientific entities and businesses.

TERMS AND CONDITIONS FOR SUBMITTING AND IMPLEMENTING PROJECTS

Barriers impeding Programme's accessibility to Polish entities.

Beneficiaries of the Programme assessed there is a generally good alignment between the rules on eligibility envisaged in the Programme and their needs. The selection of thematic fields is rated highest (98% of positive responses). Moreover, the project selection procedure is assessed very positively, especially in terms of transparentness of project selection criteria (92% of positive responses).

- Conclusion: The rules on eligibility as established in the Programme are assessed as appropriate given the needs of beneficiaries.

Project duration was assessed positively by little more than half of participants. This is mostly connected with the external factors affecting Programme. 91% of beneficiaries opted generally for prolonging the envisaged duration of their projects implemented in the 3rd. edition of the Programme. There is a posibility to extend the duration of the project until 30th April 2024 by a number of months depending on the start date.

- Conclusion: The project duration could be prolonged to 30th April 2024.

Many recent evaluation studies concerning participation of research entities in international cooperation funding schemes, have identified their internal capacities as one of the key barriers. Therefore, we took a closer look at the administration and management of the projects and establishing international cooperation. These findings have been confirmed by the results of the current study, however the relevance of these factors for project implementation has been found to be varied.

In the study a generally inadequate administrative support was observed among participating research institutions, which resulted in often excessive workload, overburdening Principal Investigators and distracting them from their substantial tasks in the project. There is a need to undertake measures boosting internal capacity of Project Promoters.

Barriers to implementing the Programme (including COVID-19)

The impact of the COVID-19 pandemic was universal: 80% of survey participants point to the COVID pandemic as a significant factor impacting project implementation, whereas 91% of beneficiaries need to extend the duration of their project.

- Conclusion: The Programme Operator is open to allowing for duly justified changes to be introduced as to the duration of projects. If necessary, they might be extended by up to one year, with the final implementation deadline being compliant with the final date of eligibility under the Programme, which is 30 April 2024.

A rapidly deteriorating economic environment prone to shocks stemming from both pandemics and war in Ukraine: 83% of respondents indicated increased price of goods and services, and 61% increased cost of employment, as significant factors impacting on project implementation; with 30% of beneficiaries declaring the need to introduce changes in the material content of projects under implementation.

- Conclusion: Programme Operator is inclined towards acting on the opinion submitted by the National Focal Point, suggesting reuse of programme's savings from foreign exchange differences so as to support currently running projects.

Cultural differences regarding project management and collaboration

More than half of respondents (52%) do not perceive the existence of cultural differences regarding project management and project collaboration, and more than 25% have no opinion. Those who acknowledge them mostly view these positively, while 20% of respondents view them negatively. Cases in which cultural differences became apparent primarily concern situations, where the need arose to perform previously unforeseen work in a relatively short period. Polish teams are more likely to respond to such needs. Respondents participating in the interviews noted that more significant differences are evident between the academic and business worlds than between Polish and Norwegian teams.

- Conclusion: cultural differences are marginally apparent, are not perceived as problematic and do not significantly impact project implementation.
- Conclusion: it is not necessary to make beneficiaries aware of the existence of cultural differences beforehand, nor to prepare them to deal with problems related to cultural differences.

Protection of intellectual property in projects

95% of the respondents assessed that the negotiation of provisions of their consortium agreements concerning intellectual property rights issues took place in a friendly or neutral atmosphere. Only 14%

stated that reaching an agreement with a partner on IPR required longer negotiations than other provisions of the agreement.

- Conclusion: agreeing IPR provisions of the agreement that were acceptable to all consortium members was not a significant challenge.

Agreements between consortium members do not cover all issues related to the management of intellectual property in projects. Relatively rarely were terms agreed on how to determine the market value of intellectual property and when to commercialise it. This situation was influenced by the level of advancement of the projects - all of them are still in progress.

- Conclusion: further decisions on intellectual property will need to be taken after the projects are completed - particularly if rights to research results are to be commercialised.

The majority of Principal Investigators declared that the project had increased their knowledge of IP management (55%) and that it would be easier for them to manage IP in future projects (52%).

- Conclusion: participation in projects had a positive impact on the level of competencies in IP management.

THEMATIC RELEVANCE OF THE PROGRAMME

The text mining analysis of 434 project proposals submitted to 'Applied Research' Programme in the third edition revealed that in general thematic areas of the Programme were interesting to applicants with two exceptions: 'Socio-economic development' and 'Unmanned vehicles'. The most interesting Programme thematic area was the one covering energy, transport, and climate with an emphasis on energy. This area triggered synergies between several other strongly buzzing areas, i.e., digital and industrial, food and natural resources, welfare, health and care and CO_2 capture solutions.

There was widespread interest in the various thematic areas of the Programme, as the participation of Principal Investigators from 36 out of a total of 49 scientific disciplines was recorded. However, this interest matched the potential of Polish scientific institutions to varying degrees. This was because the calls were targeted at specific thematic areas mainly of an implementation nature. Thus, basic sciences (such as chemical, biological, and physical sciences) were less interested in applying for funds. In turn, disciplines related to the most interesting Programme thematic areas, such as climate, environment, energy, and engineering were overrepresented in project proposals (where many more project proposals were submitted than the potential indicates). There are also disciplines whose potential is rather sufficiently exploited in project proposals such as biomedical engineering, architecture and urban planning, mathematics, and ICT. Finally, there are disciplines which, even though they fall within the thematic areas of the Programme, are not sufficiently represented in the project proposals. These disciplines relate to two thematic areas of the Programme: (1) 'Welfare, health and care' and (2) 'Social and economic development'. These areas are a key focus of the strategic documents, and thus it would definitely be worthwhile to strengthen the promotion of the Programme among scientists from the disciplines of both medical, health, pharmaceutical sciences and business and economics sciences, in order to increase their appearance in the Programme.

- Conclusion: The 'Applied Research' Programme has attracted researchers from most scientific disciplines, but to varying degrees. In particular, the two thematic areas of welfare, health, care, and socio-economic development are under-represented in the Programme.

It is difficult to justify the potential for companies to bring new technologies to market, as the majority of companies (44) in consortia are knowledge-intensive service companies that may have limited capacity to implement technologies and bring them to market (although they may further develop, sell and license technologies). Only 20 companies were manufacturing companies and 12 were ICT companies.

- Conclusion: Projects tended to focus on enhancing collaboration between researchers activating their existing potential rather than developing technologies to be implemented in the market as innovations.

PLANNED EFFECTS OF THE PROGRAMME

Effects with planned indicators

Only one indicator target, which involves the number of grant agreements with consortia involving companies, will not be achieved. As a result of the completed calls, 40 such agreements were signed (38 in POLNOR 2019 and 2 in POLNOR CCS). Thus, the degree of achievement of the target value of the indicator is 89%. The remaining four result indicators (Peer-reviewed scientific publications submitted, Joint peer-reviewed scientific publications submitted, New products/technologies developed, Registered applications for Intellectual Property Protection) will, according to the declarations of beneficiaries in the grant agreements, be significantly exceeded (for example that concerning the development of new products and technologies - by more than two and a half times (251%)). The vast majority of beneficiaries are of the opinion that there is no or very small risk of failing to achieve the targets set in their contracts. The most tentative indicator is the number of patent applications. This indicator also has the highest percentage of "I don't know/difficult to say" responses (26%). This is due to the uncertainty, natural at this stage of the research, as to whether the future results of the R&D work carried out will qualify for patent application.

The bilateral result indicator relating to the number of contractually planned joint applications for further funding of joint projects exceeds the target value by almost ten times (59/6). Other bilateral result indicators relating to the quality and satisfaction with the cooperation between consortium partners and institutions cooperating in the implementation will be measured by the donor (survey) at the end of the Programme.

- Conclusion: The aggregate values of the indicators planned in the contracts significantly exceed the target values of the Programme indicators. The beneficiaries expect to achieve the planned indicator targets.

Participation of business entities in the Programme/Practical use of research results

At the stage of project design, it was important or very important for 88% of Principal Investigators that the results of the project had the potential for practical use, e.g., in the business sector. 79% of POLNOR beneficiaries declared that businesses were involved in the formulation of projects. Enterprises participate in 49% of the supported projects. The total number of companies involved in the projects is 49. The average share in the total cost of the projects in which they are involved as covered by companies is 19%.

- Conclusion: The supported projects are to a large extent pro-business oriented. Although companies are present in a large number of projects, their financial participation is moderate, which is due, among other things, to the lack of a required minimum level of financial participation by companies in the projects, the leadership taken by the scientific units and the level of financing.

Signals concerning any examples of the inappropriateness of the terms and conditions for application or implementation of projects, given the needs of economic operators, were rare. Companies appreciated: the international character of projects, the possibility to act as a consortium member and not as a project leader, the lack of formulation in the grant agreement of an obligation to implement the results of projects.

- Conclusion: the conditions for applying for and implementing support should generally be considered to be tailored to the needs of economic entities.

Companies spent 87% of their allocated budgets on industrial research. More than half of the companies did not carry out any experimental development as part of their projects. This situation was influenced by a number of circumstances, such as: a lower level of funding for experimental development , the lack of an obligation to implement results, the realisation of R&D in areas of new, rarely explored issues. The majority of projects funded from the POLNOR call will end between technology readiness level (TRL) 6 and 7 - similar to projects from other calls (POLNOR CCS, IdeaLab, SGS).

- Conclusion: the participation of companies in the Programme did not translate into a strong orientation of projects towards higher levels of technology readiness but this should not be judged negatively. Industrial research has a much greater potential to generate completely new knowledge than experimental development.

At the time of the evaluation, none of the projects had been completed. 65% of respondents indicated that their projects would need to be continued once all the research work planned in the project proposal had been carried out. 98% of them intend to participate in projects continuation. Only 23% of projects will end with results practically ready for implementation. The most frequently indicated risk threatening the commercialisation of results is the lack of financial resources necessary to continue the project in order to bring it to higher levels of technological readiness.

- The effects of the projects on the practical application of the research results will be observable in the long term and will largely depend on whether the projects can be continued.

Participation of female researchers in the Programme (SGS call)

According to recent studies cited in this report[1] one of the key barriers hindering the participation of female scientists is their low appreciation of their own scientific achievements and conviction about the limited chances for obtaining funding in international competition. The SGS call answered these challenges very well. It was immensely popular among its participants: 337 applications were submitted in total, whereas 31 projects were contracted in the Programme.

- Conclusion: the call is very well targeted so as to amend identified barriers. Its popularity points to high demand. However, that leaves also some room for fine-tuning of future interventions. Profiting from consistently high demand, the eligibility criteria for beneficiaries might be even more targeted at most vulnerable groups among female researchers. This may involve increasing available funding or adding some additional criteria for project assessment (e.g., additional marks for returnees from maternity leaves etc.). Another possibility to advance the maturity of this intervention would be to increase the complexity of the projects, e.g., while allowing to finance research apparatus.

1 „The functioning of women and men in science" by the NCN Analysis and Evaluation Team and the Committee for Analysis of Scientific Activity of the NCN Scientific Council, Kraków 2022.

Expected impact of the Programme on the career development of young researchers

According to the programme's monitoring indicators, 30 young scientists were supported, which means that the target values of the indicator were exceeded. Based on the survey results, it can be assumed that the impact on young scientists' careers may have been even more significant, as 65 respondents indicated a positive impact of project implementation on the careers of young scientists. In addition, in every second project proposal submitted, the Principal Investigator was a young scientist. This is especially true for SGS grant applications.

- Conclusion: beneficiaries are positive about the programme's focus on the career development of young scientists, pointing to numerous benefits in this regard, such as new publications, new contacts, doctoral thesis.
- Conclusion: the Programme fills a gap in funding for applied research conducted by young scientists (NCN funds only basic research).

LINKAGES BETWEEN THE SECOND AND THIRD EDITION OF EEA & NORWAY GRANTS ('BASIC RESEARCH' AND 'APPLIED RESEARCH' PROGRAMMES)

Institutional links: The analysis covered project proposals in the second and third editions, including the 'Basic Research' Programme. In total, project proposals consortia comprised 447 unique scientific and business entities in terms of VAT number, including 115 from Norway. Of the 447 entities, 130 appeared in the second but not the third edition, and 168 did not appear in the second edition but did appear in the third edition. This means that only 111 institutional entities appeared in project proposals in both editions. However, despite the significant change and the appearance of a number of completely new institutional entities in the third edition, most of the project proposals consortia in the third edition consisted of partners with experience from the previous edition, and almost all institutional Project Promoters had such experience.

- Conclusion: The programme mainly contributed to the creation of new consortia, however, consortia included at least one partner with experience from the second edition, indicating the durability of the institutional experience of institutional project promoters and partners.

Personal links: Institutional experience is unlikely to ensure consistency of personal networks, as the 2,748 researchers appearing in project proposals of the second and third editions (including 'Basic Research' Programme) form 1,978 links. However, 97% of these links are single, indicating that researchers are overwhelmingly working in various partnerships formed specifically for projects (and not continued).

- Conclusion: The continuity of project teams in the third edition is barely visible, as only 4% of researchers working in those teams submitted proposals in both editions.

Thematic links: The most interesting Programme thematic areas of the 'Applied Research' Programme (such as climate, environment, energy, and health) are a continuation of the research topics already undertaken in the second edition. In contrast, the thematic links between the second edition of the Programme and the third edition of the 'Basic Research' Programme are rare but when they do occur, they are strong (in other words, rare keywords occur repeatedly). This means that only a small proportion of projects developing basic research fit into research desirable for new product, service and solution development. The direct reason for the rare but strong links to the second edition is not only the experience of the Principal Investigators from the previous edition, but above all the lack of focus of the call on topics related to the 'Applied Research' Programme. Interestingly, despite the identified lack of persistence in the project teams (described above), the consistency of themes is high.

- Conclusion: Researchers submitting project proposals to the 'Basic Research' Programme are far less likely to continue the topics of project proposals from the second edition than researchers submitting project proposals to the 'Applied Research' Programme. Despite the identified lack of persistence in the project teams (described above), the consistency of topics is high in the latter Programme.

PROGRAMME IMPLEMENTATION AND MANAGEMENT SYSTEM

General quality of service provided by the Programme Operator to beneficiaries is adequate and well assessed in the survey. The exception is slow processing of requests and inquiries or signing important project documentation e.g., annexes etc.

- Conclusion: the number of project counsellors could be increased in the Programme.

Some reservations noted in the study concerned deficits of IT system operated by the NCBR. The Programme Operator requested more information on Romanian implementation of IT support, which was provided through a case study.

- Conclusion: NCBR is aware of recurring problems with the IT system and is currently working on the development of a new IT system.
- Another systemic issue that was raised by members of the Programme Committee aimed to better clarify and specify in more details their scope of duties. Also, members of this advisory board would benefit from obtaining more information about lessons learned in previous editions of the Programme. Although the issue of the scope of responsibilities of this body was raised in this evaluation study, no recommendations on changes have been proposed in consequence of discussions during the final workshop. By comparison with other Programmes selected for the purposes of case studies in this evaluation (i.e.,Romanian Research Programme and Baltic Research Programme) the scope of responsibilities of the Programme Committee is similar and results from the general provisions for analogous programmes financed from NFM and EEA.

RECOMMENDATIONS

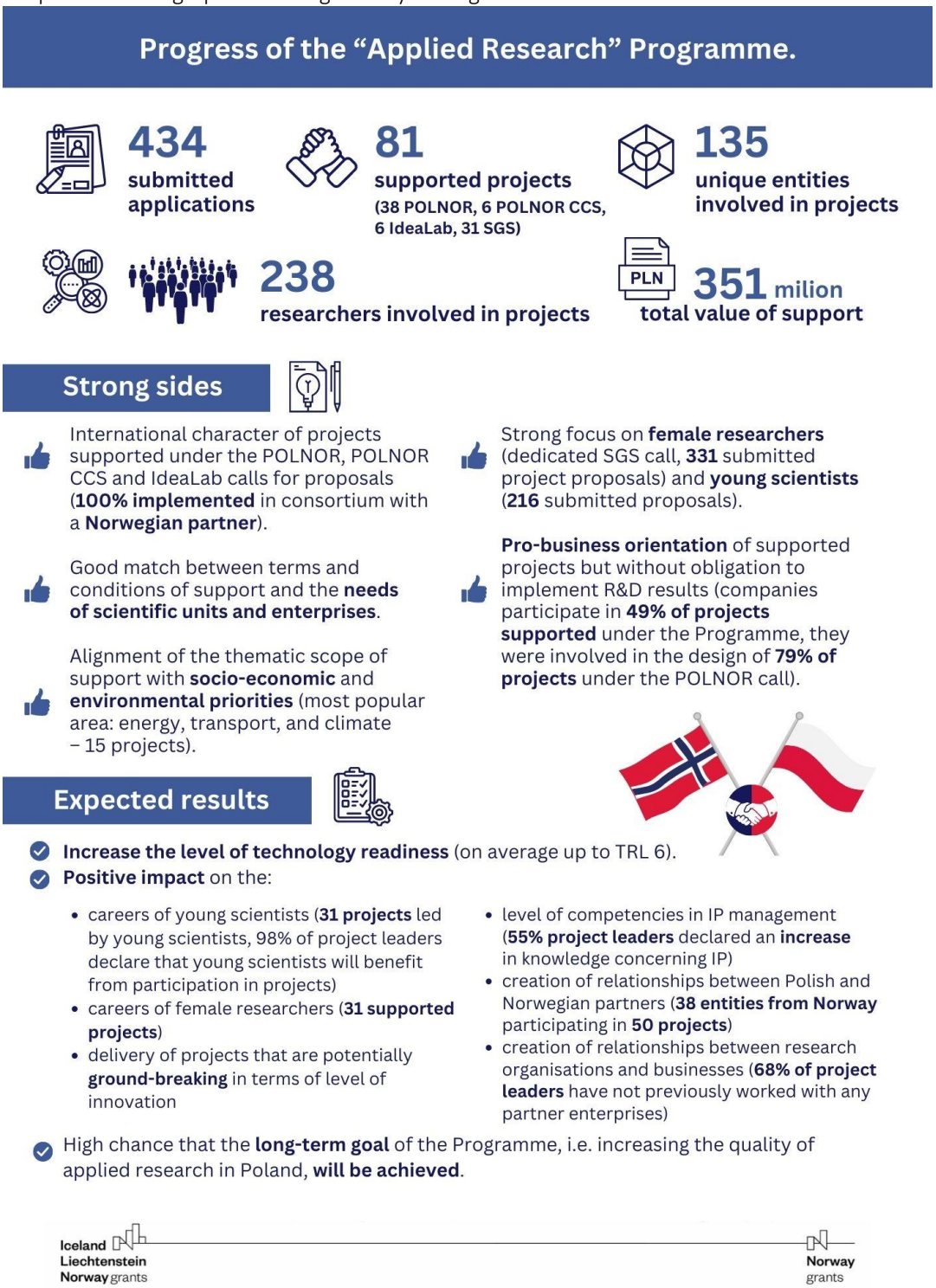
Detailed suggestions on how to implement the recommendations can be found in Chapter No. 7 (Recommendations).

- Implementation by the Programme Operator of mechanisms that will minimise the risk of perfunctory participation in projects by companies, resulting from their low financial commitment. Possible ways of implementation: requiring minimum financial contribution from companies to the eligible costs of the project; evaluation, at the project selection stage, of the company's planned degree of commitment to the project; introduction of a requirement for the company to be the leader of at least one task carried out in the project.
- Reflecting the specificity of individual calls in the way project proposals are evaluated by the Programme Operator. Possible ways of implementation: differentiation of criteria between calls; differentiation of scoring weights between calls for proposals; keeping the same criteria but varying their definition; sensitising experts evaluating proposals to the different specificities of calls for proposals.
- Introduction of additional measures by the Programme Operator to positively influence the participation of companies in the Programme and the chance to commercialise research results. Possible ways of implementation: stimulating the inclusion of actions in the development phase of

projects by awarding bonus marks at the evaluation stage; giving preference at the evaluation stage to those projects in which the financial participation of companies is higher; admission of scientific and industrial consortia in the SGS call; giving a scoring preference to those project proposals submitted in the SGS call, which foresee cooperation with the economic sector.

- Implementation of measures to foster the dissemination of knowledge on the possibility of separating the responsibility for the research part and the formal-legal part of R&D projects in science sector units. Possible ways of implementation: Organising training courses for project supporters employed in administrative units (departments) so that they can become familiar with the practices of Norwegian grant offices.
- Organization of training courses (e.g., in the donor country) for project supporters employed in administrative units (departments) so that they can become familiar with the practices of Norwegian grant offices in terms of supporting researchers in implementing projects and preparing contracts.
- Apply for more working months assigned to the staff of the Programme Operator.
- Increasing the allocation of funds in the SGS call, the average value of project and adding more requirements concerning eligibility of applicants to increase the maturity of intervention targeted at female researchers. Alternatively, the separate path for female researchers might be added to basic calls of the Programme or additional scores for female Principal Investigators applying in these calls.

Graphic 1 An infographic showing the key findings of the evaluation.



Source: own elaboration

1. INTRODUCTION – AIM OF THE STUDY AND METHODOLOGY

The subject of the study was to carry out a mid-term evaluation study of the “Applied Research” Programme under the 3rd edition of the EEA Financial Mechanism and Norwegian Financial Mechanism 2014-2021.

The main objective of the study was to assess the progress of the “Applied Research” - EEA FM and NFM Programme from the point of view of ensuring that the objectives of the Programme were effectively met. The specific objectives concerned:

- Assessment of the feasibility of achieving the intended effects of the “Applied Research” Programme;
- Evaluation of “Applied Research” programme participants’ activity in the transition from basic to applied research and further opportunities for the practical use of the supported projects results;
- Assessment of the soundness of the programme implementation and management system.

The study used a theory-supported evaluation paradigm, specifically the so-called 'realist impact evaluation' approach, which states that the effects of an intervention depend on its mechanisms (e.g., the way it is implemented) and its context.

The study was carried out using the following research methods:

- Desk research analysis, in particular: programme and competition documentation, applications, data from the monitoring system;
- Beneficiary surveys (66 surveys, 81% return rate);
- Surveys with unsuccessful applicants (169 surveys, 48% return rate);
- 12 interviews with Principal Investigators (5 POLNOR, 1 POLNOR CCS, 5 SGS, 1 IdeaLab);
- 5 interviews with companies participating in the projects (3 from Poland and 2 from Norway);
- 2 interviews with NCBR representatives;
- 1 interview with RCN representative;
- Panel of experts with members of the Programme Committee;
- 2 case studies covering research programmes in Romania and Lithuania;
- Recommendation workshop with NCBR representatives.

2. TERMS AND CONDITIONS FOR SUBMITTING AND IMPLEMENTING PROJECTS

Key findings

- The impact of COVID-19 pandemic was universal: 80% of participants in the survey point at the COVID pandemic as significant factor impacting the project implementation, whereas 91% of beneficiaries need to extend the duration of project.
- Consequences of rapidly deteriorating economic environment prone to shocks from both pandemics and war in Ukraine affected the Programme: 83% of respondents indicated increase in the price of goods and services, and 61% increase in the cost of employment, as significant factors impacting the course of project implementation, with 30% of beneficiaries declaring the need to introduce changes in the realm of projects' material implementation.
- A generally good match between the rules of eligibility envisaged in the Programme and the needs of Polish applicants, whereas well-selected assortment of eligible thematic fields is rated best (98% of positive indications).
- Competition procedure is assessed very positively, especially in terms of transparent project selection criteria (92% of positive indications).
- Internal barriers to organisational capacity for Project Promoters observed in areas related to administrative management of projects and establishing international cooperation.
- More than half of the respondents (52%) do not notice cultural differences, and more than ¼ have no opinion in this area. However, those who have noted their existence are mostly positive about them.
- The main aspects of the cultural differences relate to communication, team collaboration and the way decisions are made.
- 95% of the respondents assessed that the negotiation of provisions of the consortium agreement concerning intellectual property rights issues took place in a friendly or neutral atmosphere. Only 14% stated that reaching an agreement with a partner concerning intellectual property rights required longer negotiations than other provisions of the agreement. So far, it has been relatively rare to reach an agreement on how to determine the market value of intellectual property and when to commercialise it. This situation was influenced by the low level of projects advancement (none of them has been completed).

2.1 Barriers impeding Programme's accessibility to Polish entities.

Assessment of general conditions of project implementation in "Applied Research" Programme

Participants of the survey conducted for the purpose of this evaluation study generally assessed the conditions offered in calls as well adjusted to their needs. All projects selected for the funding had to comply with criteria that are universally applied across the Programme. They are both multi-sectoral and multi-national, meaning they are relevant for all research programmes financed from EEA and Norway Grants:

- Relevance in relation to the objective and priorities of the Programme;
- Scientific and/or technical excellence;
- Quality and efficiency of the implementation and management;

- Impact of the project.

Especially, thematic areas of the Programme matching in Poland similar topics of Horizon Europe were positively assessed by participants with 98% of positive indications. Nearly the same amount of beneficiaries expressed positive view on requirements concerning quality and efficiency of project implementation emphasising sufficient competence of Principal Investigators in conducting planned research. This conclusion is confirmed by other cross-cutting research question asking more generally for the criteria of competition, to which 92% of participants pointed out at adequacy of evaluation criteria.

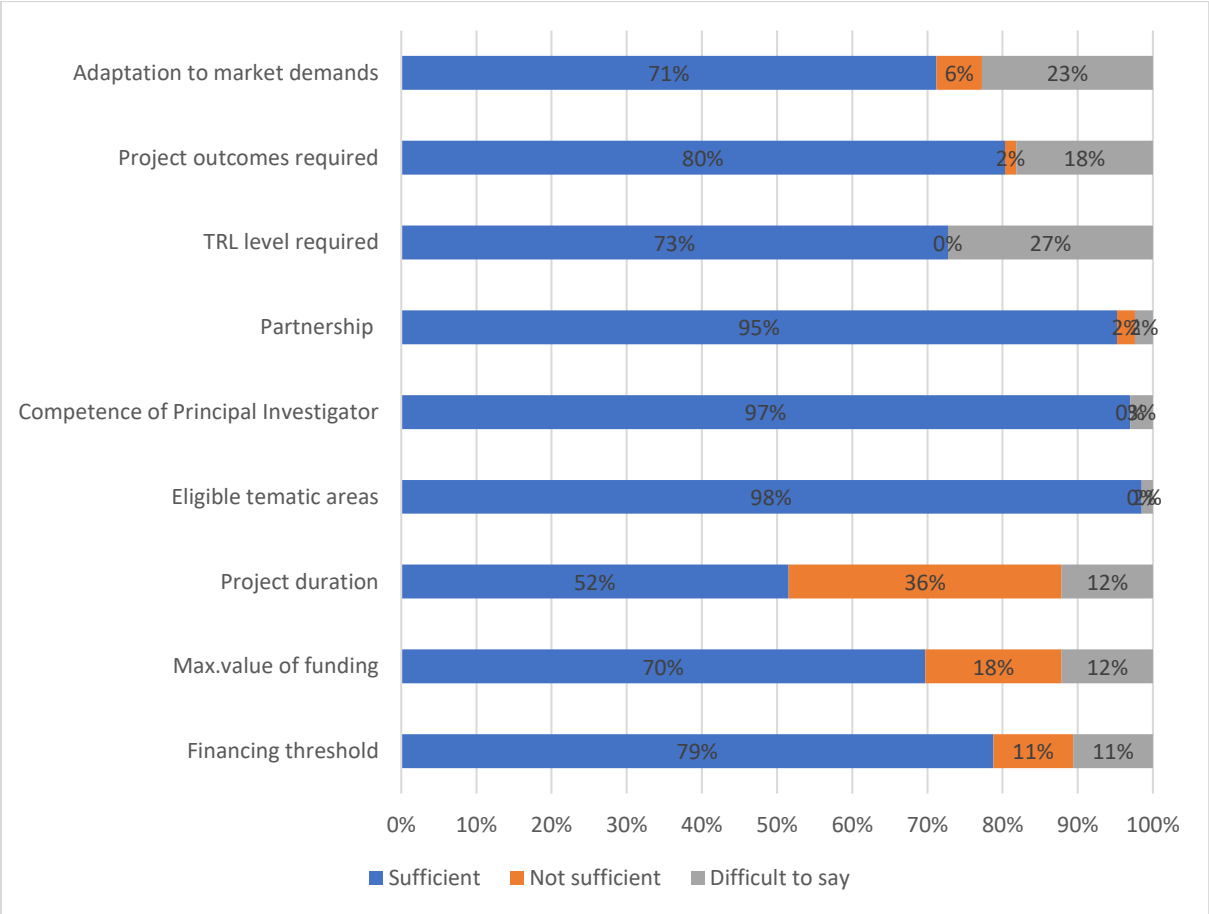
Other specific conditions framing the scope of intervention were predominantly assessed very well too. They include especially conditions of building partnerships and accessible levels of financing. Commercial applications are very welcome in the Programme. With respect to applicability of results, most beneficiaries regarded outcomes designed to measure project's performance as corresponding:

„Results are not necessarily hard, among other things because of the approach to commercialization and the nature of these end results obtained. Therefore, it is certainly not necessary to demonstrate the profitability of commercialization after completion. Well, it is a little easier when it comes to the determination of results, because here, too, the fact that we are in partnership with scientific entities means that the release of publications is somewhat natural" (quote from an interview with a consortium member).

Slightly lesser amount of respondents, but still exceeding two thirds of study participants, assessed technical readiness levels (TRL) and adaptation to the market needs as adequate in their projects. This outcome is consistent with other research question investigating whether conditions of the project were generally favourable for entrepreneurs. It needs to be stressed that requirements of the Programme allow for a certain degree of freedom in shaping the TRL levels, while exploring the innovativeness of approach without the risk of not obtaining funding due to specific TRL levels. This practical yet relaxed attitude offered by the Programme is highly appreciated by stakeholders as results from in-depth qualitative studies. In their opinion the advantage of the Programme lies in putting more emphasis on the scientific aspect instead of business development of a project:

„I am in the circle of people who are engaged precisely in the evaluation of such programmes. There is such a hypothesis circulating that the level of innovativeness of those projects which are co-financed from [ed. other popular programme] *because there is just an obligation to commercialize, well it is nothing. No, paradoxically not in projects that do not have this obligation. Why? Because companies, however, try to minimise their risk, knowing that they will have to implement these results. And they also focus on these higher TRLs. A programme such as Applied Research creates a certain room for experimentation and it could be said that this tolerance for making a mistake is higher, which encourages greater innovation"* (quote from an interview with a Principal Investigator).

Graph 1 Assessment of conditions of project implementation in “Applied Research” Programme



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=66

The lowest score in the study was attributed to project duration, which was assessed positively by little more than half of its participants. Prevailing reasons behind this relatively low opinion are connected with the external factors affecting Programme, commented in other sections of this report. Thus, they do not relate with the general construction of the Programme. However, in SGS scheme participants of the qualitative research opted generally for prolonging the envisaged duration of projects, which is currently amounting up to 24 months with possible extension until 30th of April 2024. They argued it should resemble the standard duration of a research project, which amounts to 36 months. One of the examples justifying such approach is given below:

„It's all quite short for someone to recruit so steadily for a PhD. And I tried to find such a person, but in our country it is so that in order to put out such a project for the doctoral school, it has to be a minimum of two years. I didn't know that, because I had 18 months entered” (quote from an interview with a Principal Investigator of SGS grant).

Internal capacity of applicants

While investigating barriers encountered by Polish participants of the Programme, we took a closer look at a couple of relevant aspects reflecting on their internal capacity. They referred to the systemic support offered to applicants by academic institutions in administrative management of their projects and establishing international cooperation. Unfortunately, in many up-to date evaluation studies concerning participation of research entities in international cooperation funding schemes, their internal capacity

turned out to be of one of key barriers[2]. Inadequate administrative support results in often excessive workload, overburdening Principal Investigators and distracting them from their substantial tasks in the project. In our study it proved to remain a valid to many beneficiaries, even if it was not universal:

„Well right now I'm also just preparing the documents for hiring a PhD student and there's really a lot of it. Also, it is this administrative issue that unfortunately takes up a lot of time that could be used for something else. But we have to get on with it" (quote from an interview with a Principal Investigator).

„Basically, the people who are administratively supposed to help me at the university are passing their duties on to me and making me find out certain things about the [ed. administrative] *progress, I would prefer this person who is already appointed at the university and this is their job and they are supposed to, for example, help me settle financial matters (...) Well, I don't really like the fact that apart from the fact that I'm supposed to be responsible for the content, to support the implementation of the project, that it's just at every stage and every literal string to be pulled"* (quote from an interview with a Principal Investigator).

Only little better are conditions by universities for establishing the international cooperation. Even if three quarters of Principal Investigators declare to have it already developed at a satisfying level before implementation of the project, 64% of them admit relying on personal contacts rather than existing formal strategies or partnerships offered systemically by their entities. Only one third of participants of the study had such prior arrangements at their universities, including, e.g., bilateral agreements, staff exchanges or scholarships related to the thematic field of project:

„Generally, it is that we have personal contacts, plus networking. That is, we can [ed. implement projects] *by making personal contacts and networking on topics that interest us. We are in the Taylor network of this European network, which has over 50 different entities. And that seems to me, fitted into the strategy of, I would say, probably a group of people more interested in developing artificial intelligence in the faculty"* (quote from an interview with a Principal Investigator).

Albeit establishing an international cooperation for the project was predominantly assigned to Principal Investigator, while adding to their many responsibilities, it was not deemed a factor disabling the implementation of a project.

Addressing the above constraints, we have discussed some possibilities to ameliorate them during the workshop with representatives of Programme Operator. The ideas referred mostly to relieving the administrative burdens posed on academic staff by proposing following activities:

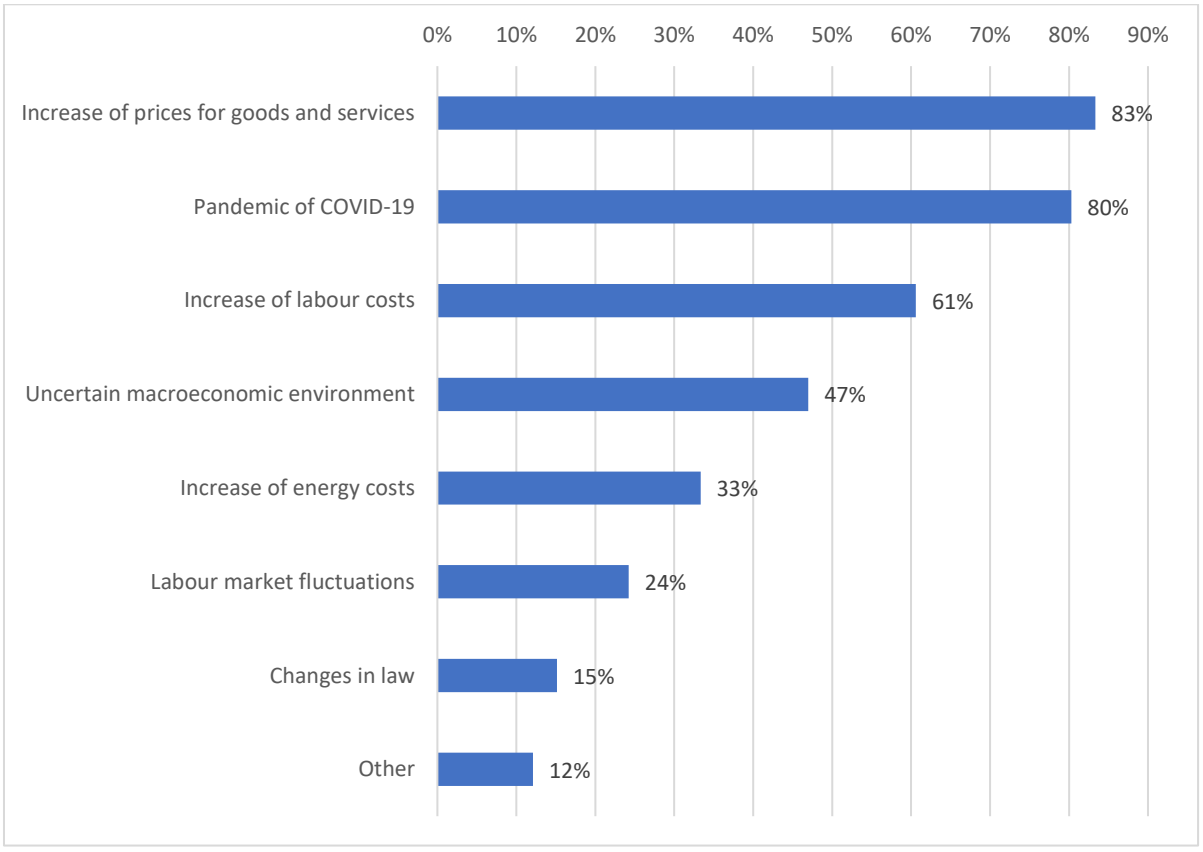
- Launching a mentoring programme - experienced project managers from previous editions could help inexperienced newcomers while taking part in information meetings with those potentially interested in the Programme.
- Dissemination of good practices among applicants, considering not only the content-related but also administrative aspects of the projects' implementation.
- Organising study visits for administrative staff from Polish universities to Norwegian partners in order to observe practices adopted in these organisations.
- Requirement to earmark administration costs in direct costs of the project. Dedicated allocation would have to be applied for this purpose.

[2] „The functioning of women and men in science" by the NCN Analysis and Evaluation Team and the Committee for Analysis of Scientific Activity of the NCN Scientific Council, Kraków 2022.

2.2 Barriers to implementing the Programme (including COVID-19)

Most projects implemented in the"Applied Research" Programme launching its first calls in 2019 were considerably affected by COVID 19 pandemic and its aftermath. Not only physical restrictions hitting the first phase of project implementation spanned for over a year, but the pace of recovery was rather slow and return to business as usual only gradual. In most cases, the COVID pandemic has contributed to increase in the duration of project tasks. This was linked to prolonged delivery of services and supplies needed for the projects, as well as difficulties in contacting partners, in particular foreign. Although anti pandemic restrictions were imposed ubiquitously, they were considered more severe in Norway, especially considering travelling abroad. Unfortunately, in many cases this period was meant to initiate effective co-operation or even begin with the research phase. In many projects restrictions impaired also dissemination process with conferences being called off and long persisting reluctance against organising massive events.

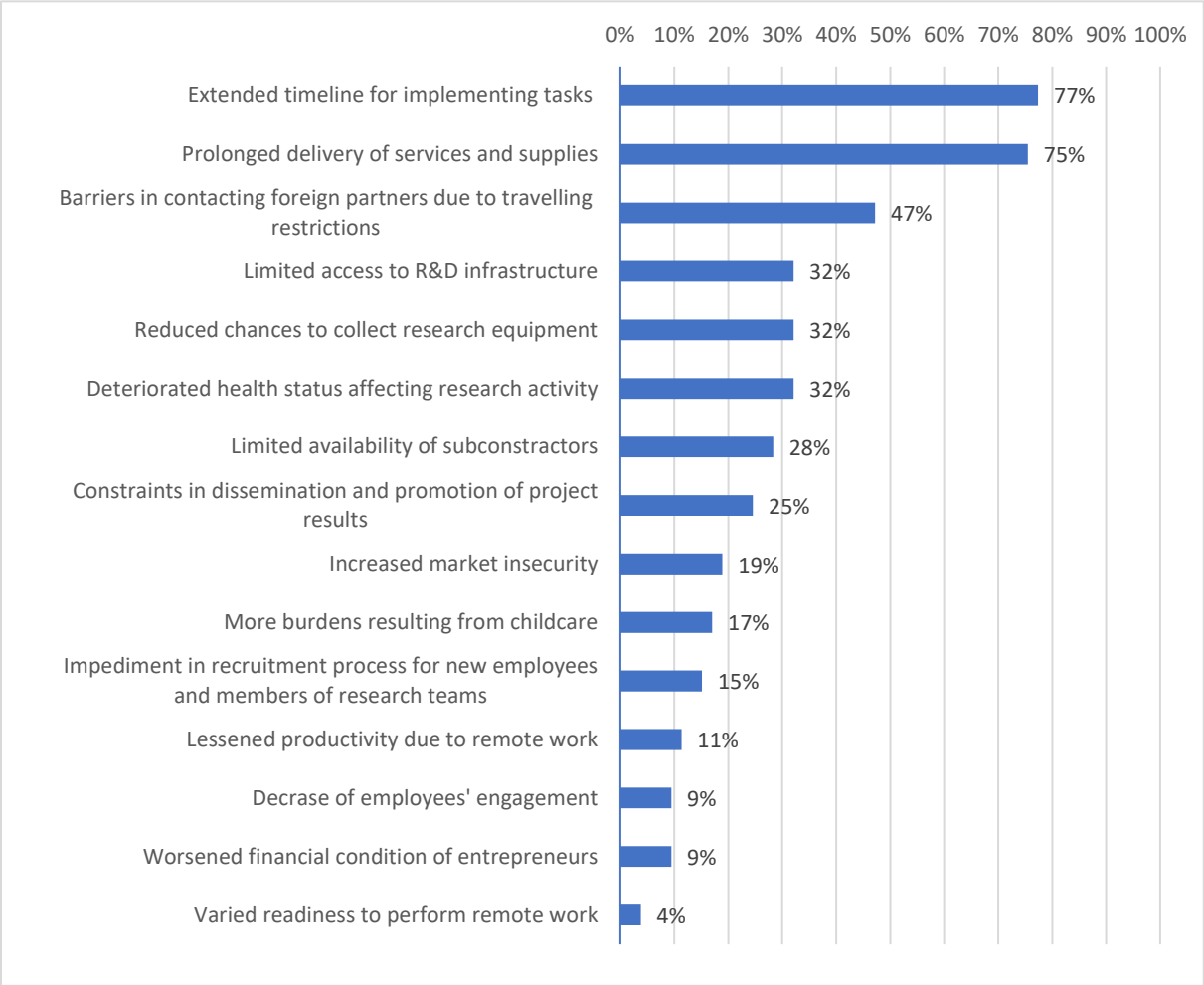
Graph 2 Main external factors impacting project implementation in experience of beneficiaries who were affected



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=66

Similarly academic internships were quite slow to recover. Pandemics changed some social patterns even more permanently, while shifting from direct face to face contacts towards hybrid or virtual forms of interactions. To a lesser extent, the pandemics affected productivity of staff involved in projects, i.e. their health status, commitment or technical preparedness to work remotely. On the contrary, release from many on spot duties contributed with more time devoted to research, unless the access to R&D infrastructure was essential.

Graph 3 Consequences of COVID-19 impacting project implementation in experience of beneficiaries



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=53

The main direct impact of COVID-19 pandemics reflects in extending the project timelines. This conclusion is confirmed by other cross-cutting research question asking more specifically for changes introduced in the projects. 70% of participants of the survey claimed they already extended their project duration, whereas 21% who had not yet done it, were planning to do so.

Inflationary pressures and increasing cost of money, including the cost of foreign currency, affected the implementation of projects with equal intensity: 83% of survey participants experienced an increase of prices. It is linked with changes in the material scope of the projects. 23% of respondents admit having made some changes to the material scope and 6% are planning to introduce changes to the material scope of project implementation. However, they are not substantial changes affecting the essence of the projects, which are not allowed and would require a re-evaluation of the original project proposal. Beneficiaries are rather looking for savings by replacing budget items with cheaper equivalents whenever possible. These savings were made mostly for conference fees and travel costs in the projects. However, the scale of the problem seems considerable:

„The [ed. difference between] *original estimates and the final ones was really almost 40%. So that's the kind of difference that really makes you have to sit down hard and analyse that cost estimate. This is where the contact with the NCBR supervisor came in. How do we solve this? Are we able to reallocate these funds*

ourselves? Do we need to do something else? (...) How can we manage this at the university so that it continues to function. So, some solutions were taken here. So, this price increase was noticeable. In terms of some alternative technologies that will emerge, nothing is known about that at the moment. (...) Here again, this contact with the supervisor from NCBR was very necessary and very helpful to simply establish what possibilities we have" (quote from an interview with a Principal Investigator).

In spite of many setbacks no entity cancelled the contract agreement. Participants of the study did not report on new themes emerging in relation to recent changes in the macro environment of the projects. Experts from Programme Committee inquired if they would recommend such changes regarding introduction of new themes, e.g., specifically related to health and social welfare themes, maintained they should not be imposed top-down but rather left for future applicants to decide.

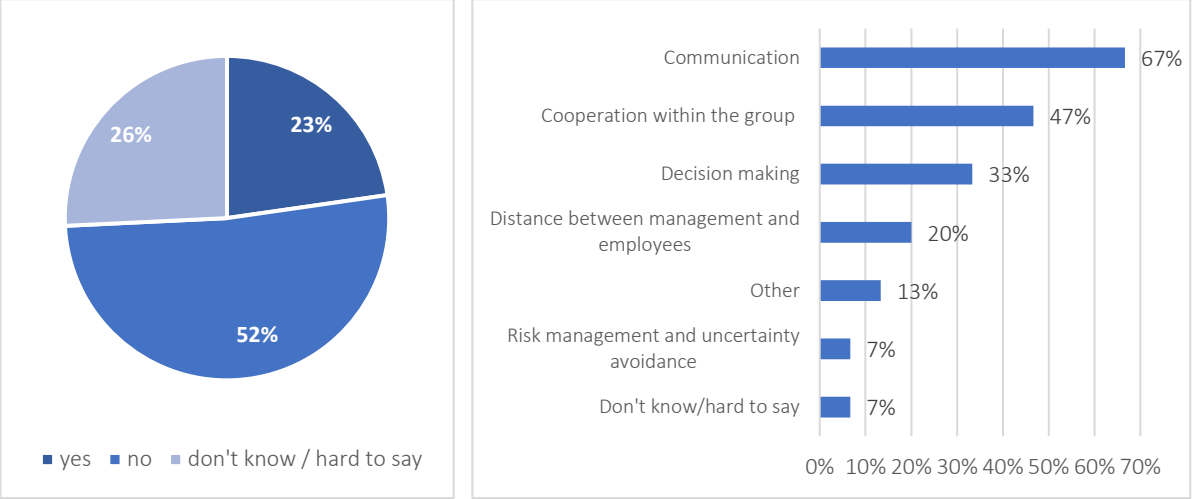
Response to occurring difficulties with projects' implementation planned by the Programme Operator

Programme Operator is open to allow for duly justified changes in the duration of projects. If necessary, they might be extended up to one year, with the final implementation deadline compliant with the final eligibility period in the Programme, which is 30 April 2024. In response to material difficulties reported in projects, Programme Operator inclined towards the opinion submitted by the National Focal Point, suggesting the reuse of the programme's savings from foreign exchange surpluses in order to support currently running projects. These savings will be applied only to POLNOR. POLNOR CCS and IdeaLab beneficiaries and targeted solely at research organisations. The individual amount of additional financing will amount up to 7% of the project funding. Eligible beneficiaries will have to request for additional funds that could cover either up-to-date increases of projects' costs or enhancements in the scope of projects. This approach may be regarded as a good practice shared with other Programme Operators of bilateral programmes and is currently being revised in Romania.

Cultural differences among partners

The survey among beneficiaries shows that 23% of respondents perceived the existence of cultural differences. The remainder either responded that there were no such differences or could not comment on the issue, suggesting that cultural differences did not become apparent in the projects. Respondents who participated in the interviews indicated more differences between staff in academic and private sector institutions than differences based on nationality. The interviews showed that Norwegians are less flexible than Poles, acting in line with plans, contract provisions and procedures. This is assessed by the Polish partners as a professional approach to the job, however when they would expect more inputs than initially planned - as inflexible.

Graph 4 Share of respondents perceiving cultural differences and areas affected by differences



Source: own elaboration based on a survey among beneficiaries of the Programme "Applied Research", N=66 (figure on the left); N= 15 (figure on the right)

The cultural differences identified are not seen as a barrier to project implementation. Ultimately, the Polish partners accept that in their cooperation they can count on what had been agreed and written down in their contracts, but not on quick reactions to suddenly changed circumstances. This has taught respondents to pay attention to the way contractual provisions are drafted. It was emphasised in the interviews, that if differences do arise, they tend to be perceived positively, as they help to get to know a slightly different style of working, characterised by higher levels of respect for colleagues' time. Communication problems related to the language barrier, if they arise at all, are on the Polish side. On the other hand, the approach to administrative issues is assessed differently - some respondents note that the administration on the Norwegian side is very well prepared to handle all project documentation, as this is handled by separate departments (not the researchers themselves). However, this increases the response time to requests related to the administrative handling of projects. Some respondents point to difficulties that arise due to a lack of understanding on the part of the Norwegian partners of the formal and financial requirements. Problems of this type are overcome through discussions, explaining the Polish procedures and their purpose, the need to justify expenses, etc.

Based on the data collected, it appears that the scale of problems arising from cultural differences has decreased. A previous evaluation report commissioned by NCBR on the effects of the Polish-Norwegian Research Cooperation Program emphasized that the Programme's implementation practice was influenced by cultural issues, organizational behaviour patterns and work standards that differ between Poland and Norway. It was noted, too, that although cultural differences were the substrate of some of the problems encountered, the respondents did not overestimate their importance. The majority of respondents, while showing awareness of the existence of such differences, did not consider that they create barriers that specifically threaten the proper implementation of projects and bilateral cooperation as a whole.

2.3 Protection of intellectual property in projects

Contracting process

According to the provisions of the Guides for Applicants, signing the contract with the Programme Operator was conditional on the prior conclusion of consortium agreements between Project Promoter and project partners. This rule was applied in practice in the case of the POLNOR, POLNOR CCS and IdeaLab calls for proposals, under which the only permissible formula for the implementation of projects was precisely the consortium formula. The Guide for Applicants specified the required minimum scope to be covered by partnership agreements, which had to include, inter alia, provisions concerning intellectual property rights. The adoption of this requirement should be regarded as highly appropriate. Only 1/3 of beneficiaries declared that they started to discuss with partners the subject of intellectual property rights to the results of research planned in the project at the stage of proposal submission[3] , whereas 59% did this at the stage of drafting the consortium agreement. Therefore, it can be assumed that the requirement formulated by the Programme Operator stimulated partners to address the issue. The lack of such a requirement could create a temptation to postpone reaching agreement concerning intellectual property.

Surveys conducted among beneficiaries show that only one in ten indicated difficulties in agreeing on the content of a consortium agreement with a partner. Most frequently (3 answers) this concerned the issue of assigning intellectual property rights. Provisions of the agreement related to the split of the budget between partners, and the exchange rate used for settling indirect costs were each indicated by two respondents. Providing applicants with a consortium agreement template may have been conducive to reducing disputes between partners, especially as the qualitative research shows that practically all project promoters used this template. It provided a starting point for the preparation of the proper contract, thus avoiding the impression that the content of the contract was "imposed" by one of the consortium members. It was common among the interviewed respondents to indicate the high usefulness of the template.

Turning strictly to those provisions of the agreement which concerned intellectual property rights, it is worth noting at the outset that in 4 out of 5 cases these provisions were created jointly by the consortium members. Only in 12% of cases their sole author was the Project Promoter and in 2% the Norwegian partner[4] . The widespread involvement of partners in the process of drafting provisions of the agreement concerning intellectual property should be assessed as highly positive - it certainly fostered the development of provisions satisfactory to all parties.

As far as the process itself is concerned, it mainly took place remotely. Only 12% of projects required face-to-face meetings with a partner. In part this popularity of the remote form can be attributed to its generally much more frequent use as one of the social effects of the COVID pandemic. It is worth noting in this context that the vast majority of project contracts were signed between 2020 and 2021, i.e., at the peak of the pandemic. This means that consortium agreements were concluded in a similar timeframe, hence the use of a remote formula in the process of working out contract provisions relating to intellectual property rights is fully understandable. It should also be assumed that the lack of the need for face-to-face meetings with the partner was also related to the generally smooth flow of reaching arrangements. 95% of the respondents assessed that this took place in a friendly or neutral atmosphere. Only 14% stated that

[3] Of which 31% strictly at the stage of developing the proposal for submission and 2% at the stage of establishing cooperation, even before starting work on the submission.

[4] 5% of respondents answered "don't know/difficult to say".

reaching an agreement with a partner concerning intellectual property rights required longer negotiations than other provisions of the agreement. This could, of course, have been influenced by existing previous relationships between persons representing the project partners. According to the survey, 71% of the Principal Investigators had worked with the enterprise involved in the project in the past or at least knew the company's representatives. One interviewee put it this way:

Yes, but we always get along. I mean we never get into any business or scientific contacts with people that we don't trust on a human level as well. I mean you could say that we are friends with all these people and we don't try to pick and wrest something for ourselves [quote from the interview with Principal Investigator].

In the majority of projects (64%) the process involved not only members of the research team implementing the project, but also lawyers / intellectual property protection specialists. Individually interviewed representatives of scientific units indicated that consortium agreements are always subject to review by specialised organisational units. A similar mode of operation was identified in one of the project partner enterprises - the provisions of the agreement had to be agreed by the "parent company" located abroad.

Level of advancement of IP arrangements

The issue of intellectual property rights is complex and includes, among others, issues such as the assignment of rights to specific research results to specific partners, the valuation of rights, strategies for dissemination of results and their legal protection. It was therefore interesting to investigate whether the existing arrangements between partners regarding intellectual property are comprehensive or whether there are still some 'open', unresolved issues. Only one-fifth of respondents declared that they had reached full agreement with their partners on each of the six IP issues asked about in the survey. The most common arrangements already reached related to indicating:

- which, and how, research results can be disseminated (76%);
- to which research results the partners will have rights to by virtue of their financial participation in the project, and with respect to which they will need to make payments, if they will want to take advantage of them (62%).

Least frequently noted was the reaching of a full agreement concerning the timeframe after the end of the project for concluding a sales/licensing agreement; and agreement on who will be involved in determining the market value of that part of the intellectual property, which will be the subject of a possible sales/licensing agreement (in both cases 29% of respondents). At the same time, these were among the issues that have so far been discussed between partners the least frequently. Detailed data can be found in the following table.

Table 1 Stage reached in negotiations with partners on specific issues related to the management of intellectual property generated by the project

	We have reached a full agreement with our partners on this issue	We have not yet reached a full agreement with partners on this issue - arrangements are ongoing	We have not raised this topic with our partners at all	I don't know/difficult to say
Identify which research outputs the partners will have rights to by virtue of their financial participation in the project, and which they will have to pay for should they wish to use them	62%	12%	14%	12%
Establish how the market value of that part of the intellectual property that will be the subject of a possible sales/licensing agreement will be determined	31%	24%	36%	10%
Determine who will be involved in establishing the market value of this part of the intellectual property	29%	17%	40%	14%
Determine at what timeframe after project completion a sales/licensing agreement should be concluded	29%	14%	45%	12%
Determine which, and how, research results can be disseminated - e.g., at conferences, in scientific articles	76%	7%	14%	2%
Determine which research results should be protected under industrial property law (e.g., by patents)	52%	24%	14%	10%

Source: own elaboration based on a survey among beneficiaries of the "Applied Research" Programme, N=42

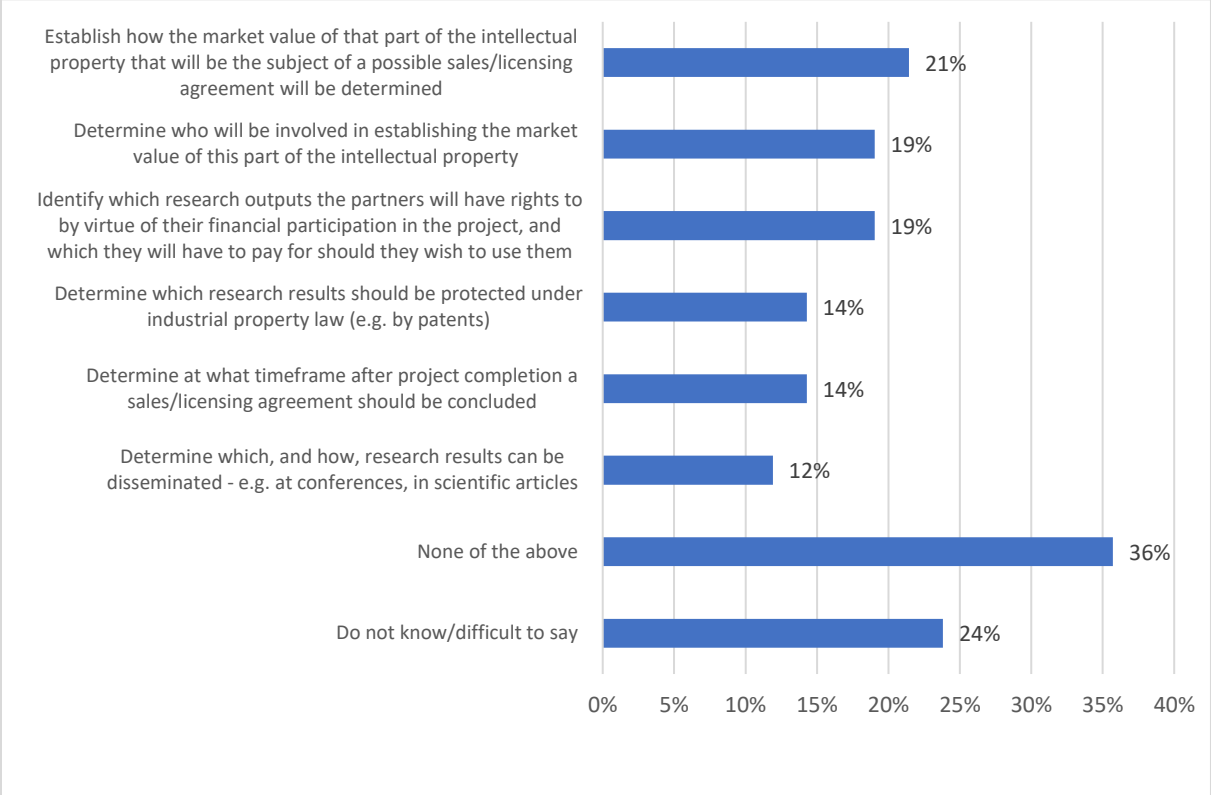
Taking into account the level of advancement of the projects (at the moment of conducting this evaluation none of them was completed) and their focus on industrial research rather than experimental development, it should not be surprising that the issues related to establishing the market value of research or the timeframe for concluding the agreement on technology transfer remain unresolved in the majority of projects. This is because they are related to the commercialisation stage, which, as a rule, takes place after the research work has been completed. The conducted qualitative research shows that in the opinion of respondents, it is too early to make such decisions, as it is difficult to predict what the commercialisation potential of the obtained results will be. At the same time, taking into account the information provided by the respondents, it can be assumed that the main role in the process of possible

valuation of the rights and selection of the form of commercialisation will be played by organisational units or persons responsible for legal issues/protection of intellectual property/technology transfer.

Challenges in reaching an agreement on IP

Principal Investigators were also asked to indicate whether, in their opinion, it was/can be particularly difficult to reach an agreement with a partner on any of the specific issues identified in the table related to the management of the IP created in the project. A majority of 60% of the respondents did not indicate any such issues (including the 24% response rate of "don't know/difficult to say"). Considering the responses of the remaining respondents, it is not possible to conclude that any one issue was clearly more problematic compared to the others.

Graph 5 Issues related to the management of intellectual property created in the project for which it was/can be particularly difficult to reach agreement with the partner

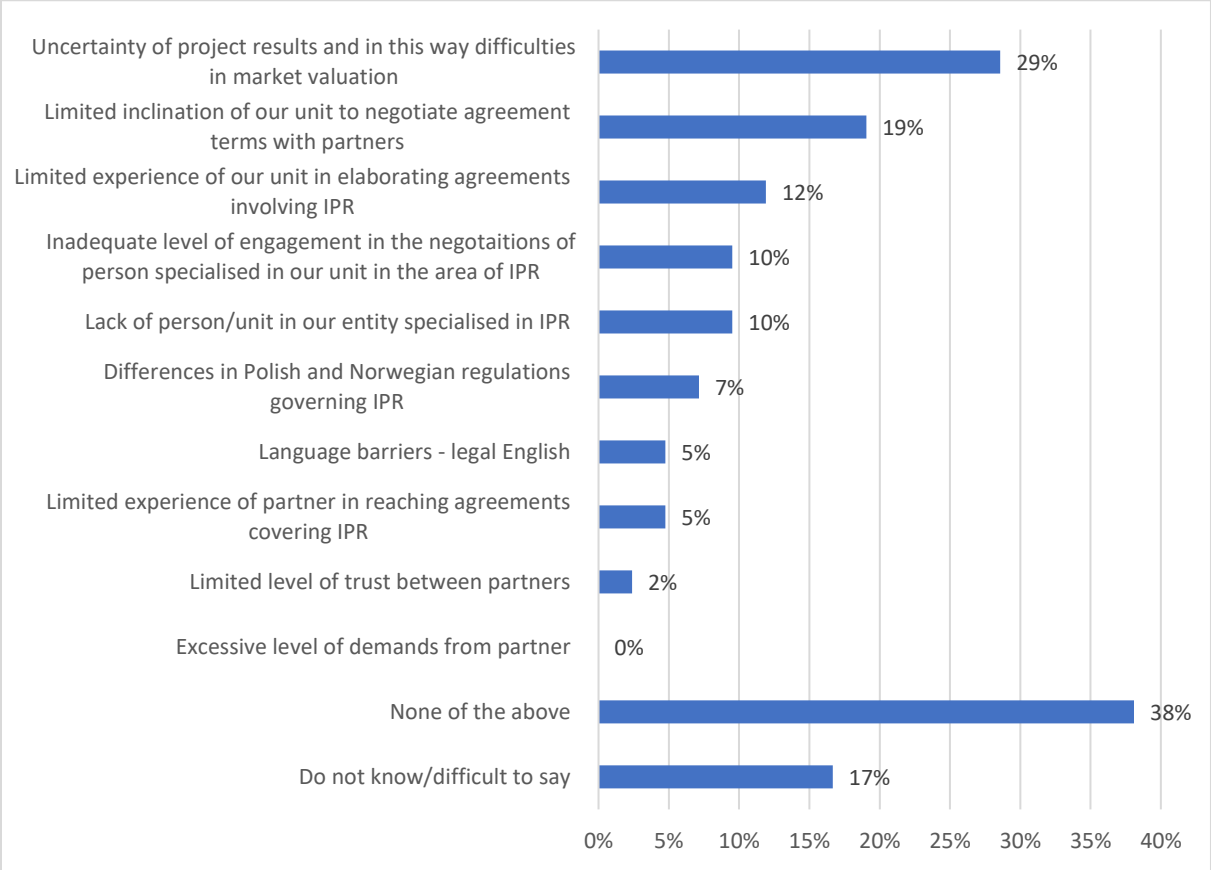


Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=42

In addition to determining how problematic it might be to reach agreement on specific IP management issues in the project, the difficulties associated with the negotiation process itself with the partner (insofar as it related specifically to IP issues) were analysed. Slightly more than half perceived no problems whatsoever, which applied both to current negotiations as well as those that could possibly be carried out in the future. Of the remainder, the largest percentage indicated uncertainty about the outcome of the project and thus the difficulty in determining the market value of the IP. This area has been noted earlier - the projects are still in progress; in addition, even at the moment of completion, most of them will be relatively "far from the market", which will certainly make it difficult to determine the commercialisation potential of the results and thus their value. The second most frequently indicated answer was that the Principal Investigator's home organisation was not very willing to negotiate the content of partnership agreements. This would indicate that in some units there exist ready-made templates for agreements

concerning intellectual property, the provisions of which are not likely to be modified to take into account the expectations of partners. It seems that in the case of such a sensitive issue as IP, an element of negotiation, the results of which will be reflected in the content of the agreement, is essential. Its absence may be perceived by the partner as unequal treatment and as a desire to impose certain solutions, which in extreme cases will make cooperation impossible. The next three most frequently noted responses can be grouped under the term of insufficient IP management capacity. The source of issues in this area may refer to: the lack of a person/unit in the entity specialising in the subject of intellectual property rights; their insufficient involvement in the process of negotiating with partners; and the limited experience of the entity in concluding agreements concerning intellectual property rights. A total of 17% of respondents indicated these 3 answers. Although this is not a very high percentage, it shows that in some scientific units research staff continues not to receive sufficient support in the process of intellectual property management. Detailed data is provided in the chart below.

Graph 6 Problems that have arisen or are likely to arise during negotiations with a partner concerning the intellectual property generated by the project



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=42

Evaluation of the rules governing how rights to research results are shared

It is worth taking a closer look at the opinions of beneficiaries on the terms originally expressed in the project co-financing contract, according to which the property rights to the results of basic research, industrial research and experimental development being the result of the project are vested to the Project Promoter or project partners in proportions corresponding to their actual share in the total amount of eligible costs. 17% of the surveyed Principal Investigators (among those who implemented the project in a consortium) considered that these terms did not reflect the actual participation of individual project

partners in the creation of intellectual property - the Principal Investigators claimed that as a result of their application they received less property rights than would have resulted from their actual contribution to the creation of intellectual property. One in ten Principal Investigators indicated that it was the project partner who had reservations about these terms, arguing that they were unfair to them. In total, in almost 1/4 of the consortium projects these terms were assessed critically - either by the Principal Investigator or the partner[5] . This percentage should be considered relatively high. An interesting argumentation pointing to the weaknesses of these terms, especially in the context of international projects, was presented by one of the interviewees, pointing to the fact that the level of remuneration in Norway is much higher than in Poland. Since carrying out similar (in terms of workload) R&D at the premises of a foreign partner is clearly more expensive than at a Polish partner, and the share in property rights was related to the share in eligible costs, there was a risk of granting more rights to foreign partners than their actual contribution to the creation of IP.

They have such rates that I really dream of ever having such in my life. Nearly 50% of the amount is consumed by our Norwegian. And in view of this, there would follow the entitlement to half of all the results of these projects. However, when it comes to the creation and intellectual contribution, work etc., this is definitely less. [quote from an interview with the Principal Investigator].

In light of the above data, it should be considered that it was an appropriate solution for the Programme Operator to abandon these terms and to give consortium members the freedom to regulate the issue related to property rights to research results. To this end, annexes to contracts were concluded with beneficiaries already in 2020, according to which all intellectual property rights created as a result of the project and related access rights may be distributed between the Project Promoter or project partners, in a manner duly reflecting their work packages, contributions and mutual interests. It is worth noting that Horizon 2020 also does not link the extent of IPRs held by consortia members to their share of eligible project costs which should be considered as good practice.

Impact of projects on IP knowledge sharing and knowledge growth

45% of the beneficiaries of projects in which a Polish partner participated, declared that they shared their knowledge/experience related to IP issues. In the case of Norwegian partners, the percentage was 40%. These are relatively high values, especially as the qualitative research shows that it was mainly the project leader who had the burden of preparing the consortium agreement - the role of the partners was mainly to comment on it. The majority of promoters of consortium projects declared that thanks to the implementation of the project their knowledge concerning IP management increased (55%) and that it would be easier for them to manage IP in subsequent projects (52%). This is probably influenced by the fact that in the past, slightly more than 1/3 of Promoters[6] participated in projects in which IPR agreements were concluded with business entities. Only 12% of the respondents indicated that, based on the experience gained from the project, they have introduced new solutions concerning the management of the intellectual property. This result should not come as a surprise - it should be assumed rather that the

[5] It is worth mentioning that some of the companies which are beneficiaries of the OP Smart Growth and implement projects in scientific and industrial consortia also raised objections to such terms. See: Evaluation study on the Assessment of the impact of implementation of selected measures of the 4th axis of the OP SG and EC programmes on the development of scientific entities, stimulation of cooperation and commercialisation and development of R&D staff, as well as on internationalisation of Polish science and the possibility of building international partnerships in order to apply for the EU Framework Programme - MODULE II; EGO, LB&E; Warsaw 2020.

[6] Value refers to Promoters of projects implemented in consortia.

introduction of such solutions is not the responsibility of academics but of persons/units dealing with intellectual property issues in the organisation.

Mechanism supporting the dissemination of the results of the research carried out in the project

The POLNOR 2019, POLNOR CCS and IdeaLab calls included an instrument to encourage consortia to disseminate research results. The consortium is entitled to a bonus that increases the aid intensity by 15 percentage points, for the wide dissemination of the results of industrial research or of experimental development if within 3 years from the end of project implementation the results obtained by the project promoter or project partner are presented during at least 3 scientific and technical conferences, including at least one of national importance, or published in at least two scientific or technical journals, or disseminated in full via freeware or software with an open access licence.

In the second edition of the NFM Polish-Norwegian Research Programme [7] achievements in the area of dissemination of research results were very high - 1069 scientific papers were published. The emergence of economic partners in consortia may have negatively affected the willingness to publish research results. Analysis of indicators declared by consortia does not confirm these concerns. All indicators in grant agreements related to the dissemination of research results are impressive - a total of 682 articles and conference presentations have been declared (on average more than 13 per project), of which 236 are joint articles by Polish and Norwegian partners. The declared values considerably exceed the target values for these indicators adopted in the Programme (142% and 225% respectively). It also seems that the declared values will be met - 90% of the consortia have already published or have drafted articles they intend to publish. The current values for publication and co-publication rates at the end of 2021 admittedly reached only 30% and 12% respectively, but publications on research results inherently appear after the research has been completed. In the questionnaire-based survey, 82% of respondents see no risk or very low.

The importance of publications for representatives of scientific units is obvious - publications (in addition to patents and utility models) are the main measure of a Polish scientific unit's productivity in parametric evaluation. This assessment influences the amount of funding made available to scientific units from the state budget. In the qualitative research, representatives of scientific units noted with satisfaction the awarding of bonus marks in POLNOR calls for proposals for dissemination of research results. In the questionnaire-based survey, more than half of the respondents (51%) - Project Investigators - indicated "greater chances for publications in highly ranked (impact factor) scientific journals/conferences" as one of the three main benefits of participation in the project.

The question arises whether the natural tendency of scientific entities to disseminate the acquired knowledge does not in contradiction to the interests of enterprises, which want to be the exclusive owners of the created know-how or at least to keep the created knowledge confidential for as long as possible. This thesis seems to be confirmed by the results of evaluation studies, in which entrepreneurs indicate subcontracting agreements as the preferred model of cooperation with scientific entities, because then the dissemination of results and IPP is decided solely by the entrepreneur.

Data from the literature review points to the fact, that there are factors that strengthen or weaken the chances of cooperation between scientists and entrepreneurs. In the former case, within the context of making research results public, are participation in conferences in which entrepreneurs also participate,

[7] Final report on the implementation of the programme under the Norwegian Financial Mechanism 2009-2014, NCBR, 2017

publications in the professional and trade press. A weakening factor is the publication of R&D results in scientific journals (reduces the possibility of cooperation by 67%)[8] .

These observations were not confirmed in the survey conducted among POLNOR beneficiaries.

The issue of publishing research results at conferences and in scientific and professional journals was not controversial at the stage of signing the cooperation agreement - 76% of respondents - Principal Investigators - declare that full agreement on this issue was reached and only 7% that agreement was not fully reached. Only 12% of Principal Investigators found it difficult to agree with business sector partners, which research results could be published.

In interviews, entrepreneurs confirmed that agreeing which R&D results can be published is a marginal issue. Above all, entrepreneurs declare that they are interested in disseminating research results. In particular when this concerns publication in journals and conferences with an international reach, which is treated as an activity increasing the company's recognisability on foreign markets.

Some of the enterprises participating in project consortia are research companies. In this case, the publication of research results is also a direct promotion of the company's research services. In this situation, the publication of research results is necessary as an element of authentication of the services and products offered. The employees of these companies often have academic degrees or are in the process of accumulating a portfolio of work for underpinning their next degree. In this situation, the company is interested in the scientific publications of its employees.

The process of agreeing on which content can and cannot be published is a natural one, as publications are generally shared, so content is agreed during drafting.

In publications where there are technical details we naturally discuss with each publication what details can and cannot appear. Generally it is not the case that <enterprise> guards the details of the solution very jealously - we are also interested in publicity and the problem of publication has not yet appeared in such a form that we wanted to do an interesting article and <someone> said no, because we cannot publish that. (Quote from an interview with a partner in the consortium - an entrepreneur)

The only situation where enterprises actually limit the scope of knowledge disseminated concerns research results stemming from work carried out for the company's commercial clients and covered by confidentiality arrangements (NDA - Non-Disclosure Agreement).

The most desirable forums in which enterprises would like to disseminate research results are publications in journals and industry conferences. Partners from research units meet this expectation. In the questionnaire survey, project promoters declared that they would publish research results jointly with members of the business partner's research team (65%), at industry conferences (61%) and in the business partner's industry journals (48%).

[8] Feldy, M.: Researcher-business communication: differences in the ways women and men disseminate research results. Problems of Management, Finance and Marketing 40, 2015, 123-133

3. THEMATIC RELEVANCE OF THE PROGRAMME

Key findings:

- The two Programme thematic areas identified as the most significant challenges after analysis of current Polish strategies and the National Recovery Plan are transport and health. The areas relevant to Polish development challenges and consistent with Horizon Europe support areas are digital development, low-carbon economy and energy transition. To the greatest extent, the 'Applied Research' Programme projects fit into the socio-economic challenges: health, biotechnology and the closed-loop economy.
- Keyword analysis revealed that the majority of the Programme thematic areas were of high interest to applicants, with 'Energy, transport, and climate' in the POLNOR and SGS calls[9] being the most interesting, thus confirming its significance for strategic development of Poland.
- The Programme thematic area 'Energy, transport and climate' causes the greatest cross-area synergies, as it is strongly linked to other buzzing thematic areas, i.e., 'Digital and industry', 'Food and natural resources', 'Welfare, health and care', and 'CO_2 capture solutions'.
- Two thematic areas of the Programme were characterised by minimal interest from applicants, i.e., 'Socio-economic development' and 'Unmanned vehicles'.
- In addition, the project proposals submitted in the thematic area of 'Socio-economic development' did not reflect the scientific potential of Polish research institutions, nor did the project proposals submitted in the thematic area of 'Welfare, health and care', which does not fully correspond to the assumptions of the strategic documents emphasising these areas.
- The potential for companies to further develop technologies and bring them to market is rather weak as majority of companies in consortia are knowledge-intensive service companies that might have limited capacity to implement the technologies and bring them to market unless the developed technologies would be sold or licensed to manufacturing or ICT companies.

Most interesting Programme thematic areas for Polish applicants and their relevance

The analysis of interest in the Programme thematic areas covered all 434 project proposals submitted to NCBR in the third edition, as interest should be measured by the intention to implement projects and the reported need for funds. An analysis of the interests was carried out using text mining and network analysis techniques. For each Programme area, keywords occurring in project proposals were assigned to see exactly what topic is of particular interest in each area[10], which may give more insights into the interests of research teams. All keywords occurring in one project were linked to each other (each keyword to each

[9] Although the SGS did not have subject areas assigned, these were imputed to ensure the completeness of the survey objectives.

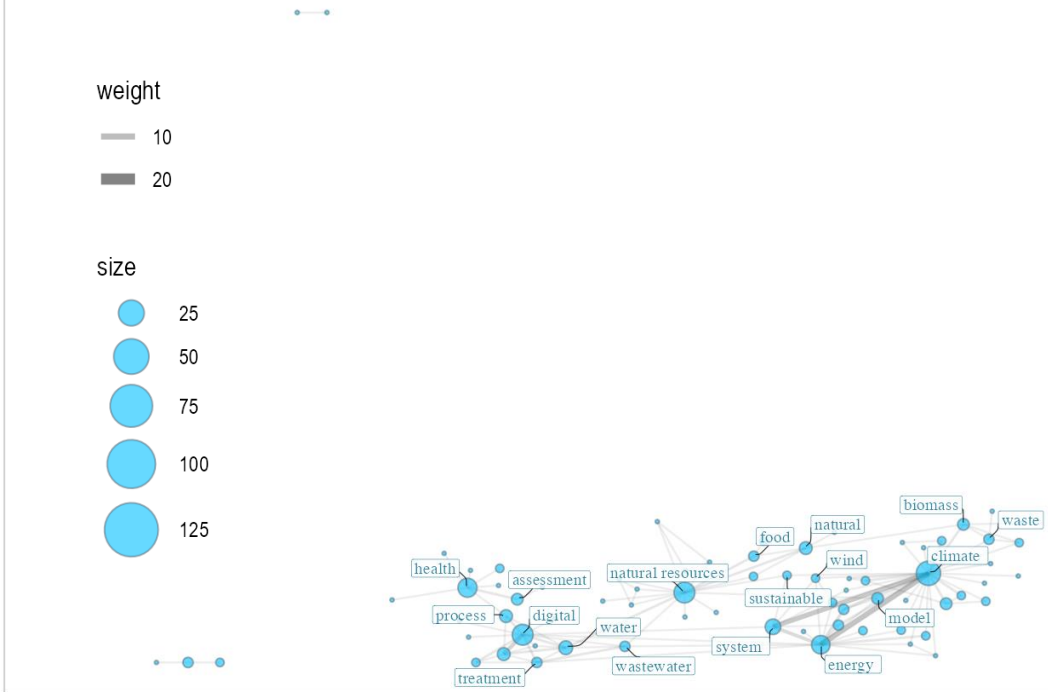
[10] As the Programme areas were missing from 337 project proposals to the SGS, these areas had to be imputed before the analysis could proceed. As only 97 applications were assigned an area, a model using the maximum abundant description of these projects had to be created to correctly carry out the analysis. Therefore, the model was constructed using 97 project titles, 97 abstracts, 556 keywords appearing in 97 project proposals, the most detailed classification of projects according to the OECD nomenclature (two different variables as project proposals might had two OECD classifications), one NABS 2007 nomenclature, and the assignment of one of 17 National Smart Specialisations. These were then used as predictors of the Programme thematic areas in missing project proposals to the SGS. A Support Vector Machine (SVM) with a linear kernel was then applied, recommended for text classification.

keyword)[11], and also to the Programme area assigned to the project. Assignment to an area was done analogously to 'keywords to keywords', in other words, areas were also used as keywords. This gave the thematic areas of the Programme a central role in the network graph, as they were the most connected nodes. For clarity, keywords connected only to one other keyword were discarded. Graphic 2 illustrates the overall network of keywords and thematic areas grouped by different calls, as the calls might not be comparable (for example, the IdeaLab call on cities was dedicated to individual experts who then developed with their consortia a limited number of project proposals, and similarly POLNOR CCS 2019 was defined very narrowly). These differences between calls may be observed by the sizes of nodes and edges as they are comparable between subgraphs.

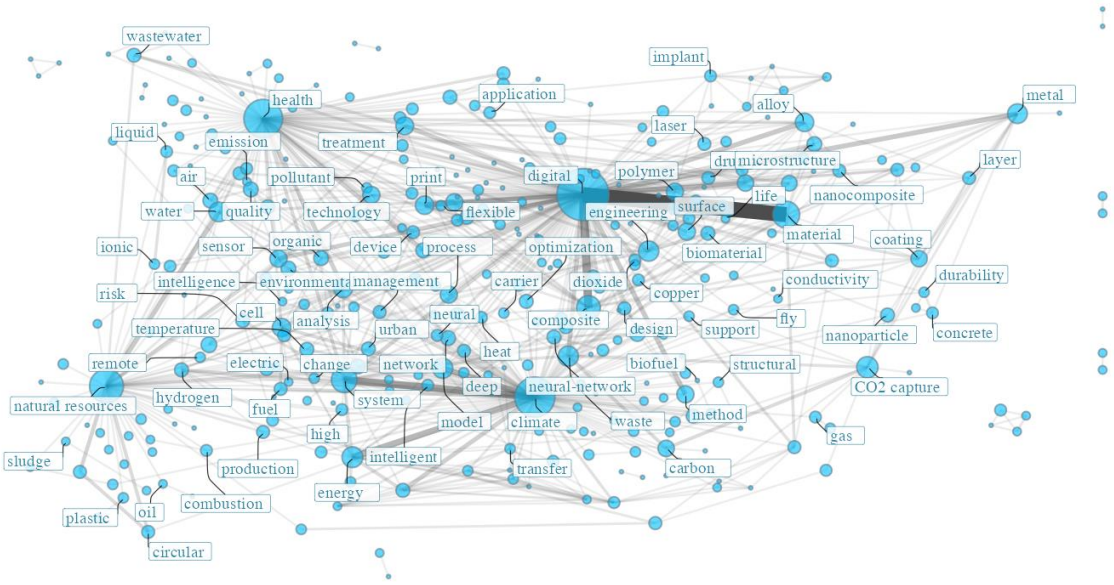
[11] A total of 1,838 author keywords in the 434 project proposals were used. As some keywords were in fact phrases (e.g., 'CO_2 capture in molten salts') and used singular and plural words (e.g., 'nanoparticle' or 'nanoparticles'), the keywords had to be cleaned up. To this end, keywords were separated by white spaces, lemmatized, and cleared of coordinating conjunctions, prepositions, symbols, determiners, and particles. As a result, 1,878 unique keywords were identified and converted to lowercase, except for proper names (e.g., 'Janus', 'Peltier', 'Copernicus') and elements (i.e., AL, AG, CU, LI, NI, NA, TH, TI, ZN).

Graphic 2 Network analysis of keywords in the thematic areas of the Programme according to the calls of the third edition ('Applied Research').

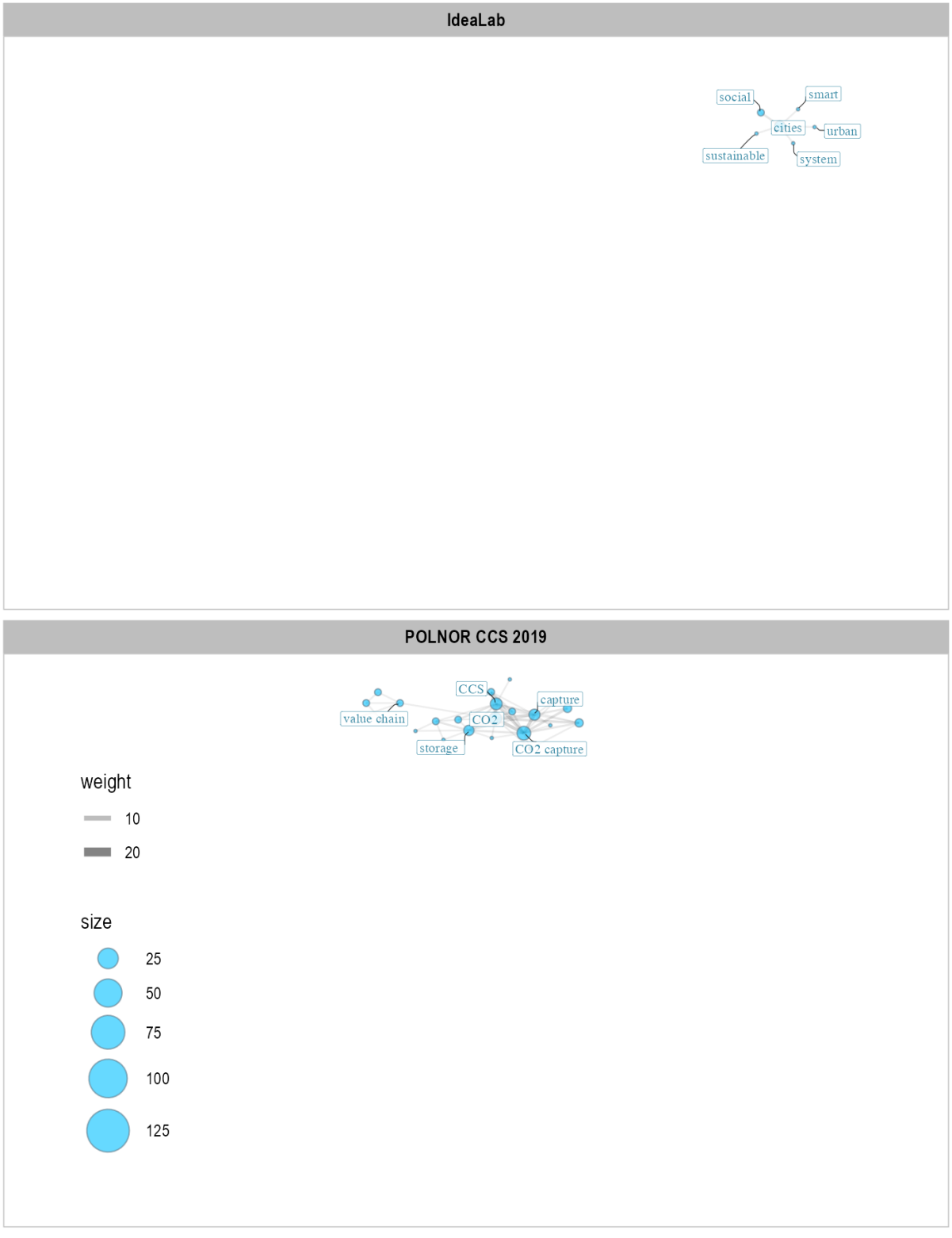
POLNOR 2019



SGS



(Continued)



Source: own compilation based on data from the NCBR. Note: The size of a node reflects the number of occurrences of keywords in project proposals for different calls, the width of an edge reflects the number of co-occurrences of two keywords in project proposals for different calls.

Energy, transport, and climate ('climate' in the graph) is the most interesting thematic area of the Programme taken up by the submitted project proposals in both the POLNOR 2019 and SGS calls. As can be seen in the graph, 'energy' and various 'systems' (e.g., energy system, innovative system, AI in support system, ecosystem, smart heating system, thermal protection system, cooling system or system integration) are the most frequent words in this area, followed by the words: 'sustainable', 'wind', 'biomass', 'fuel', 'biofuel', 'waste'. In the POLNOR 2019 call, the Programme's thematic area 'climate' was linked to two other thematic areas: 'Digital and industry' ('digital' in the graph), and 'Food and natural resources' ('natural resources') creating synergies as in these areas research focused on topics described by the words: 'natural', 'food', 'water', 'wastewater' and 'treatment', thus also related to nature and climate. In contrast, the Programme thematic area 'health' appears to be disconnected from other areas, while 'Socio-economic development' and 'Unmanned vehicles' areas are virtually absent.

In the SGS call, the greatest diversity of topics and synergies between Programme's thematic areas may be observed. In addition to the keywords mentioned above, the following topics were of most interest to the applicants: 'material(s)' relating to materials engineering, waste materials, metamaterials, biomaterials, bioactive materials, nanomaterials, graphene materials; 'composite(s)' relating to nanocomposites, ecological composites, bio composites, 3D printable composites, composite coatings and layers; 'engineering' relating to various topics: software, process, wind, materials, surface, protein, tissue, biomedical, bioengineering, nanoengineering; 'model(s)' relating to mathematical models, machine-learning models, cognitive processes models; 'waste' relating to zero-waste, bio waste, recycling waste materials, post-production waste, solid waste, textile waste, waste to energy and heating; 'metal(s)' relating to metal forming, metal matrix, metal organic frameworks, metal nanoparticles, metal oxides, heavy metal leaching; and 'water' relating to (rain)water reuse and retention, surface waters, potable water, water supply, water quality, water splitting, water gasification.

IdeaLab and POLNOR CCS 2019 are rather small calls that are dedicated to specific topics and thus homogeneous in terms of thematic areas. We may clearly notice that the first one mainly focuses on social learning and connections, pro-environmental behaviour, sustainability including urban agriculture and mobility choices, smart cities, smart energy systems, and rainwater systems. The second call focuses mainly on CO_2 capture and storage, while the value network is somehow barely related to the main area. Interestingly, the themes from both calls are linked to the other two general calls (POLNOR 2019 and SGS), with words such as 'system', 'sustainable', 'urban', 'smart', 'CO_2', 'storage' and 'capture' being key connectors.

The relevance of the Programme's thematic areas according to scientific potential

The linking of the Programme's thematic areas with the potential of scientific and research institutions in Poland must follow the same classification. As the OECD / NABS classifications of scientific disciplines used in project proposals differ from the classifications of Polish scientific disciplines to which Polish scientists are assigned, the OECD / NABS classifications first had to be converted to the Polish classification. To this end, each of the 434 project proposals submitted under the 'Applied Research' Programme was assigned to the discipline of its Principal investigator. Project proposals were also characterised by the total budget of the Polish partners in order to eliminate the impact of project size on results. The budget of project proposals assigned to each Polish discipline was then compared with the total potential of that discipline in Poland (measured by the number of researchers assigned to that discipline).

The 'Applied Research' Programme covered 36 out of 49 scientific disciplines in Poland. The graphic below demonstrates that, in general, **the disciplines assigned to project proposals are weakly correlated with the**

scientific potential of Polish scientific and research institutions. This is confirmed by a correlation coefficient equal to 0.28 with p = 0.0515.

Some disciplines are significantly overrepresented in project proposals comparing to the potential of all Polish scientific and research institutions. These disciplines are related to the most interesting Programme thematic areas, such as climate, environment, energy, and engineering. The discipline of 'environmental engineering, mining and energy' is the most favourable in relation to its potential, with 80 projects submitted with a budget of PLN 196 million, while it is assigned to 3,944 researchers. In the 'earth and environmental sciences' discipline, only 26 projects with a budget of PLN 71 million have been submitted, but it is assigned only to 2,524 researchers. Similarly, the 'materials engineering' discipline is assigned to 2,589 researchers, who have submitted 55 projects with a budget of PLN 64.3 million (indicating rather small projects).

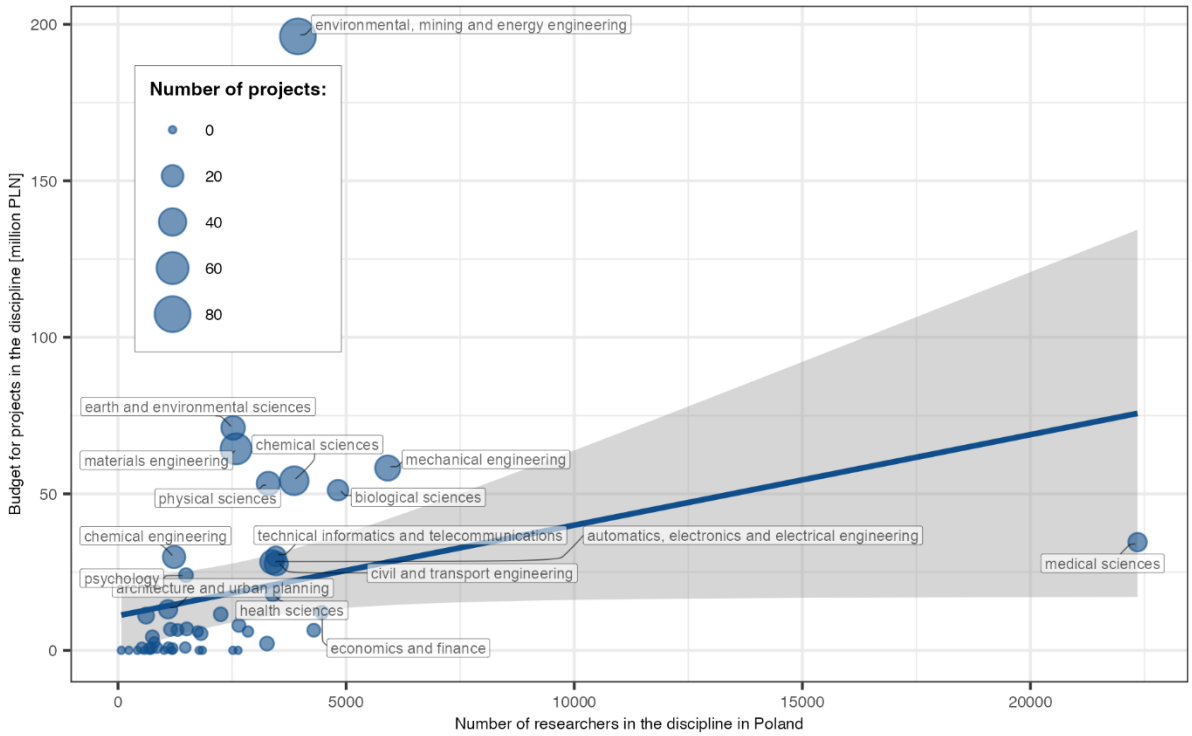
Some disciplines are quite strongly represented in project proposals, but their scientific potential is less exploited than for the disciplines described above. This applies to 'mechanical engineering' and the chemical, biological and physical sciences, which, even if they are above the blue line in Graphic 3, are considerably to the right compared to the disciplines mentioned above. For example, in the first discipline, 31 project applications were submitted for a total of PLN 58.2 million, while the potential reaches 5,912 researchers. The weaker exploitation of the potential of these disciplines is due to their more basic nature, which is of limited utility in innovations prepared together with companies.

There are also disciplines whose potential is rather sufficiently exploited in project proposals (located in the grey area in the graphic 3 below), to mention biomedical engineering, architecture and urban planning, mathematics, technical computing and telecommunications, automation, electronics and electrical engineering, agriculture, and horticulture, among others. This is because they fit quite well and directly into the thematic areas of the Programme (e.g., 'Digital and industry', 'Energy, transport and climate', 'Unmanned vehicles').

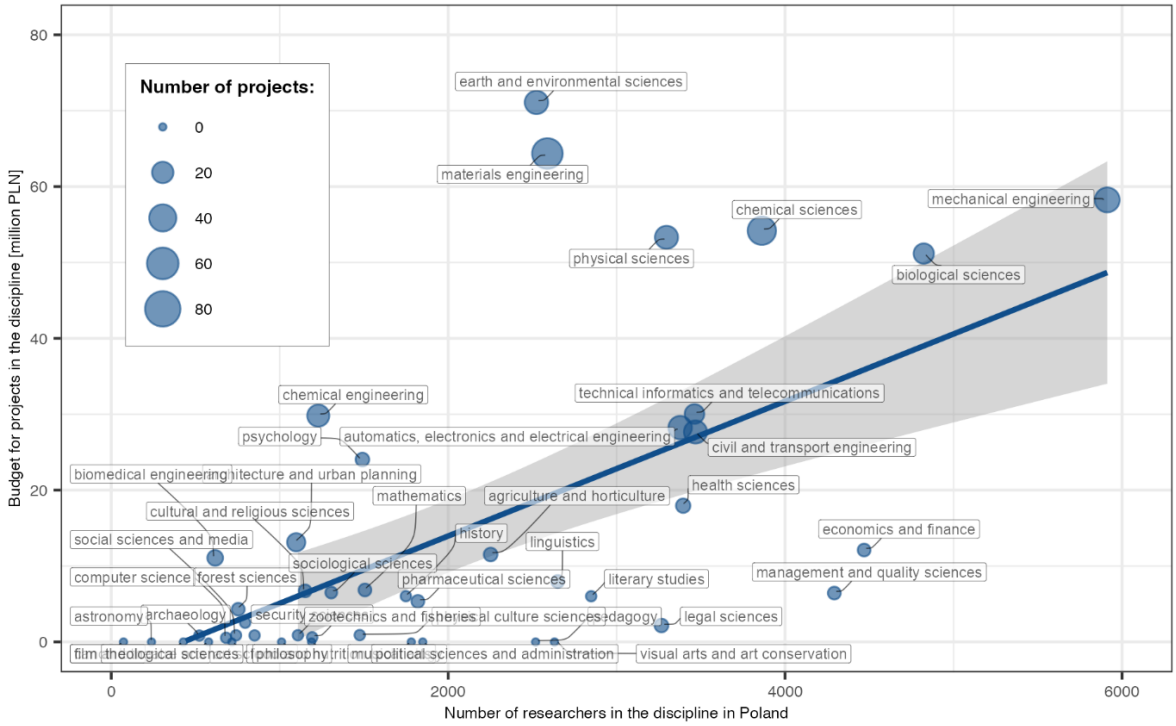
Finally, there are disciplines which, even though they fall within the thematic areas of the Programme, are not sufficiently represented in the project proposals. These disciplines relate to two thematic areas of the Programme: (1) 'Welfare, health and care' and (2) 'Social and economic development'. In the first area, 'pharmaceutical sciences', 'health sciences' and 'medical sciences' may be identified, and in the second area 'economics and finance' and 'management and quality sciences' may be identified. While the first area appeared in the keyword analysis performed above, the second thematic area was invisible. It would definitely be worthwhile to strengthen the promotion of the Programme to researchers in these disciplines.

Graphic 3 Relation between the number of researchers in disciplines in Poland and the budget for project proposals in the third edition of 'Applied Research' Programme assigned to disciplines in million PLN.

(a) Full graphic of disciplines



(b) A close-up of the densest disciplines



Source: own compilation based on data from the NCBR. Note: the blue line indicates a linear trend with the confidence interval in grey.

The potential for companies to further develop technologies and bring them to market

The potential for companies to further develop their technology can only apply to three calls of the third edition of the 'Applied Research' Programme (excluding SGS), therefore only 97 project proposals were analysed here. The analysis showed that 107 unique companies participated in consortia (out of 97 project proposals), with as many as 44 assigned to section M (Professional, scientific, and technical activities), including 6 from Norway. **As they are knowledge-intensive service companies, they may have limited capacity to implement the technologies developed in the projects and bring them to market unless these technologies would be sold or licensed to other companies.** Confirmation of this thesis would require in-depth research in companies. Only 20 companies were assigned to Section C ('Manufacturing') and 12 companies to Section J ('Information and Communication'), which could potentially incorporate directly newly developed technologies into their products and services. The remaining companies are spread across other sections.

Therefore, most project proposals focus on the further development of technologies rather than their potential implementation in manufacturing or ICT. Manufacturing and ICT companies could potentially be interested in implementing new technologies, as there is a wide range of manufacturers of chemicals, plastic products, electronics, precision instruments or engines and turbines, among others. However, there are only 32 such companies and, in addition, the number of companies included in the selected projects drops to 14. In addition, the main buzzword in the projects, i.e., 'energy', is not represented in the companies and health is represented by one Polish hospital and one spa.

Potential for the programme to apply for further funding and patent applications

It is too early to assess the suitability of Programme areas to apply for further funding, as the latest available report is from 2021. Only seven project proposals were submitted by project teams, including four to National Programmes and three to Horizon 2020. Only three projects received funding, including one for Horizon 2020. Only one project team filed three patent applications in 2021. Given that in 2021 most projects have only just started, it is reasonable to assume that further effects will follow as the Programme draws to a close.

Socio-economic challenges in Poland / environmental challenges / sustainable development

It was assumed under the Programme "Applied Research" that the implementation of grant-aided projects could be helpful in driving further R&D projects funded under Horizon Europe. For this reason, the thematic areas in which project proposals could be submitted were intended to reflect the areas identified by the European Commission as priorities, addressing the most important development challenges in Europe.

Although Polish participants' success rate when applying for grants under Horizon 2020 and Horizon Europe is relatively low[12], the assumption remains valid. Currently, the clusters where challenges addressed by Horizon Europe have been identified are: (i) Health; (ii) Culture, Creativity and Inclusive Society; (iii) Civil Security for Society; (iv) Digital, Industry and Space; (v) Climate, Energy and Mobility; (vi) Food, Bioeconomy, Natural Resources, Agriculture and Environment. However, these do not cover the full spectrum of challenges identified in Poland.

[12] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13444-Horizon-2020-programme-final-evaluation_en

Therefore, the table below presents the challenges that have emerged in Polish strategic documents at the national level, taking into account current strategies and the National Reconstruction Plan. The table shows the top ten challenges according to their importance. The number of occurrences illustrates how often a particular challenge has been noted in policy documents. The weighted number of occurrences is the sum of the products of the occurrences in all documents and the weights reflecting the up-to-dateness of the document divided by the sum of the weights. The higher the weighted number of occurrences, the more important the challenge in question.

It appears that transport (land, air, and water) and its impact on the environment remains a core challenge. This area combines infrastructure issues with sustainability and environmental issues. Second in importance is the area of health and the healthcare system. These two key challenges fit with the areas supported by Horizon Europe and should therefore remain among the thematic areas of the Program.

The next three areas, which are particularly important and both stem from issues identified in Polish strategies, and are supported by Horizon Europe, are digital development, transformation towards a low-carbon economy, and energy transition.

Table 2 Development challenges identified in current strategies and the National Recovery Plan

Challenge	The policy document from which the challenge is drawn	Challenge weight	Areas covered by research programmes	Number of project proposals
Improving transport infrastructure, zero-emission transport, environmental impact of transport, multimodal systems	KPO, SRT2030, PEP2020, NSRF, Environmental Policy, SRG, Productivity Strategy	265	Cities for the future: services and solutions, Energy, transport and climate, Unmanned vehicles	12
Inadequate quality and limited access to health services Capacity of the health system to respond rapidly to epidemic threats	KPO, NSRF, Environmental Policy, SRKL2030, SRKS2030, ZSU2030, SRG, SZRWRiR, Productivity Strategy	203	Welfare, health and care, Cities for the future: services and solutions, classification based on National Smart Specialisations (KIS), OECD, IEA and NABS codes	50
Preparing employees for flexible change, securing human resources for an ageing population	KPO, SRKL2030, SRKS2030, ZSU2030, NSSR, SRG, Productivity Strategy	60	Not applicable	0
Wider and more secure use of digital services across all sectors of the economy	SOR, KSRR, SRG, SZRWRiR, SRKL2030, SRKS2030, Productivity Strategy	66	Digital and industry, Energy, transport and climate	12

Industry 4.0, automation, robotisation, application of artificial intelligence	KPO, SRG, SRT2030, SRKL2030, Productivity Strategy, ZSU2030	49	Digital and industry, classification based on National Smart Specialisations (KIS), OECD, IEA and NABS codes	13
Transformation of key economic sectors to **a low-carbon** model	KPO, PEP2020, Environmental Policy, NSRF, SRG, SRT2030, Productivity Strategy	46	Development of CO2 capture solutions integrated in power and industry processes	21
Qualifications - providing the right skill sets and digital competencies, preparing for mass retraining in a transformational environment	KPO, SRKL2030, ZSU2030, KSRR, SOR, SZRWRiR	36	Not applicable	0
Increasing the use of **renewable energy sources** - accelerating this process, including by developing the use of hydrogen technologies	KPO, Environmental Policy, PEP2020, Productivity Strategy	24	Energy, transport and climate, Development of CO2 capture ...	20
The use of **biotechnology** (including the production of biological drugs and the synthesis of new fuels)	KPO, SRG, Productivity Strategy	19	Welfare, health and care, classification based on National Smart Specialisations (KIS), OECD, IEA and NABS codes	45
Transformation towards a **closed-loop economy due to** increasing environmental pressures and limited natural resources	PEP2020, Environmental Policy, KPO, KSRR, Productivity Strategy	16	Food and natural resources, Energy, transport and climate, classification based on National Smart Specialisations (KIS), OECD, IEA and NABS codes	39

Source: own calculations based on current strategy documents and NCBR data

The national strategies highlight two developmental challenges related to human resources development that are not reflected in the thematic areas of the Programme "Applied Research", as they are not linked to technology development and thus do not fit into the programme's objectives. While other challenges are addressed, some important issues are not sufficiently addressed by project promoters. For instance, there are relatively few proposals that tackle issues related to transport technology, whereas quite a few are focused on biotechnology and the circular economy. Health research garnered the greatest interest, which is aligned with an important developmental challenge and is also supported under Horizon Europe.

4. PLANNED EFFECTS OF THE PROGRAMME

Key findings

- The aggregate values of the indicators planned in the contracts significantly exceed the target values of the Programme's indicators. The beneficiaries do not see any threat to the achievement of the planned indicators.
- Companies participate as consortium members in 49% of all funded projects. Participation was stimulated primarily by the requirement to form a scientific and industrial consortium in the POLNOR call. At the same time, the financial participation of companies in projects is limited - on average they account for 19% of the project budget. In cases of extremely low financial involvement, there is a risk that the added value contributed by the company to the project is negligible.
- Companies spent 86% of their allocated budgets on industrial research. More than half of the companies did not carry out any experimental development as part of their projects. This situation was influenced by a number of circumstances, such as: a lower level of funding for experimental development, the lack of an obligation to implement results, the realisation of R&D research in areas of new, rarely explored issues.
- At the time of the evaluation, none of the projects were completed. The expected average level of technological readiness after project completion is 6.6 in POLNOR and 6.24 in other calls. 65% of respondents indicated that the project would need to be continued once all the research work planned in the project proposal had been carried out. Only 23% of projects will end with results practically ready for implementation. The effects of the projects on the practical application of the research results will be observable in the long term and will largely depend on whether the projects can be continued.
- The Programme positively influenced the supply of projects that are potentially ground-breaking in terms of level of innovation. The lack of obligation to implement the results of R&D work favoured risk-taking, experimentation, which are necessary in highly innovative ventures. Projects focused on the industrial research stage. This research has a much greater potential to generate completely new knowledge than experimental development, which is defined as: acquiring, combining, shaping and using knowledge and skills that are currently available.
- Overall demand and performance of SGS Call is well above expected. SGS Call is successful in addressing key barriers limiting number of women leading research in technical sciences. While this path is unique in itself, it could be fine-tuned towards increasing maturity of the intervention's design.
- The impact on the careers of young scientists is stronger than expected in relation to the targets defined for the Programme.
- The impact of the Programme on the careers of young scientists is manifested in new scientific publications, networking opportunities, and doctoral and postdoctoral theses, which will be based on the results of the research carried out.

4.1 Indicative effects

Contribution to the achievement of the Programme objectives

The objective of the Programme "Applied Research" is to increase the quality of applied research in Poland by strengthening research cooperation between Poland and Norway, developed on the basis of equal partnership between Polish and Norwegian research organisations and enterprises. At the same time, the Programme Agreement itself points to the goal of developing increased research-based knowledge.

The intervention logic of the Programme "Applied Research" is based on the management by results model[13]. In this model, the focus is on achieving the results of change to which the intervention contributes through activities and outputs achieved.

The Programme has defined two outcomes. Outcome 1: Increased levels of activity in the implementation of applied research in Poland; and Bilateral Outcome: Increased cooperation between institutions involved in the Programme on the beneficiary and donor country sides.

Monitoring indicators have been assigned to each outcome.

Outcome 1 has been characterised by five indicators: R.1.1. Peer-reviewed scientific publications submitted, R.1.2. Joint peer-reviewed scientific publications submitted, R.1.3. New products/technologies developed, R.1.4. Registered applications for Intellectual Property Protection, R.1.5. Number of signed collaborative agreements between research organisations and companies involved in the programme.

The indicators relate to the objective of the Programme, in particular "increasing the quality of applied research" (R.1.4. and R.1.5. concern cooperation with enterprises and protection of IPR, which is related to the assumed economic usefulness of the effects of the projects - a long-term goal of applied research) and "increased development of knowledge-based research" (R.1.1. and R.1.2. - new publications) and "strengthening of scientific and research cooperation between Poland and Norway" (R.1.2. - new joint publications with Norwegian partners). They can therefore be considered appropriate as indicators for monitoring the Programme objectives.

Table 3 Outcome 1 indicators.

Indicator Indicator value	R.1.1. Peer-reviewed scientific publications submitted	R.1.2. Joint peer-reviewed scientific publications submitted	R.1.3. New products/technologies developed	R.1.4. Registered applications for Intellectual Property Protection	R.1.5. Number of signed collaborative agreements between research organisations and companies involved in the programme
Current	93	13	27	4	40
Current / target	30%	12%	51%	8%	89%

[13] Results Guideline, March 2021

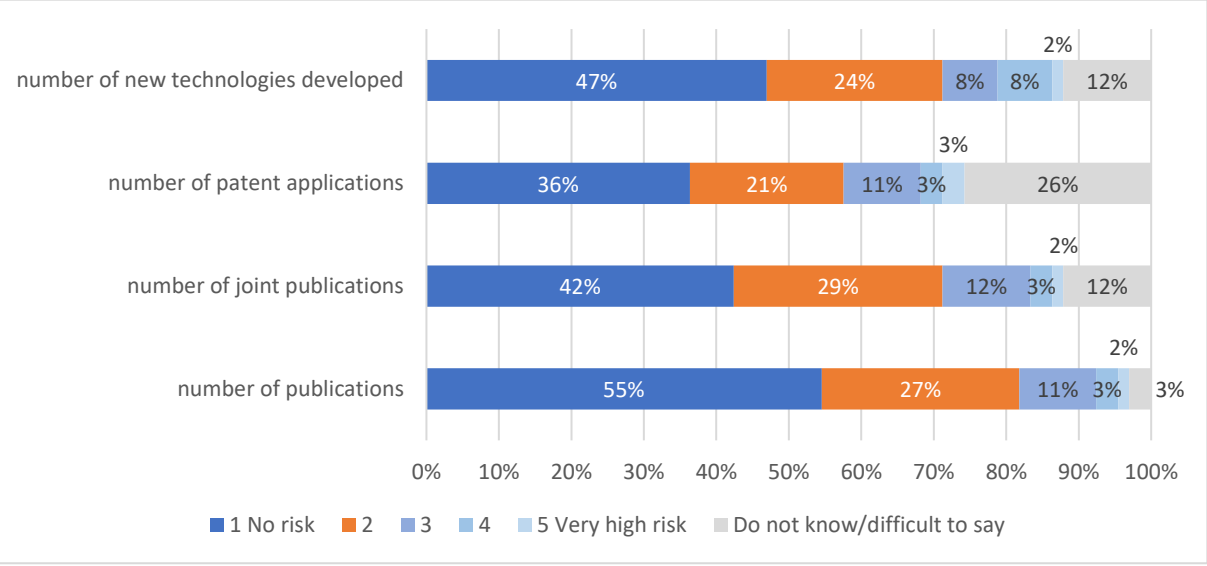
Target	315	105	53	53	45
Forecast - contracts	**446**	**236**	**133**	**80**	n/a
Forecast/target	142%	225%	251%	151%	89%

Source: own elaboration based on data provided by the Programme Operator (end of 2021)

Only one result indicator will not be achieved. Indicator R.1.5 counts the number of funding agreements for consortia that include enterprises. As a result of the completed calls, 40 such agreements were signed (38 in POLNOR 2019 and 2 in POLNOR CCS). Thus, the degree of achievement of the target value of the indicator is 89%. At the same time, it is worth noting that the number of enterprises participating in the Programme amounts to 49 (including 37 SMEs).

The remaining four result indicators will, according to the declarations of the beneficiaries in the grant agreements, be significantly exceeded, including R.1.3. concerning the development of new products and technologies - more than two and a half times (251%). The projects are currently at an early stage of implementation, as evidenced by the current values of the indicators. In the annual report summarising the results of the Programme at the end of 2021, the IProgramme Operator assessed the risk of not achieving the declared target values of indicators in the contracts as high[14]. In turn, the beneficiaries in the questionnaire survey carried out at the end of 2022 and the beginning of 2023 assess this risk as rather moderate (cf. chart below). The vast majority of beneficiaries believe that there is no or very low risk of failing to achieve the targets in the contracts. The most questionable indicator is the number of patent applications. This indicator also has the highest percentage of "I don't know/difficult to say" answers (26%). This is due to uncertainty about the eligibility of future R&D results for patent application, which is natural at this stage of project implementation.

Graph 7 Risk of non-achievement of indicators declared by beneficiaries in contracts



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=66

In interviews with beneficiaries and NCBR representatives, a number of factors affecting delays in project implementation were pointed out, which could pose a threat to the achievement of planned indicators.

[14] Annual Programme Report FM 14-20. Poland, PL-Applied Research, 2021.

These are discussed in detail in the chapter "Factors affecting project implementation". In order to address this, project implementation periods are being extended, which, according to the interviews, applies to the majority of contracts and proceeds without major disruptions, with a full understanding of the situation on the part of NCBR. Project budgets will also be supplemented with additional funds[15] coming from "savings" resulting from exchange rate differences (approx. 7% of project co-financing), which are to compensate beneficiaries for price and cost increases related to inflation.

The Bilateral Outcome was characterised by four indicators: RB.1. Joint applications for further funding (applies to project partners), RB.2. Level of trust between cooperating entities in Poland and donor states, RB.3. Level of satisfaction with the partnerships (institutional cooperation), RB.4. Share of cooperating organisations who apply the knowledge acquired from bilateral partnerships.

The Bilateral Outcome indicators refer to both the quality and satisfaction from the cooperation between project partners (RB.1) and institutions cooperating in the implementation of the Programme (RB.2, RB.3, RB.4).

It is noteworthy that already at this stage of project implementation (value reported at the end of 2021), the target value of RB.1 has been exceeded more than twice (11/6), and the number of joint applications for further funds for joint projects planned in the agreements (59) exceeds the target value of RB.1 by almost ten times (983%). Monitoring data shows that the vast majority of projects (46/50 = 92%) plan to continue cooperation in the form of joint applications for further funding. This confirms the thesis, resulting from the evaluation of the previous edition of the Polish-Norwegian Programme[16], that the main motivation for cooperation in bilateral partnerships was the possibility of conducting research in an international research environment, and that the possibility of obtaining funding for further research is a factor that determines the sustainability of the research teams formed.

In interviews with people involved in programming and implementation, establishing and maintaining cooperation between Polish and Norwegian partners in order to apply for further research funding in an international research environment is indicated as an important objective of the Programme. The default European programme for which POLNOR is supposed to "prepare" project teams is the EU Horizon Europe programme. According to interviewees from NCBR and RCN it is for this reason that the thematic areas of POLNOR overlap with those of Horizon Europe.

Indicators characterising levels of satisfaction and effects (in the form of implementation of good practices) of the bilateral outcome (indicators RB.2. to RB.4.) will be measured (satisfaction surveys) by the Donors' side after the end of the Programme.

Each outcome consists of contributing outputs - the results of the activities implemented under the specific objectives. A comparison of the projected outputs indicator values, which are the summed-up values of the indicators planned in the implemented projects, with the target values adopted in the Programme shows that the projected values, if achieved, will exceed the target values of the Programme. Values achieved currently[17] confirm the reality of this expectation.

The exceptions are following indicators:

[15] Applies to POLNOR 2019,POLNOR CCS and IdeaLab projects.

[16] Evaluation of the Polish-Norwegian Research Cooperation Programme, NCBR, 2017.

[17] Annual Programme Report FM 14-20. Poland, PL-Applied Research, 2021.

- Number of SMEs supported. Under the POLNOR 2019 and POLNOR CCS 2019 calls for proposals, 37 different SMEs received funding, one of them in 2 projects. Thus, the degree of achievement of the target value of the indicator was 74%;
- Number of CCS projects supporting the realisation of the pre-implementation phase. 1 such project has been contracted, while the planned target value of the indicator is 2 (achievement rate - 50%).

The target value of the bilateral output indicator defined as Cooperation between beneficiary and donor state entities supported, will also not be achieved. The total number of signed co-financing agreements for Polish-Norwegian consortia is 50, while the planned number is 53 (the degree of achievement of the target value is 94%).

The contribution of projects selected under the various calls for proposals to the objectives of the Programme varies. This results, inter alia, from the available budget and the number of contracts, but also from the specificity of support in a given call for proposals. The analysis of outcome indicators related to potential possibilities of implementation of project results (R.1.3. Number of developed/developed products/technologies and R.1.4. Number of applications for protection of Intellectual Property Rights) shows that the contribution of POLNOR and POLNOR CCS to the Programme per project is at a similar level. However, the market potential of new products and technologies developed under POLNOR CCS projects seems to be higher, which may be evidenced by the higher rate of IPR protection applications planned to be filed, per project.

4.2 Participation of enterprises in the Programme

Scale of company participation, motivations and matching support to needs

The extension of the scope of support to entrepreneurs should be regarded as one of the key changes introduced in the third edition of the Programme. In the POLNOR call for proposals, the participation of business entities as consortium members was obligatory, while in the POLNOR CCS and IdeaLab calls it was optional. In the SGS call, consortium projects were not eligible for support. Importantly, in each call, enterprises could act as the Project Promoter.

In practice, enterprises participate in 49% of the supported projects: all of the 38 projects supported in the POLNOR call and two out of the six supported in the POLNOR CCS call. Enterprises are leaders of two projects and operate as consortium members in all the other projects. The total number of enterprises involved in the projects is 49, of which 38 are located in Poland and 11 in Norway.

The qualitative research conducted among entrepreneurs shows that the motivations behind joining the projects were varied. In the first place, which should not come as a surprise, were financial motivations - the Programme created opportunities to obtain non-repayable support for the implementation of R&D actions. In this respect, it could be treated as an alternative to the OP Smart Growth; the key parameter for companies, i.e. the level of co-financing of industrial research and experimental development, was identical in both programmes. For some business entities, the international character of the projects was important - the experience gained from participation in such a project was a value in itself. It also provided an opportunity to establish new contacts. One of the interviewees indicated that an additional argument in favour of participating in the ”Applied Research” Programme was that it was conducive to freer experimentation, as a result of the lack of any obligation on the beneficiaries to implement the results of R&D. This observation provides a good starting point for determining whether the support was tailored to companies' needs.

The conducted research, both qualitative and quantitative, shows that the inappropriateness of any of the terms and conditions for applying or implementing projects to enterprises needs was signalled only rarely. In the questionnaire-based survey, only one entity (out of 40 that implemented a project in consortium with an enterprise) gave an example of such inappropriateness, pointing to the excessive timeframe of the process and excessive amounts of paperwork. In interviews, enterprises also mentioned a number of formal requirements which had been imposed on them, but they did consider these as a factor significantly reducing the attractiveness of the support. Some of the interviewees had previous experience in implementing projects supported by public sources (including the OP SG), so the scope of the administrative burden involved in the Programme did not come as a surprise to them. Moreover, the statements made by enterprises indicated that the burden on the part of the consortium member is, however, lower than on the part of the Project Promoter. The requirement that the enterprises considered burdensome concerned the award of public contracts in accordance with the Guidelines for the Award of Contracts under the EEA Financial Mechanism 2014-2021 and the Norwegian Financial Mechanism 2014-2021. It should be noted that the provisions of these Guidelines are very similar to those of the Guidelines on the eligibility of expenditure[18], in particular with regard to the so-called competitive procedure. In a study commissioned by the Ministry of Development Funds and Regional Policy, the necessity to apply this procedure was considered to be one of the four key administrative burdens for the beneficiaries of the OP SG[19] .

Taking this into account, the terms and conditions for applying for and implementing support should generally be considered as fitting to the needs of business entities. They are generally similar to, for example, the conditions applicable under the OP SG. The following three features should be regarded as the most important differentiators of the Programme with respect to the supports under the OP SG, which are at the same time its advantages:

- possibility of implementing international projects;
- possibility for enterprises of participating in research projects as a consortium member rather than as a project leader[20];
- lack of inclusion in the grant agreement of any obligation to implement project results.

The role played by economic entities in projects

The starting point for determining the role of enterprises in research projects supported under the Programme should be the scale of their financial involvement. The data provided by NCBR shows that although enterprises participate in 49% of the supported projects, their share in the total cost of co-financed projects is only 14%. This rises to 19% if only the cost of projects in which enterprises participate is taken into account. The values of the enterprises' budgets varied significantly between the projects - they ranged from PLN 32 000 to PLN 3.9 million (median = PLN 1.1 million). Detailed data is provided in the table below.

[18] Full name: Guidelines on the eligibility of expenditure under the European Regional Development Fund, the European Social Fund and the Cohesion Fund 2014-2020

[19] Assessment of the administrative burden of beneficiaries of the Operational Programme Smart Growth 2014-2020; CODE-Design, STOS; Warsaw 2017.

[20] Such a possibility was not offered under the fast track. It was, to a certain extent, allowed under Measure 4.1 of the OP SG.

Table 4 Basic data on financial participation of enterprises in projects

Total value of all projects supported	PLN 370 million
Total value of projects involving enterprises	PLN 265.2 million
Total value of costs attributable to enterprises	PLN 50.8 million
Median value of the projects in which enterprises participated	PLN 6.6 million
Median value of tasks assigned in the project to enterprises	PLN 1.1 million

Source: own elaboration based on data provided by the Programme Operator

On average, the relatively limited financial participation of enterprises in projects is influenced by the following circumstances:

- The projects have been initiated primarily by scientific entities, which certainly has resulted in a different distribution of research and thus financial focus, than if enterprises had been the initiators.
- 100% financing level for research units and an average of 70% for business entities - entrepreneurs, as entities investing their own resources in projects, had to take into account primarily the financial aspect when determining their involvement in projects. On the side of scientific entities, this limitation did not exist.
- No minimum requirement set for contributions from economic entities to the project budgets.

The role played by enterprises in projects can be viewed both through the types of research in which they were involved and the structure of expenditures under various cost categories.

As far as the first approach is concerned, the survey shows that almost all enterprises conducted industrial research as part of their projects. A certain surprise, which requires an in-depth explanation, is the result of only 38% of enterprises that decided to carry out experimental development, i.e. research covering levels 7, 8 and 9 of technological readiness. This translated into a structure of project implementation expenditures incurred by enterprises, in which 87% of funds were allocated to industrial research, only 10% to experimental development and 3% to basic research. Detailed data on the involvement of enterprises in particular types of research is provided in the table below:

Table 5 Involvement of enterprises in the implementation of different types of R&D

Type of research	Number of projects involving enterprises in which this type of research took place	Number of enterprises involved in this type of research	Percentage of enterprises involved in this type of research	Financial expenditure by enterprises on this type of research
Basic	10	6	12%	PLN 1.5 million
Industrial	40	47	94%	PLN 44.2 million

Experimental development	22	19	38%	PLN 5.1 million

Source: own elaboration based on data provided by the Contracting Authority

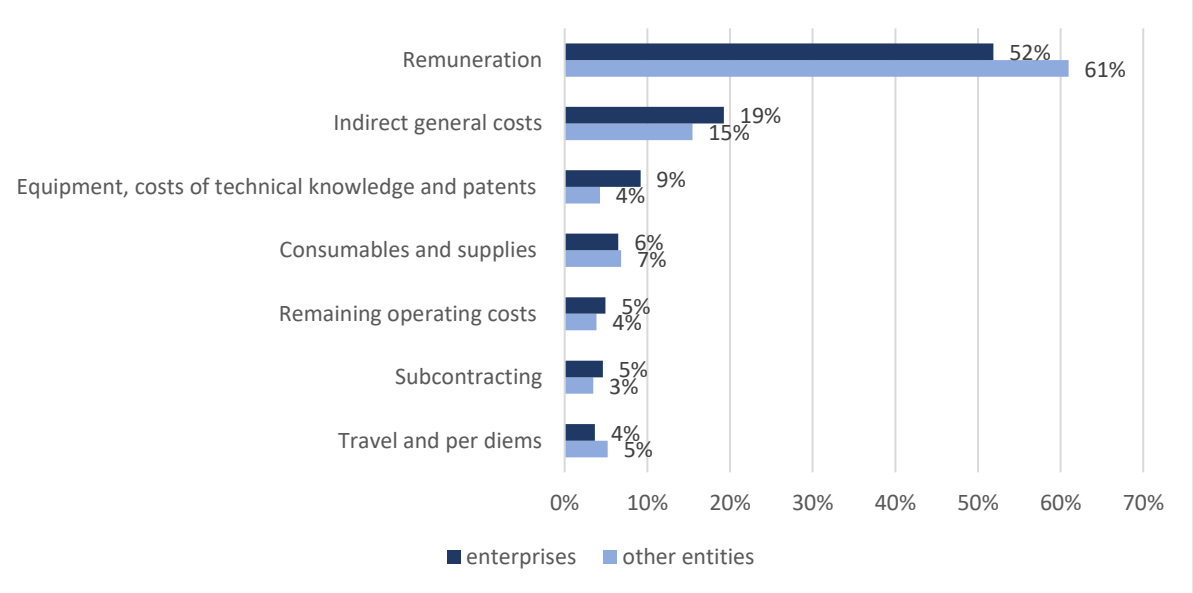
One could expect that enterprises would be primarily interested in engaging in research work that is closest to the market, i.e. at the highest technology readiness levels (TRL). However, this has not been the case, which has been influenced by the following circumstances:

- The level of funding for experimental development is 20 - 25 p.p. (depending on the size of the company) lower than in the case of industrial research. Thus, from a financial point of view, it was more advantageous for enterprises to engage in R&D covering TRL 2-6;
- Expanding on this point - some interviewees signalled that the boundary between industrial research and research development can be fluid. This may have led some business entities to carry out research 'under the guise' of industrial research (and therefore more intensively supported), that was in practice experimental development;
- There was no obligation imposed on project participants to implement results, hence enterprises did not have to bring their projects to the last level of technological readiness immediately preceding implementation. It is worth adding that in the OP SG, enterprises were obliged to include experimental development in the project;
- Some interviewees signalled that industrial research can be significantly more expensive than experimental development - as being conducted at lower TRLs, it is subject to greater risk of uncertainty and thus involves investment of resources in research directions that can prove to be unpromising.
  In our case, it has been structured in such a way that we test everything in industrial research, by which I mean everything in the laboratory, so that we know the risks involved in the use of the technology, so that we can simulate, model this technology and so that the process of demonstrating the solution later goes fairly smoothly. That is why this emphasis is stronger and longer on industrial research than on experimental development. That is by then, let's say, the icing on the cake and the implementation of what has been developed before. [Quoted from an interview with a consortium member];
- The focus on industrial research may in some cases have been indicative of the ground-breaking nature of the R&D carried out - it addressed new issues that are mainly explored at lower levels of technological readiness. The technology had not yet been tested under real-world conditions. It was therefore necessary to carry out in-depth, large-scale industrial research first, as there was little opportunity to rely on research already carried out by other research teams.
  Please note that going three years back, as far as the utilisation of .... is concerned, there was actually very little going on here. Our project is, as far as I know, one of the first projects in this industry. And prior to our project, there was actually very little work, very little information regarding the development of such technology and hence this applied research. It was necessary to carry out a large amount of this research. If we were starting this project now, it would probably be possible to start from some higher level based on the knowledge that is now available. We were starting from scratch. [Quoted from an interview with a consortium member];
- The already mentioned initiation of projects primarily by research units, which are more interested in carrying out industrial research rather than experimental development;
- Probably existing lower capacities of enterprises for the carrying out of industrial research on their own, as compared to experimental development, may be prompting enterprises to take advantage

of the opportunities offered by projects implemented in consortia with academic institutions through focusing specifically on this type of research.

With regard to the structure of the types of costs incurred by the business entities by individual cost categories, outlays on remuneration clearly predominated. In general, the structure of expenditures in companies and other types of supported entities was similar.

Graph 8 Share of outlays by each cost category in total project budgets (data only for projects involving enterprises).



Source: own elaboration based on data provided by the Programme Operator

The impact of the inclusion of business entities as obligatory members of consortia in the POLNOR call for proposals on the project evaluation and selection process on the part of NCBR / the work and expenditure scope of projects.

As indicated earlier, the participation of business entities in the POLNOR call was mandatory. Experience from the POLNOR CCS and IdeaLab calls indicates, that replacing such a requirement only with an option to include business entities in the composition of consortia, results in the lack of participation of enterprises in 83% of the projects. In this context, the mechanism used in POLNOR should be considered appropriate. Moreover, it fostered a greater orientation of projects on the needs of the economic sector - 79% of POLNOR beneficiaries declared that business entities participated in the project design. The average for other calls was only 14%. On the other hand, the mechanism did not stimulate the initiation of projects by business entities - only 13% of POLNOR beneficiaries declared this to be the case.

In follow-up to the introduction of the requirement for participation of business entities, no other rules were included in the terms and conditions for application or evaluation of projects, which could have stimulated greater involvement of enterprises in projects - not only in quantitative, but also in qualitative terms. In this context, attention should be paid first of all to the lack of any requirements on minimum levels of financial participation in the projects, and to the fact, that project proposal evaluation was carried out in a manner analogous to that used in other calls.

As far as the first of these two areas is concerned, the introduction of such a threshold seems justified in the light of the research findings. The financial participation of some of the enterprises in the total project

budgets was negligible - in extreme cases it did not exceed 1% and in 29% of the projects not more than one in ten zlotys was spent by the enterprises. The smallest own contribution to a project (not including co-financing) by an enterprise amounted to PLN 13 000, with the total project value coming in at almost PLN 5.5 million. The presented data shows that in some projects the significance of the enterprises participation in the research work was marginal. It can be assumed that they had a negligible impact on both the shape of the project and the course of its implementation. It is hard to resist the impression that in such cases the main motive behind the cooperation with an enterprise was solely the desire to meet the call for proposals requirements. In this context it is worth noting the results of the survey, where 14% of the respondents declared that if the terms and conditions of the call for proposals had not required the project to be implemented in a consortium with a business entity, they would have preferred to implement the project without the participation of such an entity[21]. Taking this into account, it is recommended that the Programme Operator establishes for enterprises a minimum level of financial participation in the eligible costs of projects.

As far as the method of project selection is concerned, the adoption of a single approach, common for all calls for proposals, raises doubts. It seems that the different profiling of individual calls should also be reflected in the evaluation system. For example, in the POLNOR call, where the participation of business entities was required, the project selection process could take into account the following aspects: the role of the business partner in the project, the implementation potential of the solution, the level of technological readiness at end of project. These will inevitably not be relevant or will be noticeably less relevant in the SGS call where partnerships were not allowed. The effect of differentiating the evaluation system between calls for proposals can be achieved in various ways, e.g., by using different criteria, different scoring weights of criteria or their definitions, sensitising experts evaluating proposals to the specificity of the individual calls.

As far as the work and expenditure scope of projects co-financed from the POLNOR call for proposals is concerned, the analyses carried out show that their average cost amounted to PLN 6.2 million and was several times higher than the cost of projects from the SGS call for proposals (which resulted from the limitation of the value of support to EUR 200 thousand) and slightly lower than the average value of projects from the POLNOR CCS (PLN 9.4 million) and IdeaLab calls for proposals (PLN 8.1 million). Interestingly, an analysis of the structure of project budgets shows that out of all the calls, it was in POLNOR that the significance of experimental development in the co-financed projects was the lowest - both in terms of the percentage of projects in which such work was envisaged and its share in the total budget. A number of circumstances influencing the strong focus of projects with business entities participation (i.e. mainly projects from POLNOR) on industrial research have been indicated in an earlier section of this report.

The data presented in the table below further reinforces the argument related to differences in the intensity of support between industrial research and experimental development. This is well illustrated by the SGS call, in which scientific units receiving 100% funding regardless of the type of research conducted were the only recipients of support. The financial aspect was therefore irrelevant when deciding which funds to allocate to which levels of technological readiness. In the POLNOR call, research units implementing projects in consortia with enterprises also had to take into account their partners' financial capacities, which certainly influenced the shape and scope of projects. This is confirmed by the data: while within the framework of supported projects every fifth zloty allocated for industrial research came from

[21] The percentage refers to a 'rather yes' response. None of the respondents answered "definitely yes".

economic entities, in the case of experimental development it was only every tenth zloty[22]. In practice, the share of experimental development in total project expenditure in projects selected in the POLNOR call was 12 p.p. lower than in the SGS call.

Table 6 Significance of individual types of R&D in supported projects - data by call for proposals

Type of research	share in number of projects				share of total budget			
	POLNOR	POLNOR CCS	SGS	IdeaLab	POLNOR	POLNOR CCS	SGS	IdeaLab
Basic	24%	50%	26%	50%	2%	3%	2%	4%
Industrial	95%	83%	87%	50%	80%	73%	67%	34%
Experimental development	50%	50%	58%	83%	18%	23%	30%	62%

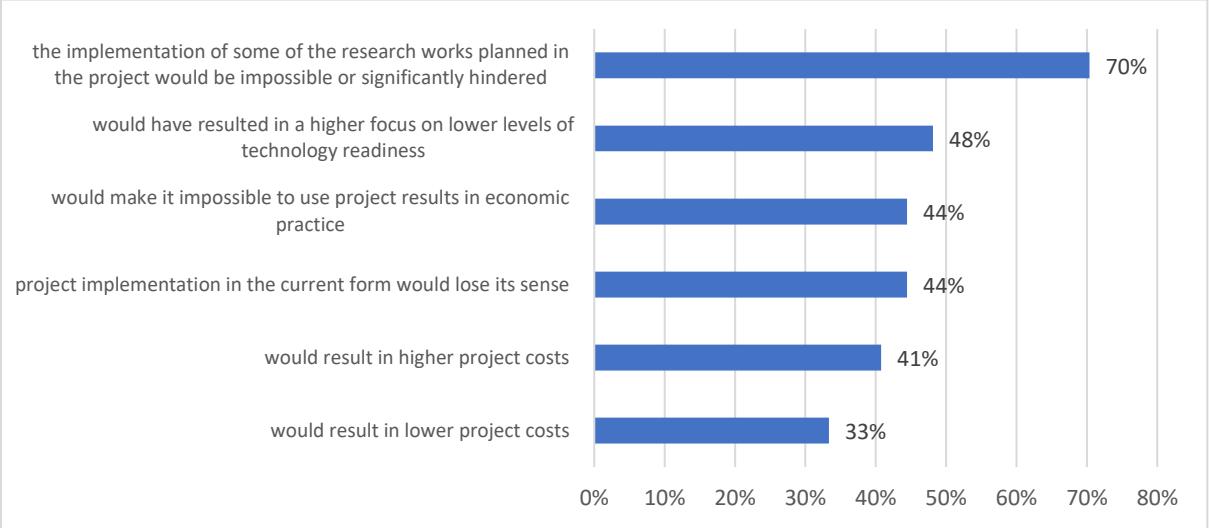
Source: own elaboration based on data provided by the Programme Operator

In light of the data presented above, it should not come as a surprise that the expected average level of technological readiness, to which the projects from the POLNOR call will be brought, will be very similar to the level from the other calls (6.6 vs. 6.24). This explains why almost identical percentages of beneficiaries of the POLNOR call and beneficiaries of other calls (65% and 66%) indicated that their projects would need to be continued after all the research actions planned in the project proposal have been completed. On the other hand, it is the beneficiaries of POLNOR who have provided a higher assessment of the chances of commercialising the solution after all the research works have been completed (POLNOR - 54% indications on high and very high chance, other calls – 31%). The above themes are developed in more detail in the next chapter.

Finally, it is worth exploring the opinions of POLNOR's beneficiaries on the probable effects that would have resulted if a business entity had not been involved in the project. By far most often they indicated the effect that the implementation of some of the research works planned in the project would be impossible or significantly hindered. This shows that in most projects the consortium member enterprises provided access to resources (e.g., personnel, equipment) complementary to those of the participating scientific entities.

[22] The data relates only to projects in which enterprises have participated.

Graph 9 Likely effect of not involving the business entity in the project (responses 'definitely yes and rather yes').



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=42

4.3 Practical use of research results

The extent to which the inclusion of business entities as compulsory members of consortia in the POLNOR call for proposals affect the possibilities of practical use of project results.

The extent to which the results of research conducted under the Programme "Applied Research" are likely to be used in business practice. Paths of commercialisation.

At the stage of project design it was important or very important for 88% of Principal Investigators that the results of the project had the potential to be used in practice, e.g. in the business sector (97% in POLNOR and 71% in the other calls). The information presented in this chapter should be as a very preliminary assessment of the chances of these expectations materialising. This is due to the fact that at the time of this evaluation none of the supported projects had been completed. Moreover, the declarations of Principal Investigators expressed in the survey indicate that when all the work planned in the project proposals has been completed, only in the case of 23% of projects their results will be ready for implementation in practice. The majority of projects will require continuation at higher levels of technological readiness, mainly concerning the experimental development stage - the average TRL to which the supported projects will be brought is level six. It is also worth noting that at this moment none of the beneficiaries (among those participating in the survey) was of the opinion that further continuation of the project, taking into account the implementation aspect, would be pointless. In none of the projects the results of the work carried out so far provide any basis for concluding, that their implementation will be impossible or unjustified.

The actual scale of commercialisation of research results will only be observable in the long term. Only 9% of those respondents who declared that the project will need to be continued intend to commercialise the results immediately after the completion of that part of the project which is financed from the funds of the Programme “Applied Research” (42% indicated that only after the finalisation of all research work, while 49% gave the answer "don't know/difficult to say").

In the light of the above information, it was important to find out the beneficiaries' opinions on the chances of commercialisation of the project results, assuming that all research works preceding implementation are completed (regardless of whether they will be financed from the Programme or from another source). The

respondents were asked to assess these chances using a five-point scale, where 1 meant that this probability was very low and 5 - very high. The distribution of responses - both for the total number of respondents and by POLNOR and other calls - is contained in the table below.

Table 7 Distribution of responses to the question: How do you estimate the chance of commercialisation of the project results within two years of the complete completion of all research work?

	Total	POLNOR	Other
1 - very low	5%	0%	9%
2	9%	12%	6%
3	26%	27%	25%
4	28%	35%	22%
5 - very high	14%	19%	9%
I don't know/difficult to say	19%	8%	28%

Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=58

The declarations of those surveyed indicate that they assess the commercialisation potential of their solutions moderately positively - the percentage of indications for answers 4 and 5 amounts to 42%, and in the case of beneficiaries of the POLNOR call it is 23 p.p. higher than in the case of beneficiaries of other calls. This is clearly resulting from the obligatory participation of enterprises in projects and much more frequent involvement of enterprises in project design.

As far as the risks that could hinder or prevent commercialisation are concerned, the risk related to the need to continue research work initially carried out with support from the Programme comes to the fore. Almost half of the respondents fear that they will not have the financial resources necessary to continue the project in order to bring it to higher levels of technological readiness. This concern is understandable - the costs of further R&D activities may be significant, which will most likely result in the need to apply for external sources of support. There is a risk that beneficiaries will not obtain such support, which may be influenced by a number of circumstances, such as: a negative evaluation of the submitted project proposal, inability to submit a project proposal due to the project not fitting into the call's requirements (e.g. non-alignment with smart specialisations, lack of possibility for a foreign entity to participate in the project, lack of possibility for a scientific unit to act as a leader). The optimal situation would be one in which, within the framework of the Programme "Applied Research", projects are brought to a stage where their commercialisation potential is high enough that economic entities are interested in their continuation. They must therefore rate highly the chance of implementing the solution, which would justify the further investment of funds in the project. In such a situation, it would be the business entities who would take over the leading roles in the projects from the research units, and it would be their responsibility to obtain funding for its continuation. This would have the advantage that instruments to support R&D projects involving higher levels of technological readiness are primarily aimed at business entities (cf. for example, the design briefs of the programme European Funds for a Modern Economy or regional programmes under the financial perspective 2021-2027). Therefore, it will be much easier for business entities to obtain funding for the continuation of projects than will be the case for scientific entities. On the other hand, it is to be expected that some projects will end at a stage that does not justify shifting the "centre of gravity" from the research unit to the enterprise - both in terms of work involved and financing. These types of projects can be considered to be most at risk of finding themselves in a so-called funding gap, i.e. a

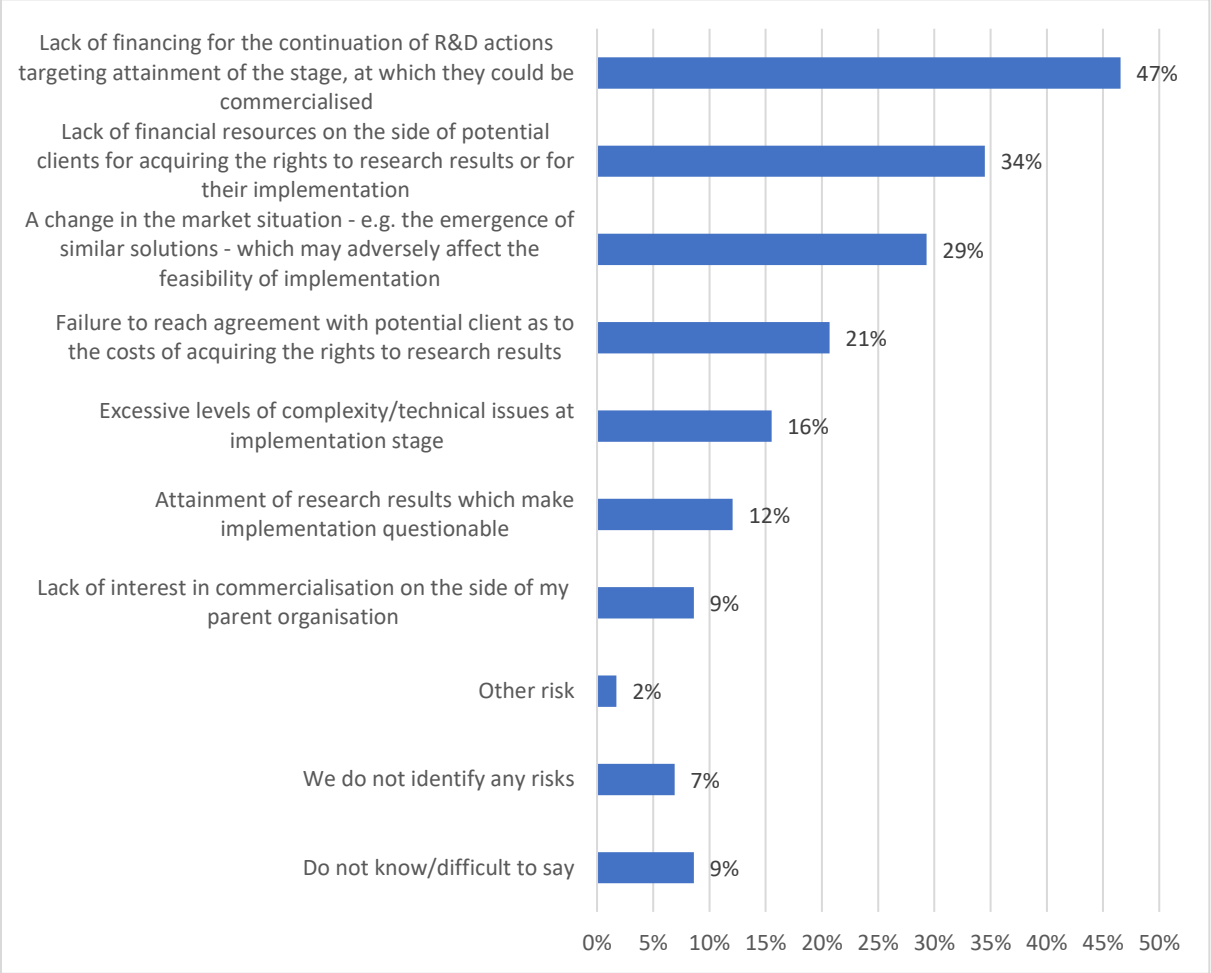
situation in which obtaining funding for their continuation will be very difficult. A certain solution would be to provide support for these types of projects in the next edition of the Programme "Applied Research", but taking into account the previously noted gaps between editions of several years, this may be difficult.

The second most frequently mentioned risk concerns the lack of financial resources on the part of potential clients to acquire rights to research results or to implement them. It is difficult to predict at this point to what extent this risk is likely to materialise - as indicated earlier in this report, the valuation of the intellectual value created as part of the project will, as a rule, be carried out only after all the work has been completed, when an entity expresses interest in obtaining the rights to specific results. It would appear, that the lower the financial participation of a business entity in the project, the higher the risk. It should be assumed that the extent of an enterprise's rights to the results of a project is more or less a reflection of its financial commitment - small financial participation translates into a small share in the creation of intellectual property. In such cases, an enterprise interested in commercialisation would most likely have to purchase a significant part of the rights to the results from the research unit, which would probably be reflected in their value. This is another argument in favour of introducing mechanisms that will stimulate greater financial participation of enterprises in projects.

It is worth noting that in the case of this risk, the difference in the frequency of indications between the beneficiaries of POLNOR and the beneficiaries of the other calls is the most visible. It amounts to exactly 28 p.p. Beneficiaries of calls in which the participation of enterprises as consortium members was not obligatory perceived the risk of lack, on the part of potential clients, of financial resources for the acquisition of rights to research results or the implementation of their results much more frequently. In the vast majority of these projects enterprises did not participate at all, which, as it were, automatically translates into a wider scope of rights to research results that enterprises would have to acquire. In addition, qualitative research shows that in at least some projects implemented in the consortium formula, attempts were made to shape the division of tasks between partners in such a way, that implementation by the business entity was possible either solely on the basis of the results of R&D work carried out by the enterprise or with the use of only some of the results belonging to the research unit.

Only 7% of respondents did not perceive any risks associated with the commercialisation phase. Detailed data is provided in the chart below.

Graph 10 Risks related to the commercialisation of the results of the R&D carried out under the supported projects



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=58

Given the current level (March 2023) of advancement of the projects, it should come as no surprise that almost half of the respondents (48%) were unable to determine the most likely form of commercialisation of the results. The remaining respondents by far most often (43%) indicated licensing, which seems to be the most optimal form both for the research unit, which does not permanently lose the rights to research results, and for the business entity - insofar as it allows the investment in rights to research results to be spread over time and the value of the right to depend on its actual commercial potential (e.g. by specifying that the value of the licence will be tied with the revenue generated as a result of the implementation).

59% of Principal Investigators indicated that the rights to the results of their research would most likely be obtained by a Polish entity, 24% by a Norwegian entity and 17% by an entity from another country.

Summary

Summarising the results presented in this and in the previous section, it should be stated that most supported projects have potential for commercialisation, the sources of which can be found in:

- subsidising primarily industrial research and experimental development (the limit for basic research was 10% of eligible costs);
- the involvement of business entities in the project design process;

- compulsory participation of business entities in projects from the POLNOR call, which accounted for 47% of the total number of projects supported, and which accounted for 64% of the total value of support.

At the same time, one should be aware that we are still talking about potential and the assessment of the actual scale of commercialisation will be possible only in a longer perspective - it is worth conducting a study in 3-4 years, which will show what the "further fate" of projects from the third edition was. However, the scale of practical use of the results of undertaken actions should not be used as a measure of success or failure of the Programme. It should be emphasised that its primary objective was to increase the activity of Polish scientists in the implementation of applied research. Beneficiaries were not obliged to include the stage of experimental development in their projects, let alone implement the results of the works carried out.

The Programme's terms and conditions on the competitive approach to project identification and the role of enterprises are to be considered fully appropriate. They have allowed for attaining the following:

- Increasing the pro-business orientation of projects compared to the second edition of the Programme, with the changes introduced between editions being evolutionary rather than revolutionary. As a result, the Programme, despite including the perspective of enterprises, retained its more "science" rather than "implementation" oriented character.
- At least partially filling the gap in the portfolio of sources of support for R&D projects available to enterprises and scientific entities. It should be noted that supported projects would have little or no chance of receiving support from the OP SG, i.e. a key programme supporting the implementation of R&D of an applied nature - under that programme, the leaders of consortia had to be enterprises, their share in the total eligible costs of the project had to be at least 50%, projects had to include the stage of experimental development, an obligation to implement the results of R&D was imposed on beneficiaries.
- Positively influencing the supply of projects that are potentially ground-breaking in terms of level of innovation. As indicated, projects focused on the industrial research stage. This research has a much greater potential to generate completely new knowledge than experimental development, which is defined as: acquiring, combining, shaping and using knowledge and skills that are currently available. The lack of obligation to implement the results of R&D work favoured risk-taking, experimentation, which are necessary in highly innovative ventures.

Regardless of the above-mentioned strengths of the Programme, it is worth considering in what direction it should evolve. It seems advisable to "raise the bar" further when it comes to the applied character of research and to stimulate cooperation between the scientific sector and the economic sector more strongly, than previously (especially in the SGS call). At the same time the situation should be avoided, in which the only element differentiating the Programme from other instruments of support for applied research would be its international character. For this reason, it is highly recommended to maintain the absence of any obligations to include the experimental development or implementation stages in projects. Detailed recommendations are included in the table of recommendations.

The extent to which project teams/individual members or contractors have experience in commercialisation or implementation of R&D results?

The research shows that a significant proportion of the surveyed Principal Investigators or members of their research teams involved in projects supported by the Programme had previous experience of participating in projects of a pro-business nature. The research indicates that among the total number of applicants for support from the Programme:

- 69% participated in R&D projects in which enterprises were involved, but not as consortium members;
- 68% participated in R&D projects carried out under a scientific-industrial consortium formula;
- 48% were involved in R&D projects where the results were commercialised (implementation, sale, licensing).

These results directly testify to the occurrence of a kind of self-selection mechanism - mainly scientists/research teams with experience of cooperation with the economic sector applied for participation in the Programme. This should not come as a surprise in light of the Programme's focus on industrial research and experimental development and the requirement to establish a consortium with an economic entity in the POLNOR call. The research shows that it was the applicants to POLNOR who had clearly more experience in cooperation with industry than applicants to the other calls (see Table 8). It is worth recalling that more than 1/3 of the Principal Investigators declared that they had previously cooperated with the enterprises, now being members of the consortium.

Table 8 Experience of Principal Investigators applying for support from the Programme in cooperation with the economic sector

	Participation in projects in which economic entities participated, but not as consortium members		Participation in projects in which economic entities participated as consortium members		Participation in projects where the results have been commercialised (implementation, sale, licensing)	
	POLNOR	Other	POLNOR	Other	POLNOR	Other
Experience is possessed by the project leader or members of the team	83%	66%	85%	65%	63%	45%
No experience	8%	16%	8%	21%	18%	28%
I don't know/difficult to say	10%	18%	8%	15%	20%	27%

Source: own elaboration based on survey among beneficiaries of the Programme "Applied Research", N=66

No significant differences were identified between beneficiaries and those unsuccessfully applying for POLNOR support in terms of experience in previous cooperation with the economic sector.

Good practices for commercialisation of R&D project results applied in the donor country that can be used in Poland

As according to the European Innovation Scoreboard 2022[23] Norway (with indicators at 122% of the EU average and 114% of the EU average for strong innovators) is one of the most innovative countries, it has

[23] https://ec.europa.eu/assets/rtd/eis/2022/ec_rtd_eis-country-profile-no.pdf

much to offer in terms of commercialisation good practices. The following review of practices is based on desk research.

The Norwegian system targets funding gaps related to the commercialisation of research results. The Research Council of Norway (RCN) supports technology development up to the pre-commercial phase. The RCN invests in those projects, in which the results of publicly funded research have commercial potential, providing funding in stages based on milestones achieved. Research institutes and other eligible entities can apply for funding for a Qualification Project, which serves to clarify uncertainties that may prevent the project from progressing through the commercialisation process. If the qualification project is successful, the results can form the basis for an application for further funding in the form of a Proof-of-Concept project, so as to reduce technological and market risks. It is also possible to apply for a Proof-of-Concept grant without a prior Qualification Project. Calls for proposals are open for all thematic areas and the project can be at TRL levels 2-7. Up to 100% of the budgeted project costs can be applied for, there is no requirement for an own contribution and the project costs are the actual costs necessary to implement the project. The Proof-of-Concept grant is awarded to projects in the pre-commercial phase[24].

From 2022, all beneficiaries who are research organisations or public sector bodies (Project Promoters and Partners) must have a Gender Equality Plan available on their website. It must be in place at the time they sign the grant agreement for projects awarded funding by the Research Council. This requirement does not apply to the business sector, special interest organisations or the non-governmental sector. If during the evaluation projects attain equal scores in the qualitative criteria, projects led by women project managers and projects that address important societal challenges are selected. The Research Council evaluates proposals on the basis of the criteria 'excellence', 'impact' and 'implementation'. Experts involved in the evaluation possess experience in commercialising research results and knowledge of relevant technologies or fields of application. Project proposals are evaluated and decided on as they come in. Project promoters are informed of the funding decision usually within five to six weeks and no later than three months after submission. Typical project activities include: optimisation, clarification and demonstration of technology concepts and results; clarification of fields of application, market potential, willingness to pay and development of business models and strategies; networking with potential investors, industry partners, customers and users; preparation of the basis for Freedom to Operate and preparation and submission of patent applications[25].

Another programme run by the Research Council is the Young Talent Research Project, which aims to support young researchers with high research potential and commercialisation ambitions[26]. The preparation of an application is relatively straightforward (maximum 11 pages), and one can receive between NOK 4 and 8 million (about EUR 434 k and 687 k) for projects lasting between 36 and 48 months.

There are also other institutions supporting the commercialisation of research results. Innovation Norway is a government agency that provides funding and support to entrepreneurs and companies looking to develop and commercialise innovative products and services. The agency offers various funding programmes and support services, such as mentoring and coaching, to help entrepreneurs and researchers take their ideas to market. Grants are used for projects where the socio-economic benefits of the project are significant and the technical risks are high. The most popular grant programmes are related to environmental technologies, collaborative innovation and more environmentally friendly use of bio-

[24] https://www.forskningsradet.no/en/

[25] https://www.forskningsradet.no/en/call-for-proposals/

[26] https://www.forskningsradet.no/en/call-for-proposals/2023/researcher-project-young-talents-fripro/

resources (e.g., Commercialization Grants, Grants for market clarification, Green growth loan, Grants for environmental technologies, Grants for smart transport solutions, Grants for bioeconomy projects, Green investment grant in rural areas, etc)[27].

EU programmes for radical innovation are also available. Innovation loans can be used for the commercialisation of new solutions, strengthening working capital, growth and internationalisation. Grants are reserved for Norwegian enterprises that meet minimum requirements for good business practices. Innovation Norway also provides global accelerator programmes to assist start-ups and growth companies in the international market. These programs offer access to mentors, networks, and capital[28].

The information on Norwegian practices related to commercialisation is supplemented by the results of qualitative research. This research shows that good practices applied in the donor country that can be used in Poland concern not only commercialisation, but also are of a broader nature. First of all, attention is drawn to the quality of contracts used in R&D projects, which clearly define the rights and obligations of the parties, addressing the issue of protecting intellectual property rights, among other things. Even if the R&D project under which the cooperation takes place does not provide for commercialisation, a defined path should be established in case the research does result in patents or results that are suitable for commercialisation. Researchers who apply for a grant are usually not knowledgeable about legal issues, so agreements governing intellectual property and rules of cooperation between partners should be developed by lawyers employed by grant bureaus or project services departments. Resources and competences in this area should be built not only on the basis of the bilateral cooperation programme, but also on an ongoing basis, based on the experience gathered during the implementation of different programmes and projects. This requires a long-term investment in human capital, as well as the adequate motivation of non-scientists involved in R&D projects. At universities and research institutes, such employees are often treated as less relevant to the achievement of the institution's goals, which is not a correct assumption. Research institutes with the highest success rates in applying for funds from centrally managed EC research programmes (Horizon 2020 and Horizon Europe) have improved their administrative processes, including legal and financial support. This enables them to build consortia that lead to success. Polish science sector institutions participating in bilateral cooperation programmes should have the opportunity to see how Norwegian grant bureau's function and what advisory support they provide in R&D projects. The grant offices should ensure that contracts are formulated in a way that all parties can understand (which can be difficult if the contracts are translated from Polish and contain wording typical of the Polish system). Therefore, the best solution seems to be to use model agreements similar to those in Horizon Europe, as they are familiar to the partners.

In conclusion, the most relevant to use in the next edition of the NFM Applied Research program seems to include the opportunity to learn about the functioning of Norwegian grant offices, their work organization, tasks and role in R&D projects. Improving the operation of the administrative side may bring benefits in the form of a greater number of R&D projects carried out in international consortia by Polish science sector units.

4.4 Participation of female researchers in the Programme (SGS call)

The Small Grant Scheme (SGS) Call aimed to support applied research projects led by female scientists in technical sciences. It was envisaged to contribute to the general development of scientific research in

[27] https://www.innovasjonnorge.no/no/tjenester/innovasjon-og-utvikling/finansiering-for-innovasjon-og-utvikling/

[28] https://www.innovasjonnorge.no/en/start-page/

Poland, but more specifically, to strengthen the scientific career prospects of female researchers involved. The total allocation earmarked for the SGS Call for Proposals was EUR 5 000 000 (increased to EUR 5 737 307), with min. project financing amount of EUR 50 000 and max. of EUR 200 000. Apart from requirements concerning the submission of a project by a single Polish entity (acting as Project Promoter) with a female researcher leading the project (acting as Principal Investigator), the remaining conditions of the call were relatively more flexible in comparison to other paths in the Programme. They allowed for greater thematic freedom, while offering no predefined financial envelopes allocated to OECD's 11 fields of science and technology. The conditions of the call did not oblige beneficiaries to establish international cooperation, nevertheless it was sometimes done at the project level regardless.

Considering the rather small size of the project's budget and the specific structure of its eligible cost, the call favoured mainly the progress in scientific careers of female researchers, possibly completing important career steps like obtaining the PhD title, graduating from post-doctoral studies or being granted a title of professor. Other focal area observed for this call was involving young researchers in project implementation. The main outputs of the call are expressed by output 1.3 "Support to women researchers provided" and build up the values of gender disaggregated output 1.2 „Support to researchers conducting applied research provided". Other than that, outputs typical for other research projects in the Programme are aggregated without „gender perspective", i.e.: output's 1.1: Number of peer-reviewed scientific publications, Number of new products/technologies developed, Number of registered applications for IRP, Number of SMEs supported and 1.4 Number of grant projects lead by young researchers.

The call was immensely popular among its participants: 337 applications were submitted in total, 32 were recommended for financing, whereas 31 projects were finally contracted in the Programme. More than 50% of applicants were young Principal Investigators. The success rate of applicants rests at the level of 9%.

The results of our study point out at considerable demand for organising separate calls for female researchers in technical sciences. The evidence collected for purposes of this evaluation supports the main conclusions of the much broader survey „The functioning of women and men in science" drafted for NCNNCN in 2022, presenting results of the poll for 5790 participants, 3722 of which were female researchers[29].

The activity of women and men in obtaining funding for research projects in national competitions is high, but relatively low, when it comes to foreign competitions. One of the main barriers for participating in international competitions rely for both sexes in limited access to information about foreign grants. An additional result of our study suggests that awareness of existing international funding schemes may be even better among men than women in technical sciences, as some participants of our study declared obtaining the information about the call from their male colleagues („who might not share the information, should the call be open for both sexes").

According to the report cited above participants in the survey of both genders were equally interested in being a research project manager, while more detailed results show that there was a predominance of men with experience in this field. The main reason explaining this situation is attributed to the low opinion of women of their scientific achievements and conviction of limited chances for obtaining funding. Against this backdrop, evidence from our study highlights the strong motivation of female Principal Investigators to develop their scientific careers and gain new competences in managing projects. In spite of often previous

[29] „The functioning of women and men in science" by the NCN Analysis and Evaluation Team and the Committee for Analysis of Scientific Activity of the NSN Scientific Council, Kraków 2022.

experience in conducting research projects, our interviewees were positioned before mostly in executive or administrative roles[30]. SGS's beneficiaries also confirm their doubts related to leadership skills and would like to have more experience in managing projects. However, the participation in SGS project has greatly contributed to acquiring the necessary skills, which is supported by the following evidence:

„This is, I think, my greatest achievement, because I was previously a Miniature [ed.project] *manager. But these are very small projects in comparison, and even the organisational aspect here, in this type of project, of this rank, you can really learn a lot"* (quote from an interview with a Principal Investigator of SGS grant).

„Leadership skills too, group management above all. That's for sure and it's like I say in a university environment. This is the first opportunity for me to lead a team in this way, so I will definitely develop these skills" (quote from an interview with a Principal Investigator of SGS grant).

Even if employing measures targeting gender issues in all programmes is explicitly required by the Donor, a call dedicated only to women in technical sciences, is rather unique in the spectrum of other bilateral programmes funded by NFM. No equivalent was found in analysed case studies, what adds a pioneering touch to this path of funding. Therefore, it is obvious this path should be continued. Considering the high demand declared by applicants as well as a good level of previous research experiences by beneficiaries, we might propose some enhancements reformulating the assumptions for implementation of the SGS call in future. They derive mostly from outcomes of the workshop conducted at the end of our study, where main observations from this field were creatively confronted with the vision of NCBR (Programme Operator). The recommendations below might help fine-tune the expected achievements demonstrated by this path, while not necessarily being implemented simultaneously or to the same extent:

- Increasing the allocation of funds in the call. It could entail not only the bigger number of projects financed, but alternatively extend the scope of projects, e.g., by increasing value of projects (with extended timeline) implemented in competitions dedicated only to women.
  Currently SGS call is evidently oriented at boosting career perspectives, while researchers would welcome more funding for research infrastructure as some participants of the survey expressed their projects might benefit from including this component, while allowing for more substantial advancement also in terms of general development of discipline apart from gender balance alone. This is illustrated by the following quote:
  "If the research topic is to be motivated more, then perhaps it would also be worthwhile to include a category in which it would be possible to purchase research apparatus, because sometimes there is a need to realise certain topics if there is no specific equipment. And here, in this competition, there was no such category. One could use what already exists. Sometimes when one does something new, there simply is no such equipment. I had to give up some part of my idea, so that I could only work with the apparatus that was available in the unit where I was employed" (quote from an interview with a Principal Investigator of SGS grant).

- Enhancing the maturity of this intervention might result in adding more specific measures for its efficacy. It could be done too on the Programme's level. New cross-cutting indicator for general Programme outcome, e.g., „Participation of women (as project leaders) among beneficiaries" could be proposed.

[30] As indicated in NCBR's evaluation study "Involvement of women in R&D projects under NCBR programmes" (2022). Accessed by: https://www.gov.pl/web/ncbr/zrealizowane2 [March 2023].

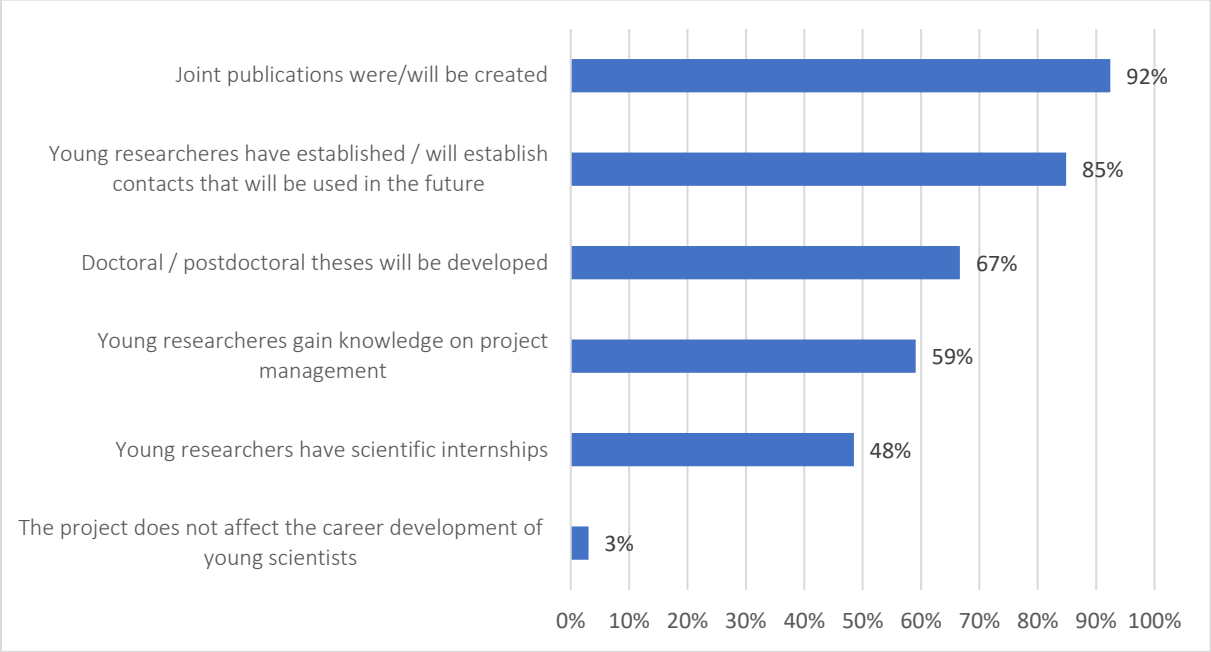
- Narrowing the catalogue of applicants in competitions dedicated to women, e.g., by adding scores in the evaluation of project proposals for women returning from maternity. The current conditions for eligibility are very friendly to applicants and the calls arise considerable interest among applicants, there is a room for stricter and more targeted eligibility rules.
- Creating a package of advisory services for female beneficiaries who have not previously applied for funding to increase the chances of new applicants.
- Adding obligation to build international consortia. While international collaboration is already happening in many SGS projects, adding such requirements might result in developing a special mentoring tool.
- Establishing training in other aspects of project implementation, such as commercialisation of projects, which is a generally difficult aspect across all competitions.
- Introducing better, tailored communication informing about competitions dedicated for women.
- Organising information meetings of potentially interested applicants with leaders who have previously won NFM grants.

4.5 Expected impact of the Programme on career development of young scientists

216 project proposals were submitted to the Programme, where the proposed Principal Investigator was a young scientist.[31] 200 of these project proposals were in SGS. The SGS provided funding opportunities for small-scale projects, allowing young scientists to explore their research interests and develop their skills. This type of funding was particularly valuable for early-career researchers who often struggle to secure funding for their projects. The Programme addressed a gap in funding for research conducted by this group of academics. In the end, 27 proposals received funding and, according to the Programme's monitoring indicators, 30 young scientists were supported, meaning that the indicator's targets were exceeded. Furthermore, the scale of the impact on the careers of young researchers may have been even more significant, as in the survey 65 respondents indicated a positive impact of the project implementation on the careers of young scientists, as shown in the graph below.

[31] Young researcher is defined in Article360 section 2 and Article 360 section 3 of the Act of 20 July 2018 on the Law of Higher Education and Science, (Journal of Laws item 85, 2020). According to the aforementioned law, a young scientist is a person engaged in scientific activity who: 1) is a doctoral student or academic teacher - and does not have a doctoral degree, or 2) holds a doctoral degree, from the attainment of which no more than 7 years have elapsed and is employed in an entity referred to in Article 7(1) of the aforementioned Law.

Graph 11 Impact of the Programme on the careers of young scientists as perceived by respondents



Source: own elaboration based on a survey among beneficiaries of the Programme "Applied Research", N=66

Young scientists who are Principal Investigators and have participated in the study, note that it was an opportunity to conduct independent research, a valuable experience in their professional development. Conducting independent research helps young scientists develop critical thinking and problem-solving skills and gain experience in project management and leadership. The skills and experience gained through the grant will allow them to better compete for future funding opportunities and jobs in academia and industry. In the Polish environment an important aspect involves developing an appropriate academic record for attaining habilitation. This record consists not only of project management or cooperation with other research centres (the latter is a statutory requirement), but also of an appropriate number of scientific publications. In order to publish, you need to have the results of your research, which is precisely what the project provides. Respondents rated the Programme highly in this respect; it was noted and appreciated that more importance was given to the development of researchers than the development of the research area itself. It was pointed out in the interviews that through the implementation of the projects, young scientists have the opportunity to do research internships in Norway, gain experience working in international teams and, through this, take up jobs in Norwegian companies. Other benefits included: (a) access to mentors other than one's supervisor, including Norwegian professors (b) learning about the working style at other universities, (c) practical preparation for work in companies in research departments.

5. LINKAGES BETWEEN THE SECOND AND THIRD EDITION OF EEA & NORWAY GRANTS (INCLUDING 'BASIC RESEARCH' AND 'APPLIED RESEARCH' PROGRAMMES)

Key findings

- 93% of beneficiaries indicate that the most important motivation for participating in the Programme is the possibility of implementing projects in an international research environment, as such cooperation provides better opportunities for the scientific development of research team members (82%). Almost all project teams (92%) plan to apply jointly to further international calls for proposals. 74% of beneficiaries regards participation in the Programme as the opportunity to expand their international networks with the view to making further attempts at applying for funding for international research projects.
- The second and third editions of the Programme, including 'Basic' and 'Applied Research' Programmes, contributed to attracting 447 unique institutional entities in terms of VAT number (including 115 from Norway) and forming a number of international consortia in project proposals.
- Only 111 institutional entities submitted project proposals in both editions. At the same time, 130 institutional entities ceased participating in the Programme after the second edition, and 168 completely new institutional entities appeared in the project proposals of the third edition (including FWD measure), indicating the formation of new consortia with new configuration of partners rather than the persistence of old ones.
- However, despite the significant change and the appearance of a number of completely new institutional entities in the third edition, the majority of the third edition consortia (excluding SGS) in the 'Applied Research' Programme (95 out of 97 project proposals) included institutional project partners with experience from the previous edition, and majority of institutional Project Promoters (74 out of 97) had such experience, also as a promoter of the project proposal in the second edition (71 out of 97).
- Institutional experience is unlikely to prove the persistence of personal networks, as the 2,748 researchers in the Programme form 1,978 links, 97% of which are single, indicating that researchers are overwhelmingly working in various partnerships formed specifically for one project proposal. The continuity of project teams in the third edition of 'Basic Research' and 'Applied Research' Programmes is barely evident, as only 4% (112) of Polish and Norwegian researchers submitted proposals in both editions (and 51, i.e., 2% are Principal Investigators in the project proposals of both editions), but even they mostly collaborate with researchers present in only one edition (although there are a few examples of scientific networks led by the most active researchers, involving multiple institutions and projects).
- The exploitation of institutional capacity in the consortia submitting project proposals in the third edition, together with the weak continuation of cooperation at personal level, may indicate organizational learning, i.e., the transfer of experience to researchers completely new to the Programme from the same institution, so that they also gain experience in implementing projects from the Programme. This calls for in-depth research.
- The most interesting thematic areas of the 'Applied Research' Programme (such as climate, environment, energy, health) are a continuation of the research topics already undertaken in the second edition, as numerous keywords found in the 'Applied Research' Programme are included in the project proposals of the second edition.

- The thematic links between the second edition of the Programme and the third edition of the 'Basic Research' Programme run by the NCN are rare but when they do occur, they are strong (in other words, rare keywords occur repeatedly), indicating that only a small proportion of projects developing basic research fit into research desirable for implementation. The direct reason for the rare but strong links to the second edition is not only the experience of Principal Investigators from the previous edition, but above all the lack of focus of the call on topics related to the 'Applied Research' Programme in 'Basic Research' Programme.
- Researchers submitting project proposals to the 'Basic Research' Programme are far less likely to continue the topics of project proposals from the second edition than researchers submitting project proposals to the 'Applied Research' Programme. Despite the identified lack of persistence in the project teams (described above), the consistency of topics is high in the latter Programme.

The extent to which projects implemented under the Programme contribute to the creation of new partnerships, especially international ones, and the extent to which they are a continuation of previously established cooperation.

The objective of the Programme "Applied Research" is to increase the quality of applied research in Poland by strengthening scientific and research cooperation between Poland and Norway. In individual interviews NCRD representatives admit that the commercialization of the results of applied research carried out in the co-financed projects is an expected, but unlikely, direct effect of the project in the case of a large part of the implemented projects. During the interviews, both NCBR representatives and donors – the Norwegian Research Council – emphasised the expected positive outcome in the form of cooperation in an international research environment and its continuation in the future. This is evidenced by:

- adopting the same thematic areas in POLNOR as in the European programme Horizon Europe. It is the intention of those responsible for the programme's design that POLNOR should be a kind of "incubator" for projects and teams, which will then apply for further international funding, in particular under the aforementioned Horizon Europe programme;
- the use of the bilateral result indicator RB.1. Joint applications for further funding to monitor the effects of the Programme, indicating that this is an important and expected outcome of the Programme.

The programme's design is well aligned with the expectations of the beneficiaries. In the questionnaire survey, 93% of beneficiaries indicate that the most important motivation for participating in the Programme is the possibility of implementing projects in an international research environment, as such cooperation provides better opportunities for the scientific development of research team members (82%). A similar observation on the motivation for participating in the bilateral programme was made in the evaluation of the previous edition of the Programme[32] .

In interviews, representatives of Polish universities emphasise that the role of international projects in the scientific development of research team members and maintaining the project team is crucial. Firstly, international projects allow access to the latest knowledge, which is important for the professional development of research team members. Secondly, the financial aspect is also important. Obtaining additional funding to finance the additional salaries of research team members is a prerequisite for keeping young, valuable researchers on the research team. Without these additional funds, the salaries that

[32] Evaluation of the Polish-Norwegian Research Cooperation Programme, NCBR, 2017.

scientists receive at Polish universities are not competitive with those offered by industry. In the questionnaire-based survey, 62% of respondents indicated that one of the motivations for applying to the Programme was "to obtain funds for their own professional development and that of our research team members". International projects also allow to continue lines of research that are important to the team – this was also one of the motivations for participating in the Programme that was most frequently indicated in the survey (74% - "to obtain funding to develop a line of research that is important to us").

Therefore, almost all project teams (92%) plan to apply jointly to further international calls for proposals[33] . The rate of planned joint applications to international programmes exceeds the target value by almost ten times (59/6).

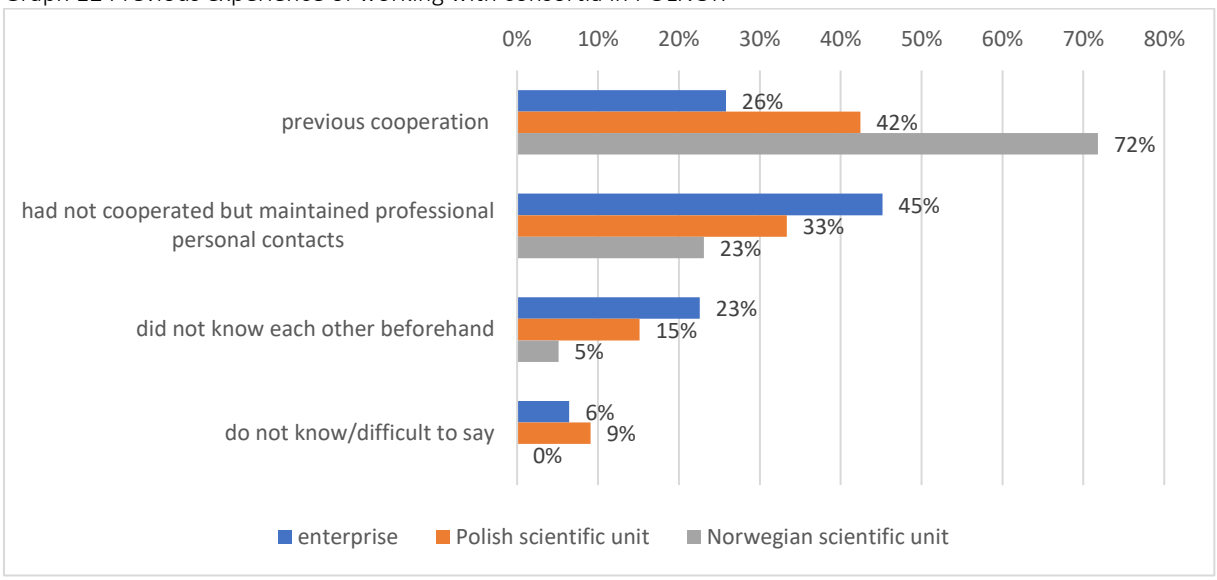
The beneficiaries, moreover, have extensive experience in implementing projects funded under international programmes – in 70% of the beneficiaries' – the project promoters – research teams, the manager or members of the teams have already taken part in R&D projects funded under European international programmes (e.g., Horizon 2020).

Three out of four Principal Investigator's surveyed (74%) indicated, that the greatest benefit of participating in the Programme is the increased opportunity to expand their international networks with the view to making further attempts at applying for funding for international research projects. The qualitative research described mechanisms for including in cooperation networks those enterprises and research units that are or have been reliable partners of current consortia members in other international projects. These contacts are in general and out of necessity personal, with only 33% of respondents declaring that formalised forms of international cooperation, such as a contract between institutions etc., function in their organisation. Two out of three respondents (64%) point exclusively to their and their team members' personal contacts with researchers at foreign universities, as those which allowed them to find a partner and jointly apply. The initiative to form a project consortium came most often (64%) from the current Project Promoter.

Previous good cooperation is an obvious driver for further joint endeavours, especially in the case of foreign partners. Based on the results obtained in the questionnaire-based survey of POLNOR beneficiaries (cf. graph below), it can be seen that it is most difficult to find a Norwegian partner without previous contacts (5% of answers) and most often the cooperation is a continuation of previous cooperation (72%). In the case of Polish partners, previous cooperation or at least professional personal contacts are also important, although to a lesser extent.

[33] Including SGS teams, which of course plan to apply and not apply together for the next international competitions.

Graph 12 Previous experience of working with consortia in POLNOR



Source: own elaboration based on survey among beneficiaries of the "Applied Research" Programme, N=39

Expanding networks sometimes has a non-obvious direction, such as the contact with universities in Taiwan, described in one interview, obtained through a Taiwanese doctoral trainee, one of the members of the Norwegian team.

This scientist <from Taiwan> is employed by the Norwegians, <....> a very good computer scientist who came into this project and we are thinking about a joint Polish-Taiwanese project, because he is in Norway at the moment, but colleagues in remained in Taiwan (quoted from an interview with the Principal Investigator).

Some of international call for proposals requires partnership with not only scientific institutions but also with enterprises. Various mechanisms were observed when searching for such partners. The percentage of respondents previously cooperating with entrepreneurs – the current project partners – is the lowest (26%) when compared to those previously cooperating with other partners – Polish (45%) and Norwegian (72%) universities. Nevertheless, almost four out of five (78%) promoters declare that they, or members of the current research team, have had previous experience in cooperating with entrepreneurs as consortium members in a research project. It seems moreover, judging by the profile of the enterprises participating in the interviews and also as indicated by the RCN representative, that enterprises participating in the Programme are often spin-offs, or have been founded by former or current employees of universities, and therefore have strong and established contacts with the scientific community. Interviewed representatives of enterprises participating in the Programme emphasise that participation in such a project has for them a marketing dimension (prestige and international recognition resulting from participation in an international research project), but also a developmental dimension. In interviews with representatives of the Programmes Committee and with representatives of enterprises, the innovativeness of the R&D projects carried out was a recurring theme. It was emphasised that the lack of a requirement to immediately implement research results in business practice has a positive impact on their quality and innovativeness. If such a requirement exists, in order to reduce the risk associated with their implementation, the submitted solutions usually do not carry a significant level of new knowledge. This is how one interviewee put it:

There is an unwritten rule of thumb with research and development projects implemented in an industry that something called an R&D project is 89% already done. ...Such conservatism in this type of industrial

implementation occurs.... Such projects <as in POLNOR> are quite rare. Here, there is a great opportunity to build something in cooperation with scientific units, which can then be prepared for implementation with a relatively small expenditure of time (quoted from an interview with an entrepreneur – member of a consortium).

Similar conclusions were reached by the authors of the evaluation of Measure 4.1 of OP SG[34] , in which the results achieved by consortia led by a scientific unit turned out to carry higher levels of new knowledge than in the case of consortia led by enterprises.

Institutional links between the second and third edition of the Programme ('Basic Research' and 'Applied Research')[35]

The Programme (both second and third edition) attracted a massive number of institutional entities[36] participating in several project proposals each. As the table below reveals, a total of 447 unique institutional entities participated in the second and third editions of the Programme (covering both 'Basic' and 'Applied Research' Programmes), including 115 from Norway (26% of the total). The lower participation of Norwegian partners results from the lack of a foreign partner requirement in the SGS call. This also affects the average number of projects submitted by one entity. One Polish and one Norwegian entity participated in 5 projects (1642/332) and 5.7 projects (659/115) on average, respectively.

Table 9 Characteristics of participation and number of unique institutional entities in the second and third editions of the EEA and Norway Grants Programmes by nationality

Specification	Total number of institutional entities' occurrences in project proposals	*including occurrences of Norwegian institutional entities*	Total number of unique institutional entities in project proposals	*including Norwegian unique institutional entities*
Submissions for the **second** edition (excluding Bilateral Cooperation Fund – FWD measure) operated by NCBR	1171	*374 (32%)*	267	*83 (31%)*

[34] Evaluation study on the Assessment of the impact of the implementation of selected measures of the 4th axis of the OP SG and EC programmes on the development of scientific entities, stimulation of cooperation and commercialisation and development of R&D staff, as well as on the internationalisation of Polish science and the possibility of building international partnerships in order to apply for the EU Framework Programme - MODULE I, NCBR, 2020

[35] The study on the creation and persistence of linkages and partnerships within the framework of the NFM and EEA FM required a massive amount of work. The data collected in databases in both editions and through different institutions are hardly comparable. Even the databases maintained by one institution (NCBR or NCN) do not contain definable dictionary fields, which implies various entries of the same entity names, personal names and surnames, degrees, titles, and roles of individuals. Moreover, there was a lack of a database of people involved in the projects, CVs had to be analysed and, as it turned out in these CVs, many people were not affiliated with project partners. An additional concern was natural economic processes, such as entity name changes, entity mergers (especially in the case of Norwegian universities), and female name changes in the case of project participants. Therefore, the bulk of the time was spent cleaning up the data and attempting to make it consistent. All this was attempted to be made consistent, but there may still be inaccuracies beyond the control of the research contractor.

[36] A unique institution is understood to be a legal entity with a unique VAT number, and thus the whole university or research institute was seen as an institutional entity. For Norwegian entities, the same principle applies, but the distinction was made by name, as VAT numbers were only partially available.

Specification	Total number of institutional entities' occurrences in project proposals	*including occurrences of Norwegian institutional entities*	Total number of unique institutional entities in project proposals	*including Norwegian unique institutional entities*
Successful submissions for the **second** edition (excluding FWD measure) operated by NCBR	266	*105 (39%)*	120	*50 (42%)*
Submissions for the **FWD measure** in the second edition operated by NCBR	194	*97 (50%)*	81	*34 (42%)*
Successful submissions for the **FWD measure** in the second edition operated by NCBR	176	*88 (50%)*	77	*32 (42%)*
Submissions for the **third** edition ('Applied Research' Programme) operated by NCBR	778	*138 (18%)*	262	*53 (20%)*
Successful submissions for the **third** edition ('Applied Research' Programme) operated by NCBR	256	*79 (31%)*	135	*38 (28%)*
Submissions for the **third** edition ('Basic Research' Programme) operated by NCN	NA	*NA*	NA	*NA*
Successful submissions for the **third** edition ('Basic Research' Programme) operated by NCN	159	*50 (31%)*	70	*20 (29%)*
Submissions for the **third** edition (**total**, i.e., 'Basic Research' and 'Applied Research' Programmes) operated by NCN/NCBR	937	*188 (20%)*	291	*59 (20%)*
Successful submissions for the **third** edition (**total**, i.e., 'Basic Research' and 'Applied Research' Programmes operated by NCN/NCBR)	415	*129 (31%)*	176	*46 (26%)*
Total submissions *(second edition, FWD, and third edition) operated by NCBR/NCN*	**2302**	***659 (29%)***	**447**	***115 (26%)***
Total successful submissions *(second edition, FWD, and third edition) operated by NCBR/NCN*	**857**	***322 (38%)***	**251**	***79 (31%)***

Source: own compilation based on data from the NCBR and the NCN. Note: NA denotes no available data. For the analysis, the submission of an application to the NCN is considered as project implementation.

A lot of institutional entities ceased participating in the Programme after submitting project proposals in the second edition, including those implementing projects. 130 unique institutional entities, see table 10, first row (including one-third of the Norwegian ones), i.e., 29% of all institutional entities participating in the Programme (37% for the Norwegian ones) after submitting project proposals in the second edition, did not submit any project proposal in the third edition (to 'Basic Research' Programme, FWD measure, 'Applied Research' Programme). This cannot be explained only by discouragement towards the Programme, evaluation of projects, or poor cooperation in consortia, as a quarter of Polish (18/70) and almost 40% of Norwegian (19/50) institutional entities implemented projects in the second edition (see table 10, second row). For Norwegian institutional entities, this result can be partly explained by changes in their operation (mainly mergers with other entities and name changes), but in many Polish cases, these are large public entities, including universities and units of the Polish Academy of Sciences. This should be of interest to the Programme Operator unless these consortia, or rather their staff, have submitted projects to other Programmes, including in particular Horizon 2020.

The third edition (of both 'Basic' and 'Applied Research' Programmes) attracted mostly entirely new institutional entities not previously involved in the Programme, thus representing an unlikely continuation of earlier collaborations between institutional entities. In the third edition, as many as 168 new unique institutional entities entered the Programme (see table 10, third and last row), including 4 through successful participation in the FWD measure (in the second edition), with 291 being the total number of unique institutional entities in the third edition (see table 9). Moreover, most of the entities changed between editions of the Programme. Only 111 entities (including 36 from Norway) submitted project proposals in both editions[37]). They therefore accounted for 42% of those submitting in the second edition (111 / 267) and 38% in the third edition (111 / 291).

[37] 267 (unique institutional entities submitting project proposals in the second edition) + 291 (unique institutional entities submitting project proposals in the third edition) – 447 (all unique institutional entities in the NFM AND EEA MF Programme). This calculation does not include entities participating in FWD measure in the second edition.

Table 10 Characteristics of flows between the second and third edition of the EEA and Norway Grants Programmes by nationality

Specification	Total number of institutional entities' occurrences in project proposals	*including occurrences of Norwegian institutional entities*	Total number of unique institutional entities in project proposals	*including Norwegian unique institutional entities*
Submissions **only** for the **second** edition **(and not continued, including FWD measure)**	261	*114 (44%)*	130	*43 (33%)*
Successful submissions **only** for the **second** edition **(and not continued, including FWD measure)**	50	*29 (58%)*	37	*19 (51%)*
Submissions for the **third** edition **for the first time (no support from FWD in the second edition)**	255	*30 (12%)*	164	*26 (16%)*
Submissions for the **FWD measure** in the second edition and continued in the third edition (submissions to the 'Basic Research' or 'Applied Research' Programmes)	160	*79 (49%)*	55	*21 (38%)*
Successful submissions for the **FWD measure** in the second edition and continued in the third edition (submissions to the 'Basic Research' or 'Applied Research' Programmes)	145	*72 (50%)*	54	*21 (39%)*
Submissions for the **FWD measure** in the second edition **(and not continued)**	34	*18 (53%)*	26	*13 (50%)*
Successful submissions for the **FWD measure** in the second edition **(and not continued)**	31	*16 (52%)*	23	*11 (48%)*
Submissions for the **FWD measure** in the second edition **for the first time** (no submissions to other calls in the second edition) regardless of the submissions for the third edition	19	*7 (37%)*	16	*6 (38%)*
Submissions for the **FWD measure** in the second edition **for the first time (and not continued)**	13	*4 (31%)*	12	*4 (33%)*

Specification	Total number of institutional entities' occurrences in project proposals	*including occurrences of Norwegian institutional entities*	Total number of unique institutional entities in project proposals	*including Norwegian unique institutional entities*
Successful submissions for the **FWD measure** in the second edition **for the first time (and not continued)**	10	*2 (20%)*	9	*2 (22%)*
Successful submissions for the **FWD measure** in the second edition **for the first time** and continued in the third edition (submissions to the 'Basic Research' or 'Applied Research" Programmes)	5	*3 (60%)*	4	*2 (50%)*

Source: own compilation based on data from the NCBR and the NCN. Note: NA denotes no available data. For the analysis, the submission of an application to the NCN is considered as project implementation.

Despite its rather small size, the FWD action in the second edition contributed to three different objectives with varying results. Firstly, of the 81 unique institutional entities who submitted 194 proposals to the FWD action, averaging 2.4 proposals each (see Table 9), 55 unique entities were present in the second edition and managed to submit a full project proposal for the third edition (for both the 'Basic Research' and 'Applied Research' Programmes), see Table 10. These experienced actors were also more active in the FWD, as they each submitted an average of 2.9 proposals. In contrast, the success rate in the FWD action was rather similar for those experienced in the second edition and the others (reaching 91%).

Secondly, **numerous institutional Project Promoters did not benefit from the FWD measure.** Table 10 indicates that 26 unique institutional entities (out of 81, i.e., one in three), after submitting an average of 1.3 projects each to the FWD measure, did not submit a full project proposal to the third edition (although there is uncertainty about 'Basic Research' Programme as data from NCN is only available on selected projects). It is difficult to explain this phenomenon as these institutional actors were similarly successful in obtaining funding in the FWD action (91% of applications were awarded to 23 unique institutional Project Promoters). Also, these institutional entities already had experience from the second edition, although a large number (16 to be exact, i.e., one in five) had a first contact with the Programme that ended in failure with the formation of a consortium and the submission of a full project proposal in the third edition. This should be investigated in depth by the Programme Operator.

Thirdly, **the FWD action failed to support the completely new institutional entities in the Programme** (those that did not participate at all in the second edition) in finding consortium partners. Table 10 demonstrates that 12 of the 16 unique institutional entities new to the Programme did not submit any project proposals to the third edition (for both the 'Basic' and 'Applied' Programmes). 9 out of 12 were successful in obtaining funding in FWD, although their success rate was lower than that of the other actors (77%, 10 out of 13 project proposals were funded). Only 4 unique institutional entities formed 5 consortia and became a Project Promoter in the third edition in both Programmes.

Despite the significant change and a number of completely new institutional entities in the third edition (of the 'Basic' and 'Applied Research' Programmes), the institutional entities in the project proposals consortia had the experienced institutional background from the second edition. Table 11 provides the characteristics of the 97 consortia submitting project proposals for the third edition ('Applied Research' Programme excluding SGS). The consortia consisted on average of 3.9 entities, including 1.4 entities from Norway. In each consortium, 2.5 (64%) institutional partners had an experience of submitting a project proposal in the previous edition. Surprisingly, in 95 projects at least one institutional partner had such experience. Even more interesting is that in 74 projects, the institutional project promoter had such experience, and 71 of these had already acted as institutional project promoter previously. In addition, 60 out of 377 (16%) institutional partners in consortia (other than the project promoter) were project promoters in the previous edition and they were present in 42 project proposals (43%). Only institutional partners of 16 project proposals had no experience as project promoters in the second edition. This gives massive organisational experience in project proposal preparation but does not necessarily translate into personal cooperation.

Table 11 Characteristics of the 97 consortia submitting project proposals for the third edition of the 'Applied Research' Programme (excluding SGS).

Characteristic	Value
Number of **Polish and Norwegian institutional partners** in project proposals	377
Average number of **Polish and Norwegian institutional partners** per project proposal	3.89
Number of **Norwegian institutional partners** in project proposals (proportion of all institutional partners in project proposals)	137 (38%)
Average number of **Norwegian institutional partners** per project proposal	1.41
Number of **Polish and Norwegian institutional partners** in project proposals that submitted at least one project proposal in the second edition (proportion of all institutional partners in project proposals)	246 (65%)
Number of project proposals in which **at least one institutional partner** submitted at least one project proposal in the second edition (proportion of all project proposals)	95 (98%)
Number of project proposals in which **Project Promoter** submitted at least one project proposal in the second edition (proportion of all project proposals)	74 (76%)
Number of project proposals in which **Project Promoter** submitted at least one project proposal in the second edition **as Project Promoter** (proportion of all project proposals)	71 (73%)
Number of project proposals in which **institutional partners other than the Project Promoter** submitted at least one project proposal in the second edition **as Project Promoter** (proportion of all project proposals)	42 (43%)
Number of project proposals in which **no institutional partner** submitted at least one project proposal in the second edition as Project Promoter (proportion of all project proposals)	16 (16%)

Source: own compilation based on data from the NCBR.

Personal links between the second and third edition of the Programme

The programme attracted a massive number of researchers. In total, table 12 indicates that 2,748 unique researchers participated in the project proposals, mainly in the second edition, where 609 project

proposals were submitted. Thus, in the second edition, unique 2,060 researchers were reported (one researcher contributed on average to 1.13 projects), of which 587 had the role of the Principal Investigator (each had this role on average in 1.05 projects). In the third edition, 726 and 75 unique researchers were reported in projects submitted to 'Applied Research' and 'Basic Research' Programmes (in the latter case only data on successful submissions were available), respectively.

In both editions, almost all links between researchers are single, indicating that researchers in the vast majority of cases work in different partnerships formed specially for the project proposals. 97% of all links (i.e., 1,919 out of 1,978) are single links, thus only 3% (59) are multiple links. Two project proposals are linked by only 16 pairs of researchers (0.8%), four project proposals are linked by 35 pairs (1.8%), five project proposals are linked by three pairs (0.2%), while nine project proposals are linked by the rest (5 pairs, i.e., 0.3%). This small number of multiple links is rather indicative of the lack of persistence of the teams in project proposals between editions but should be analysed in depth as the links may not be direct (for example, one researcher suggests her/his colleague for the next project proposal).

Table 12 The total contribution of researchers and unique appearances of researchers in the second and third edition of the EEA and Norway Grants Programmes ('Basic Research' Programme operated by NCN and 'Applied Research' Programme operated by NCBR).

Specification	Total contributions of researchers to projects	Sum of unique researchers	*Ratio of contributions to projects per researcher*
Submissions for the **Programme (total)**	3,182	2,748	*1,16*
Submissions for the **Programme** as **Principal Investigators (total)**	1,123	1,038	*1,08*
Successful submissions for the **Programme (total)**	817	752	*1,09*
Successful submissions for the **Programme** as **Principal Investigators (total)**	265	251	*1,06*
data separately for editions:			
Submissions for the **second** edition	2,329	2,060	*1,13*
Submissions for the **second** edition as **Principal Investigators**	614	587	*1,05*
Successful submissions for the **second** edition	486	467	*1,04*
Successful submissions for the **second** edition as **Principal Investigators**	109	107	*1,02*
Submissions for the **third** edition ('Applied Research' Programme)	778	726	*1,07*
Submissions for the **third** edition as **Principal Investigators** ('Applied Research' Programme)	434	428	*1,01*
Successful submissions for the **third** edition ('Applied Research' Programme)	256	238	*1,08*

Successful submissions for the **third** edition as **Principal Investigators** ('Applied Research' Programme)	81	81	*1,00*
Successful submissions for the **third** edition as **Principal Investigators** ('Basic Research' Programme)	75	75	*1,00*
Submissions for the **second** and **third** edition ('Applied Research' Programme & 'Basic Research' Programme)	278	112	*2,48*
Submissions for the **second** and **third** edition ('Applied Research' Programme & 'Basic Research' Programme) as **Principal Investigators**	113	51	*2,22*
Successful submissions for the **second** and **third** edition ('Applied Research' Programme & 'Basic Research' Programme)	59	27	*2,19*
Successful submissions for the **second** and **third** edition ('Applied Research' Programme & 'Basic Research' Programme) as **Principal Investigators**	23	11	*2,09*

Source: own compilation based on data from the NCBR and the NCN. Note: Data on submissions for NCN is unavailable. For the analysis, the submission of an application to the NCN is considered as project implementation.

The continuation of project teams in project proposals of the third edition (of both the 'Basic Research' and 'Applied Research' Programme) is hardly evident. Only 4% and 5% of regular unique team members and Principal Investigators, respectively, were present in the submitted project proposals in both the second and third editions. These researchers were more active than the others, as each of the unique 112 researchers appeared in an average of 2.5 projects, while all the unique researchers appeared in only 1.16 projects per person. Given such a low proportion of unique researchers present in both editions, it does not seem useful to analyse the overall persistence of project teams in subsequent editions. Only all the links of the 112 collaborating unique researchers present in both editions should be included in the analysis.

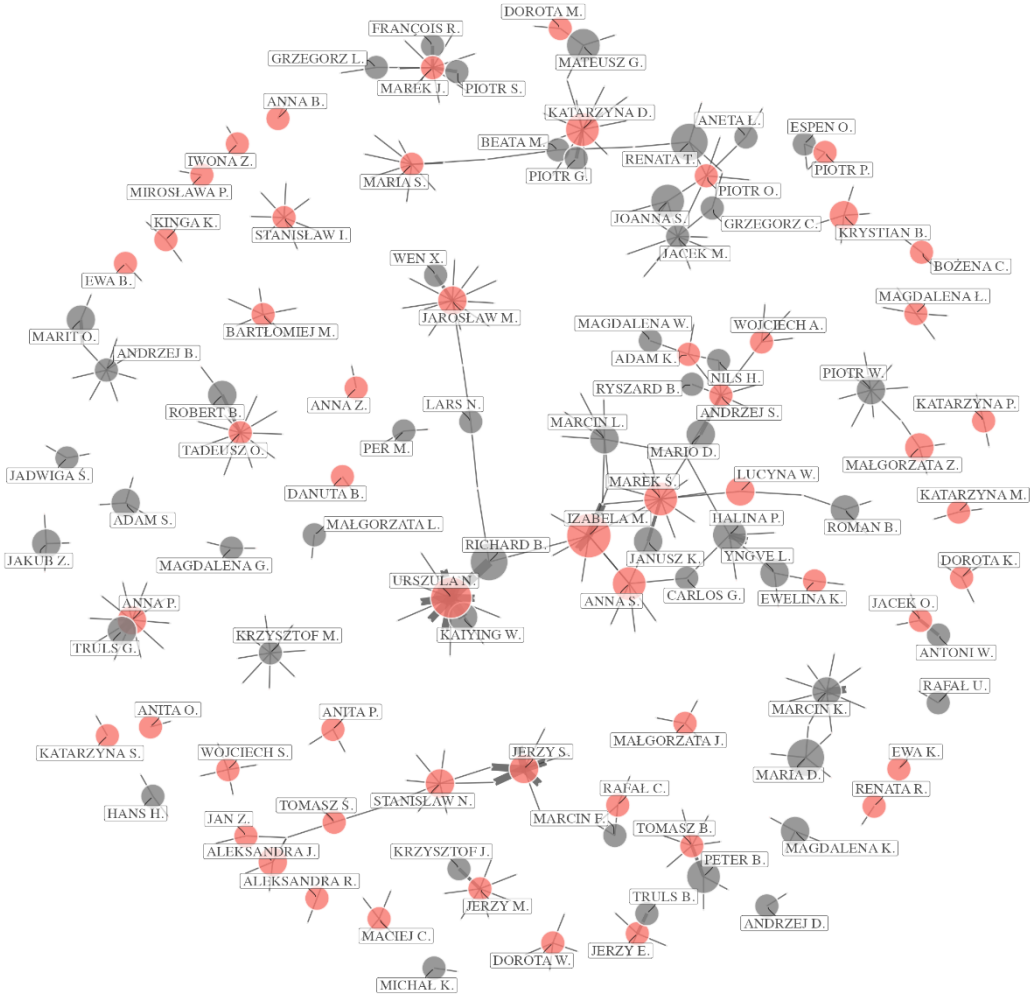
Collaborative networks of researchers in the second and third editions of the Programme

Unique researchers present in project proposals of both editions (of both the 'Basic' and 'Applied Research' Programme) collaborate in rather isolated teams most often with other researchers who were present only in one edition, thus indicating a lack of persistence between editions. Graphic 4 presents the links of the 112 unique researchers present in both editions with other researchers. The size of the nodes reflects the number of project proposal appearances only if the researcher has participated in project proposal from both editions. The absence of a node therefore indicates a researcher who was only present in one edition. Red nodes indicate Principal Investigators from the third edition, i.e., potential initiators of consortia. The width of the edges reflects the number of co-appearances of both researchers in joint project proposals. As a whole, such a network consists of 391 scientists, thus mostly scientists from both editions only collaborate with 279 scientists present in one edition. On the other hand, the number of researchers is large, and this may also indicate a wide market of researchers for future project proposals.

There is one large network of research teams cooperating with various institutions and submitting multiple project proposals. This network includes initiators from the Silesian University of Technology, West Pomeranian University of Technology, Czestochowa University of Technology, Wroclaw University of

Science and Technology, Institute for Chemical Processing of Coal, and even Warsaw University of Technology. There can also be indicated much smaller cluster of team cooperation in the upper right side of the graph, comprising initiators from Poznan University of Technology and Institute of Technology and Life Sciences.

Graphic 4 Collaborative networks of researchers present in project proposals of both editions of the Programme.



Source: own compilation based on data from the NCBR and the NCN. Note: the size of the nodes indicates the number of project proposal appearances of researchers present in both editions of the Programme, red nodes indicate the principal investigators in the third edition.

Most of the scientists present in both editions (including 'Basic' and 'Applied Research' Programme) initiate consortia (are principal investigators), and even if they do not, they collaborate with long-standing Principal Investigators. Nearly all subgraphs consist of at least one red node, indicating the project's Principal Investigator from the third edition. In contrast, total grey subgraphs (without any red nodes) are only a few. This is confirmed by the table 10 above indicating that almost half of the researchers present in both editions were also Principal Investigators in both editions (51 out of 112). This implies their considerable competence in initiating and leading multiple projects. However, such individuals are few in number compared to all researchers in project proposals of the Programme.

Thematic links of projects submitted between the second and third edition of the Programme ('Applied Research')

Text mining techniques were used to analyse the links and synergies between the second edition of the Programme and the third edition of the 'Applied Research' Programme run by the NCBR. A total of 1,827 keywords were used in all 434 project proposals submitted to the 'Applied Research' Programme. Keywords were then searched for in the title and abstract of 613 projects from the second edition (see graphic 5). 307 of the 1 827 keywords from the 'Applied Research' Programme were present in the second edition. The most frequent word ('energy') appeared in 122 project proposals, followed by 'water' (92 appearances), 'materials' (92), 'treatment' (91), 'environment' (83), 'management' (80), 'efficiency' (79), 'carbon' (64), 'health' (64), 'climate' (59), and CO2 (59). It is therefore clear that **the most interesting Programme thematic areas are a continuation of the research topics already undertaken in the second edition**.

*Graphic 5 Keyword **cloud of third edition project proposals appearing in second edition project proposal descriptions***

Source: own compilation based on data from the NCBR. Note: The maximum number of appearances corresponds to 122 out of 613 project proposals.

Thematic links of projects submitted between the second and third edition of the Programme ('Basic Research')

Similarly, an analysis of the projects submitted under the third edition of the 'Basic Research' Programme operated by NCN was carried out to assess their continuation or development of the results of the projects from the previous edition. First, all keywords from the projects implemented in the latter Programme were extracted. In the 75 projects, there were 444 keywords that were searched for in the titles and abstracts of the second edition project proposals. Many of the keywords were in fact whole phrases and therefore not found in the titles and abstracts. For the sake of clarity, several general keywords were dropped, including

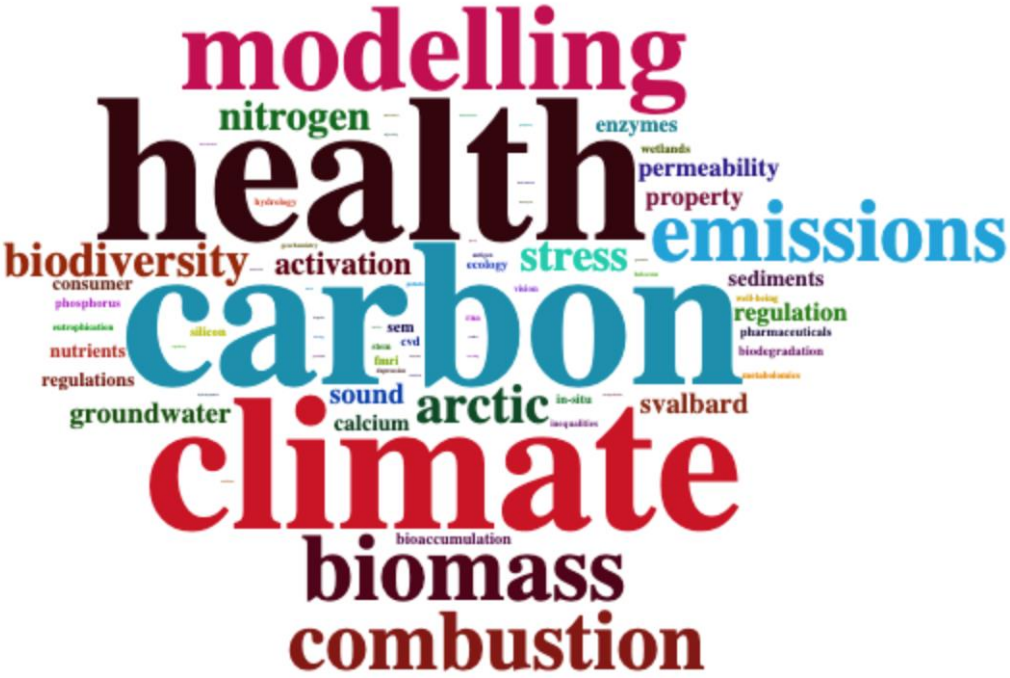
the most popular ones, such as 'Poland' and 'Norway', which appeared in 149 and 85 project proposals, respectively.

Links between the two Programmes are rare but strong. Only 73 keywords were found, indicating that the majority of projects described by 371 keywords (implemented in the 'Basic Research' Programme) are not related to the second edition. In addition, only 14 words occurred in more than 10 project proposals from the second edition, indicating that the project proposals in the second edition described by 59 keywords relate to topics of little relevance to the second edition. In contrast, the most frequent link was for one in ten projects, i.e., 64 projects out of 613, indicating significant links.

The most common links between the two programmes were health (64 projects), carbon (64 projects) and climate (59 projects), as the graphic 13 below indicates. Also, less frequent keywords refer to these topics indicating that projects developing basic research in these areas are indeed well embedded in the second edition.

The immediate reason for the rare but strong links to the second edition is the experience of the Principal Investigators from the previous edition. Only nine researchers contributed to teams submitting project proposals to the second edition calls. In addition, a qualitative analysis of project titles and keywords revealed that a number of projects are far from the Programme thematic areas identified for the 'Applied Research' Programme. Principal investigators should have designated areas of the 'Basic Research' Programme before applying for funding. Otherwise, the Programme will not generate synergies with 'Applied Research' Programme.

Graphic 6 Keyword cloud from the 'Basic Research' Programme project appearing in project descriptions in the second edition of the Programme.



Source: own compilation based on data from the NCBR and the NCN. Note: The maximum number of appearances corresponds to 64 out of 613 projects.

Researchers submitting projects to the 'Basic Research' Programme are far less likely to continue the topics of project proposals from the second edition than researchers submitting project proposals to the 'Applied Research' Programme. A total of 307 keywords appears in project proposals of the second edition of the 'Applied Research' Programme, with 99 keywords appearing in more than 10 project proposals. Project proposals from the 'Applied Research' Programme use more popular keywords than the 'Basic Research' Programme, such as energy (122 projects), materials (92 projects), water (92 projects), treatment (91 projects), environment (92 projects), management (80 projects) and efficiency (79 projects).

Despite the identified lack of persistence in the project teams (described above), the consistency of themes is high. This is a result of the direct indication of research areas in the calls and the forcing of researchers to fit into the areas of interest. At the same time, a certain degree of flexibility in the design of the project proposals has resulted in a diversity of scope and range of project areas, which yielded a variety of keywords appearing in both editions.

Results of field research regarding projects continuation

One in three beneficiaries (33% - 22 out of 66 surveyed) in the questionnaire-based survey declares that the project implemented under the Programme is a continuation of an earlier project financed from public sources or has a strong relationship with it. Among those declaring continuation, 32% (7 projects) were financed as projects under the Norwegian Financial Mechanism. The remaining projects were most often financed from national public funds (e.g. National Science Centre - 5 projects), from Structural Funds (e.g. NCBR, Foundation for Polish Science - 5 projects) and from European programmes such as Horizon 2020 or ERA NET and others (5 projects).

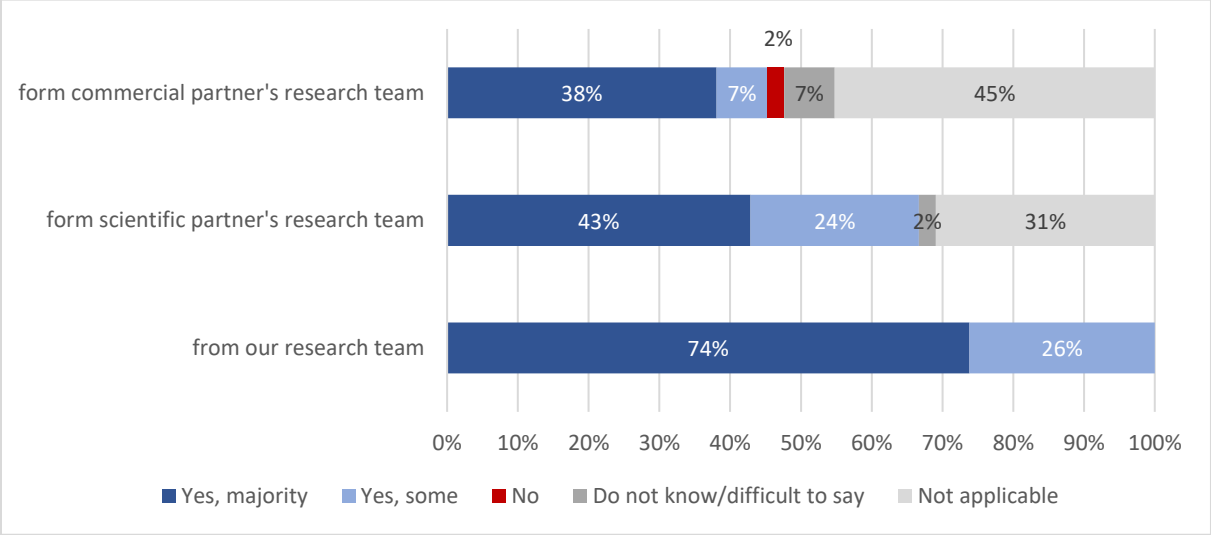
In the survey, 98% of POLNOR beneficiaries felt that the thematic areas defined in the Programme were fully aligned with the specifics of their research project. In the qualitative research, representatives of the Programme Committee positively assessed the broad definitions of the research areas proposed in the Programme. Representatives of scientific units were of a similar opinion in individual interviews.

During the interviews, representatives of NCBR and the Research Council of Norway (RCN) acknowledged that they followed the themes in force in Horizon Europe when defining the POLNOR thematic areas. Such an approach resulted from the conviction that achieving the long-term goal of the Programme "Applied Research" i.e. increasing the quality of applied research in Poland, would be facilitated by the implementation of projects in an international research environment. Further considerations arose from this initial premise. Firstly, the duplication under POLNOR of the subject matter covered in Horizon Europe was to help in bringing together teams of researchers from Poland and Norway specializing in such areas, which could find a source of funding in Horizon Europe. Secondly, the similar thematic focus of both programmes increases the chances that projects implemented in POLNOR, if they require continuation, may find funding for it in Horizon Europe. The issue of financing further stages of R&D work in ongoing POLNOR projects is important, as a possible direct continuation of currently implemented projects under the next edition of the bilateral Polish-Norwegian programme will be impossible, due to the timetable for launching the next edition (if it does take place). Our interlocutors from the Programme Committee and NCBR estimate that the next funding may appear in 4 years at the earliest. Meanwhile, 65% of survey respondents declared that the ongoing project will require continuation, i.e. further research work, before the results have the potential to be implemented in economic practice.

Almost all surveyed Principal Investigators whose projects will require continuation declare their willingness to participate in the continuation of ongoing research (84% - "Definitely yes", 14% - "Rather yes"). If these projects were to be continued, Principal Investigators intend to employ most or at least some

members of their own research team (74%) when carrying out these projects. Similarly, a smaller but still relatively large proportion of Principal Investigators say they would like to employ members of the research teams of their current academic and business partners (cf. chart below). In the qualitative research conducted with respect to project promoters and partners, the issue of continued collaboration was discussed. All interviewees expressed themselves positively about the partners in the consortium in which they are carrying out the project. Already, according to their accounts, various discussions and "preliminaries" are taking place in order to jointly apply for further funds for the continuation or implementation of other joint projects. Of course, the criterion of fitness for purpose and added value that a given partner can bring to a project consortium is always decisive, and this also depends on the subject matter and specifics of the calls for proposals in which they intend to participate.

Graph 13 Declarations of Principal Investigators regarding the employment of research team members in follow-on projects to those currently underway.



Source: *Own elaboration based on survey among beneficiaries of the Programme "Applied Research", N=42*

6. IMPLEMENTATION SYSTEM OF THE PROGRAMME

Key findings

- insufficient number of project officers on the side of NCBR;
- need to improve the IT system for managing dealings with beneficiaries;
- possibilities exist for optimising the involvement of the Programme Committee in the process of programming support.

Assessment of the project proposals submission process

The majority of beneficiaries regarded the proposal submission process as labour-intensive (85% of responses), yet also cost-effective. Proposal development is assessed by 73% of respondents as being of medium to low cost. In the qualitative research we noted that beneficiaries appreciate the possibility to prepare the proposal on their own, without a need for hiring external consultants. This is due to the user-friendly documentation and the low number of annexes. Evidence of this can be found in the following statement:

"Reasonable was also the >size<, but also the complex scope of this proposal was large enough to present really what kind of plan we have, and yet the limits were reasonable, so that it didn't take up an overwhelming amount of time. Of course, it took quite a lot anyway, however. But yes, it was quite reasonable" (quoted from an interview with the Principal Investigator).

External assistance would have been required by Principal Investigators if there was a need to develop, for example, comprehensive business plans.
The vast majority of beneficiaries assess the procedure for applying for Programme funds very highly. 92% of the respondents positively assess the evaluation criteria applied in the Programme, they also find the results of the evaluation process understandable as communicated by the Programme Operator.

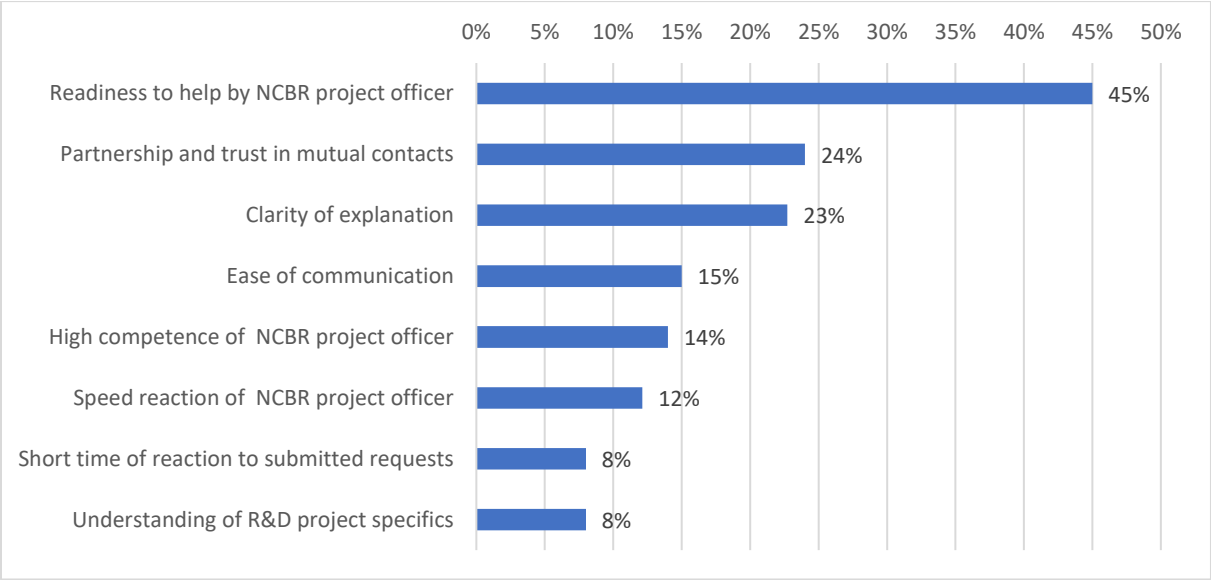
The procedure envisaged for selecting proposals seems transparent to 86% of beneficiaries. Against this background the duration of the procedure comes out with a slightly lower assessment. It is positively marked by 62% of beneficiaries. None of the beneficiaries raises any objections to the quality of the NCBR's handling of the application process, and 78% of the respondents claim that the quality of this handling is good or very good.

"In spite of the formal side, which I think was very successful, because there was great contact even at the communication stage, when the proposal was submitted, there were never any problems to find out the timeframe when it would be processed. All these stages were there. There were no problems finding out what stage the proposal was at. When the contract was being constructed it was fine too and now, as the project is going ahead, there is no problem either. We know who is in charge of finances, we know who is in charge of formal and legal matters. It's very nicely run. And it was quite nice, because it was a short application e.g., for an advance payment" (quoted from an interview with the Principal Investigator).

Assessment of the project implementation process

In the opinion of survey respondents, the assessment of the quality of NCBR service provided to beneficiaries during project implementation is lower than the evaluation of the proposal submission process. A small part of beneficiaries, amounting to 10% of the respondents in total, even assesses it negatively. 27% of beneficiaries believe that the quality of service of the project implementation process is average, while the remaining part - 63% - indicates a positive or very positive experience of the process.

Graph 14 Strengths of NCBR in the process of customer service



Source: own elaboration based on a survey among beneficiaries of the "Applied Research" Programme, N=66

The aspect rated lowest in the survey was the speed of response to questions and the duration of procedures, including in particular the long-time of waiting for applications and decisions, the long-time for signing documents including annexes. Statements made by respondents in the qualitative research pointed to the low availability of project officers as the reason for this:

"In fact, maybe a little bit of a downside is that I don't always manage to call and contact the person who is responsible for the project. So, there's a lot of this different written content, a lot of instructions, a lot of interpretation, and that's fine. But it would also be good, for example, to be able to call the person who looks after this call, who looks after this project specifically, to be able to ask if I'm really thinking correctly (...). Once I've established that this is exactly what it's all about, rather than writing emails and then waiting for e.g., 2 weeks and the person doesn't understand what I mean here at all" (quoted from an interview with a Principal Investigator).

At the same time, the beneficiaries most highly rated the high personal commitment of the project officers, whose willingness to help was rated highest among all possible answers in the survey. They also appreciate other positive features of a relationship based on partnership and mutual trust. They give good marks to the clarity of communication and systemic solutions introduced in the project documentation, e.g., templates for annexes involving the typical scope of changes in the project, etc.

A more detailed analysis of the distribution of beneficiaries' answers may indicate that the reason for their negative judgements is rather staff shortages - an insufficient number of staff dedicated to dealing with projects. This is confirmed by the following statement:

"Ok, I think (...) NCBR in general has probably not enough staff and they probably have quite a heavy workload, so I don't know if they, if they just are able to devote that much time to each supplicant" (quoted from an interview with a project leader).

In the qualitative study, there is also the element of frequent turnover of project officers:

"During this short period of time, where the project is two years long and basically is implemented i a year and a half, the financial officer has changed three times. So, when I wrote to the previous financial officer, well it happened that this person didn't answer for two months, well because this person left work. (...) there is a problem, because the people who administratively help me at the university to deal with the project are discouraged" (quoted from an interview with a Principal Investigator).

Nine people are currently involved in the operation of the Programme on the part of the Programme Operator at average annual basis. Discussions with representatives of the Programme Operator, confirm that this is an insufficient number of FTEs per person-month to ensure an optimally smooth implementation of the assigned tasks. The operation of the programme requires remaining in contact with many partners: NFP, donors, the Research Council of Norway, etc. Project administration, in turn, requires the involvement of additional departments, also outside the International Cooperation Department.

In addition to insufficient staffing, the second area reported in the survey, where there was an opportunity to respond freely to an open-ended question, covered concerns raised about the IT system. These were as follows:

- bureaucracy and lack of access to the LSI system for people other than the manager;
- a complicated system for completing financial data, that takes a lot of time;
- project timetable, which had to be completed in the system. However perhaps it would have been more convenient to do this separately;
- website for entering reports;
- IT system, operation of the IT division.

These topics are confirmed in another element of our study. The Programme Operator is aware of the deficits of the IT system for managing proposal submissions and this area was defined during the qualitative interview as one of the areas to look for good practices in other countries implementing similar bilateral programmes co-financed by NFM and EEA FM. The practice coming from Romania is described in detail within the case study annexed to this report. Currently, NCBR has established a project team to develop the architecture of the new IT system.

In terms of the management of the Programme, no other useful practices have been defined in the international environment. From an interview with a representative of the Research Council of Norway, it emerged that NCBR is perceived as a very advanced and mature institution in its role as Programme Operator. The high quality of programme documents, which show an evolutionary approach based on continuity but also critical reflection on previous editions of the Programme, was seen as a particularly positive feature of the cooperation.

Another systemic issue that was raised during the expert panel was the competencies of the Programme Committee. It consists of Polish and Norwegian scientists, providing opinions in cases involving divergent assessments of project proposals, especially in the field of interdisciplinary projects. Members of the Committee, although they consider their experience in cooperation with the Programme as interesting, evaluate it as limited. The members of the Committee do not question their position in the implementation design as it is envisaged in the Programme, but they would like to have the scope of their competence and the general purpose of their involvement explained in greater details in the beginning of their assignment. Also, in Romanian practice the PC plays a similar role in the programme (where the programming process of interventions is guided by the results of a survey with all actors involved) In general members of the Committee suggested it might be potentially useful to extend the role of this advisory body also during the programming phase. However, that would require a deeper restructuring and a solid preparation on part of

all actors engaged. It is not feasible under circumstances of changing composition of members from one edition of the Programme to the other. On the other hand, members of the Committee would have to make multiannual commitments to be engaged in the Programme to such an extent. It would also require considerably more time invested in each Programme's edition on the part of the experts. The members of the Committee addressed in this study were not able to foresee if they were able to accept such long-term commitment. Meanwhile, the idea behind this advisory board is to gather the plethora of diversified members demonstrating interdisciplinary and high expertise relevant to the current themes outlined in the Programme.

Of the minor improvements, Committee members would like to have more information and inputs on the Programme at their disposal They would like to obtain more information concerning previous editions of the Programme to accommodate lessons learned in their current practice. They would see horizontal contacts with other members of Programme Committees in other countries covered by bilateral cooperation as valuable. They also reported the need for modifications to the Consensus Report during peer-reviewed evaluation.

7. Recommendations

No.	Finding	Recommendation	Address	Method of implementation	Deadline for implementation	Class of recommendation	Thematic area	Effect
1	The financial participation of some companies in projects is negligible - in 29% of projects it did not exceed 10%. The smallest own contribution from an enterprise amounted to PLN 13 000, with the total value of that project amounting to almost PLN 5.5 million. It is hard to resist the impression that, in some cases, the main motive for cooperating with a company was solely a desire to meet the terms and conditions of the call for proposals.	Introduce mechanisms that minimise the risk of perfunctory participation in projects by companies, resulting from their marginal financial commitment.	Programme Operator	The recommendation can be implemented in the following ways: - adoption of a required minimum financial contribution from companies to the eligible costs of the project - inclusion at the stage of project proposal evaluation of the issue of the planned level of involvement of the company in the project implementation, connected with the modification of the application form through the introduction of an additional field dedicated to the description of the planned cooperation with the economic entity	Next programming period	Programme level, operational level	Innovation and research and development	Avoiding situations where the financial commitment of companies to projects is so small as to raise questions about the added value of their participation.

				- the introduction of a requirement for the company to be the leader of at least one task carried out in the project				
2	The POLNOR call for proposals used the same project selection criteria as the other calls, even though it had its own specificity related to the obligatory participation of economic entities. Projects in which the financial participation of companies was marginal were selected for co-financing.	Reflecting the specifics of individual calls for proposals in the way projects are evaluated.	Programme Operator	The recommendation can be implemented in the following ways: - differentiation of criteria between calls (e.g., in the POLNOR call the inclusion of criteria concerning the role of the business entity in the project) - differentiation of scoring weights between calls for proposals (e.g., in the POLNOR call, more weight is given to the project impact criterion) - keeping the same criteria, but varying their definition (e.g., the definition of the criterion "impact of the project" in the case of the POLNOR call could focus more on the issue of its	Next programming period	Programme level, operational level	Innovation and research and development	Positive impact on levels of alignment of the selected projects with the objectives of the call for proposals

				commercialization potential (e.g., the demand of the economic sector for the solution that is the subject of the project)) - sensitising experts evaluating proposals to the different specificities of calls for proposals				
3	The third edition of the Programme was definitely more oriented towards the application of research results in practice than the second edition. On the other hand, almost half of the projects did not involve economic entities. Financial commitment of most enterprises to the projects was low and the projects will mostly end between TRL 6 and 7, i.e. relatively far from the market. It seems advisable to increase enterprises involvement in the supported projects and thus applicability of research	Introducing additional solutions to positively influence the participation of companies in the Programme and the commercialisation of research results	Programme Operator	The recommendation can be implemented in the following ways: - stimulating the inclusion of actions in the development phase of projects by awarding bonus marks at the evaluation stage - stimulating greater financial involvement of companies in project implementation by rewarding those with a higher share of the project budget covered by companies	Next programming period	Programme level, operational level	Innovation and research and development	Positive impact on the scale of company participation in projects and the implementation potential of projects.

				- admission of scientific and industrial consortia in the SGS call - giving a scoring preference to those project proposals submitted in the SGS call which foresee cooperation with the economic sector				
4.	An important issue is a separation of research and administrative-financial activities in R&D projects through the involvement of grant offices or project service departments.	Undertake measures to foster the dissemination of knowledge on the possibility of separating the responsibility for the research part and the formal-legal part of R&D projects in science sector units.	Programme Operator	Organization of training courses (e.g., in the donor country) for project supporters employed in administrative units (departments) so that they can become familiar with the practices of Norwegian grant offices.	Next programming period	Programme level, operational level	Innovation and research and development	Professionalization of processes related to legal, administrative and financial services and, consequently, greater chances of building international consortia applying for Horizon Europe funds
5.	Deficits of NCBR numbers of staff are visible to beneficiaries who complain about prolonged awaiting for	Apply for more working months assigned to the Programme.	Ministry of Funds and Regional Policy	This recommendation might be implemented by submitting a well-argued request to the Ministry of Development	Next programming period.	Programme level, operational level	Innovation and research and development	Seamless service of the Programme, higher satisfaction lev applicants and

	responses and dragging procedures.			Funds and Regional Policy.				beneficiaries of the Programme.
6.	Increasing the allocation per scheme and per project and adding more requirements to the highly popular SGS call.	Reconsider the potential and maturity of this grant scheme.	Programme Operator	This recommendation might be implemented by adding more scores to specific targeted groups as e.g., mothers returning from maternity leaves or young researchers and/or by extending some obligations e.g., obligation to build international consortia. It entails increasing the average value of the project	Next programming period.	Programme level, operational level	Innovation and research and development	Broader more targeted intervention bringing positive gender impacts
7	Increasing the total number of female Principal Investigators in the Programme	Reconsider the maturity of Programme's intervention targeting female researchers.	Programme Operator	Adding a separate path for female Principal Investigators or bonus scores for female Principal Investigators in basic calls of the Programme (POLNOR and CCS	Next programming period.	Programme level, operational level.	Innovation and research and development.	Broader intervention towards positive gender impacts.

Source: Own elaboration

Attachments

1. Case studies.
2. Service Blueprint of the Applied Research Programme's implementation.