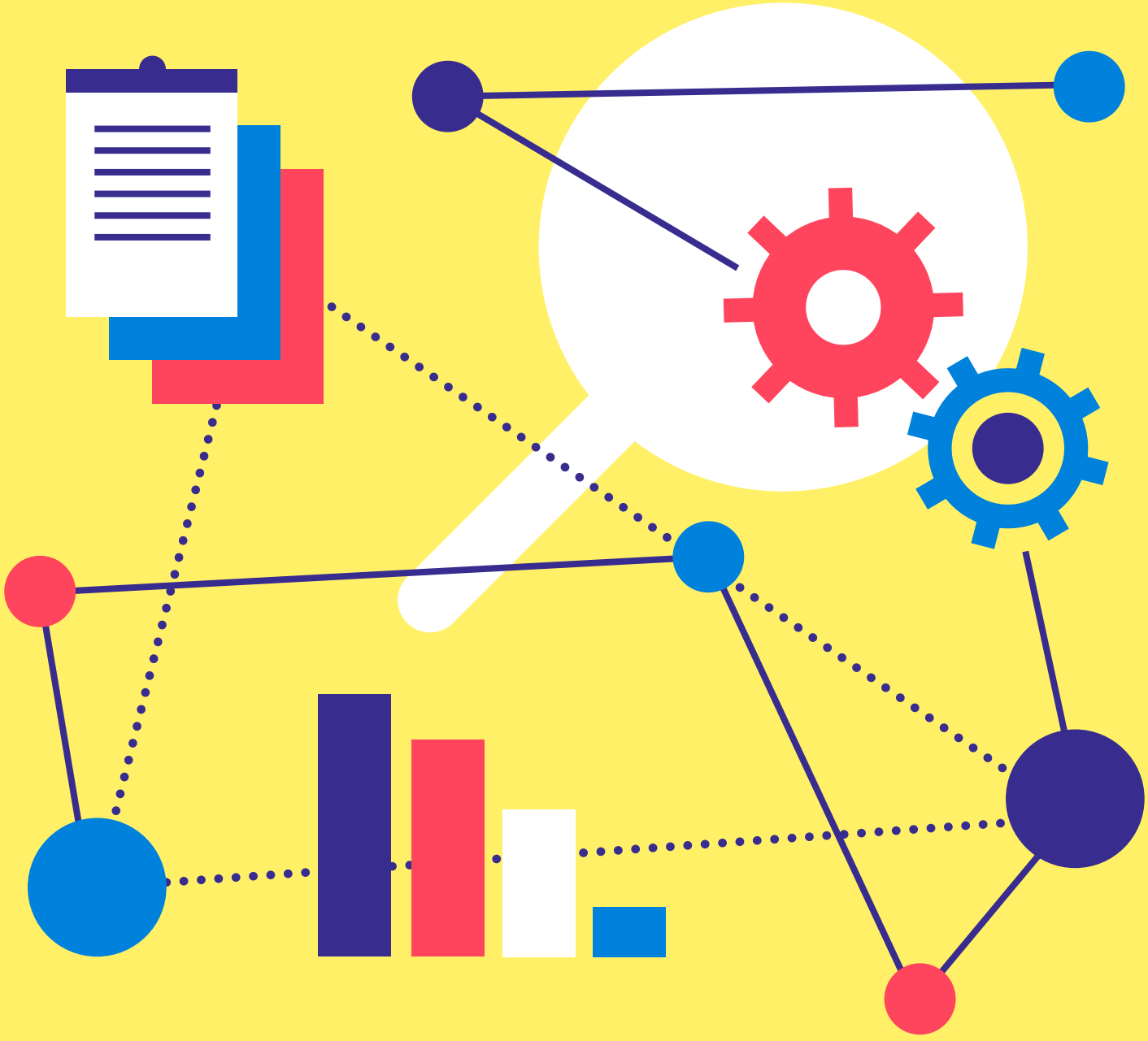
PILLAR 1 BULGARIA PUBLIC EXPENDITURE REVIEW IN SCIENCE, TECHNOLOGY AND INNOVATION (STI)

Bulgaria: Efficiency Analysis of STI Programs



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REPUBLIC OF BULGARIA
Ministry of Education and Science

SCIENCE AND EDUCATION FOR SMART GROWTH

REIMBURSABLE ADVISORY SERVICES AGREEMENT ON PUBLIC EXPENDITURE REVIEW IN SCIENCE, TECHNOLOGY AND INNOVATION AND SUPPORT FOR BUILDING EVIDENCE-BASED APPROACH FOR THE NATIONAL STRATEGIC FRAMEWORK IN EDUCATION 2030

Bulgaria: Efficiency Analysis of STI Programs

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Contents

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Abbreviations and Acronyms

CART	Credible, Actionable, Responsible, Transportable
DG OPIC	Directorate General of the Operational Program Innovation and Competitiveness
DPPI	Development of Product and Process Innovations
eHealth	Electronic Health in Bulgaria
EU	European Union
FR	Fundamental Research
FTE	Full-Time Employees
HEI	Higher Education Institution
ICT	ICT for a Single Digital Market in Science, Education, and Security
ICT-R	Improving Competitiveness and Efficiency of SMEs in ICT
IP	Intellectual Property
IPR	Intellectual Property Rights
M&E	Monitoring and Evaluation
MoE	Ministry of Economy
MoES	Ministry of Education and Science
NIF	National Innovation Fund
NSF	National Science Fund
NSME	Innovations in Newly Established SMEs
OP	Operational Programme
PER STI	Public Expenditure Review for Science, Technology, and Innovation
PRO	Public Research Organization
SARI	State Agency for Research and Innovation
SMEPA	Small and Medium Enterprise Promotion Agency
STI	Science, Technology, and Innovation
ToC	Theory of Change
UMIS	Unified Management Information System

Executive Summary

Transitioning to a more knowledge- and technology-based economy will be critical if Bulgaria is to achieve convergence with its European peers in terms of economic productivity and living standards. Despite dramatic productivity growth over the last decade, Bulgaria's productivity performance is still among the weakest in Europe. The country also faces medium- to long-term challenges in its workforce due to an aging population and high emigration. This transition to a more knowledge- and technology-based economy will require large improvements to the country's science, technology, and innovation (STI) performance, which ranks among the weakest in the EU across multiple indicators. Contributing factors to this poor STI performance include inadequate funding for research, a lack of coordination of STI policies and programs, and serious capacity issues on the part of STI implementing bodies.

The coming year presents an important opportunity for Bulgaria to improve its support for STI. The new National Recovery and Resilience Plan will allocate approximately €1.25 billion in funding for innovation-related activities. Moreover, new priorities and targets are being defined for the upcoming programming period, which will allocate approximately €1.17 billion toward research and innovation. These new investments would greatly benefit from a careful review of the strategies, policies, and programs that support STI nationally, drawing lessons and recommending reforms to ensure that the new funding is allocated efficiently and produces real impacts on the STI system.

This report assesses the efficiency of selected Bulgarian STI support programs, tracks progress on outcomes, and reports on beneficiaries' perceptions of program quality. This analysis is not intended to judge the viability of the programs included in this report, but rather to review and analyze the programs according to the needs of the Bulgarian STI system and make recommendations for their improvement. This report is the third and final major component of the World Bank's Bulgaria Public Expenditure Review for Science, Technology, and Innovation (PER STI) project. The first component of the PER STI project, the *Country Needs and Policy Mix Assessment*, provided a comprehensive assessment of the country's STI needs, an overview of the national policies devoted to supporting STI in Bulgaria, and an analysis of the alignment or gaps between policy support and the STI needs of the nation's public and private sectors. The second component, the *Functional and Governance Analysis*, analyzed the functionality of a representative set of STI policy instruments through a review of their design, implementation, and governance and provided a set of recommendations to improve the functionality and governance of the portfolio of STI support programs.

This efficiency analysis addresses an identified gap in Bulgaria's STI system: the monitoring and evaluation (M&E) of STI support programs. Previous components of this project found that STI implementors lack capacity and resources for M&E, and few evaluations of STI programs have been done during the current programming period. This report aims to address those gaps by identifying benchmarks for assessing the results of STI support programs in Bulgaria and providing a methodology and tools for carrying out such evaluations in the future.

Key Findings from Analysis of Research Support Programs

Research support programs had very different levels and compositions of administrative costs of implementation, largely due to the different management structures of the programs. Programs implemented by the National Science Fund (NSF) had a relatively high share of costs for external services and low share of costs for personnel, indicating that much of the program implementation is done by external experts rather than full-time NSF staff. By contrast, the sectoral programs of Bulgaria's National Science Programs 2018–22 portfolio have very low administrative costs overall because part of these costs are borne by beneficiary consortiums, which are responsible for part of the program administration and monitoring.

Research programs generally produced outputs and had outcomes that were in line with the program objectives, but a citation analysis raises concerns about the quality of research being produced. Publications reported by research respondents generally had lower numbers of year-normalized citations than the average Bulgarian publication indexed in the Web of Science from 2016 to 2020. This low level of citations indicates that the research being funded is not generating significant impact on the scientific community. Publications in peer reviewed journals were the most common outcome for all of the research programs, although publications per project and per unit of cost varied between programs. Capacity building outputs (in the form of seminars, conferences, and workshops; training activities; and hiring new researchers) were the most common outputs of almost every research program.

NSF programs generated relatively few collaborations during project implementation, despite the fact that increasing collaboration activity among beneficiaries is a goal of these programs. This may be because program regulations provide few incentives that encourage beneficiaries to collaborate. Additionally, some respondents from these programs noted that they would like eligibility criteria expanded to allow for more types of collaboration partners. There were few collaborations with researchers from the Bulgarian diaspora, which could be an opportunity for additional collaboration.

A small share of respondents from NSF programs reported outcomes related to prototyping, new software development, and new technology development, which are not intended results of those programs. Such projects could represent an opportunity for follow-up applied research grants that allow beneficiaries to further develop their project results. The *Country Needs and Policy Mix Assessment* showed a gap in applied research programs providing funding to public research institutions: at present, NSF regulations do not allow for funding to be used for commercialization, intellectual property (IP) development, or technology transfer, and there are few applied research programs that public researchers can access outside of NSF that would support such follow-on projects.

Respondents from researchers' programs were mostly satisfied with program processes, but some had issues with the transparency of the selection process and with monitoring requirements. Although researchers were generally satisfied with project application and selection, some were dissatisfied with the unavailability of feedback on which projects were selected, which can make selection processes appear opaque. Some respondents were also dissatisfied with program reporting requirements, particularly financial reporting rules, which require beneficiaries to provide certified and translated copies of all eligible expenses, including things like plane tickets.

Key Findings from Analysis of Firm Support Programs

Firms reported higher costs than researchers in preparing their applications, likely driven by the large share of firms that used external support to prepare their applications. Average application costs for the two firm support programs range from about 2.3 percent to 3.7 percent of the contracted grant value. Roughly 90 percent of firms used some form of external support (such as legal, accounting, or other services) to prepare their applications. Application costs can be a barrier to participation in a program, particularly for SMEs and young firms, which may not have the resources to apply.

Respondents from firm support programs generally achieved the outputs and outcomes intended by the programs, including developing and upgrading products, services, and processes; and increasing sales and employment. More than 70 percent of firm projects resulted in firms adopting a product or service for the first time. Roughly 65 percent of projects resulted in the introduction of a product or service that was new to the Bulgarian market.

Firm beneficiaries reported dissatisfaction with key areas of program implementation, including the overall application process, the transparency of project selection, and financial monitoring requirements. The *Functional and Governance Analysis* found that application processes for firms

are burdensome, particularly the supporting documentation firms must provide to support their applications, which can include financial statements, declarations of clean criminal records, tax liabilities, and offers from third parties for assets. The *Functional and Governance Analysis* also found that reporting processes were easier for beneficiaries of programs funded under EU operational programmes (OPs) than for nationally funded programs because beneficiaries of OP-funded programs report using an online portal with preloaded templates for technical and financial reports. Despite these challenges, more than 70 percent of respondents felt their project results matched their expectations and were generally satisfied with other aspects of their programs, including program rules and regulations and the accessibility of financial and administrative support.

Recommendations

The key findings from this efficiency analysis suggest several changes that could improve the efficiency and effectiveness of STI support:

1. **Consider the costs and benefits of the management and cost structures used for program implementation**. NSF and, to a lesser extent, the SME Promotion Agency (SMEPA) rely heavily on external experts in program implementation to make up for the lack of full-time staff at these institutions. This arrangement is not inherently inefficient, but increasing full-time staff and reducing the use of external services would likely increase the internal capacity of these institutions (identified as a major challenge in previous components of this PER STI project) and could lead to more effective program delivery.
2. **Analyze the quality of program outcomes, were possible, for evidence on the scientific impacts of research programs and projects**. Programs currently track numbers of publications generated by beneficiaries, but additional citation analyses on publication outputs would help implementors understand whether programs are achieving their research excellence objectives, show which publications are most influential on the scientific community, and help implementors make more informed decisions about which programs and projects to fund.
3. **Provide incentives for collaboration in programs with the objective of improving collaboration and the connections of beneficiaries**. This can be done by building collaborations into the design of programs (as a precondition for a grant award, for example), accounting for the transaction costs of collaboration in program funding, providing additional points on applications that include for research partners, and allowing beneficiaries to collaborate with a broader range of organizations during project implementation.
4. **Explore developing programs to further support beneficiaries of NSF programs**. The small share of respondents from NSF programs that reported outcomes related to prototyping, new software development, and new technology development suggests that some NSF project results

could be further developed and potentially commercialized if there were one or more applied research grant schemes to which their projects could "graduate." This would help address the gap in applied research funding programs to public research institutions.

5. **Reduce application costs for firm support programs**. Nationally funded programs would greatly benefit from an online portal similar to that used by the OPs, which allows beneficiaries to submit and receive information throughout the application and contracting process. Additionally, implementing bodies should acquire documentation (tax documents, criminal records, and so on) ex officio, where possible, and submission requirements for any documents that are not essential to the application process should be deferred until the contracting phase of the project. These changes would likely lower the need for firms to hire external consultants and services to prepare their applications and reduce the overall application costs for firms.
6. **Reduce the administrative burdens on beneficiaries during implementation**. The creation of an online portal with preloaded technical and financial reporting templates would simplify reporting processes for programs outside of the OPs. Financial report requirements could be simplified by approving R&D project expenditure plans in advance, reversing the current approach in which each expense item must be reported when incurred. For programs supporting R&D activities, expenses for R&D activities can be presumed to be eligible when reported and then verified later. In such a system, applicants would self-report whether they are eligible, and implementors would conduct audits later to verify eligible costs.

STI institutions should build on this analysis by committing to systematic monitoring and evaluation of their portfolios. As detailed in the *Functional and Governance Analysis*, more regular evaluations of Bulgaria's STI programs will require increasing the M&E capacity of STI implementors, improving institutional incentives for M&E, and committing much more resources to M&E than are currently available.

1. **Track program-level cost data**. Currently, no STI implementors systematically track all the costs related to the implementation of the programs, making it extremely difficult to understand the true costs of program implementation. Implementors can use the cost data templates that were used for this analysis to begin to more systemically collect and analyze this information.
2. **Conduct regular surveys of the beneficiaries of STI programs**. Regular surveys of beneficiaries would allow implementors to collect information on outputs and outcomes that is comparable across projects and programs and better understand the performance of their policy portfolios. Surveys can also provide information on beneficiaries' perceptions of their programs, including which aspects of programs beneficiaries believe are working well or need improvement. The survey questionnaires in the appendices to this report can be adapted for beneficiaries of a range of STI support programs

3. **Conduct regular efficiency analyses of STI programs.** Through systematic tracking of program cost data and regular beneficiary surveys, STI implementors will be able to assess programs' efficiency in the use of inputs, generation of outputs, and achievement of outcomes on a regular basis.
4. **With more complete data on costs and results, STI policymakers should use findings to improve the efficiency of STI programs in generating desired results with public funds.** This report, along with future efficiency analyses, can be used to define benchmarks and targets for STI programs, understand which programs are achieving their objectives, and make informed decisions to improve the efficiency of public funding for STI.
5. **Conduct impact evaluations of strategically important programs.** Efficiency analyses should be complemented by impact analyses, at least for strategically important programs. Guidelines for when to evaluate individual programs can be determined by a national-level evaluation framework, such as that used in the Republic of Korea, or by frameworks at the institutional or programmatic level. Impact analyses supplement data on program efficiency by establishing which changes or impacts can be attributed to a given intervention, allowing for a more complete picture of program impact and effectiveness. Instruments that are strategically important (for example, those with large budgets, supporting a large number of beneficiaries, and with large expected impacts) should undergo at least one performance evaluation and one external impact evaluation per programming period. Ideally, these evaluations should be conducted by third parties (that is, by evaluators outside of the implementing body) that do not have conflicts of interest with the instrument being evaluated.

Introduction

This document and the analysis it reports are the third major component of the Bulgarian Public Expenditure Review in Science, Technology, and Innovation (PER STI). PER STI is a methodological approach developed by the World Bank that aims to examine public spending for STI and provide actionable recommendations to increase its effectiveness. The analysis was conducted by the World Bank at the request of the Ministry of Education and Science (MoES) and in close cooperation with the National Science Fund (NSF), the Ministry of Economy (MoE), and the SME Promotion Agency (SMEPA).

This analysis builds on findings from the earlier components of the PER STI project, as well as other recent analyses of the Bulgarian STI system. Component I of the PER STI project, the *Country Needs and Policy Mix Assessment* (World Bank 2020), found that STI institutions often lack measurable objectives and targets. Component II, the *Functional and Governance Analysis* (World Bank 2021a), found three key issues that could impact the efficiency and effectiveness of STI instruments. First, STI implementors outside of the operational programs, such as the NSF and SMEPA, suffer from a lack of staff and resources to fully implement their portfolios. Second, program inputs, with the exceptions of direct financial transfers to beneficiaries, are generally not well tracked or catalogued. Third, STI implementors lack monitoring and evaluation (M&E) capacity and resources, and M&E frameworks tend to focus on monitoring and compliance with administrative regulations. Almost no evaluations take place. Moreover, only a few instruments have an explicit theory of change as part of their design, which has contributed to poorly defined and disconnected indicators for program inputs, activities, outputs, and outcomes. Several other recent reviews of the Bulgarian STI system have also identified M&E frameworks an area of concern (European Commission 2015; World Bank 2013).

This report builds on and complements this past PER work with an assessment of the efficiency of select STI programs in converting inputs into outputs and outcomes. Analyzing program efficiency allows policymakers to understand the level of investment needed to generate desired outputs and outcomes, identify inefficiencies and challenges, and make informed decisions about program design and resource allocation.

This effort makes two key contributions toward the objectives of the PER STI project. First, it provides a set of benchmarks for assessing the results of STI support programs in Bulgaria. Second, it demonstrates the efficiency analysis approach and methodology to evaluating STI instruments and provides templates and tools for STI implementors to carry out such analyses in the future.

The analysis was conducted on a subset of STI support programs, using a variety of data sources. Of the 120 STI instruments mapped in the first component of this project (the *Country Needs and Policy Mix Assessment*), 28 instruments were chosen for inclusion in component 2 (the *Functional and Governance Analysis*). In consultation with MoES and following the criteria described in Section 1 of this report, six instruments were selected from the 28 for efficiency analysis. Data on outputs and outcomes were collected through two surveys, one targeting beneficiaries from programs targeting researchers and the other targeting beneficiaries from programs targeting firms. Administrative data on the costs of program implementation were collected by program staff. These data were supplemented by analysis and findings from the first two components of the PER STI project.

Along with the analysis and recommendations included in this report, several tools were developed to support future efficiency analyses of Bulgarian STI programs. The tools include two survey questionnaires tailored to public sector researchers and to firms, respectively; a template for program cost data collection; and Microsoft Excel worksheets for analyzing and visualizing the data collected. This analysis and the accompanying tools build upon earlier efficiency analyses of STI programs in Colombia (World Bank 2018) and Croatia (World Bank 2021b).

The report is structured in nine sections. Section 1 presents the methodology, Section 2 provides a comparison of key results across the six programs included in the analysis, Sections 3 through 8 provide program-specific analysis and findings, and Section 9 provides recommendations.

1. Methodology

1. Methodology

This report aims to assess select STI programs in Bulgaria in terms of their efficiency in using inputs and generating results and their perceived quality. The analysis is guided by the following research questions:

- **Program inputs**: What are the costs of implementing the programs? Of these costs, what costs are borne by implementing bodies, and what costs are borne by beneficiaries?
- **Program results**: Are the programs generating the intended outputs? Are the programs leading to the intended outcomes? Are the programs leading to unintended outcomes? What are the outputs and outcomes per unit of cost?
- **Program quality**: How do beneficiaries perceive the quality of program processes related to application, selection, implementation, and M&E? How do beneficiaries perceive the results of their projects?

1.1 Programs Selected

Six programs were selected for analysis based on multiple criteria. The criteria includes (1) the number of projects that had been funded; (2) the prospects for the continuation of the program; (3) the availability of information and data on inputs, outputs, and outcomes; and (4) the importance of the program in the portfolio of the implementing institution. Four programs were selected focused on supporting researchers and research institutions. These four programs supported a total of 690 research projects from 2016 to 2020. Two programs were selected focused on supporting firms. They supported a total of 235 private sector projects from 2016 to 2020. Table 1.1 lists the selected programs. Within the current STI policy mix in Bulgaria, the four programs targeting researchers account for 11 percent of the overall project financing allocated for research, while the two programs targeting firms account for 3 percent of the project financing allocated for firms. All programs provided beneficiaries with grants, and those targeting firms required firms to provide matching funds.

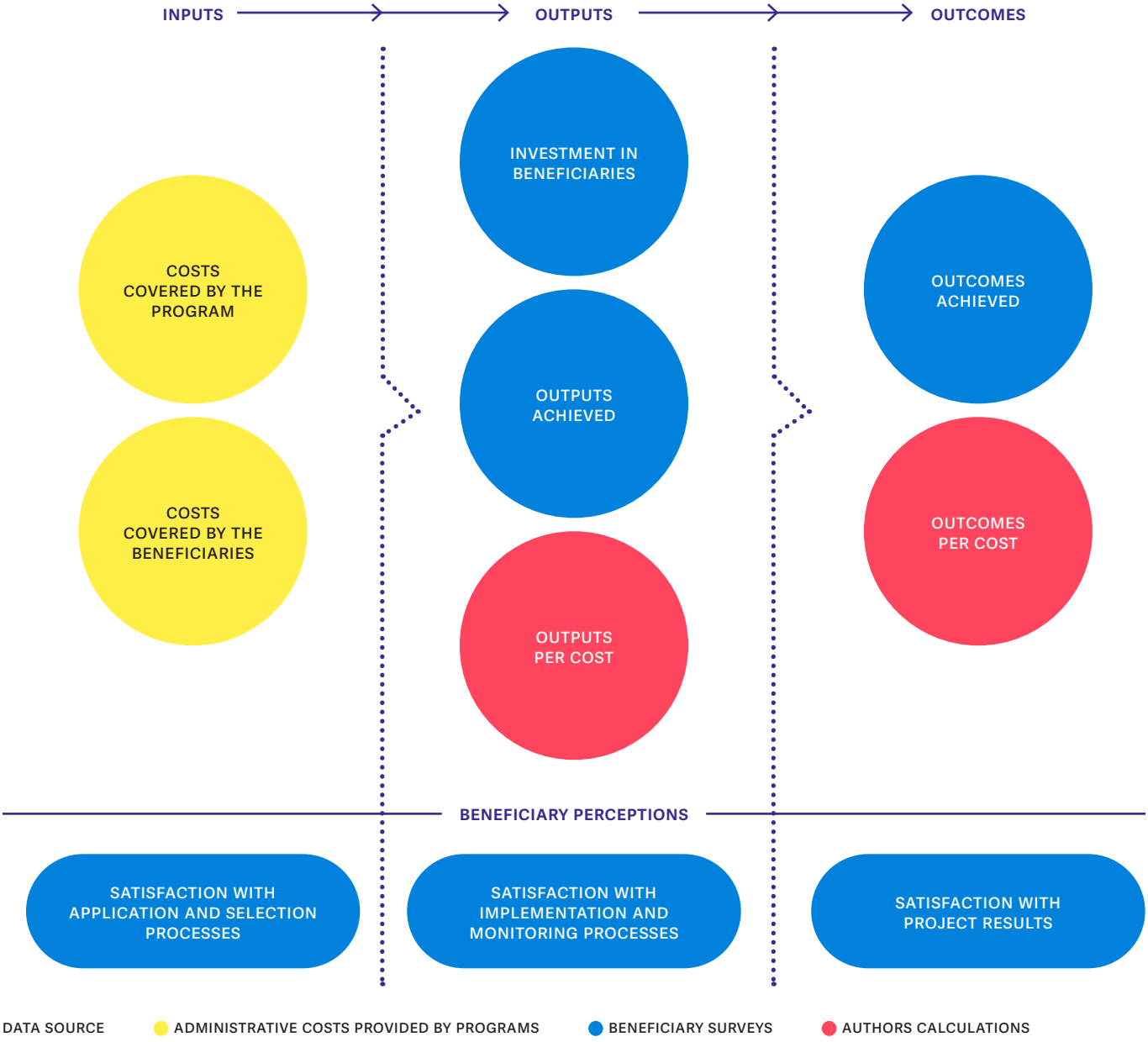
Table 1.1. Programs Included in the Efficiency Analysis

	PROGRAM	IMPLEMENTOR	# OF PROJECTS	CALLS INCLUDED
Research Support Programs	Fundamental Research (FR)	NSF	664	2016
				2017
				2018
				2019
				2020
	Vihren	NSF	10	2019
	ICT for a Single Digital Market in Science, Education, and Security (ICT)	MoES	12	2019
	Electronic Health in Bulgaria (eHealth)	MoES	4	2019
Firm Support Programs	National Innovation Fund (NIF)*	SMEPA	82	2016
				2018
				2019
				2020
	Development of Product and Process Innovations (DPPI)	DG OPIC	154	2018

Source: World Bank.
Note: DG OPIC = Directorate General of the Operational Program Innovation and Competitiveness; MoES = Ministry of Education and Science; NSF = National Science Fund; SMEPA = Small and Medium Enterprise Promotion Agency.
a. For NIF, efficiency analysis indicators (outputs and outcomes per unit of program cost) only include beneficiaries from 2018 to 2020 because administrative cost data were only available for those years.

The analysis for each program covers four areas: (1) efficiency in the use of inputs, (2) efficiency in the generation of outputs, (3) efficiency in the achievement of outcomes, and (4) perceived quality of program processes and results. These areas were defined based on the World Bank guidance note *Public Expenditure Reviews in Science, Technology, and Innovation* (Correa 2014) and build upon experiences and lessons learned from previous efficiency analysis conducted by the World Bank in Colombia and Croatia. Figure 1.1 presents the conceptual framework that guides this report.

Figure 1.1. Conceptual Framework



Source: Adapted from World Bank 2021b.

1.2 Indicators

Indicators for program inputs, outputs, and outcomes were drawn from theories of change (ToCs) that were developed for each program. (See Appendix A for the theories of change for each program in this analysis.) These ToCs were based on available program documentation and interactions with program staff.

Efficiency in the Use of Inputs

The analysis of efficiency in the use of inputs includes both program inputs covered by the program and those covered by the beneficiaries.

1. **Costs covered by the program** include the amount and composition of program costs to the implementing body. Costs include transfers to beneficiaries, in the form of direct financial transfers (such as grants and matching grants), indirect financial transfers (such as tax deductions or reductions in fees), and non-financial transfers (such as technical assistance and access to equipment). They also include the administrative costs of implementing the program in the form of personnel costs (for program design, implementation, and monitoring), fixed costs (such as office equipment, office space, and IT), and external services (such as contracts for external technical experts, legal services, or other outside services).
2. **Costs covered by beneficiaries** include application costs and contributions (cash and in kind) from beneficiaries to their projects.
3. **Efficiency in the use of inputs** includes the average administrative and operating cost per project, the average cost per project, the average cost covered by beneficiaries, and the ratio of costs covered by the program to costs covered by beneficiaries.

Efficiency in the Generation of Outputs

The analysis of efficiency in the generation of outputs looks at two key areas.

1. **Investments in beneficiaries** include total funds disbursed to program beneficiaries, average transfers per project, transfers per unit of administrative cost, and uses of funding by beneficiaries.
2. **Intended outputs achieved** includes an analysis of the outputs achieved relevant to each program (based on the program's ToC), as well as efficiency measures such as average number of outputs achieved per project and the number of outputs achieved per unit of program cost.

Efficiency in the Achievement of Outcomes

The analysis of efficiency in the achievement of outcomes relates to the average number of outcomes achieved per project relevant to each program (based on the program's ToC).

Perceived Quality of the Programs

The analysis of the perceived quality of programs relies on the beneficiaries' opinions of the quality of various program components. This includes beneficiaries' perceptions of application, selection, and contracting processes, support provided by the implementors during project implementation, sufficiency of the time and funding provided for project implementation, key success factors, and perceptions of the overall quality of the program.

1.3 Data

Data for this analysis were drawn from two surveys (one targeting researchers and one targeting firms) and administrative cost data provided by the staff of the selected programs. Surveys were administered to the entire population of research and firm beneficiaries of the selected programs from 2016 to 2020; no sampling was done of the beneficiary pool. The survey of public sector researchers was delivered to the principal investigators of 690 supported projects, while the survey of firms was delivered to a designated contact person for 236 projects. For the implementation of the beneficiary survey, the World Bank research team worked in collaboration with Alpha Research, a Bulgarian survey company. The World Bank team designed the survey questionnaires (with inputs and feedback from Alpha Research), and the survey was carried out by Alpha Research from April to July 2021. The World Bank team and Alpha Research independently verified the quality of the data collected, and Alpha Research contacted respondents when data quality flags were raised for additional verification. The survey questionnaires used for this effort were adapted to the local context and selected programs from questionnaires initially developed by the World Bank (2021b) (See Appendixes B and C for the survey questionnaires used in this analysis.). Both questionnaires include questions on the characteristics of beneficiaries, beneficiary costs and contributions (cash and in kind), their experiences and perceptions with application and implementation processes, and the results achieved to date. Questionnaires were first developed in English and then translated into Bulgarian by Alpha Research.

Overall response rates were relatively high for a survey of this kind, with just under 60 percent of all beneficiaries responding to the survey.[1] Response rates were higher for programs targeting researchers, with 63 percent of all researcher beneficiaries responding to the survey. They were lower for firms, with 51 percent of firm beneficiaries responding to the survey (Table 1.2).

Table 1.2. Program Response Rates

	RESEARCHER PROGRAMS				FIRM PROGRAMS		
	FUNDAMENTAL RESEARCH	VIHREN	ICT	EHEALTH	NIF	DPPI	TOTAL
Total beneficiaries (no.)	664	10	12	8	82	154	930
Responses (no.)	414	8	8	4	44	80	558
Response rate (percent)	62	80	67	50	54	52	60

Source: World Bank.
Note: DPPI = Development of Product and Process Innovations; ICT = Information and Communication Technologies for a Single Digital Market in Science, Education, and Security; NIF = National Innovation Fund.

Administrative data on program expenditures were gathered by implementing institutions using a template provided by the World Bank team. The template included instructions on how to categorize and calculate program costs. Expenditures were classified into direct financial transfers to beneficiaries (grants provided), non-financial support to beneficiaries (such as technical assistance, facilities, or equipment lent), and administrative and operating costs (including personnel, fixed costs, and external services). Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program. For fixed costs and external services, if the actual annual costs attributable to the programs were not available, they were estimated using a weight based on the annual personnel costs of the program as a share of total annual institutional personnel costs (for the Fundamental Research, Vihren, ICT, eHealth, and NIF programs) or a weight based on the number of projects funded by the program as a share of the total projects funded by the implementor (for the DPPI program).

Throughout the report, funding and cost data are reported in constant 2020 terms in Bulgarian lev (BGN), using the Harmonized Index of Consumer Prices.

1 Beneficiaries were considered as responding to the survey if they completed 50 percent or more of the questionnaire.

1.4 Limitations

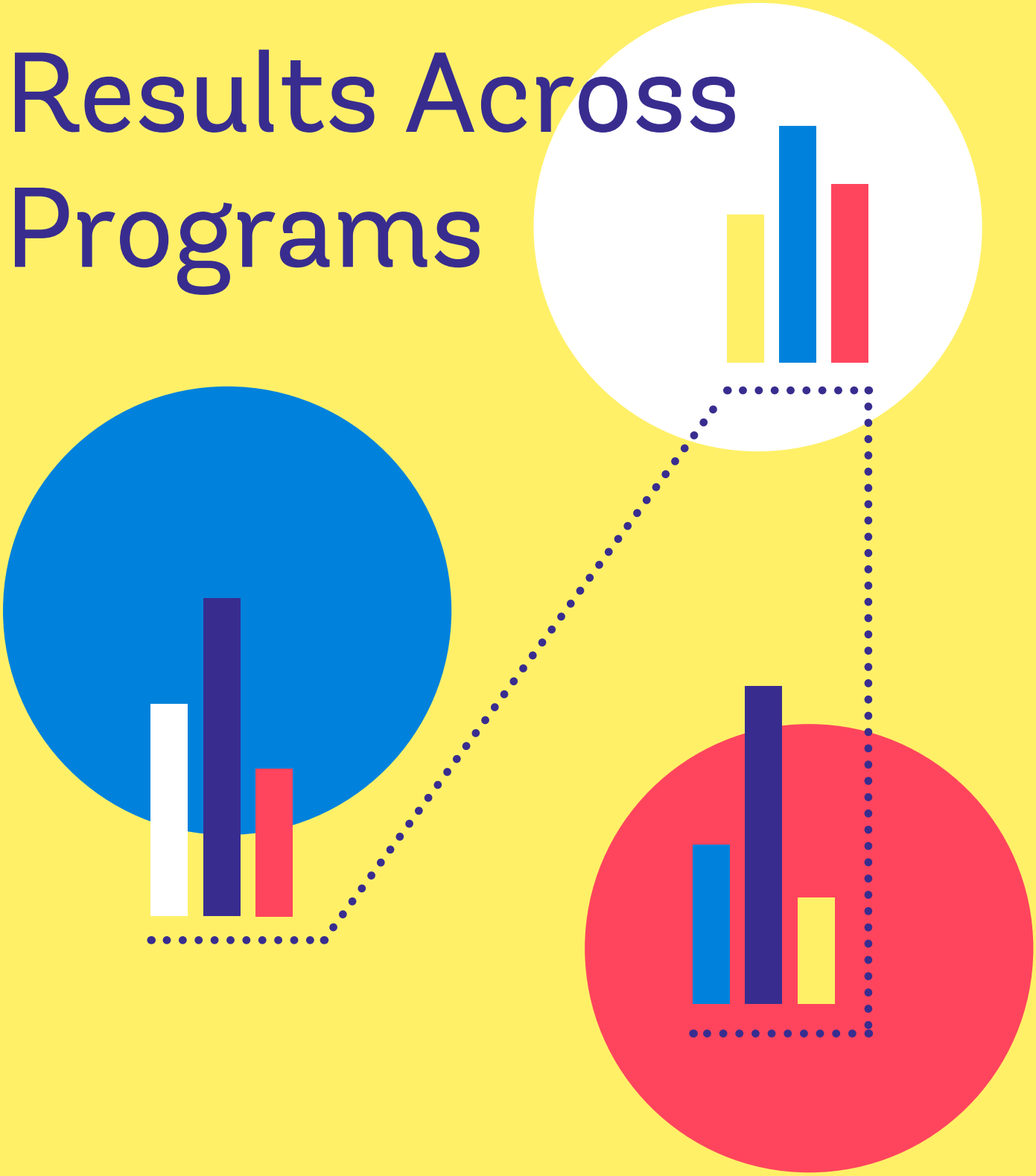
It is important to acknowledge certain limitations of this methodological approach. Firstly, this is an efficiency, not an effectiveness analysis. Specifically, it does not include an analysis of counterfactual outcomes. Therefore, it cannot assess the changes or impacts that can be attributed to the programs. Evaluating the effects attributable to the programs would require comparing data from a carefully selected group of non-beneficiaries with data from beneficiaries. Further, the methodology does not differentiate between "good" and "bad" costs. Low administrative costs are not necessarily good or efficient, but may indicate a lack of effort or attention to an instrument's design, monitoring, and so on. Pilots and experimental interventions generally require more effort (and therefore more administrative costs) to implement than established programs, so implementation costs should be viewed within the context of individual programs. Additionally, this evaluation approach could be gamed by beneficiaries familiar with the methodology by generating a large number of low-effort outputs, making their projects look more efficient at generating project results per unit of cost.

Limited data availability means there are some limitations to the administrative cost data presented in this report. This includes some missing data on fixed costs for the ICT, eHealth, and DPPI programs and missing data on external services for Fundamental Research, meaning that those costs reported here are likely lower than the actual costs of implementing those programs. (See Appendix D for full details on the collection, analysis, and limitation of the administrative costs included in this report.)

When interpreting the results, the reader should understand that not all project results are equal. Some results require more resources and a higher level of effort. (A working prototype requires more effort than a training session, for example.) Moreover, some results are more valuable than others. (A patent is worth more than a conference presentation, for example.) Where possible, information on the quantity of outputs is complemented by an analysis of their quality. For example, a bibliometric analysis was conducted on the scientific publications reported by beneficiaries. However, such an analysis is not possible for many of the outputs and outcomes in this report. For example, there is no quality measure for many firm outcomes, such as new and upgraded products, services, and processes.

The results should be also viewed within the context of the specific programs. In the case of the programs with a small number of beneficiaries (such as the National Innovation Fund, ICT, and eHealth), the findings have more descriptive than statistical value. Also, for some programs (such as Vihren, ICT, and eHealth), all of the beneficiary projects are still active, and respondents may not have had sufficient time as of the writing of this report to achieve certain results.

2. Results Across Programs



2 Results across Programs

This section presents key results (related to inputs, outputs, outcomes, and perceived quality) that can be compared across the six programs included in this analysis. Sections 3 to 8 provide more detailed findings on each of the individual programs.

When considering differences in results across programs, it is important to consider program context. The selected programs differ in their targeted beneficiaries, objectives, average contracted grant size, timelines, and other important dimensions. Some programs issued multiple calls for proposals, while other programs only issued a single call from 2016 to 2020 (Table 2.1). These differences impact the types of outputs and outcomes expected from funded projects, as well as the efficiency of the programs in producing results (See the ToCs for each program in Appendix A for a complete description of expected outputs and outcomes).

Table 2.1. Selected Programs with Target Beneficiaries, Grant Sizes, and Objectives

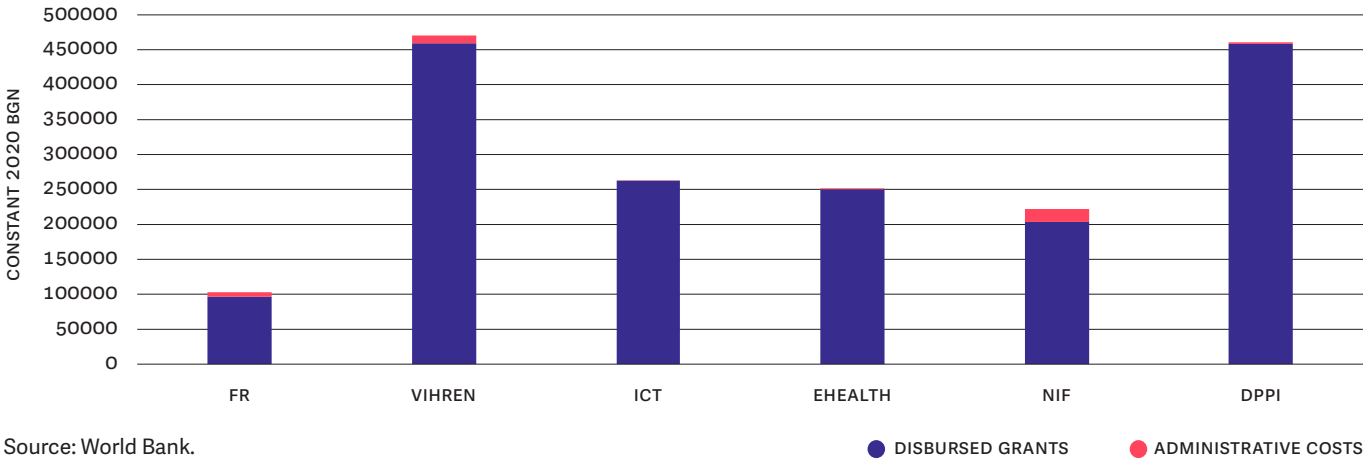
PROGRAM	TARGET BENEFICIARIES	NUMBER OF PROJECTS	AVG. DISBURSED GRANT SIZE	TOTAL GRANTS DISBURSED	# OF CALLS, 2016-2020	OBJECTIVE(S)
Fundamental Research	Researchers	664	96,626 BGN	64,159,408 BGN	5	Research excellence
Vihren	Researchers	10	459,148 BGN	4,591,480 BGN	1	Research excellence, skills
ICT	PROs, HEIs	12	262,500 BGN	3,150,000 BGN	1	R&D-based innovation
eHealth	PROs, HEIs	4	500,000 BGN	2,000,000 BGN	1	R&D-based innovation
NIF	Firms	80	203,763 BGN	13,652,088 BGN	4	R&D-based innovation
DPPI	Firms	154	458,579 BGN	70,621,104 BGN	1	R&D-based innovation; non-R&D innovation

Source: World Bank.
Note: All amounts in constant 2020 BGN.

2.1 Efficiency in the Use of Inputs

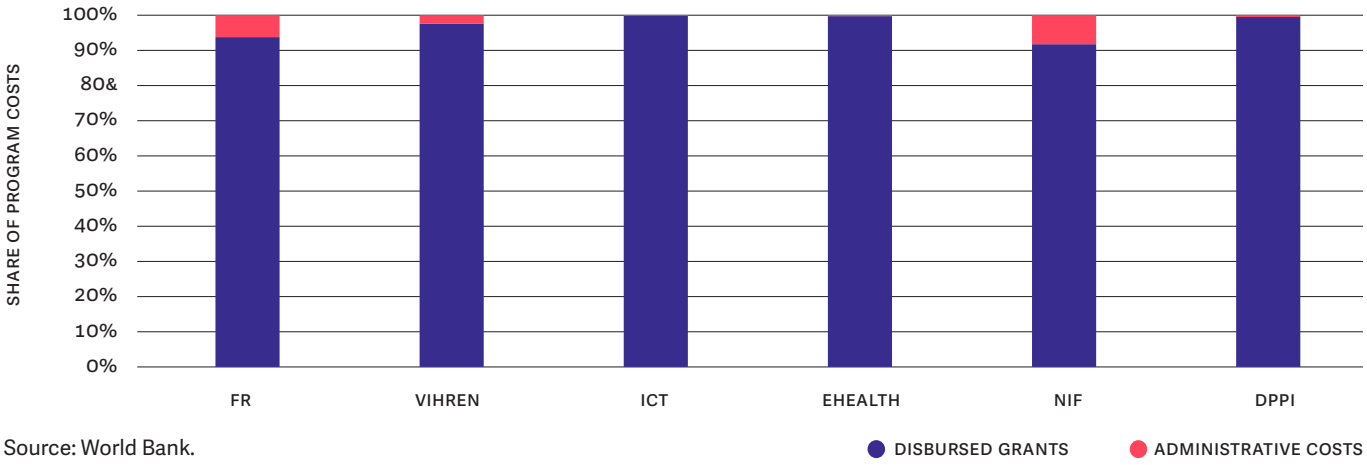
Program costs were primarily direct financial transfers to beneficiaries in the form of grants or matching grants. Vihren and DPPI had the largest cost per project due to larger average disbursed grant sizes than the other programs (Figure 2.1). Administrative costs represented between 0.2 percent and eight percent of total costs, depending on the program (Figure 2.2). The programs with multiple calls for proposals (Fundamental Research and NIF) had the highest ratio of administrative costs to overall program costs. None of the programs reported costs related to non-financial transfers to beneficiaries (such as advisory services) or indirect financial transfers to beneficiaries (such as tax deductions).

Figure 2.1. Average Cost per Project



Source: World Bank.

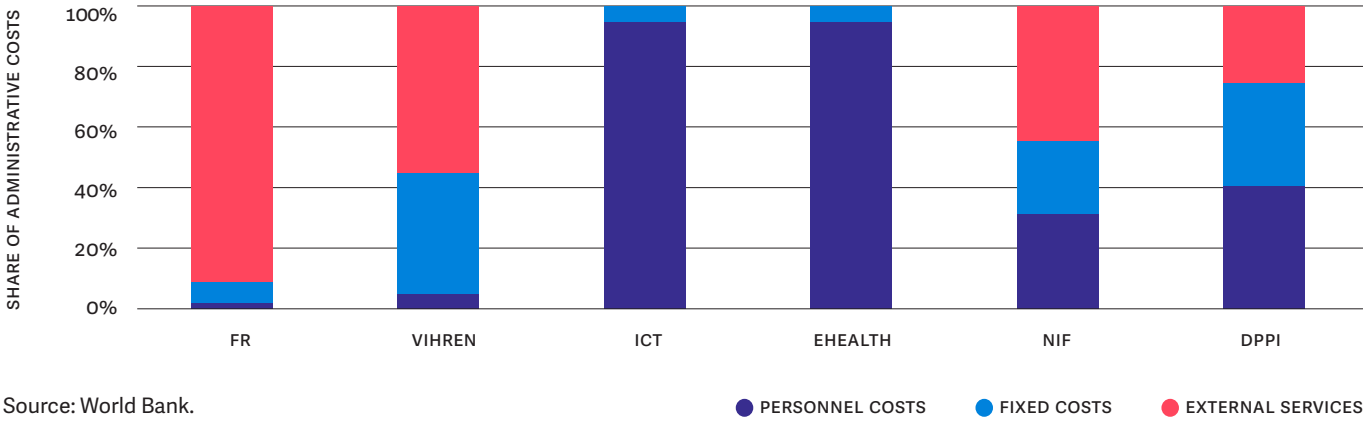
Figure 2.2. Ratio of Disbursed Grants to Administrative Costs



Source: World Bank.

For some programs, particularly those administered by NSF, personnel costs represented a very small share (less than 10 percent) of total administrative costs, while external services represented a relatively high share (more than 50 percent) (Figure 2.3). Component 2 of this PER STI project, the *Functional and Governance Analysis*, found that STI implementing bodies outside of the operational programmes suffer from a lack of full-time staff to fully implement their program portfolios. This balance of personnel costs and external services is likely due, at least in part, to the lack of staff at NSF (which implements the Fundamental Research and Vihren programs) and, to a lesser extent, SMEPA (which implements NIF). This arrangement is not necessarily inefficient or ineffective for these programs, but it does mean that the internal capacity of NSF and SMEPA may be lower than it would be if more of the program implementation was carried out internally.

Figure 2.3. Administrative Costs by Category



Source: World Bank.

Costs Covered by Beneficiaries

Programs targeting firms tended to have higher application costs. Beneficiaries of programs targeting firms reported higher costs than beneficiaries of programs targeting researchers in terms of total application costs as well as in terms of application costs as a share of contracted grant size (Figure 2.4). Application costs for programs targeting researchers ranged from about 2,200 BGN to 2,900 BGN and from 0.3 percent to 1.9 percent of the contracted grant value, while applications costs for programs targeting firm range from about 7,700 BGN to 10,500 BGN and from 2.3 percent to 3.7 percent of the contracted grant value. Given that researcher and firm respondents took roughly similar numbers of working days to prepare their applications (see Figure 2.6 below), some of the discrepancy in costs between researchers and firms may be due to the fact that some researchers view their time as "free", while firms tend to place a monetary value on the time of their employees. While the application costs for firms' programs were higher than the researcher support programs, they were lower than the application costs of firm support programs found in a similar analysis in Croatia, where application costs for firm support programs ranged from 4 and 7 percent of the average grant amount (see Box 2.1).

Firms tended to use additional support to prepare their applications to these programs. Applicants' use of external support (such as administrative, legal, or accounting assistance) to prepare their applications likely contributed to the higher application costs of firm support programs. Firm respondents generally used some form of additional support, with over 70 percent of firms applying for NIF and DPPI using some form of outside assistance to prepare their application. For programs targeting researchers, respondents were largely able to prepare applications without additional support, with under 25 percent of respondents from the Fundamental Research and Vihren programs using such support (Figure 2.5). The *Functional and Governance Analysis* found that application processes are burdensome on beneficiaries (both for programs targeting researchers and companies), although processes vary in format and complexity depending on the implementing body and specific program. Lengthy and complex application forms are common across programs, while collecting and providing supporting documentation is a larger challenge for firm support programs. Supporting documentations can include financial statements, declarations of clean criminal records, tax liabilities, and offers from third parties for assets. High application costs can represent a barrier to participation in a program – particularly for SMEs and startups, which may not have the resources available to apply. There was no application process for the ICT and eHealth programs., so beneficiaries from those programs were not asked about application costs.

Figure 2.4. Application Costs by Program

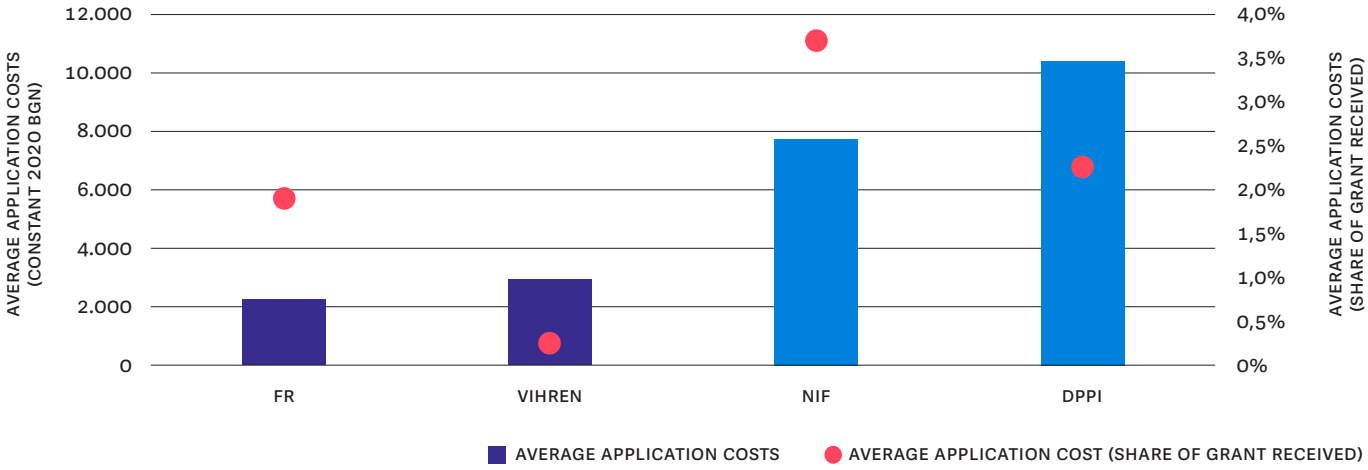
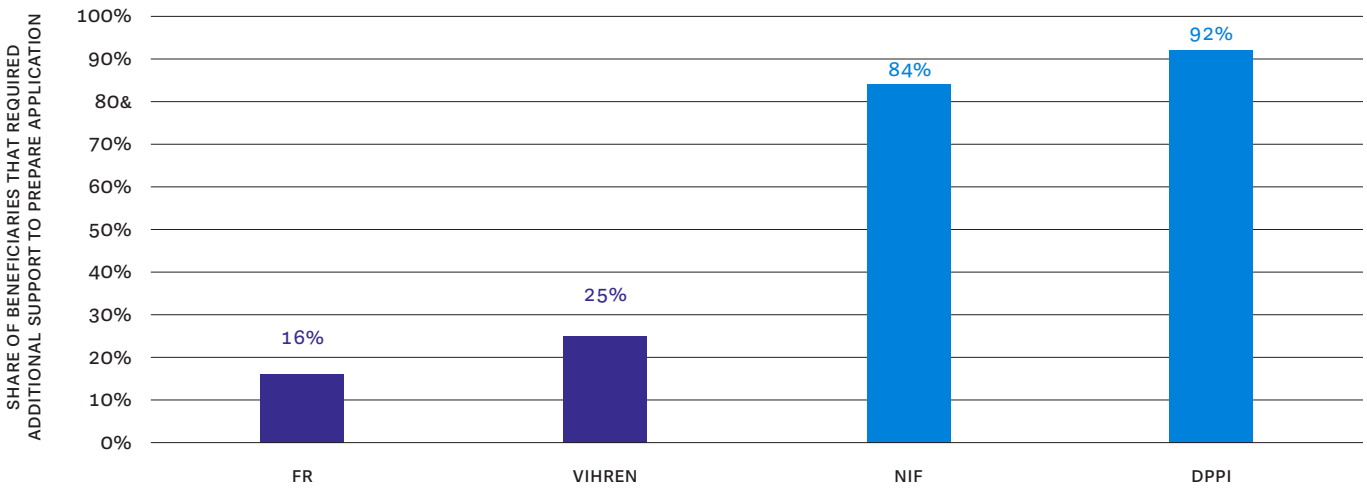


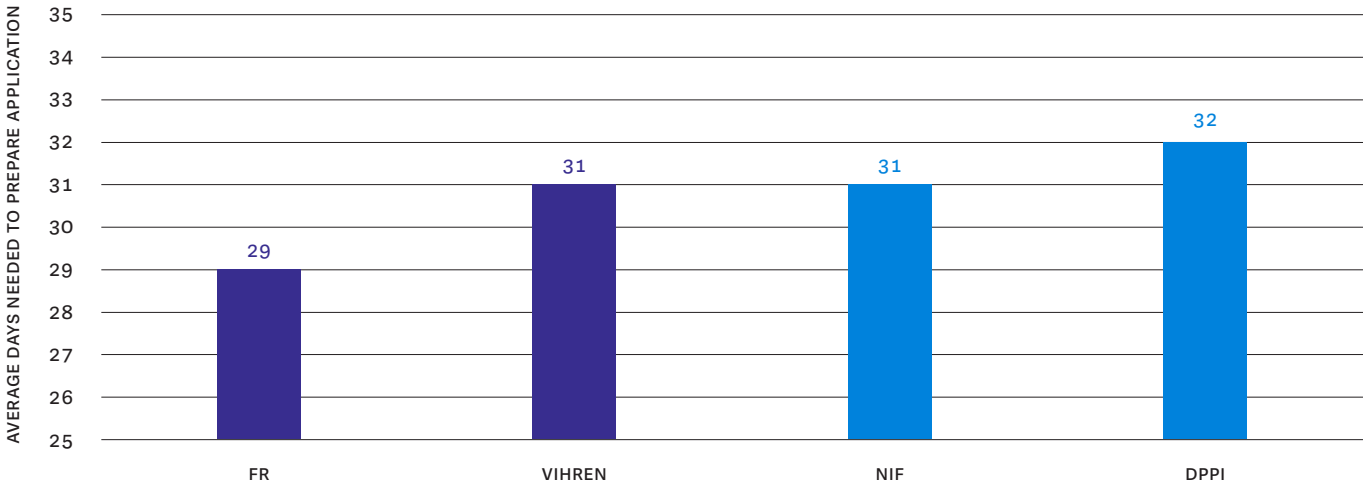
Figure 2.5. Share of Beneficiaries that Required Additional Support to Prepare their Applications by Program



Source: World Bank.
Note: Bars in purple are programs target researchers, and bars in blue target firms. There was no application process for the ICT and eHealth programs.

The time needed to prepare applications was similar across programs. The number of working days needed to prepare applications was roughly the same across programs, ranging from 29 to 32 (Figure 2.6). When comparing the labor needed to prepare applications with the findings of the recent efficiency analysis done in Croatia in 2020, Bulgaria applicants generally used more working days to prepare their applications – particularly firms (see Box 2.1). This may be indicative of more time-intensive application processes for Bulgarian firm support programs.

Figure 2.6. Time Needed to Prepare Applications by Program



Source: World Bank.
Note: Bars in purple are programs target researchers, bars in blue target firms. There was no application process for the ICT and eHealth programs.

BOX 2.1. APPLICATION COSTS OF CROATIAN STI PROGRAMS

In an analysis of the efficiency of seven STI support programs in Croatia in 2020, the World Bank (2021b) found that application costs per project were generally higher for programs targeting firms, but that, on average, applications to programs targeting researchers took more labor to prepare (Table 2.2). Average application costs represented between 1 and 7 percent of the average grant value, and applications took an average of between 17 and 30 working days to prepare.

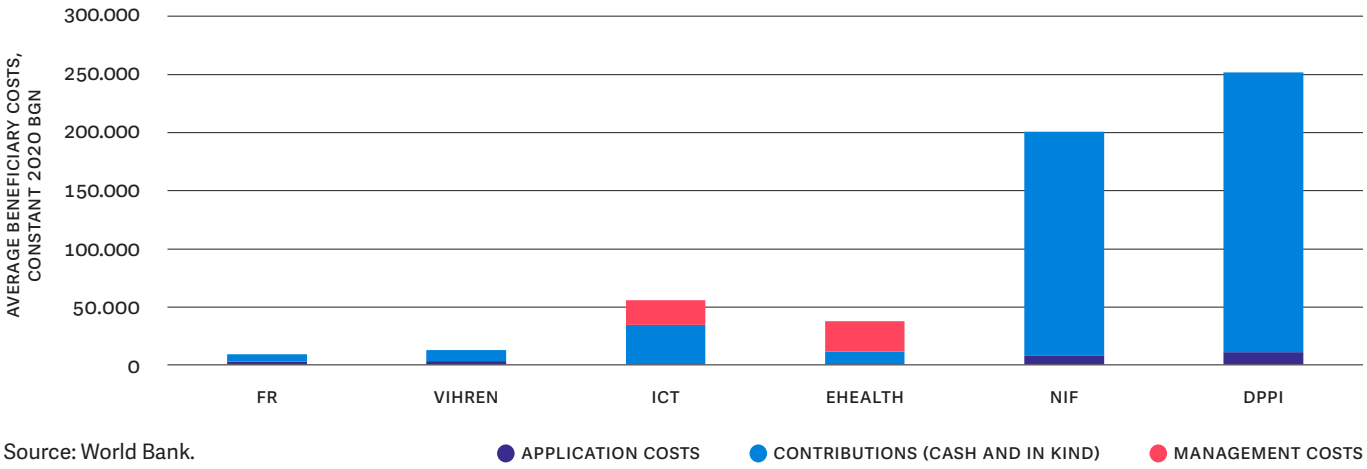
Table 2.2. Application costs and working days needed to prepare application for Croatian STI programs

	RESEARCH SUPPORT PROGRAMS					FIRM SUPPORT PROGRAMS	
PROGRAM	IRP	SIIF	STRIP	RP	RS	NSME-1	ICT-R
Application costs as share of total grant received	2.0%	0.5%	0.6%	1.5%	0.9%	4.2%	6.6%
Average working days to prepare applications	30	29	25	24	17	24	27

Source: World Bank 2021b.
Note: ICT-R = Improving competitiveness and efficiency of through ICT, IRP = Installation Research Projects, NSME-1 = Innovations in newly-established SMEs – Phase 1, RP = Research Projects, RS = Research Scholarships, SIIF = Science and Innovation Investment Fund, STRIP = Strengthening Capacities for Research, Development and Innovation.

Due to the matching grant requirements, the average costs covered by beneficiaries were highest for firm respondents. Beneficiaries of firm-support programs invested more in their projects than those of research-support programs, largely due to the matching requirements of the DPPI and NIF programs[2] (Figure 2.7). As discussed above, beneficiaries of firm-support programs reported higher application costs than researcher beneficiaries. The ICT and eHealth, programs are both sectoral programs of the National Science Programs 2018–22 portfolio, have a different design than traditional research grants: each program provides funding to a consortium of preselected research institutions in a specific scientific field. MoES delegates a portion of the administration and auditing of projects to the consortium, so some of the costs of implementing the overall program are borne by the beneficiaries; ICT and eHealth respondents also made higher contributions relative to respondents from other research support programs.

Figure 2.7. Costs Covered by Beneficiaries by Program



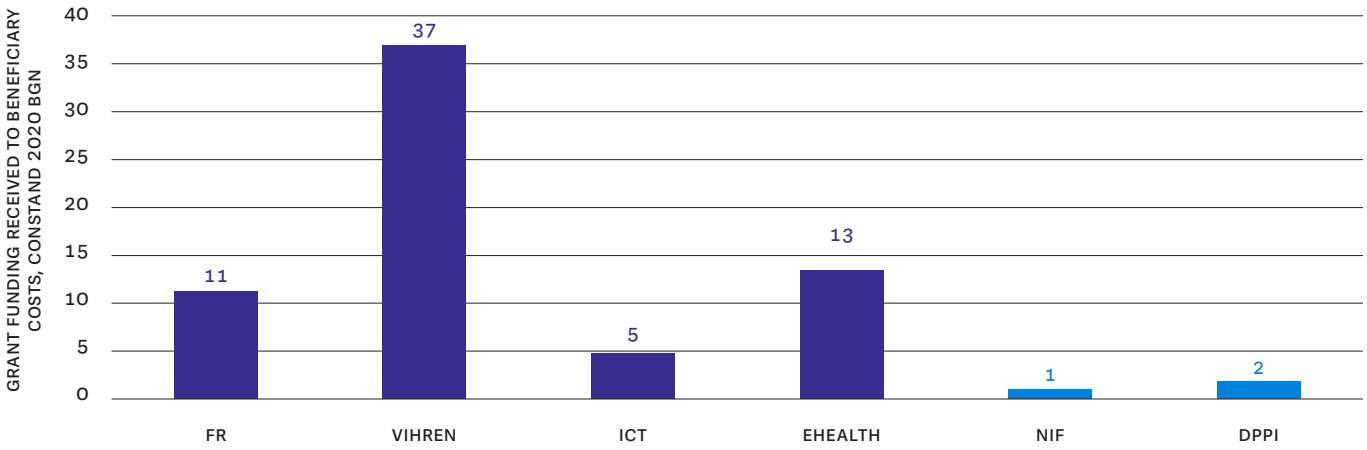
Source: World Bank.

Note: Beneficiary costs include application costs and contributions (cash and in kind) from participating firms and institutions. Costs for ICT and eHealth also include costs associated with management and auditing of the beneficiary consortiums.

2 The NIF program funds between 25 and 80 percent of total project costs, depending on the type of project, size of firm, and other factors, while the DPPI program funds between 50 and 70 percent of total project costs, depending on the size of firm. Firms are responsible for funding the remainder of project costs.

Researcher respondents received the most grant funding per unit of beneficiary cost. Specifically, beneficiaries from Vihren and Fundamental Research received the most funding relative to their costs. Vihren respondents received an average of 37 BGN in funding per BGN spent in application and contributions and Fundamental Research respondents received an average of 11 BGN for each BGN of cost. NIF and DPPI respondents received lowest levels of funding per unit of cost due to the matching funding requirement (Figure 2.8); the high matching grant requirements are in line with the objectives of these programs, which aim to spur private sector investment in industrial R&D.

Figure 2.8. Ratio of Grant Funding to Beneficiary Cost by Program



Note: Beneficiary costs include application costs and contributions (cash and in kind) from participating firms and institutions. Costs for ICT and eHealth also include costs associated with management and auditing of the beneficiary consortium. Gray bars represent programs targeting firms.

2.2 Efficiency in Generation of Outputs

There was large variation in the size of the selected programs, although the programs that disbursed the most funding also reached the largest numbers of beneficiaries. Fundamental Research and DPPI were the largest programs in terms of total funding contracted and disbursed (Figure 2.9), while Vihren and DPPI were the largest in terms of average grants disbursed (Figure 2.10). Fundamental Research and NIF were the smallest programs in terms of average grant disbursed, with an average disbursed grant amount of 96,626 BGN for FR respondents and 203,763 BGN for NIF respondents. All programs disbursed at least 75 percent of the funding contracted from 2016 to 2020, with the exception of Vihren (which only disbursed 40 percent of the funding contracted). Vihren projects have five-year implementation timelines and only began in 2019, so all Vihren projects will be active until 2023.

Figure 2.9. Total Disbursed Funding Size by Program

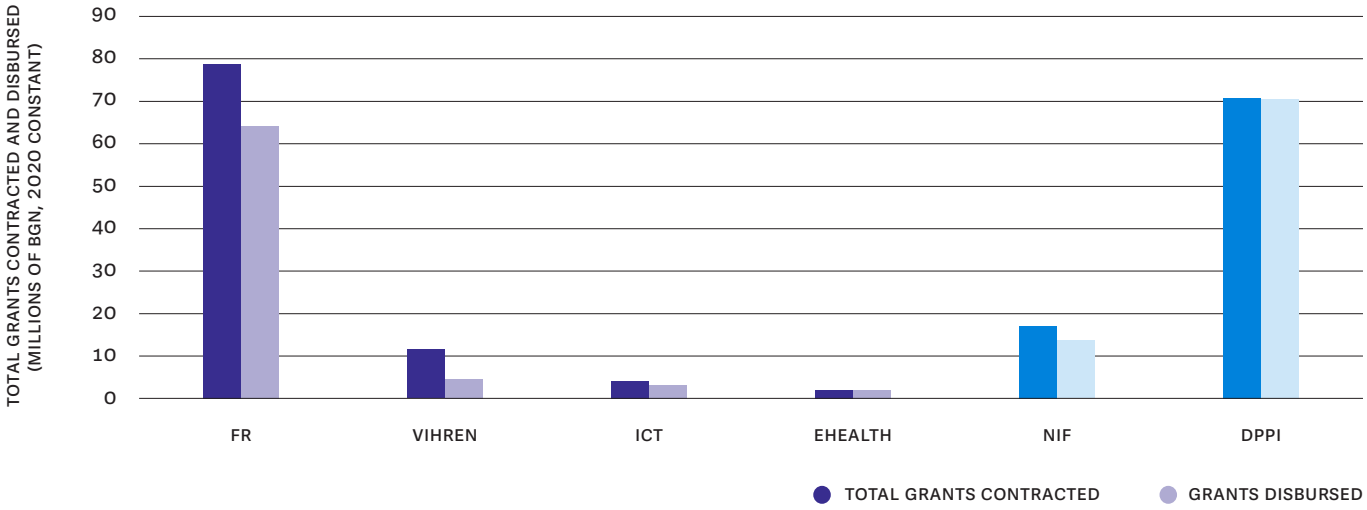
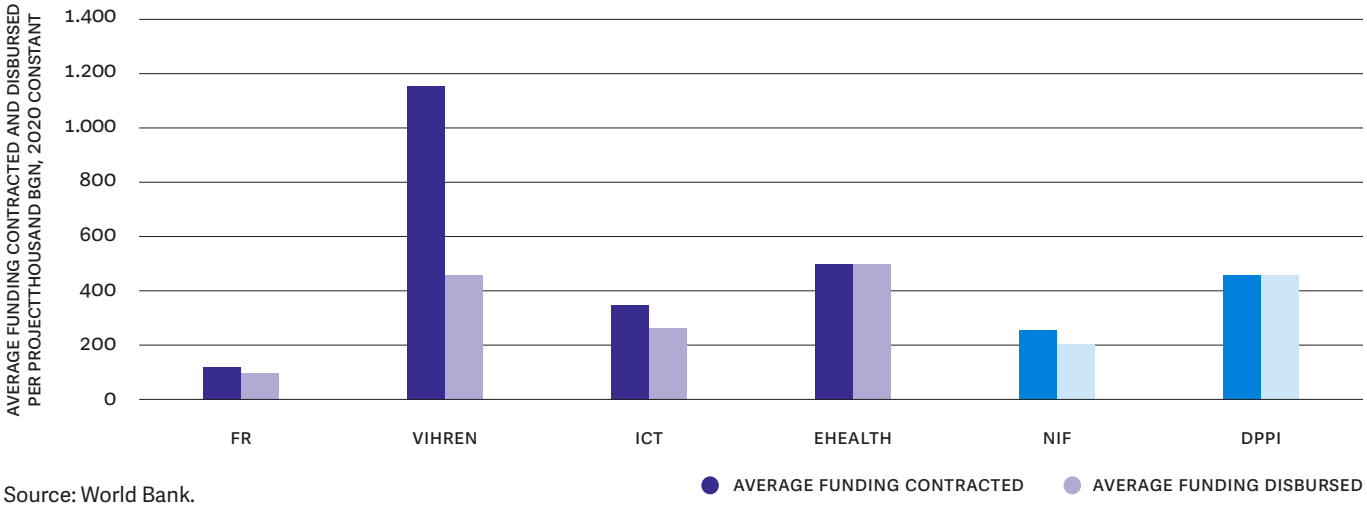


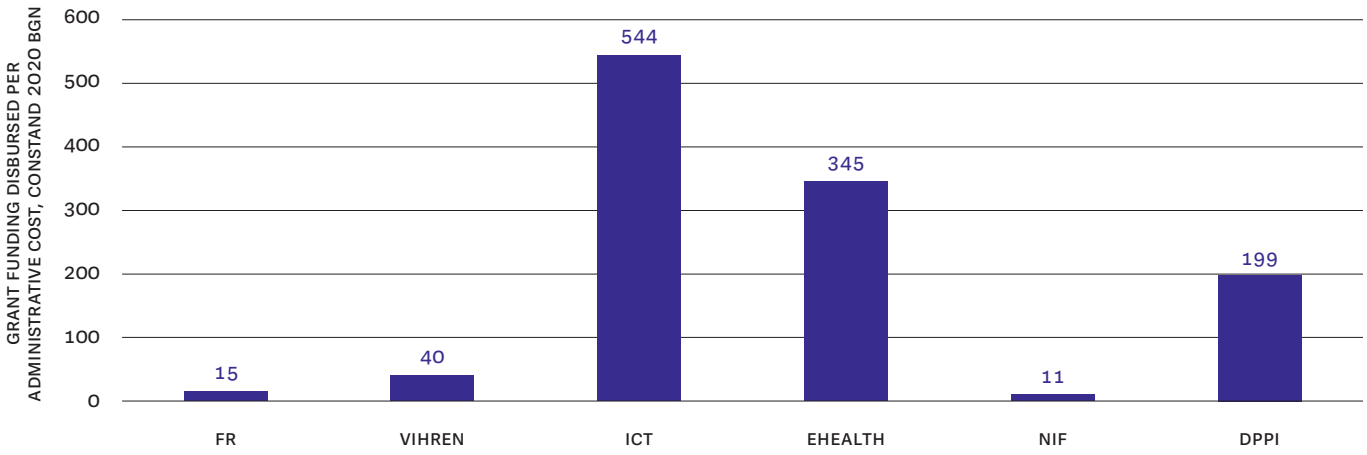
Figure 2.10. Average Disbursed Grant Size by Program



Source: World Bank.
Note: Bars in purple are programs target researchers, bars in blue target firms.

The ICT and eHealth programs provided the most disbursed grants relative to the administrative costs of implementing the programs, although some of the costs of implementing and monitoring these programs are borne by the beneficiaries. For example, the ICT program transferred 544 BGN per every BGN spent in administrative costs, however, ICT respondents reported expenses of 4.8 percent of grant funding received for management and auditing of their projects as part of maintaining the beneficiary consortium. Therefore, the differences in the ratios are likely driven by the differences in program requirements and do not necessarily reflect differences in their efficiency. NIF, Fundamental Research, and Vihren had the lowest ratio of disbursed grants to administrative costs (Figure 2.11).

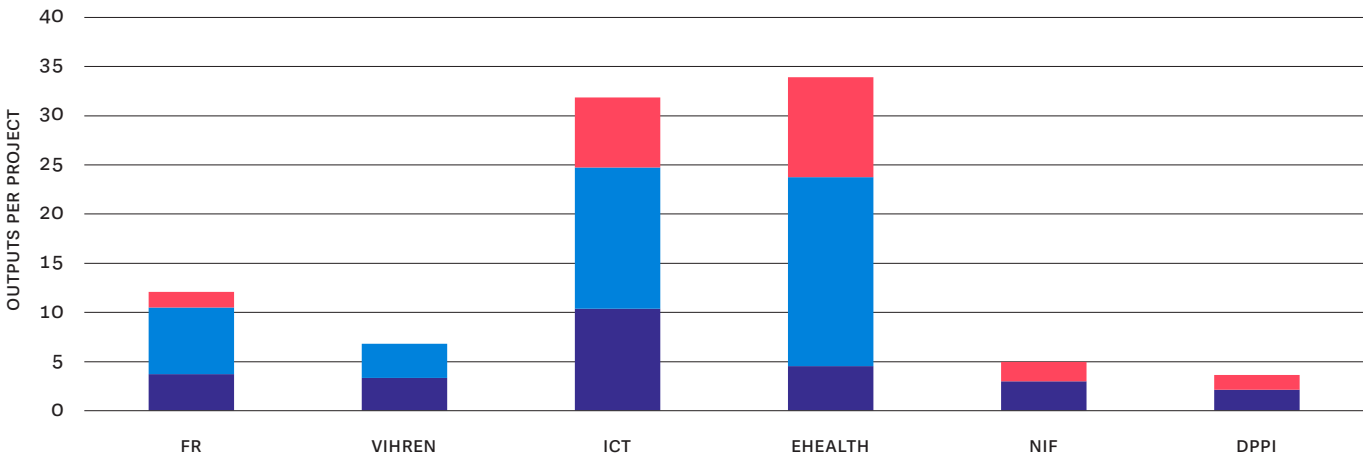
Figure 2.11. Ratio of Grants Disbursed to Administrative Costs



Outputs Achieved

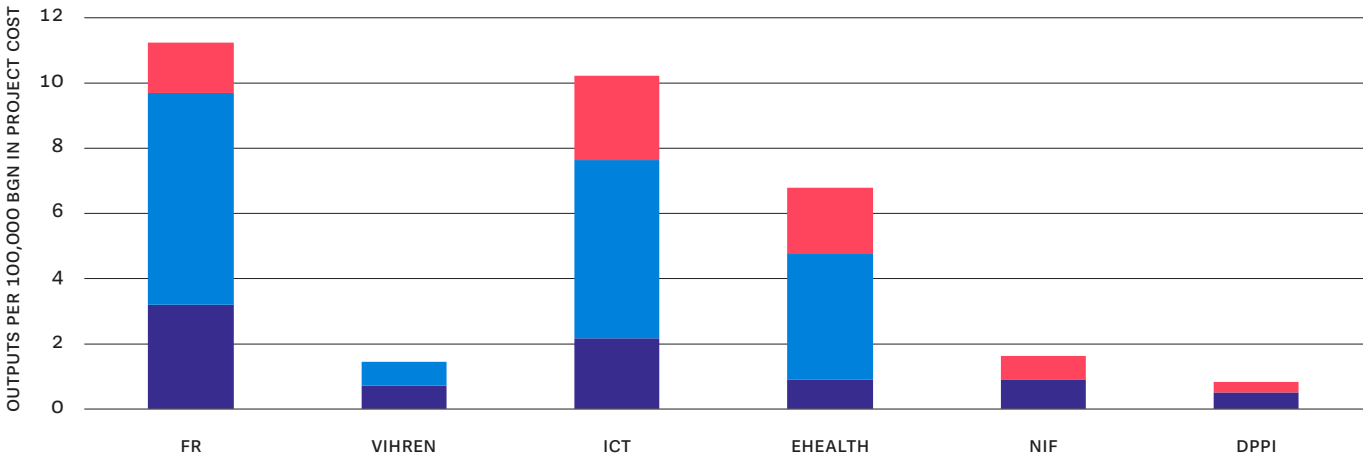
The ICT program achieved the highest numbers of outputs per project, but when considering outputs per unit of cost, Fundamental Research respondents were the most efficient at producing outputs (Figure 2.12 and Figure 2.13). The outputs tracked for each program depended on the ToC for each program (see Appendix A). In general, for research programs, outputs include capacity building (training activities and PhDs and postdoctoral researchers hired); project dissemination (seminars, workshops, and conferences); and collaborations during implementation. For firm support programs, outputs generally include capacity building (improved capabilities of employees) and collaborations pursued during implementation.

Figure 2.12. Outputs per Project by Program



Source: World Bank.

Figure 2.13. Efficiency at Producing Outputs by Program

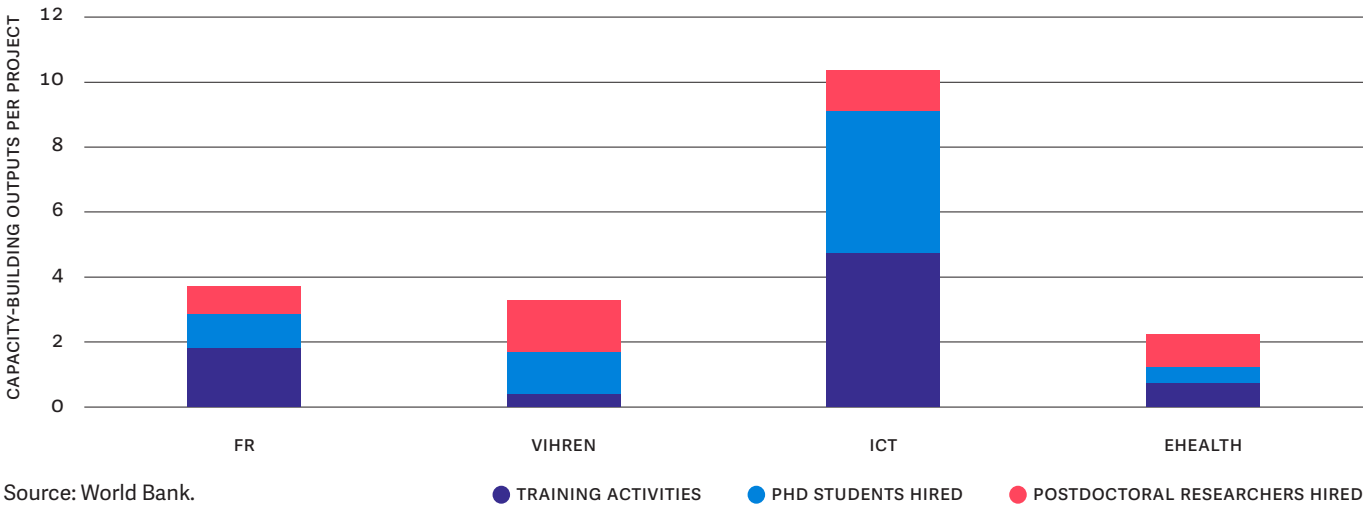


Source: World Bank.

Capacity-Building Outputs

Among research programs, ICT respondents produced the most capacity building outputs per project, while NIF respondents produced the most among firm support programs (Figure 2.14 and Figure 2.15). The relatively low numbers of capacity building outputs reported by Vihren respondents (particularly training outputs) are concerning given that the program focuses on developing high quality research teams and that hiring and training young researchers is a core objective of the program.

Figure 2.14. Capacity-Building Outputs per Project among Research Support Programs



Source: World Bank.

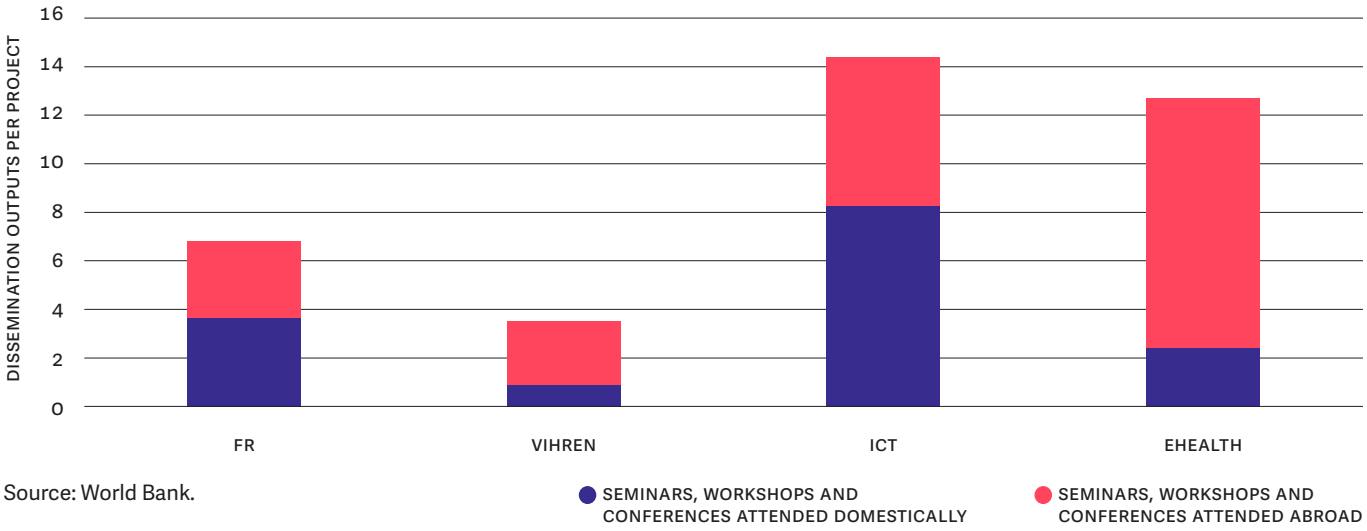
Figure 2.15. Capacity-Building Outputs per Project among Firm Support Programs

Source: World Bank.

Dissemination Outputs

eHealth and ICT respondents reported the most dissemination outputs per project, in the form of participation in the most seminars, workshops, and conferences. Seminars, workshops, and conferences attended abroad were more common across programs than those attended domestically (Figure 2.16).

Figure 2.16. Outputs Related to Dissemination per Project by Program



Source: World Bank.

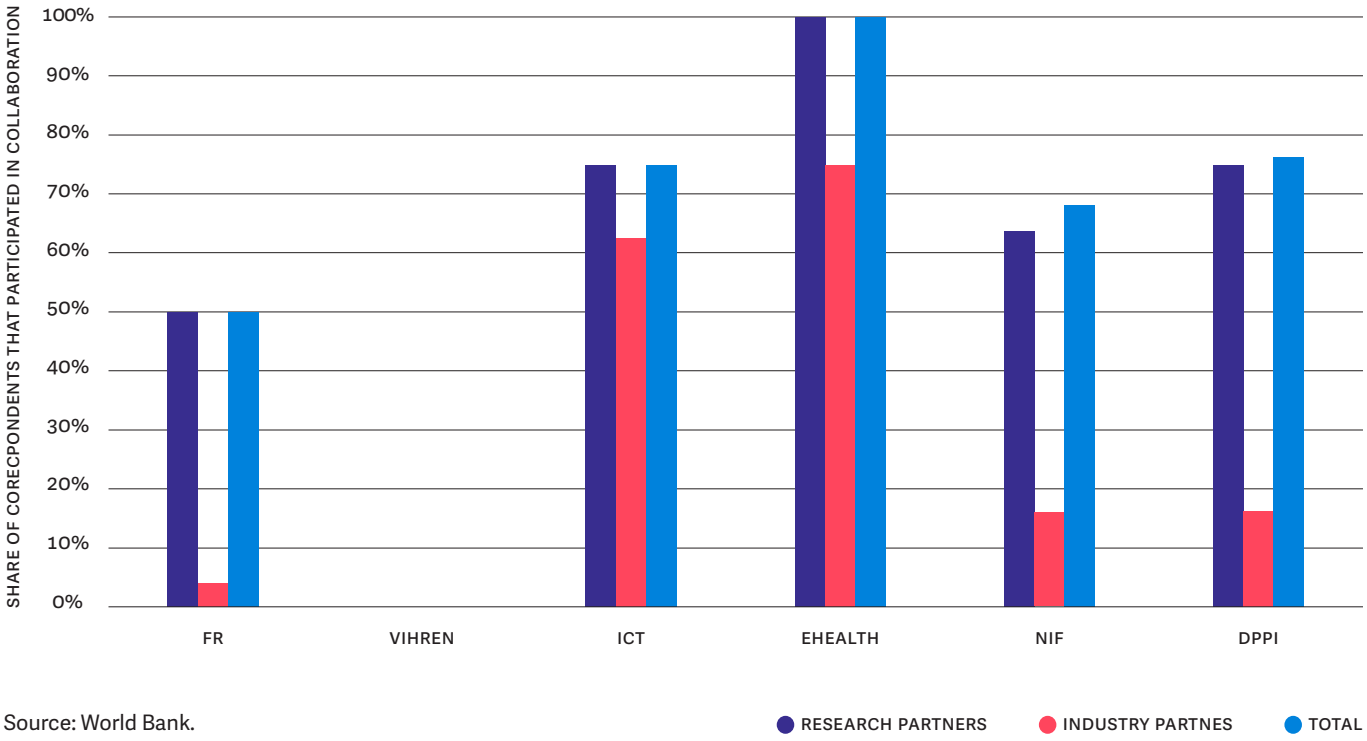
Collaborations During Project Implementation

The share of respondents that collaborated during implementation was generally low when compared STI programs from an efficiency analysis of STI program done in Croatia in 2020. (See Box 2.2.) The exception to this is respondents from the ICT and eHealth programs, which are programs where beneficiaries are members of consortiums that engage in collaborative project with each other, as well as with external partners. A lower share of respondents from the Fundamental Research and Vihren programs reported collaborations during implementation than the other programs included in this analysis (Figure 2.17), which is concerning given that both programs have objectives related to increasing connections and collaboration activities of beneficiary researchers and organizations. Respondents across programs tended to engage with research partners more often than industry partners.

Low levels of collaboration may be due to several factors. Collaboration can carry a significant transaction cost to beneficiaries, and these costs may not be accounted for in the current program designs. Fundamental Research, in particular, has an average contracted grant size of only

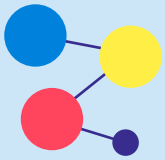
118,657 BGN (or about €61,000), so beneficiaries may see little value in sharing their small grant award with one or more research partners. Additionally, respondents from multiple programs said they would like to see the types of partners allowed under the programs expanded (for example, several Fundamental Research respondents said they would like to be able to collaborate with non-profit organizations during implementation). Such changes may help boost the number of collaborations and share of beneficiaries that collaborate across programs. As discussed in Box 2.2, collaborations among several Croatian STI programs were boosted by the fact that partnerships were mandatory for participating in the program; for Bulgarian research programs where increased connections and collaborations are an objective, including such a requirement may be useful in boosting collaborative activities.

Figure 2.17. Collaboration by Type of Partner



Source: World Bank.

BOX 2.2. COLLABORATION DURING IMPLEMENTATION OF CROATIAN RESEARCH PROGRAMS



In their analysis of the efficiency of seven STI support programs in Croatia in 2020, the World Bank (2021b) found that, among researchers, most respondents pursued collaborative projects during implementation, averaging between 1 and 3 collaborative projects per beneficiary (Table 2.3). It should be noted that partnerships were mandatory for two of these programs: the SIIF and STRIP programs required at least one collaborative partners, so a minimum of one collaborative project per beneficiary was expected.

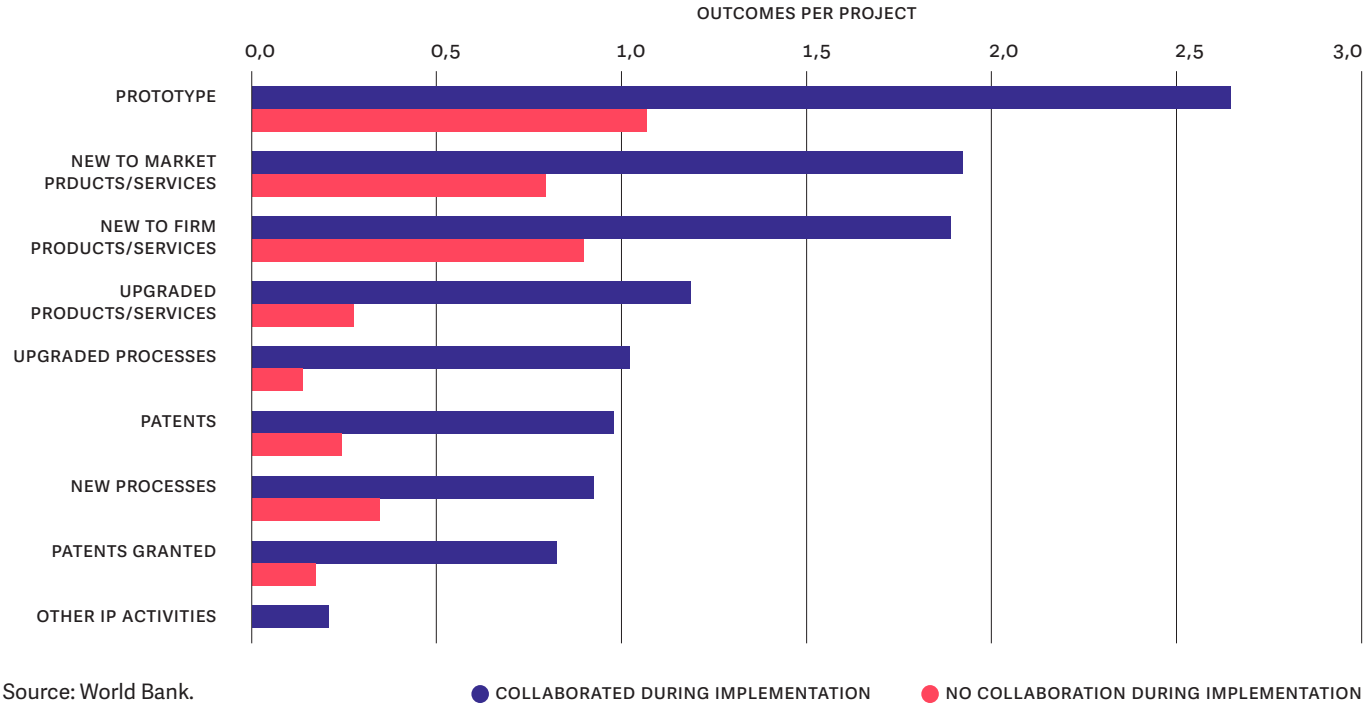
Table 2.3. Collaborations During Implementation of Croatian Research Programs

	SHARE OF RESPONDENTS THAT COLLABORATED WITH RESEARCH PARTNERS	SHARE OF RESPONDENTS THAT COLLABORATED WITH INDUSTRY PARTNERS	SHARE OF RESPONDENTS THAT ENGAGED IN ANY COLLABORATION
SIIF	75%	42%	83%
STRIP	45%	45%	45%
RP	69%	19%	73%
IRP	66%	19%	69%

Source: World Bank 2021b.

Firms that collaborated during project implementation reported more outcomes. Firms that collaborated during implementation generally reported more outcomes than firms that did not collaborate, including more prototypes, new-to-market and new-to-firm products and services, and more IP activities (Figure 2.18). However, these findings are not statistically significant due to the small number of firms that did not collaborate during implementation. Researcher respondents that collaborated during implementation produced more results (outputs plus outcomes) per project than those that did not but produced slightly fewer scientific publications per project than those respondents that did not collaborate during implementation.

Figure 2.18. Outcomes Achieved by Collaboration



Source: World Bank.

Note: N=91 for firms that collaborated during implementation; N=29 for firms that did not collaborate during implementation

2.3 Efficiency in Achievement of Outcomes

Intended outcomes differ from program to program, depending on their targeted beneficiaries and objectives. The Fundamental Research and Vihren programs are scientific research grant programs and therefore aim at achieving outcomes focused on publications and increased collaborations after project implementation. In contrast, ICT and eHealth are applied research programs and their intended outcomes focused on new technology and software development. NIF and DPPI are firm support programs and focus on the development and/or adoption of new products and processes, increased revenues, and increased employment among beneficiaries. Table 2.4 shows the intended outcomes tracked for each program.

Table 2.4. Intended Outcomes across Programs

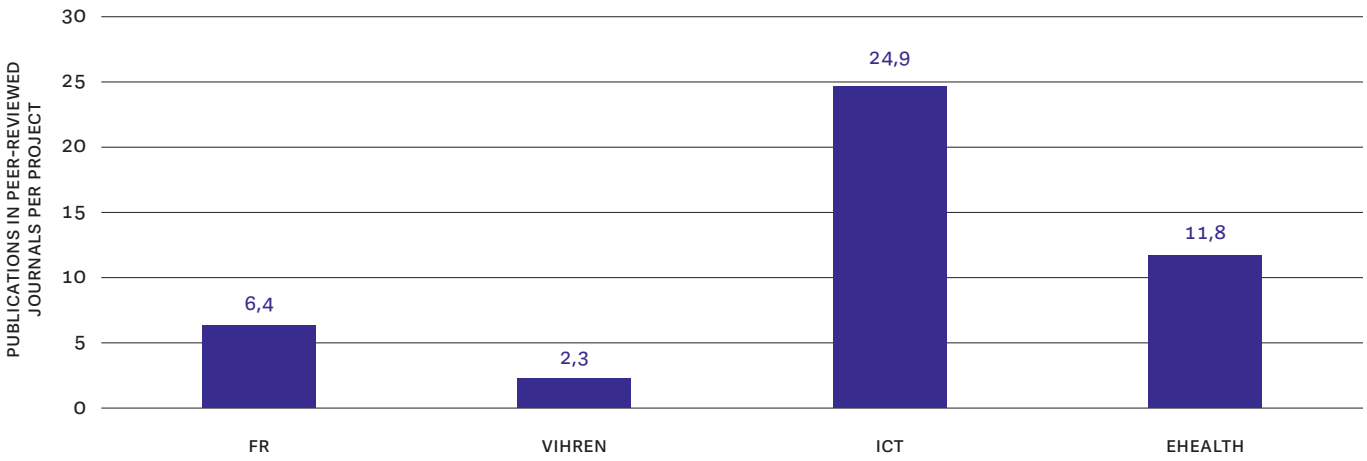
OUTCOME	FR	VIHREN	ICT	EHEALTH	NIF	DPPI
Collaborative projects after implementation	●	●	●	●	●	
Technology transfer activities (transfer agreements, new enterprises, or spin-offs)					●	
Intellectual Property (patents, industrial designs, copyrights)			●	●		
New prototypes			●	●		
*Scientific publications in peer-reviewed journals	●	●	●	●		
*New software development			●	●		
*New technology development			●	●		
**Upgraded products, processes, or services					●	●
**New products, processes, or services						●
**Companies that adopted a new technology					●	●
**Companies that increased sales					●	●
**Companies that expanded to new markets					●	
**Companies that improved their export performance					●	
**Additional workers hired					●	●

Source: Author's elaboration
* Outcomes tracked in beneficiary survey for researchers only
** Outcomes tracked in beneficiary survey for firms only

Publications

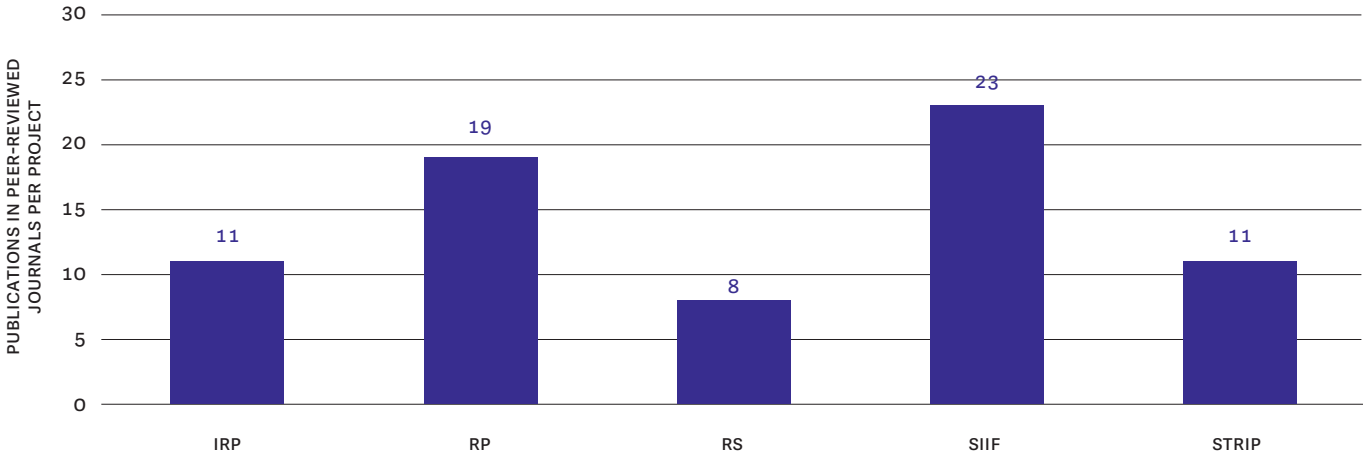
Bulgarian researchers produced similar numbers of publications per project as Croatian researchers. Bulgarian research programs reported an average of between 2 and 25 publications per project (Figure 2.19), while the Croatia research programs analyzed in World Bank (2021b) found that research programs reported an average of between eight and 23 publications produced per project (Figure 2.20).

Figure 2.19. Publications per Project by Program, Bulgaria



Source: World Bank.

Figure 2.20. Publications per Project by Program, Croatia

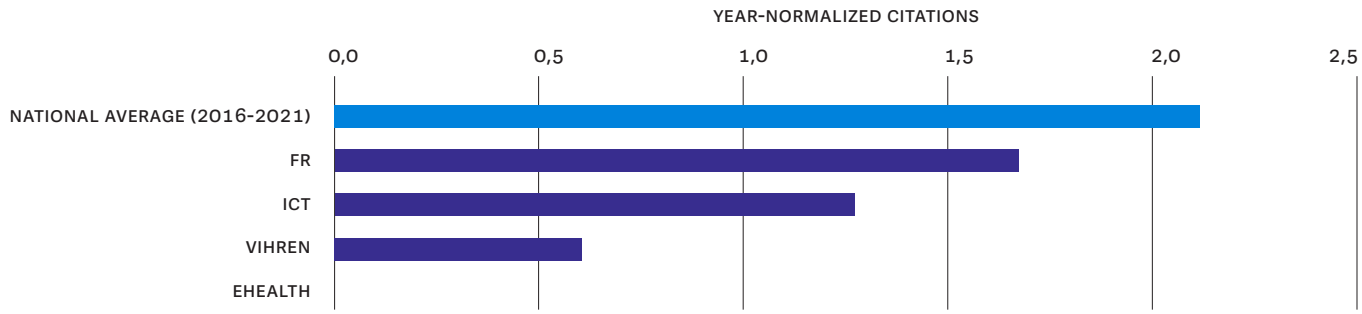


Source: World Bank 2021b.

There was substantial variation across programs in the number of publications produced per project. ICT and eHealth respondents produced the most publications in peer reviewed journals per project, while Vihren respondents produced the least (Figure 2.19). The very high number of publications per project for ICT is notable, given that the primary focus of this programs is applied research and producing new software and technologies for public use. The low numbers of publications produced by Vihren respondents is likely due to the fact that all Vihren projects began in 2019 and were only two years into a five-year project cycle at the time the program beneficiaries were surveyed – it would be expected that Vihren beneficiaries will produce more publications per project by the time of project completion.

However, publications reported by respondents generally had fewer year-normalized citations[3] than the average Bulgarian publication indexed in the Web of Science. (See Figure 2.21.) This difference raises concerns about the quality of research being conducted by beneficiaries of the four research programs included in this analysis. All four programs have research excellence as an objective, which is primarily measured through the citations received by publications resulting from funded research. Research beneficiaries were asked to list the five most important publications related to their projects for a bibliometric analysis. Of the programs targeting researchers, respondents provided detailed information on a total of 666 publications, of which the World Bank team were able to find 52 percent that were indexed in Web of Science and 43 percent that were in journals with impact factor[4]. Publications in Web of Science for all Bulgarian authors from 2016 to 2020 averaged 2.1 year-normalized citations per publication, while indexed publications produced by Fundamental Research respondents had 1.7 year-normalized citations, publications reported by ICT respondents had 1.3 per year, Vihren publications had 0.6 per year, and indexed eHealth publications had not yet received any citations.

Figure 2.21. Year-Normalized Citations per Publication



Source: Elaboration based on data from Web of Science.

3 Year-normalized citations are calculated as the number of citations of a given publication divided by the publication's age (in years).

4 Impact factor is a metric used by Web of Science based on ratio between citations and recent citable items published in a given publication.

Publications in the fields of physics, chemistry, and technical sciences (i.e., engineering) were generally the most impactful, in terms of average year-normalized citations per publication and share of publications in journals with impact factor (Table 2.5). Publications in the fields of social sciences, medicine, and agricultural science had the lowest average year-normalized citations per publication. However, it should be noted that publications in some scientific disciplines (particularly biological sciences) tend to attract more citations when compared to social sciences and humanities (Harzing, 2010), which could explain some of the differences observed across fields.

Table 2.5. Publication Impact by Scientific Field

SCIENTIFIC FIELD	TOTAL PUBLICATIONS LISTED	SHARE OF PUBLICATIONS INDEXED IN WOS	SHARE OF PUBLICATIONS IN JOURNALS WITH IMPACT FACTOR	AVERAGE YEAR-NORMALIZED CITATIONS
Agricultural studies	51	35%	24%	0.85
Biological Sciences	66	47%	44%	0.90
Chemistry	51	71%	65%	2.12
Earth science	31	55%	52%	1.09
Humanities	40	25%	18%	1.05
Mathematics Sciences and Informatics	126	55%	43%	0.93
Medicine	41	59%	44%	0.81
Physics	92	83%	75%	2.96
Social Sciences	69	32%	10%	0.59
Technical Sciences	99	51%	40%	2.02

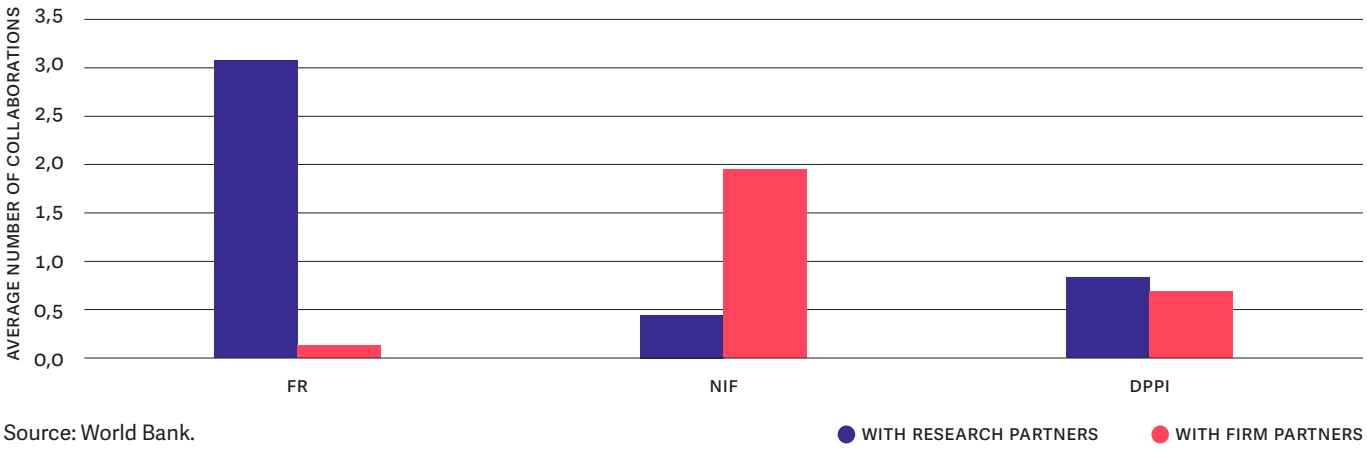
Source: World Bank., Web of Science

Collaborations after Project Implementation

Fundamental Research and NIF respondents reported the most collaborations formed after project implementation. Collaborations after project completion (a proxy for improved connections between beneficiaries and other domestic and international STI actors) were an intended outcome of the Fundamental Research and NIF programs, and respondents from both programs reported an average of over two new collaborations after implementation (Figure 2.22). Fundamental Research respondents tended to form collaborations with research partners, which is understandable given that the program focuses on basic research and increasing connections between researchers and research institutions, while NIF respondents formed more collaborations with industry partners (Figure 2.23). Collaborations after implementation were not an intended outcome of the DPPI program, but DPPI respondents reported an average of 1.5 new collaborations after implementation, suggesting that the program encourages collaboration activity among

beneficiaries without intending to. All projects for the Vihren, ICT, and eHealth programs are still active, so the collaborations after implementation metric was not tracked for those programs.

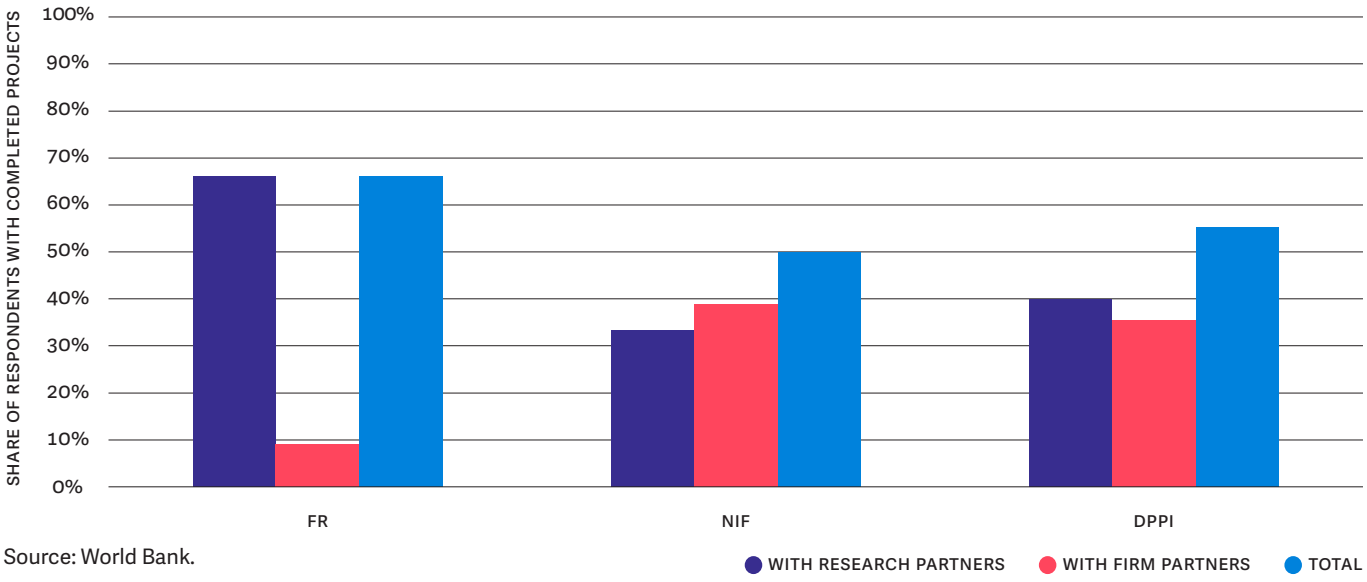
Figure 2.22. Collaborations after Implementation



Source: World Bank.

Note: The figure denotes the number of research collaborations per respondents and share of respondents that engaged in collaborations after project completion (FR n=177, NIF n=18, DPPI n=65). All projects for the Vihren, ICT, and eHealth programs are still active.

Figure 2.23. Collaborations after Implementation among Respondents with Completed Projects

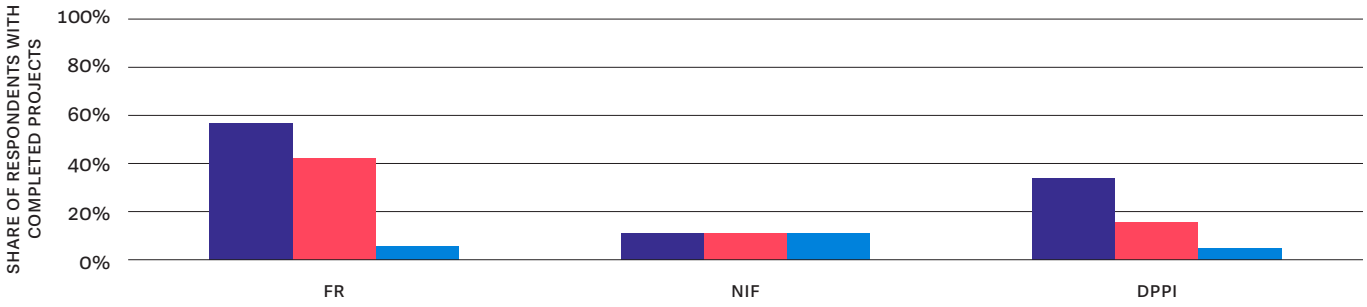


Source: World Bank.

Note: The figure denotes the number of research collaborations per respondents and share of respondents that engaged in collaborations after project completion (FR n=177, NIF n=18, DPPI n=65). All projects for the Vihren, ICT, and eHealth programs are still active.

Domestic partners were the most common type of research partner, while domestic and foreign partnerships were most common among private sector collaborations. Among collaborations with researcher partners formed after project implementation, collaborations with domestic research partners were the most common for Fundamental Research and DPPI respondents, followed by foreign research partners. Equal shares of NIF respondents engaged with domestic, foreign, and diaspora researchers (Figure 2.24). A slightly higher share of NIF respondents engaged with foreign industry partners than domestic industry partners, while the reverse was true for DPPI and Fundamental Research respondents (Figure 2.25).

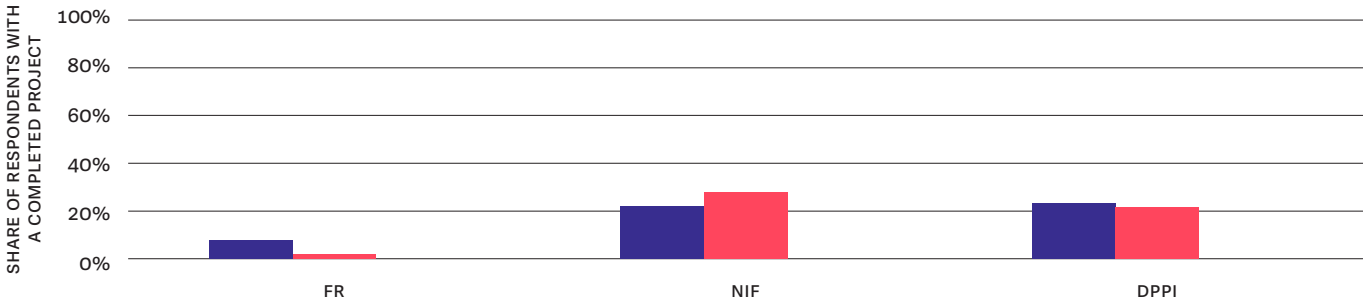
Figure 2.24. Types of Research Partners by Program



Source: World Bank.

Note: These figures show the share of respondents with a completed project that engaged in collaborations with research partners and industry partners after project completion (FR n=177, NIF n=18, DPPI n=65). All projects for the Vihren, ICT, and eHealth programs are still active.

Figure 2.25. Types of Industry Partners by Program



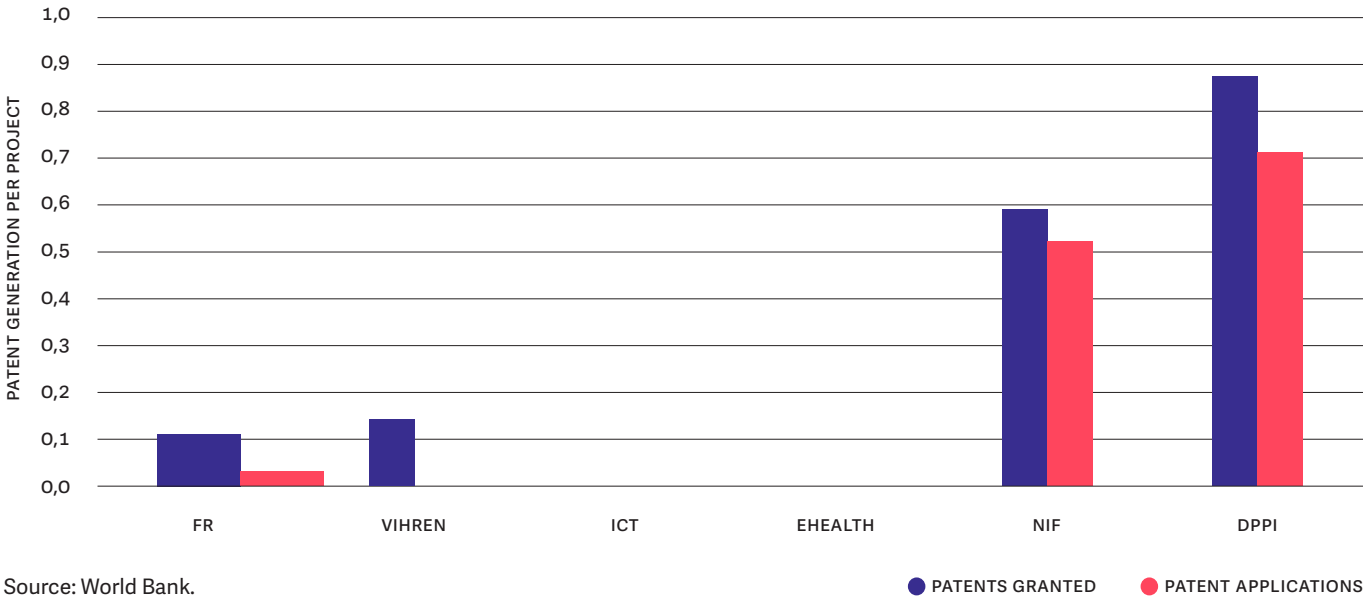
Source: World Bank.

Note: These figures show the share of respondents with a completed project that engaged in collaborations with research partners and industry partners after project completion (FR n=177, NIF n=18, DPPI n=65). All projects for the Vihren, ICT, and eHealth programs are still active.

Intellectual Property

Firm support program respondents reported more IP activity per project than research support program respondents. Firm respondents generally reported more patents granted and patent applications than researchers, which is expected given the different objectives of research and firm support programs (Figure 2.26). Fundamental Research and Vihren respondents reported moderate levels of IP generation relative to the other programs, even though IP generation is not an intended outcome of those programs. The ICT and eHealth programs reported no IP activity; while they are applied research programs focused on developing new technologies and tools for public use, respondents' projects only began in 2019 and it would be expected that the project generate patents and patent applications later in their implementation.

Figure 2.26. IP Activity per Project by Program

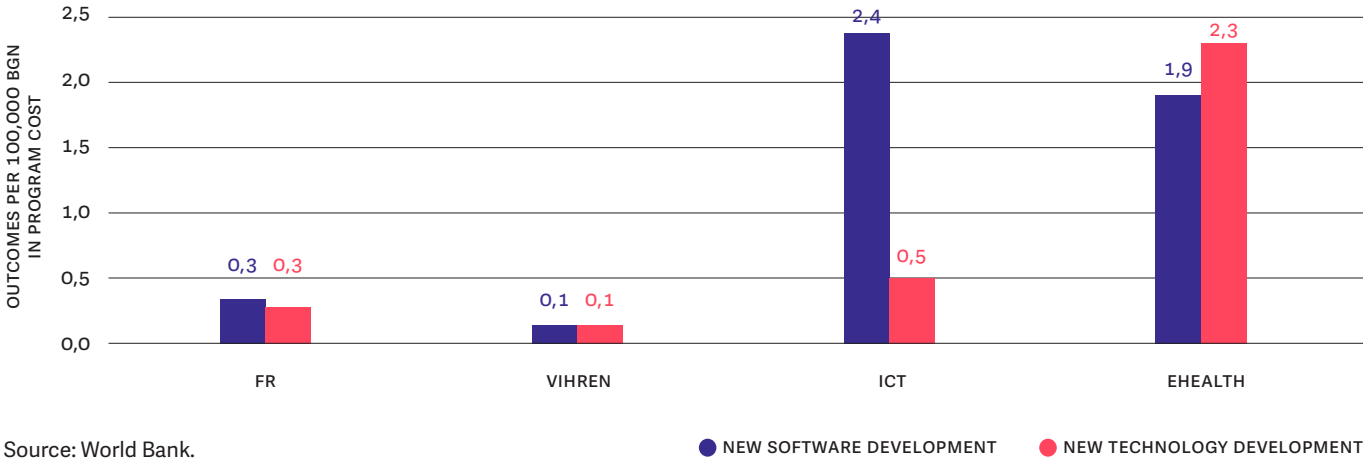


Source: World Bank.

New Software and Technologies

ICT and eHealth respondents produced the most new software development and new technology development per project, which is to be expected given that they are applied research programs that focus on the development of new digital tools and platforms for public use. Fundamental Research and Vihren programs also produced some new software and new technology outcomes, although these were not intended outcomes of those programs (Figure 2.27). These metrics were not tracked for firm support programs.

Figure 2.27. New Technology and New Software Development per Project by Program

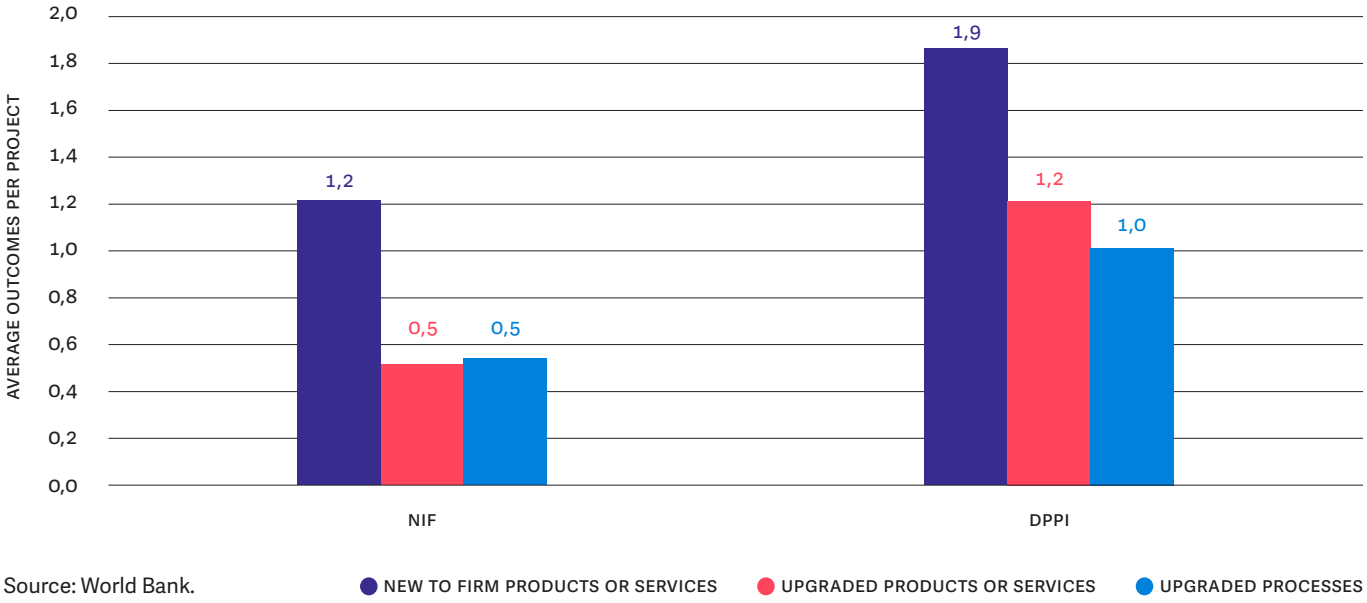


Source: World Bank.
Note: New software development and new technology development was only tracked on researcher surveys

New or Upgraded Products, Services, or Processes

DPPI respondents adopted more technologies per project than NIF respondents. Specifically, DPPI respondents reported more outcomes related to technology adoption (new-to-firm products and services) and upgraded products, services, and processes per project than NIF respondents (Figure 2.28). This understandable given that NIF focuses exclusively on technology creation, while DPPI's objectives include technology creation, adoption, and upgrading. When compared to the results of an analysis of the efficiency of Croatian innovation programs, DPPI respondents adopted roughly similar numbers of new-to-firm products or services as the Croatian Innovations in Newly Established SMEs Program (NSME-1) program and fewer than the Improving Competitiveness and Efficiency of SMEs in ICT (ICT-R) program (see Box 2.3).

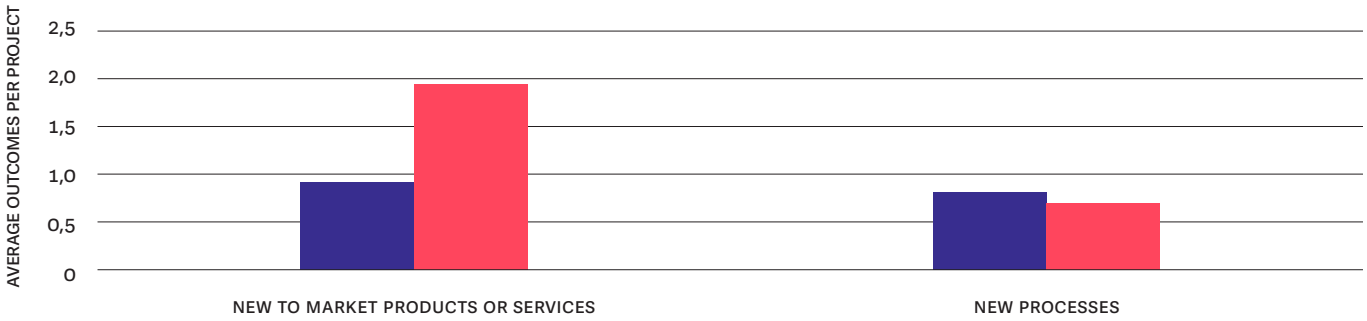
Figure 2.28. Technology Adoption per Project by Program



Source: World Bank.

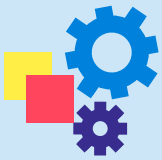
NIF respondents reported more new processes per project than DPPI respondents, while DPPI respondents reported more new-to-market products or services. Both programs have objectives related to the creation of new products, services, and processes – the major difference between the two is that NIF focuses on early-stage development projects (industrial research and experimental development), while DPPI funds projects that are closer to the market (Figure 2.29). Compared to the results of the Croatia efficiency analysis of innovation programs, DPPI and NIF respondents produced similar numbers of new-to-market products or services as the Croatian innovation support programs but fewer new processes (Box 2.3).

Figure 2.29. New Products, Services, and Processes per Project by Program



Source: World Bank.

BOX 2.3. NEW PRODUCTS, SERVICES, AND PROCESSES OF CROATIAN FIRM-SUPPORT PROGRAMS



In their analysis of the efficiency of two innovation support programs in Croatia in 2020, the World Bank (2021b) found that the analyzed programs developed an average of 1 to 4 new products, services, or processes per project. On average, respondents from the ICT-R program developed more products or services per project that were new to the firm than respondents of the NSME-1 program, but respondents from the NSME-1 program developed more new-to-market products and services. These results are due to the differences in the design of the two programs, with NSME-1 being more focused on commercializing new products or services, while ICT-R supported technology upgrades.

Table 2.6. New product, service, and process outcomes of Croatian innovation support programs

	ICT-R	NSME-1
New-to-firm products or services	4	2
New-to-market products or services	1	2
New processes	3	1

Source: World Bank 2021b.

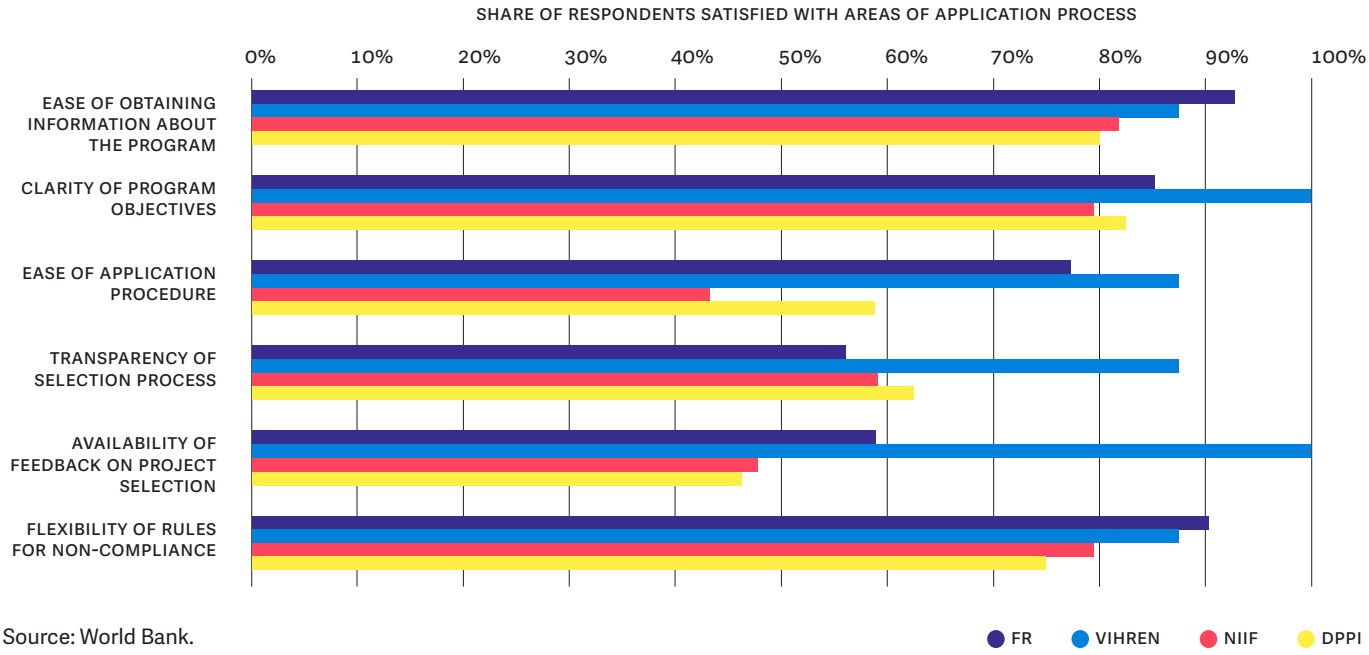
2.4 Perceived Program Quality

Respondents' perceptions of their programs' application and selection processes revealed areas of potential improvement. Respondents were generally satisfied with the ease of obtaining program information, the clarity of program objectives, and the flexibility of rules for non-compliance, with over 70 percent of respondents in the Fundamental Research, Vihren, NIF, and DPPI programs[5] saying they were satisfied with these aspects of their projects. However, respondents were less satisfied with the ease of the application process, the transparency of the selection process, and the availability of feedback on project selection – NIF and DPPI beneficiaries in particular were largely dissatisfied with these aspects of the program, with under 65 percent of respondents re-

5 The ICT and eHealth programs have no application process, so beneficiaries of those programs were not asked about their perceptions of program application and selection. See Sections 5 and 6 for more information about how beneficiaries were selected for those programs.

porting satisfaction with these aspects of their projects (Figure 2.30). Vihren respondents noted that the program uses a common selection panel for selecting projects for all the physical sciences (including astronomy, chemistry, materials science, and physics), yet project proposals may be hard to compare across all of these disciplines. The *Functional and Governance Analysis* report included several findings that supported the respondents' perceptions of program application and selection processes (see Box 2.4).

Figure 2.30. Satisfaction with Application Process by Program



Source: World Bank.
Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with selected stages of the application process. There was no application process for the ICT and eHealth programs.

BOX 2.4. APPLICATION AND SELECTION PROCESSES OF BULGARIAN STI SUPPORT PROGRAMS

Several key findings from phase 2 of this project, the *Functional and Governance Analysis*, provide evidence that support beneficiaries' perceptions of program application and selection processes:

Application

Application processes are burdensome on beneficiaries (both for programs targeting researchers and companies), although processes vary in format and complexity depending on the implementing body and specific program. Lengthy and complex application forms are common across programs, while collecting and providing supporting documentation is a larger challenge for firm support programs. Supporting documentations can include financial statements, declarations of clean criminal records, tax liabilities, and offers from third parties for assets. Because of the complexity and time needed for applications, many applications to firm support programs use external consultants to prepare their applications, as they either do not understand or do not have the time and capacity to complete the applications on their own.

For programs under Bulgarian operational programmes (including DPPI, a procedure under OP Innovation and Competitiveness), applications are done entirely electronically through the UMIS system, and templates and guidelines are provided to applicants through the Unified Management Information System (UMIS) portal. While all OP applications are done electronically, OPIC beneficiary companies have still complained about the number of supporting documents and the amount of financial information requested, and many companies use consultants to help them through the application process. Nationally-funded instruments (i.e., Fundamental Research, Vihren, and NIF) do not use the online UMIS portal, and their application processes tend to be more burdensome. For example, NIF requires applicants to provide a detailed breakdown of every participating researchers' hours of work for the duration of the project and beneficiaries of NSF must provide financial justification of requested funds by expense category for each stage of the project as part of their application.

Selection

A 2015 peer review of the Bulgarian STI system (European Commission, 2015) found a strong need to improve processes for the evaluation and funding of project proposals, due to the lack of confidence of the research community in the fairness of funding allocations and in the established peer review system for the evaluation of projects.

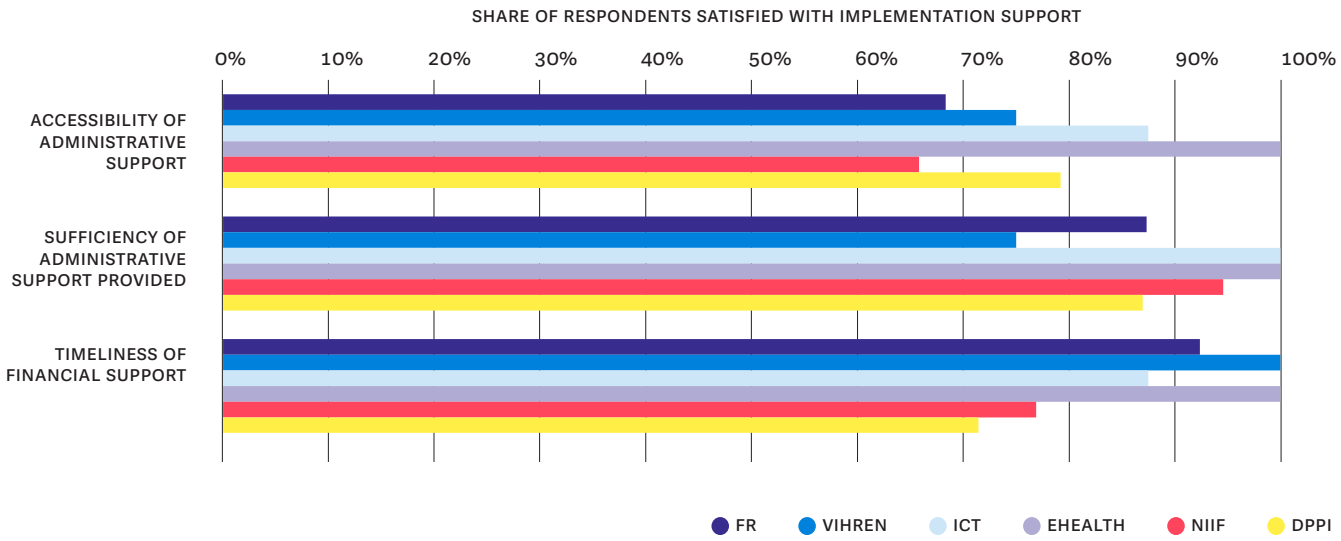
While most implementing bodies make use of external reviewers to review project applications, the DG OPIC (which implements DPPI) relies heavily on internal panels to evaluate proposals. Internal reviews lack transparency and can be biased towards an institution's cultural preferences, and for these reasons are generally not in line with good practices. The use of foreign expert reviewers is also not common, as most implementing bodies that use external experts rely exclusively on domestic expert evaluators; NSF (which implements Fundamental Research and Vihren) is one of the only implementors that uses foreign experts to evaluate applications. Relying exclusively on domestic experts is not in line with best practices, particularly in a small country like Bulgaria. Scientific and technical communities are small, which raises the risk of conflicts of interest and biased evaluations, and the expertise available for specific research areas and technologies may not be available domestically.

Further, some instruments (particularly those targeting firms) suffer from overly generic selection criteria that do not target projects with specific desirable characteristics, which can make it difficult for evaluation panels to make consistent project award decisions; this can, in turn, lead to the perception of an unfair or untransparent awards process.

Source: World Bank 2021a.

Respondents were generally satisfied with the support provided by the programs during implementation. Respondents were particularly satisfied with the administrative support provided by the programs and the timeliness of financial support, where more than 70 percent of respondents in all programs agreed or strongly agreed that they were satisfied with this category of support (Figure 2.31).

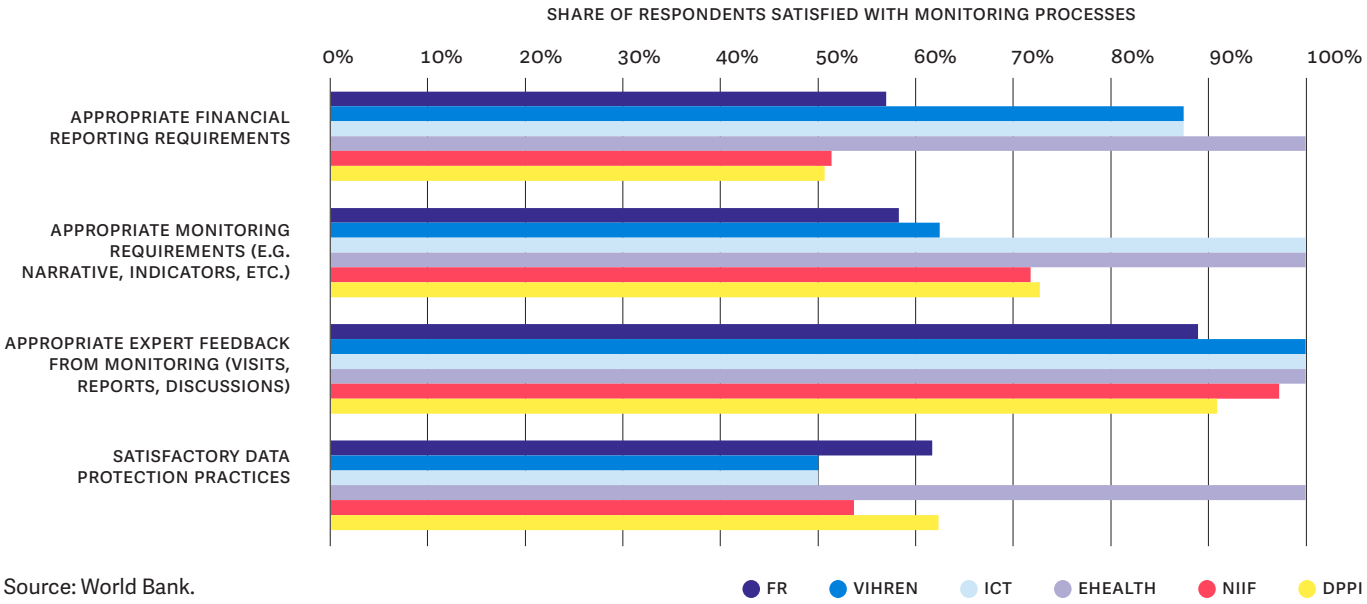
Figure 2.31. Satisfaction with Implementation by Program



Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with administrative and financial support provided.

Beneficiaries from some programs had issues with monitoring requirements. Respondents from several programs were dissatisfied with financial and technical reporting requirements, as well as data protection practices. Expert feedback from monitoring was an area of strength, with over 85 percent of respondents across programs saying that they were satisfied with the feedback they received. However, respondents from Fundamental Research, NIF, and DPPI were largely dissatisfied with financial reporting requirements, where less than 60 percent of respondents were satisfied with these requirements. Fundamental Research and Vihren respondents were also dissatisfied with technical monitoring requirements, with less than 65 percent reporting that they were satisfied with these requirements. Data protection practices was an area of concern for Vihren and ICT respondents, with only half of respondents saying they were satisfied with program practices in this area (Figure 2.32). Fundamental Research respondents noted that even small changes to project plans require NSF approval, and that NSF requires certified and translated copies of all eligible expenses, including things like plane tickets. Some NIF respondents felt that the program's financial reporting requirements were not clear enough, yet their companies were at risk of financial corrections is they violated the requirements. The *Functional and Governance Analysis* component of this PER STI project found that reporting requirements for projects funded through operational programmes (such as DPPI) where generally in line with good practice, while nationally funded programs had areas for improvement (see Box 2.5).

Figure 2.32. Satisfaction with Monitoring by Program



Source: World Bank.

Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with monitoring processes.

BOX 2.5. REPORTING REQUIREMENTS OF BULGARIAN STI SUPPORT PROGRAMS

The *Functional and Governance Analysis* report found that reporting processes for programs outside of the operational programmes had several key areas of that could be improved:

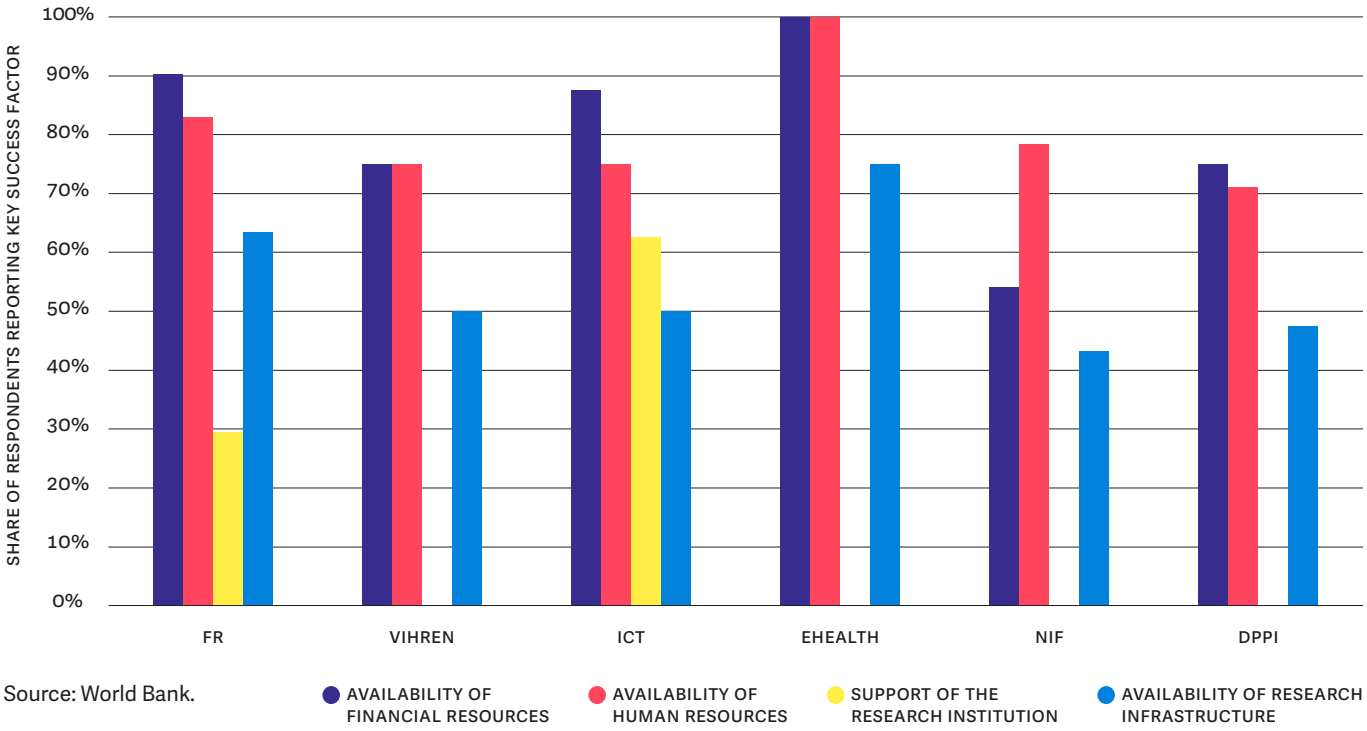
For nationally funded programs (i.e., Fundamental Research, Vihren, ICT, eHealth, and NIF), there is no online portal for submitting reports and submission is done via email or by mailing in paper forms. Fundamental Research and Vihren beneficiaries must submit interim and final technical and financial reports to NSF, and the financial reports must include certified copies of the supporting documents for the incurred direct eligible costs. NIF beneficiaries submit technical and financial reports after each stage of their project (projects can have up to three stages), and while beneficiaries are provided with standardized forms for financial reports, there is no template for the technical reports.

Reporting is much easier for projects funded under operational programmes (such as DPPI), where beneficiaries submit reports in standard, preloaded forms through the UMIS system.

Source: World Bank 2021a.

The availability of financial and human resources were the most commonly cited factors for project success across all programs. The availability of research infrastructure was reported as an important factor by 50 percent of respondents from the four research support programs, indicating that the provision of access to research infrastructure may be more important to research programs than firm support programs (Figure 2.33).

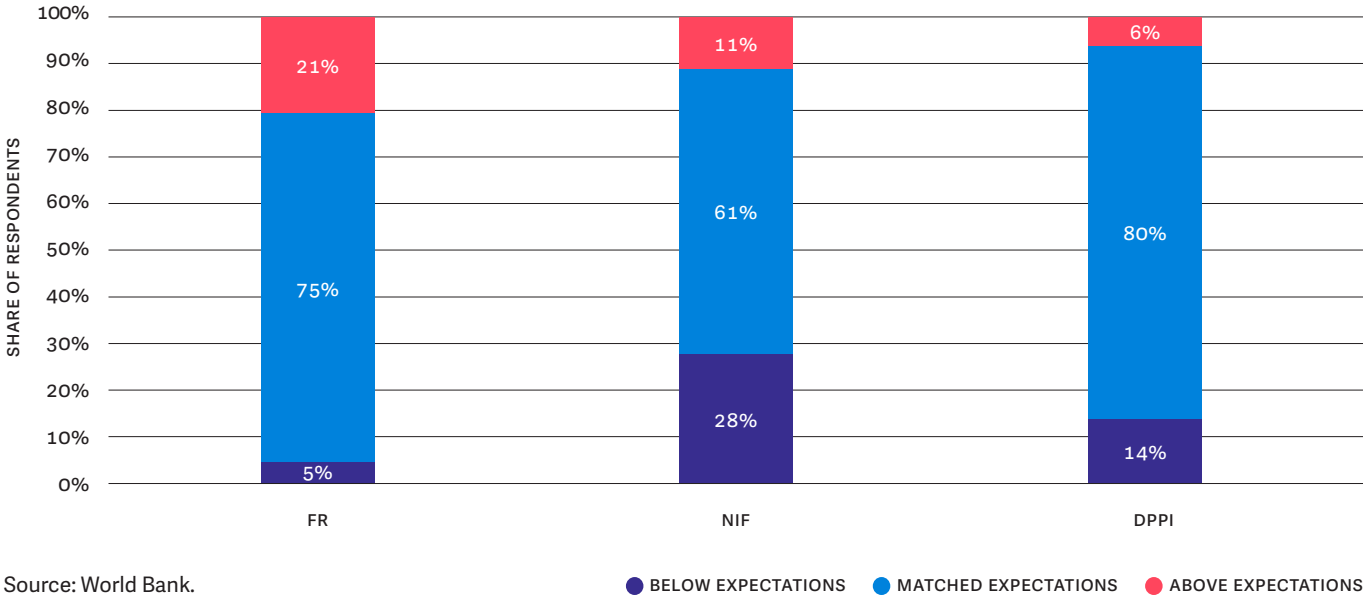
Figure 2.33. Project Success Factors by Program



Source: World Bank.

Project results largely matched respondents' expectations. Between 60 and 80 percent of respondents with completed projects across programs indicated that project results matched their expectations. Fundamental Research had the most respondents with results exceeding expectations (21 percent), while NIF had the most with results below their expectations (28 percent) (Figure 2.34). The higher share of NIF respondents whose projects failed to match expectations is likely due to the early-stage nature of the projects supported by the program, which are inherently riskier than academic research projects or later-stage commercialization projects.

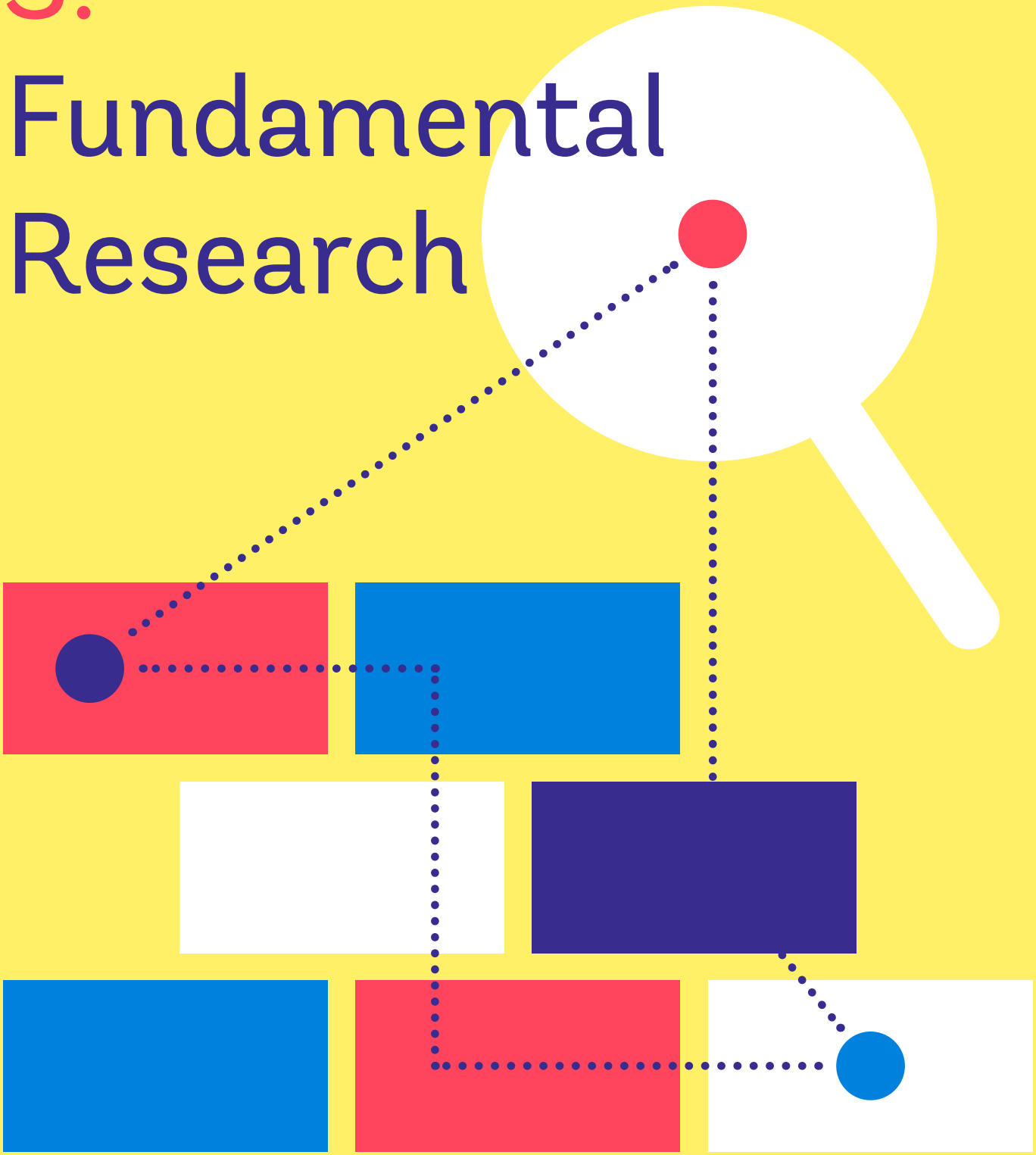
Figure 2.34. Share of Respondents Who Indicated that Project Results Matched Expectations by Program



Source: World Bank.
Note: All projects for Vihren, ICT, and eHealth are still active.

Whereas this section presented key results across programs, the following six sections of this report provide a detailed review of the findings for each of the six programs included in this analysis. This includes a description of each program and its beneficiaries, and findings on the programs' inputs, outputs, outcomes, and beneficiary perceptions.

3. Fundamental Research



3 Fundamental Research

PROGRAM SUMMARY

The Fundamental Research program is the primary mechanism for funding basic research in Bulgaria, making it an important source of funding for public sector researchers and research institutions. The Fundamental program is designed and implemented by the NSF and provides grant funding for basic research projects in one of ten scientific areas. The program focuses on improving the quantity and quality of basic research produced by the Bulgaria research sector, and thus has intended outcomes related to scientific publications in peer reviewed journals and collaborative projects formed after project completion.

External services made up over 90 percent of the administrative costs of implementing the program from 2016 to 2020, while personnel costs only represented two percent of total administrative costs, an arrangement in costs that is likely due to the to the low number of full-time staff at the NSF. This cost structure is not necessarily inefficient but increasing number of full-time program staff would increase the internal capacity of NSF (identified as a major challenge in previous components of this PER STI project) and could lead to more effective program delivery.

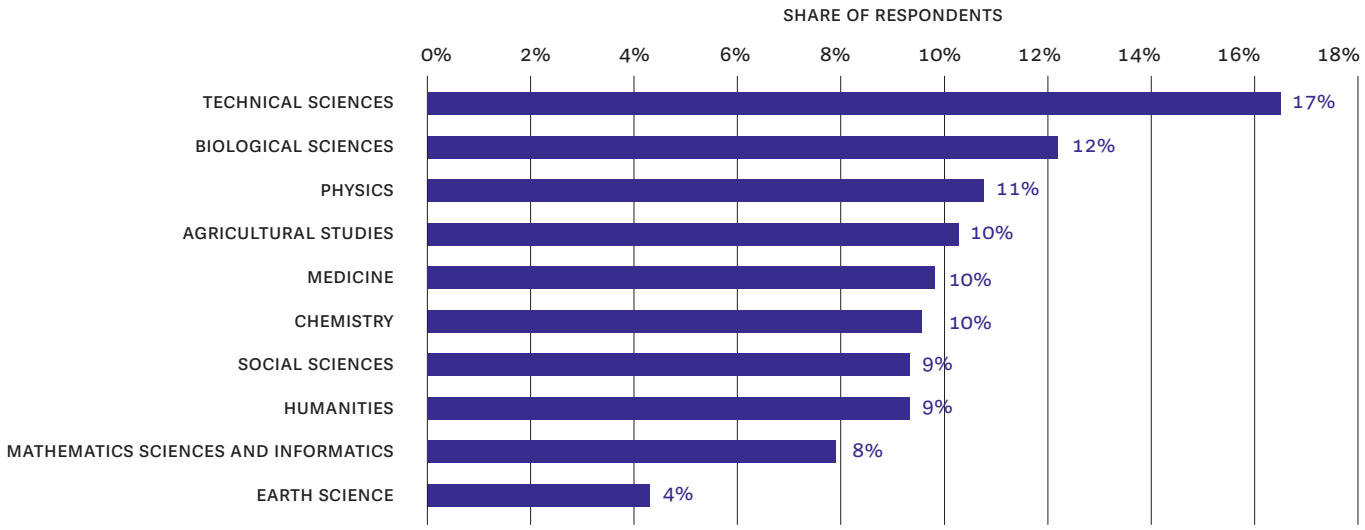
Scientific publications were the most common outcome reported by respondents, and Fundamental Research publications performed the best among the programs included in this study along several bibliometric indicators – however, they still had fewer year-normalized citations than the average Bulgarian publication indexed in the Web of Science from 2016 to 2020. Seminars, workshops, and conferences were the most common output of Fundamental Research respondents, while collaborative activities were somewhat low compared the results reported by Croatian research programs from a similar analysis in 2020. This is an area of concern because the program has objectives related to intensifying connections between science, education, business, and other innovation actors.

Respondents largely felt that the outcomes of their projects matched their expectations and were generally satisfied with program processes, although some had issues with the transparency of the selection process and technical and financial reporting requirements of the program.

The Fundamental Research program began providing grants in 2016 and has issued annual calls for proposals every year since then, funding a total of 664 projects for 79 million BGN grant funding (64 million of which had been disbursed by the end of 2020) between 2016 and 2020.

The principal investigators (or alternative points of contact) for all 664 projects funded by the program from 2016 to 2020 were surveyed for this analysis, with 414 beneficiaries responding to the survey for a response rate of 62 percent. Respondents represent 62 percent of the contracted funding for the program over the 2016-2020 period, with an average grant size of 119,106 BGN. Respondents' projects were spread across ten scientific fields, led by technical sciences (i.e., engineering disciples) (representing 17 percent of respondents' projects), biological sciences (12 percent) and physics (11 percent), while agricultural sciences, medicine, chemistry, social sciences, humanities, mathematics, and earth sciences each made up 10 percent or less of respondents' projects (Figure 3.1).

Figure 3.1. Fundamental Research Respondents' Projects by Scientific Field

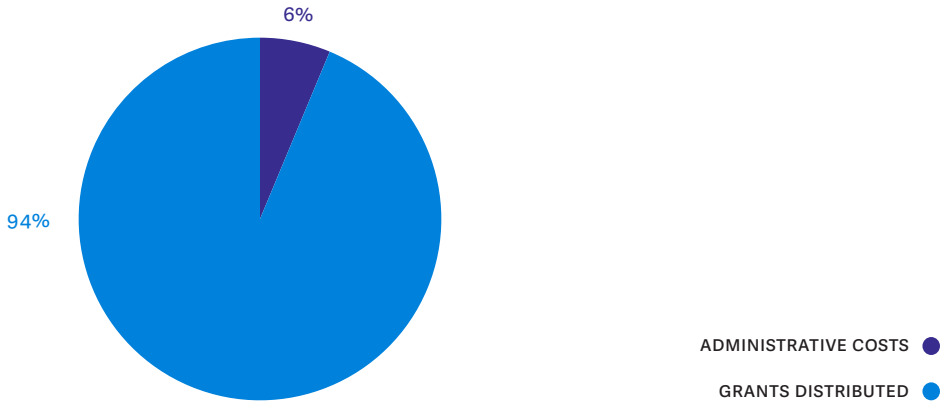


Source: World Bank.

3.1 Efficiency in Use of Inputs

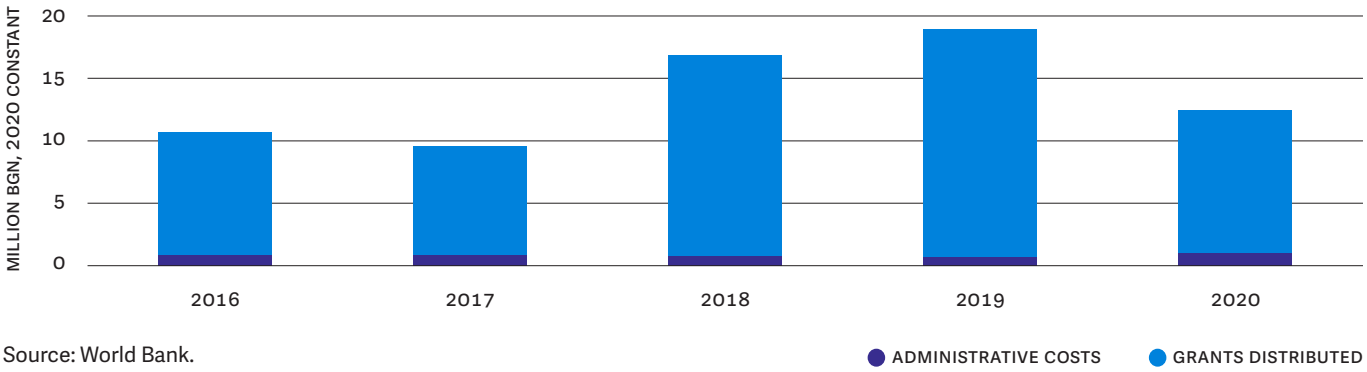
Disbursed grants made up the largest share of FR program costs, which peaked in 2019. Grants distributed to beneficiaries represented 94 percent of the costs of the program from 2016 to 2020, while administrative costs made up the remaining six percent (Figure 3.2). Administrative costs have remained relatively constant from 2016–20, which grant disbursements were highest in 2018 and 2019 (Figure 3.3).

Figure 3.2. Fundamental Research Program Costs by Category, 2016–20



Source: World Bank.

Figure 3.3. Fundamental Research Program Costs by Year, 2016–20



Source: World Bank.

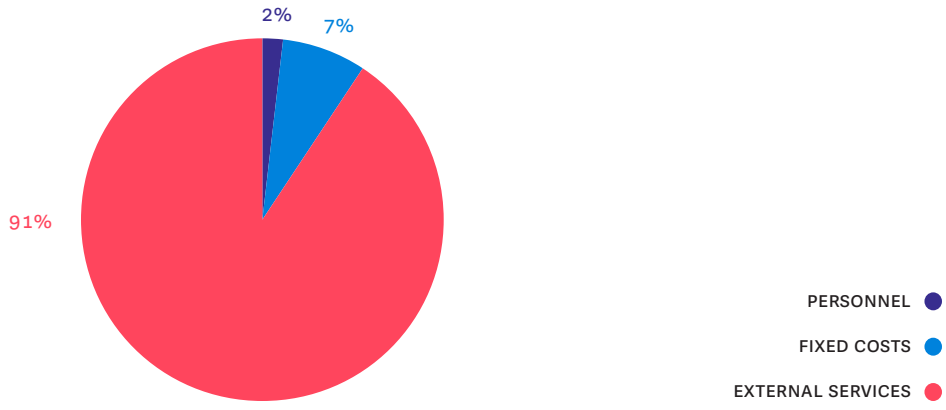
Administrative Costs

External services, in the form of contracts to technical experts to evaluate proposals, monitor projects, and provide advisory support, made up over 90 percent of program costs, while personnel costs only represented two percent of total administrative costs (Figure 3.4). Costs for external services and fixed costs were lower in 2018 and 2019 – years where the program awarded lower numbers of projects – before climbing again in 2020, while personnel costs were relatively constant from 2016 to 2020 (Figure 3.5). The program's administrative costs were highest in 2020.

The large share of costs for external services and very small share for personnel is likely due to the low numbers of full-time staff at the NSF (which has a total of 10 full-time staff members for implementing its entire portfolio of research programs). This arrangement in costs is likely done to compensate for the lack of staff at NSF. From the perspective of this efficiency analysis, this is

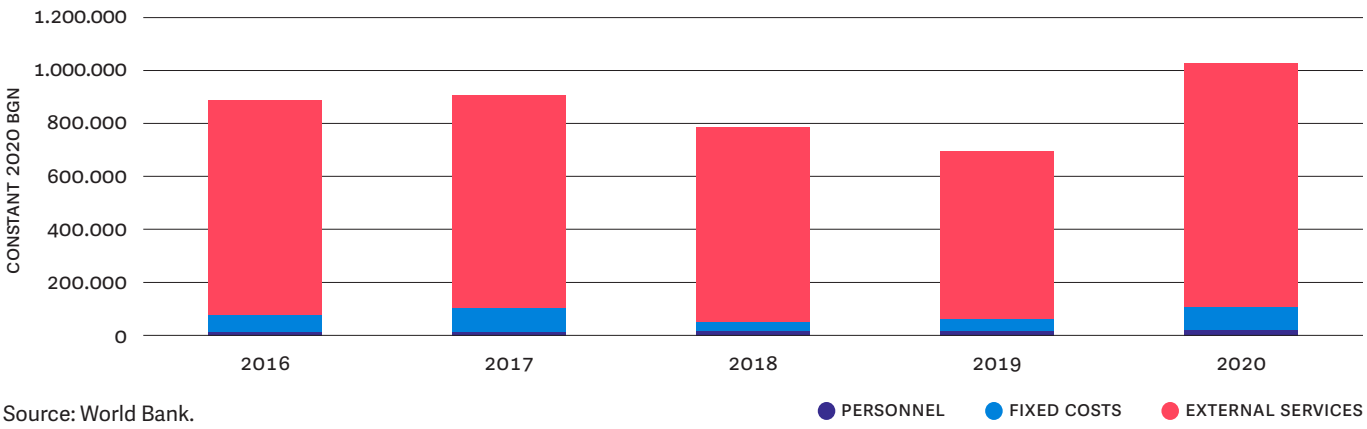
not necessarily an inefficient or ineffective arrangement; however, component 2 of the PER STI project, the *Functional and Governance Analysis,* found that the lack of staff has negatively impacted the implementation of programs at NSF in several areas, including knowledge management and M&E.

Figure 3.4. Fundamental Research Program Administrative Costs by Category, 2016–20



Source: World Bank.

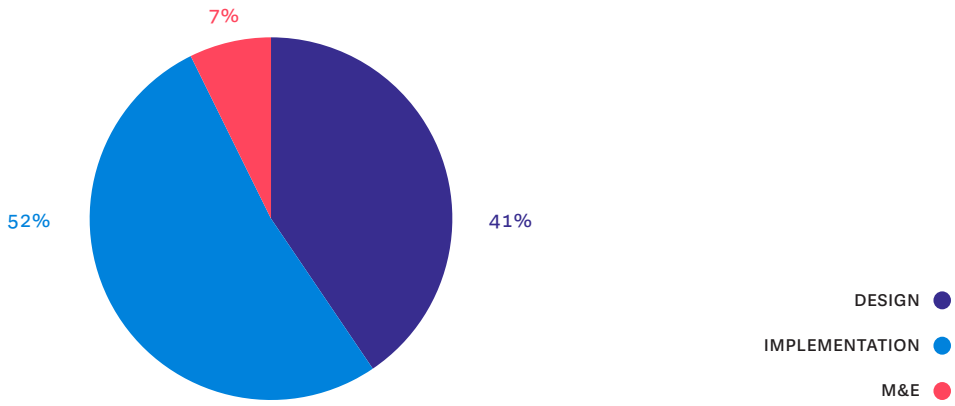
Figure 3.5. Fundamental Research Program Administrative Costs by Year, 2016–20



Source: World Bank.

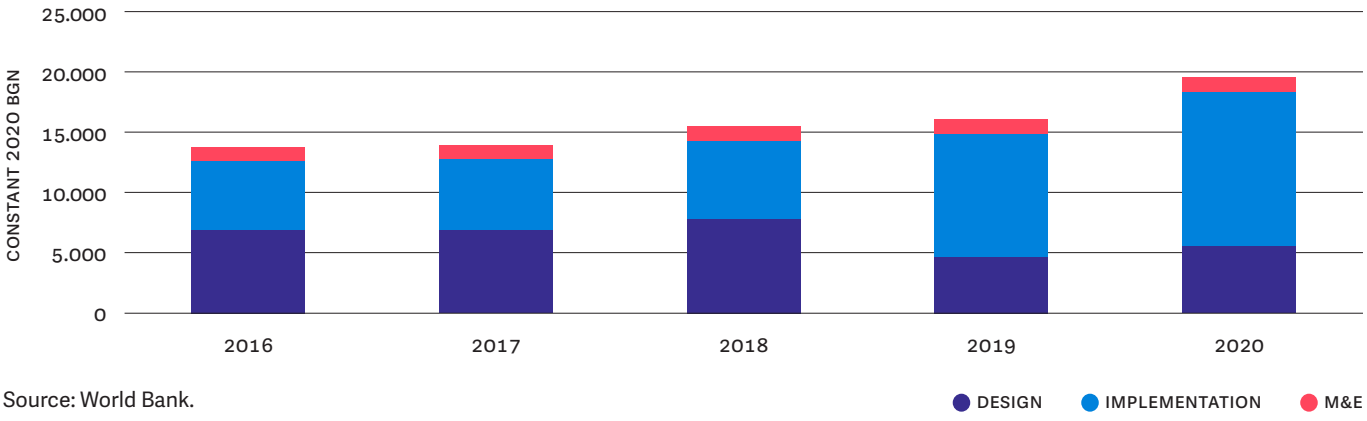
Over half of personnel costs went toward implementation, while 41 percent went to program design, and seven percent went to M&E (Figure 3.6). Most of the monitoring of Fundamental Research projects is done by external experts, which accounts for the low share of personnel costs in this area. Similarly, the program had no personnel costs for the evaluations of project proposals – this is also done by external experts contracted by the program. Personnel costs have increased yearly since 2016 (Figure 3.7). Implementation costs were highest in 2019 and 2020, which contributed to the increase in overall personnel costs in those years.

Figure 3.6. Fundamental Research Program Personnel Costs by Category, 2016–20



Source: World Bank.

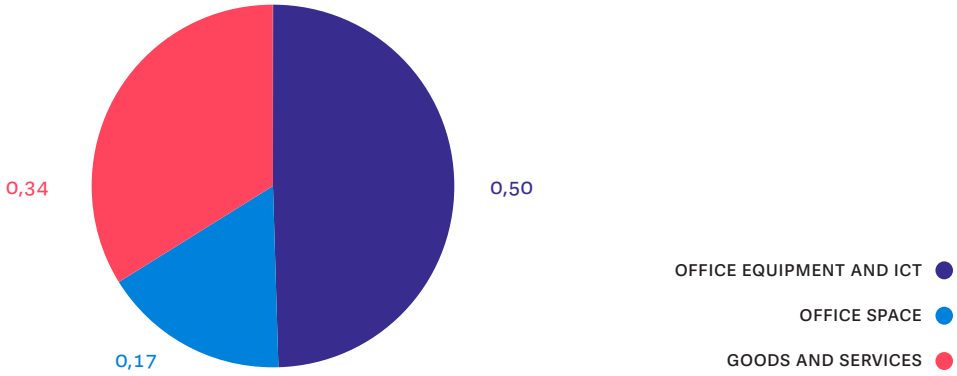
Figure 3.7. Fundamental Research Program Personnel Costs by Year, 2016–20



Source: World Bank.

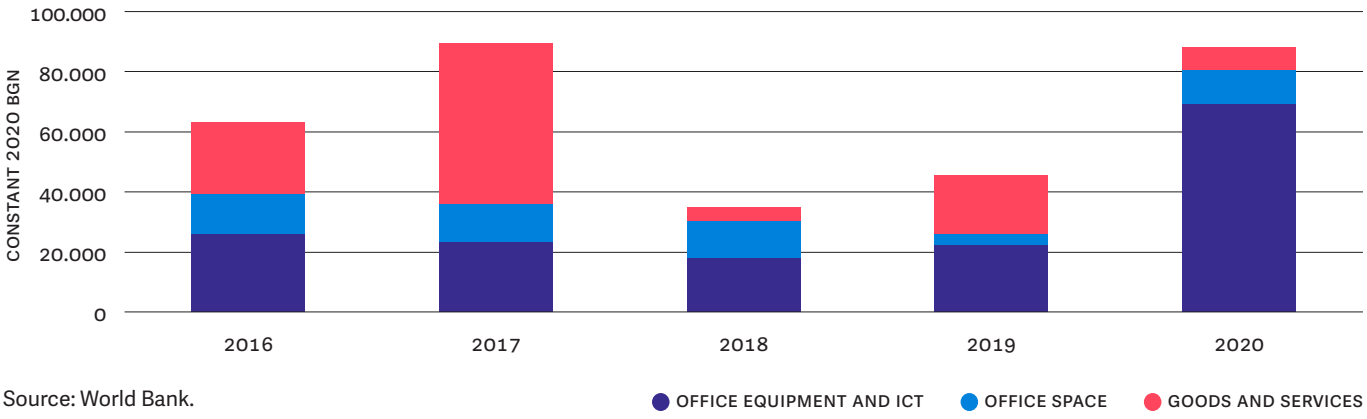
Office equipment and ICT costs made up half of the fixed costs for the program. (See Figure 3.8.) Overall fixed costs were highest in 2017 and 2020. Costs related to office equipment and ICT were highest in 2020, while costs related to goods and services were highest in 2016 and 2017 (Figure 3.9).

Figure 3.8. Fundamental Research Program Fixed Costs by Category, 2016–20



Source: World Bank.

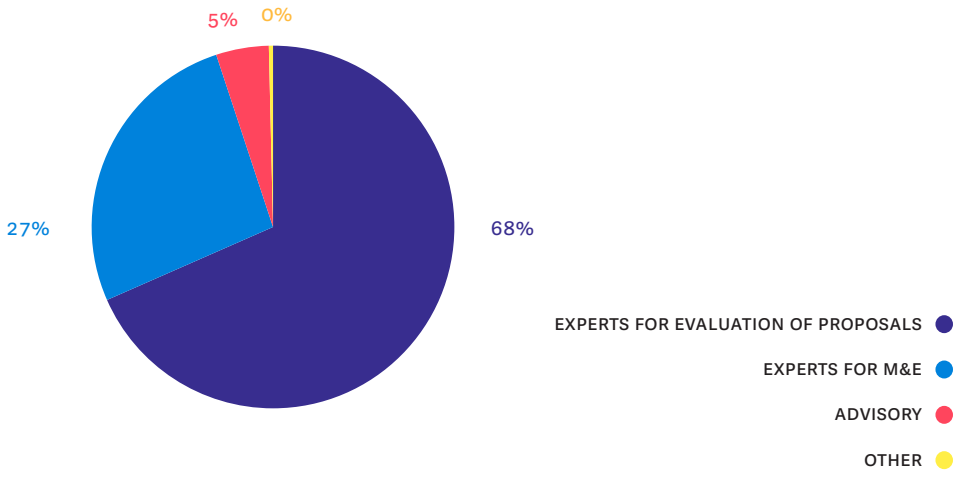
Figure 3.9. Fundamental Research Program Fixed Costs by Year, 2016–20



Source: World Bank.

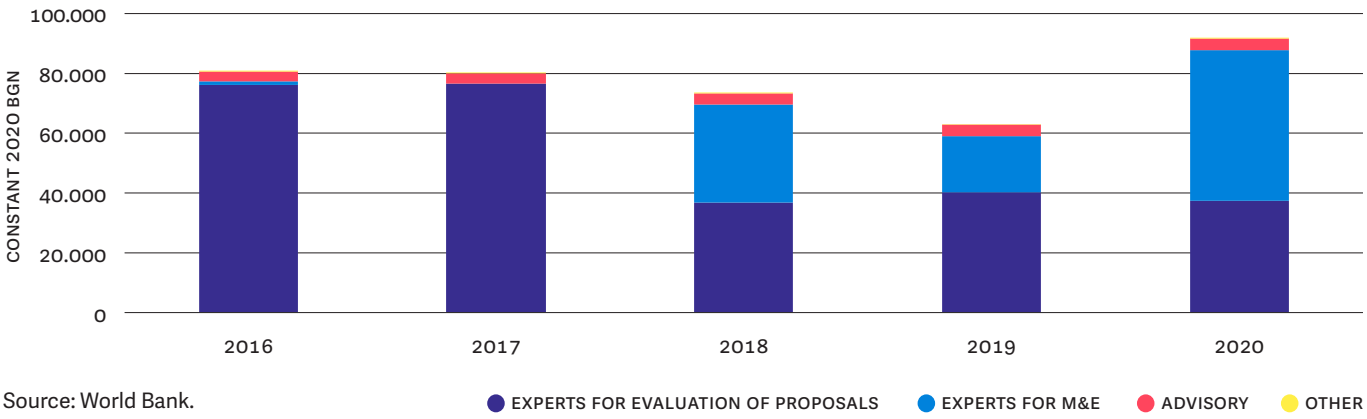
Almost 70 percent of costs for external services were related to contracting experts for the evaluation of project proposals, while 27 percent were related to contracting experts for the monitoring and evaluation of projects. NSF also utilizes external experts on several advisory commissions that provide guidance on its programming, which represented a small share of the costs for external services (Figure 3.10). Costs for experts for the evaluation of project proposals scale directly with the number of applications received in a given year, which were highest in 2016 and 2017. Costs for contracting experts for the monitoring and evaluation have risen sharply since 2018, making up over half of external services costs for the program in 2020, the year that costs for external services were highest overall (Figure 3.11). It should be noted that data were not available for costs related to experts for M&E in 2017, so external services costs were likely higher in that year and overall than what is reported here.

Figure 3.10. Fundamental Research Program Costs for External Services by Category, 2016–20



Source: World Bank.
Note: Data were not available for costs related to experts for M&E in 2017.

Figure 3.11. Fundamental Research Program Costs for External Services by Year, 2016–20



Source: World Bank.

The total administrative costs of implementing the program from 2016 to 2020 was 4.3 million BGN, with an average cost per project of 6,481 BGN (Table 3.1). The average personnel cost per project of 119 BGN and average external services costs per project were 5,877 BGN show that much of the program implementation is done by external experts and consultants. An organization like NSF would naturally rely to some extent on external evaluators to select projects and technical experts to monitor progress, but the extremely low personnel cost per project may indicate the outsourcing of project implementation to an unusual degree. NSF could consider whether it may ultimately be more effective to allocate more resources to full-time staff and fewer to external services. This may not necessarily lead to cost savings for the program, but it would increase the capacity of NSF as an implementor and allow the program to retain more institutional knowledge.

Table 3.1. Fundamental Research Administrative Costs

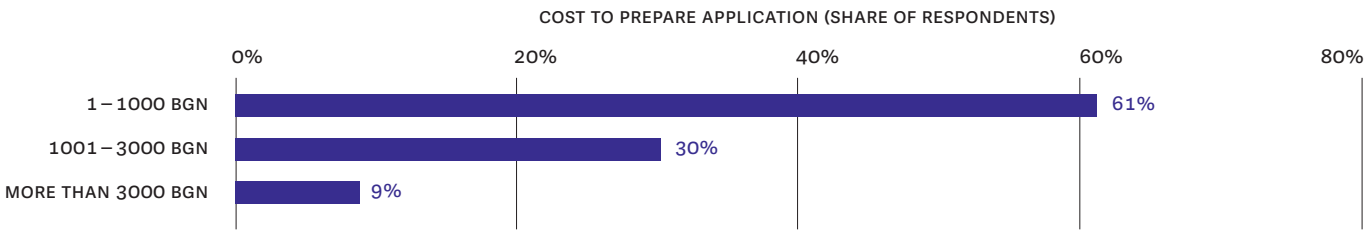
COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	78,826 BGN	119 BGN
Fixed	321,933 BGN	489 BGN
External services	3,902,639 BGN	5,877 BGN

Source: World Bank. Note: All amounts in constant 2020 BGN.

Costs Covered by Beneficiaries

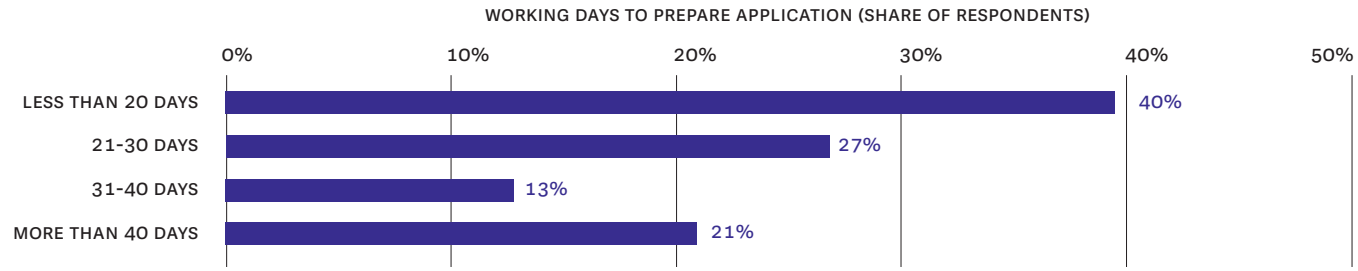
The application process for Fundamental Research is the quickest and cheapest among programs included in this analysis. (It should be noted that the program is also the smallest by average contracted grant size.) Respondents reported an average application cost of 2,258 BGN and spent an average of 29 working days preparing their application. Over 60 percent of respondents spent less than 1,000 BGN preparing their application, while less than 10 percent spent more 3,000 BGN (Figure 3.12). Two thirds of respondents spent less than 30 working days preparing their applications, while over 20 percent spent more than 40 working days (Figure 3.13).

Figure 3.12. Cost to Prepare Applications for the Fundamental Research Program



Source: World Bank.
Note: Data were not available for costs related to experts for M&E in 2017.

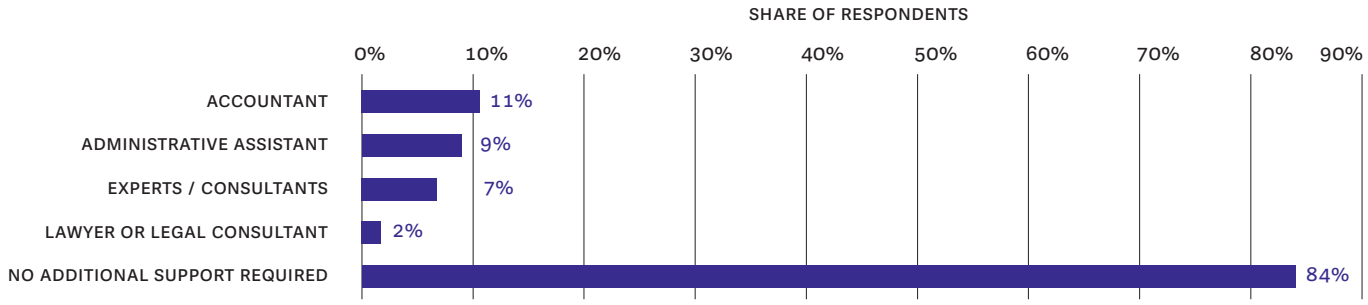
Figure 3.13. Time to Prepare Applications for the Fundamental Research Program



Source: World Bank.
Note: Data were not available for costs related to experts for M&E in 2017.

A large majority (84 percent) of respondents did not use external support (such as legal, accounting, or other services) to prepare their applications. Respondents' ability to complete their applications without external support likely contributed to the relatively low cost of application preparation when compared to other programs included in this analysis. The most common external supports used were accountants (needed by 11 percent of respondents), administrative assistants (9 percent), and expert consultants (7 percent) (Figure 3.14).

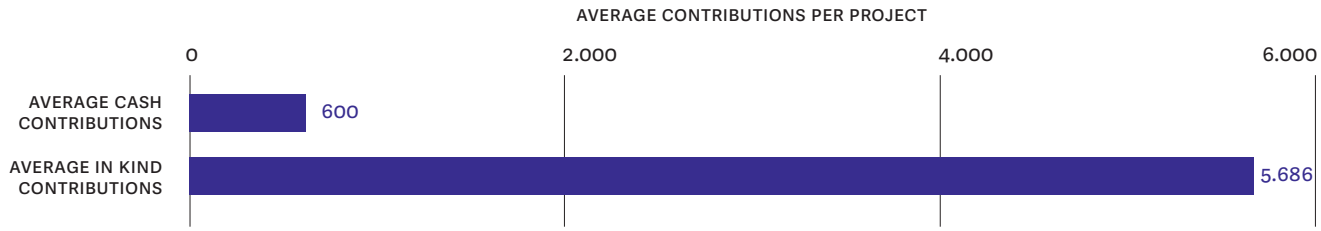
Figure 3.14. Beneficiaries Using External Support in Preparing Applications for the Fundamental Research Program



Source: World Bank.

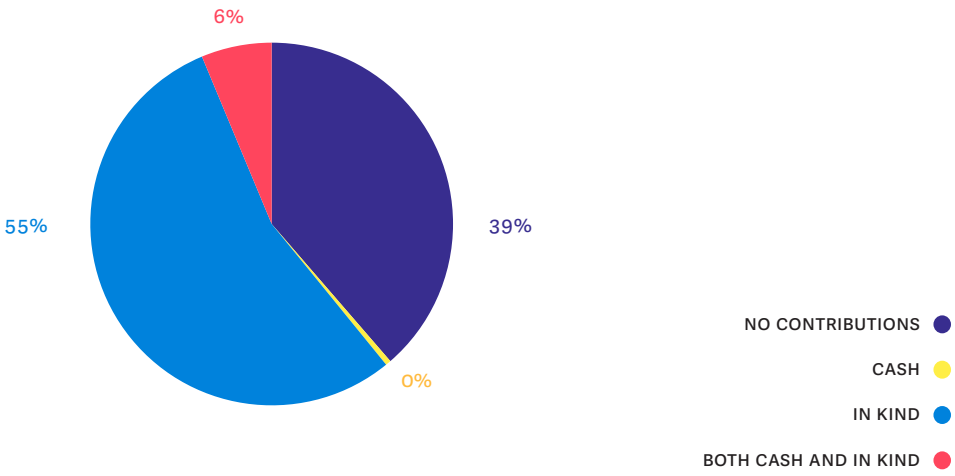
Although the Fundamental Research program has no requirements for matching contributions from beneficiaries, respondents reported an average of 5,600 BGN in-kind and 600 BGN cash contributions to the implementation of their projects. (See Figure 3.15.) In-kind contributions were the most common contribution by share of respondents, with 55 percent of respondents making in kind contributions, 39 percent of respondents making no contributions, and 6 percent making both cash and in-kind contributions (Figure 3.16). In-kind contributions for research projects could take the form of researcher salaries and the usage of facilities, laboratories, and equipment.

Figure 3.15. Value of Contributions to Fundamental Research Program Projects



Source: World Bank.

Figure 3.16. Proportions of Contributions to Fundamental Research Program Projects



Source: World Bank.
Note: Data were not available for costs related to experts for M&E in 2017.

On average, the costs covered by the program were 12 times higher than the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 103,107 BGN, while the average cost covered by beneficiaries was 8,544 BGN.

3.2 Efficiency in Generation of Outputs

For every BGN of administrative costs, beneficiaries received an average of 15 BGN in disbursed grants. The total program cost from 2016 to 2020 was 68.5 million BGN, or 103,107 BGN per project. This includes 64.2 million in disbursed grants to beneficiaries and 4.3 million in administrative costs (Table 3.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

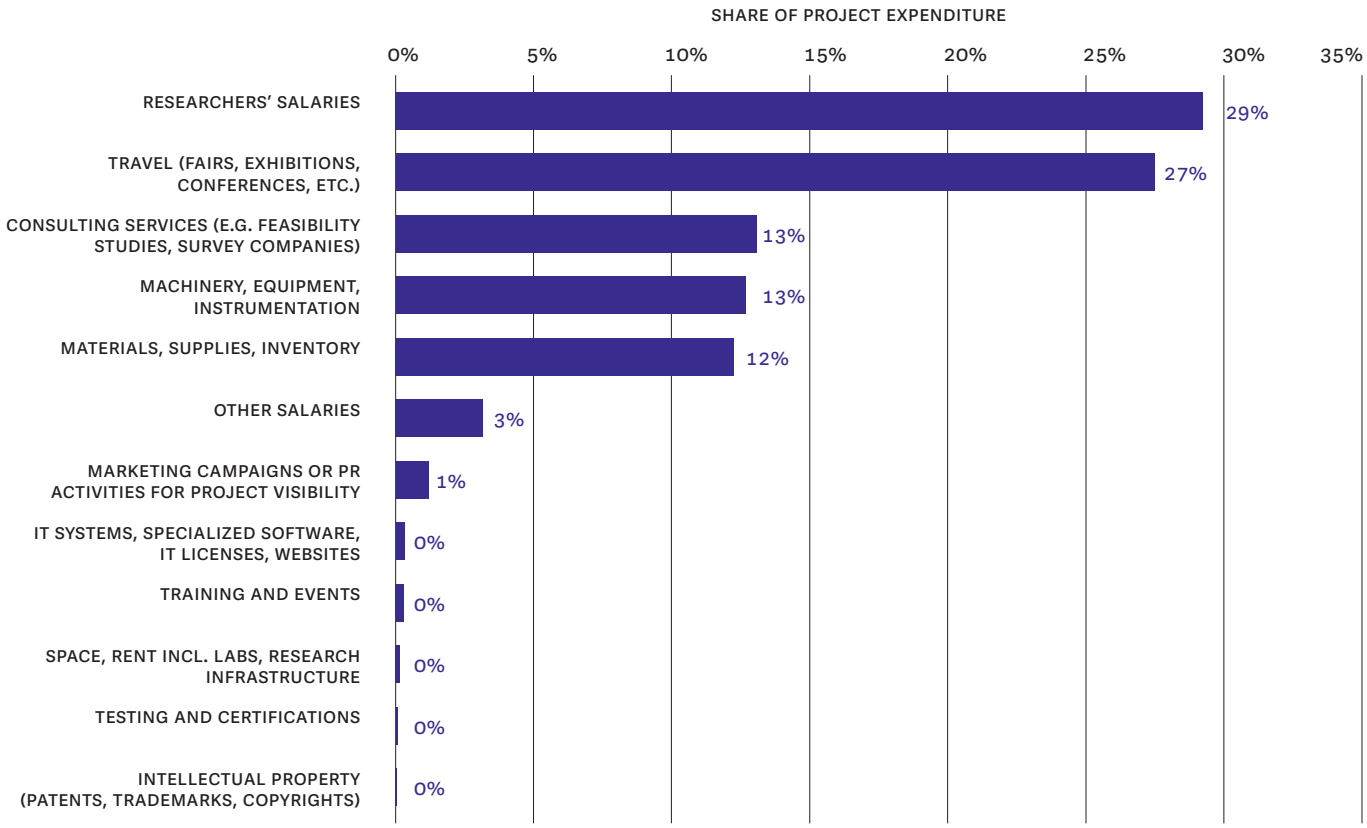
Table 3.2. Fundamental Research Program Costs, 2016–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	64,159,408 BGN	96,626 BGN
Administrative and operating costs	4,303,400 BGN	6,481 BGN
Total program cost	**68,462,808 BGN**	**103,107 BGN**

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Respondents reported researchers' salaries and travel as the largest expenditures of their project by cost category (Figure 3.17). These expenditure patterns are likely influenced by the program's regulations, which state that a maximum of 30 percent of the project budget can be spent on researcher salaries. In the first cohorts of projects funded by the program, NSF observed that almost all project funds were being spent on researcher salaries, so a cap on salary expenditures was introduced. Additionally, researchers in Bulgaria are typically not provided funding for travel (for conference, meetings, etc.) by their institutions, so Fundamental Research beneficiaries likely try to use as much funding as allowed by the program (up to 30 percent of project budget) to participate in such activities that they otherwise would not have the resources for. NSF does not allow for grant funding to be used for IP-generation or commercialization activities, which can explain why there were no expenses associated with such activities.

Figure 3.17. Fundamental Research Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Four types of outputs were tracked for the Fundamental Research project, based on the program's ToC: (1) project dissemination (in the form of seminars, workshops, and conferences), (2) training activities, (3) research collaborations during implementation, and (4) researchers involved in implementation (in the form of PhDs and postdoctoral researchers hired).

Program respondents generated a total of 5,010 outputs from 2016 to 2020, or an average of 12 outputs per project. Over that period, the program invested an average of 103,107 BGN in beneficiary projects, so respondents generated 11.6 outputs per 100,000 BGN invested.

Seminars, workshops, and conferences were the most common output of Fundamental Research respondents (an average of 6.7 per project), followed by training activities (1.8 per project), PhDs and postdoctoral researchers hired (1.9), and collaborations (1.6) (see Table 3.3).

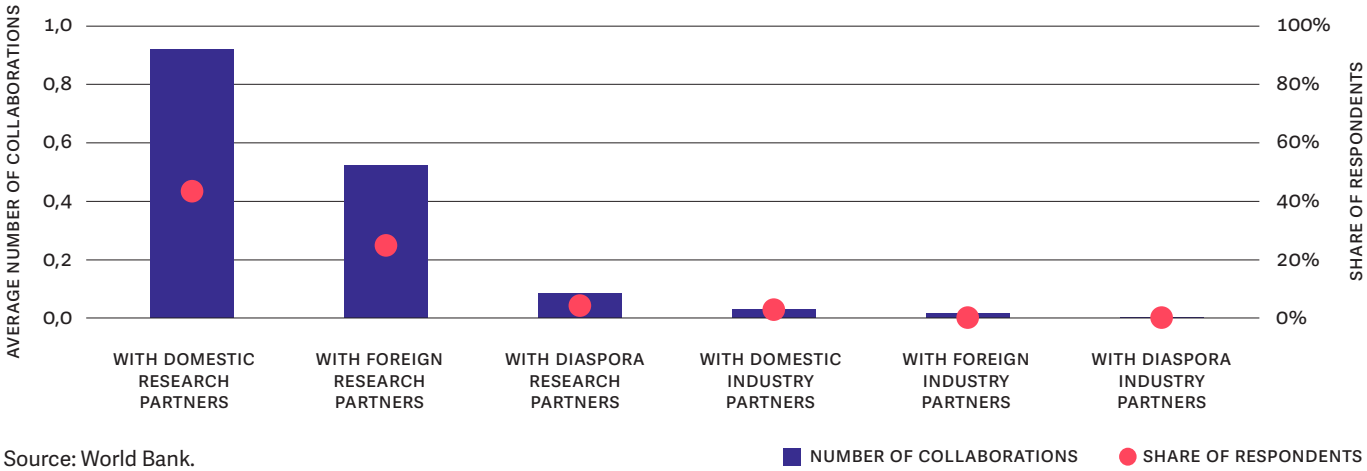
Table 3.3. Fundamental Research Outputs

OUTPUT	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTPUT
Seminars, workshops, and conferences	2,810	6.7	6.5	83%
Training activities	751	1.8	1.7	53%
Collaborations	662	1.6	1.6	50%
PhDs and postdocs hired	787	1.9	1.8	57%

Source: World Bank.

Roughly half of Fundamental Research respondents engaged in at least one collaboration during their project implementation, for an average of 1.6 collaborations per project. Research collaborations were much more common than collaborations with industry, which is to be expected given that the program focuses on basic research. Collaborations with domestic research partners were the most common, with 43 percent of respondents reporting engaging in such collaborations, while collaborations with industry partners were the least common (Figure 3.18). Collaborations were somewhat low compared the results reported by Croatian research programs from a similar analysis in 2020, which is an area of concern because the program has objectives related to intensifying connections between science, education, business, and other innovation actors. Several Fundamental Research respondents commented that they would like the program eligibility criteria changed to allow more types of partners during implementation – particularly non-profit organizations. Such changes to program regulations may help boost the share of beneficiaries that collaborate and the number of collaborations generated by the project.

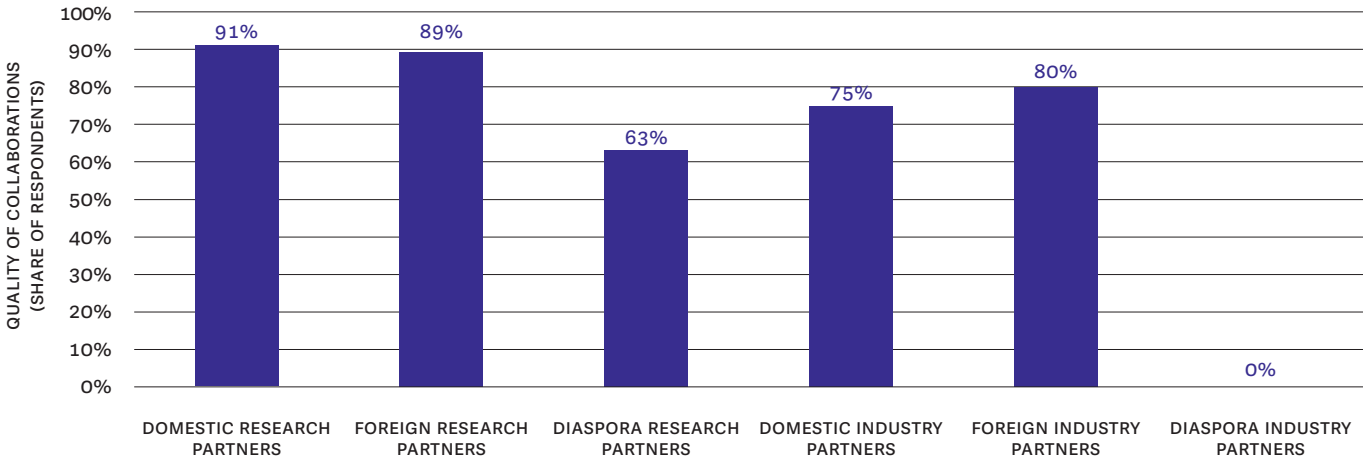
Figure 3.18. Fundamental Research Program Collaborations by Type of Partner



Source: World Bank.

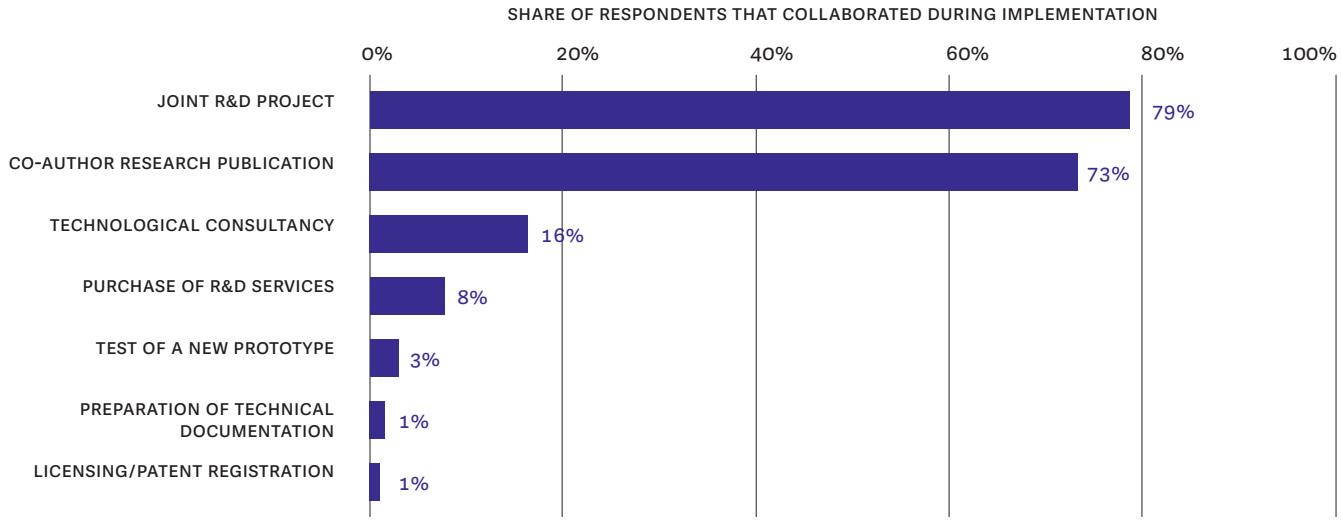
Fundamental Research program respondents rated their collaborations highly. They were generally satisfied with the quality of their collaborations during implementation, with more than 75 percent of respondents that engaged in collaborations with domestic and foreign research partners and domestic and foreign industry partners saying these collaborations were above average or excellent (Figure 3.19). Most collaborations reported by Fundamental Research respondents took the form of joint R&D projects or co-authoring research publications (Figure 3.20).

Figure 3.19. Fundamental Research Program Quality of Collaborations by Type of Partner



Source: World Bank.
Note: Left figure shows the share of respondents who rated their collaborations as above average or excellent. Right figure is the share of respondents that engaged in a given type of collaboration during implementation (n=207).

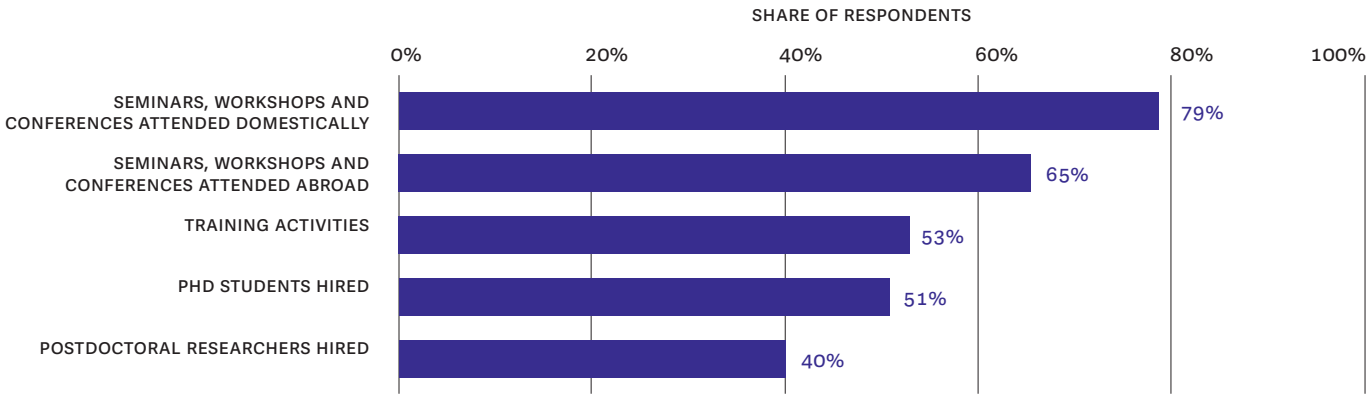
Figure 3.20. Fundamental Research Program Collaborations by Type of Collaboration



Source: World Bank.
Note: Left figure shows the share of respondents who rated their collaborations as above average or excellent. Right figure is the share of respondents that engaged in a given type of collaboration during implementation (n=207).

Seminars, workshops, and conferences were the most common capacity building activities. The majority of respondents attended seminars, workshops, and conferences, either domestically or internationally, while roughly half of respondents engaged in training activities or hired PhD students to work on their projects. About 40 percent of respondents hired one or more postdoctoral researchers to work on their projects (Figure 3.21).

Figure 3.21. Fundamental Research Program Capacity-Building Activities by Type



Source: World Bank.

3.3 Efficiency in Achievement of Outcomes

Respondents reported a total of 3,835 outcomes (intended outcomes and other), for an average of 11.1 outcomes per project. Over that period, the program invested an average of 103,107 BGN in beneficiary projects, so respondents generated 10.8 outcomes per 100,000 BGN invested.

Two outcomes were tracked for the Fundamental Research program, based on the program's ToC: 1.) scientific publications in peer-reviewed journals and 2.) research collaborations after project completion. Scientific publications were the most common outcomes reported by respondents, with an average of 6.4 per project, while the respondents with completed projects reported an average of 3.2 collaborative project after their project was finished (Table 3.4).

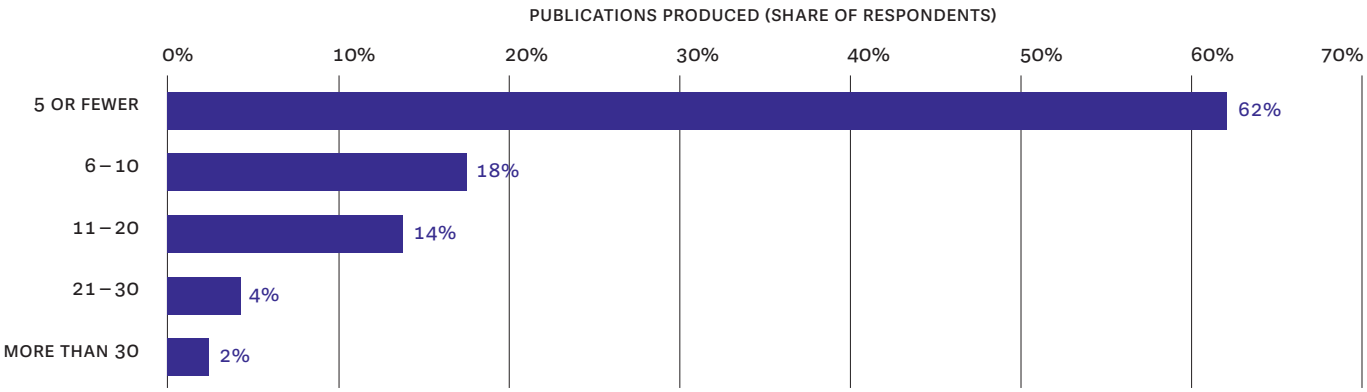
Table 3.4. Intended Outcomes Achieved by Fundamental Research Respondents

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER PROJECT	OUTCOME PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Scientific publications in peer-reviewed journals	2,650	6.4	6.2	66%
Collaborative projects with domestic research partners after project completion	409	2.3*	2.2	56%*
Collaborative projects with foreign research partners after project completion	116	0.7*	0.7	42%*
Collaborative projects with diaspora research partners after project completion	20	0.1*	0.1	6%*
Collaborative projects with industry partners after project completion	22	0.1*	0.1	8%*

Source: World Bank.
Note: * Reported per completed project (n=177).

Most respondents (60 percent) produced five or fewer publications as part of their projects, while 32 percent produced between six and 20 publications, and six percent produced more than 20 publications (Figure 3.22).

Figure 3.22. Publications Produced by Fundamental Research Projects



Source: World Bank.

Publications reported by Fundamental Research respondents performed the best among the programs included in this study along several bibliometric indicators. Fundamental Research publications had the highest average year-normalized citations and highest share of publications with international coauthors. More than half of the publications listed by respondents were indexed in Web of Science and 44 percent were in journals with impact factor (Table 3.5). However, Fundamental Research publications still had fewer year-normalized citations than the average Bulgarian publication indexed in the Web of Science between 2016 and 2020.

Table 3.5. Impact Measures of Fundamental Research Publications

Total publications listed in survey responses	609
Share indexed in Web of Science	54%
Share in journals with impact factor	44%
Average year normalized citations	1.67
Share with international coauthor(s)	56%

Source: World Bank.

Other Results

Respondents reported some activities related to IP generation and technology development, which is unexpected given the program's focus on basic research (Table 3.6). Respondents reported small numbers of patent applications and patents granted, IP activities (such as industrial designs, copyrights, transfer agreements, etc.)[6], new software development, and new technology development. This may suggest that at least a small share of Fundamental Research projects generate outputs that could be further developed into new technologies, products, or services.

Table 3.6. Other Outcomes Generated by Fundamental Research Projects

OTHER OUTCOMES	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Patent applications	46	0.1	0.1	4%
Patents granted	13	0.0	0.0	2%
Other intellectual property activities (industrial designs, copyrights, transfer agreements, etc.)	265	0.6	0.6	3%
Prototype	45	0.1	0.1	6%
New software development	140	0.3	0.3	17%
New technology development	116	0.3	0.3	20%

Source: World Bank.

6 One respondent, who reported 200 copyrights resulting from their project, was responsible for 75 percent of the "other IP activities" generated by the program.

3.4 Perceived Quality

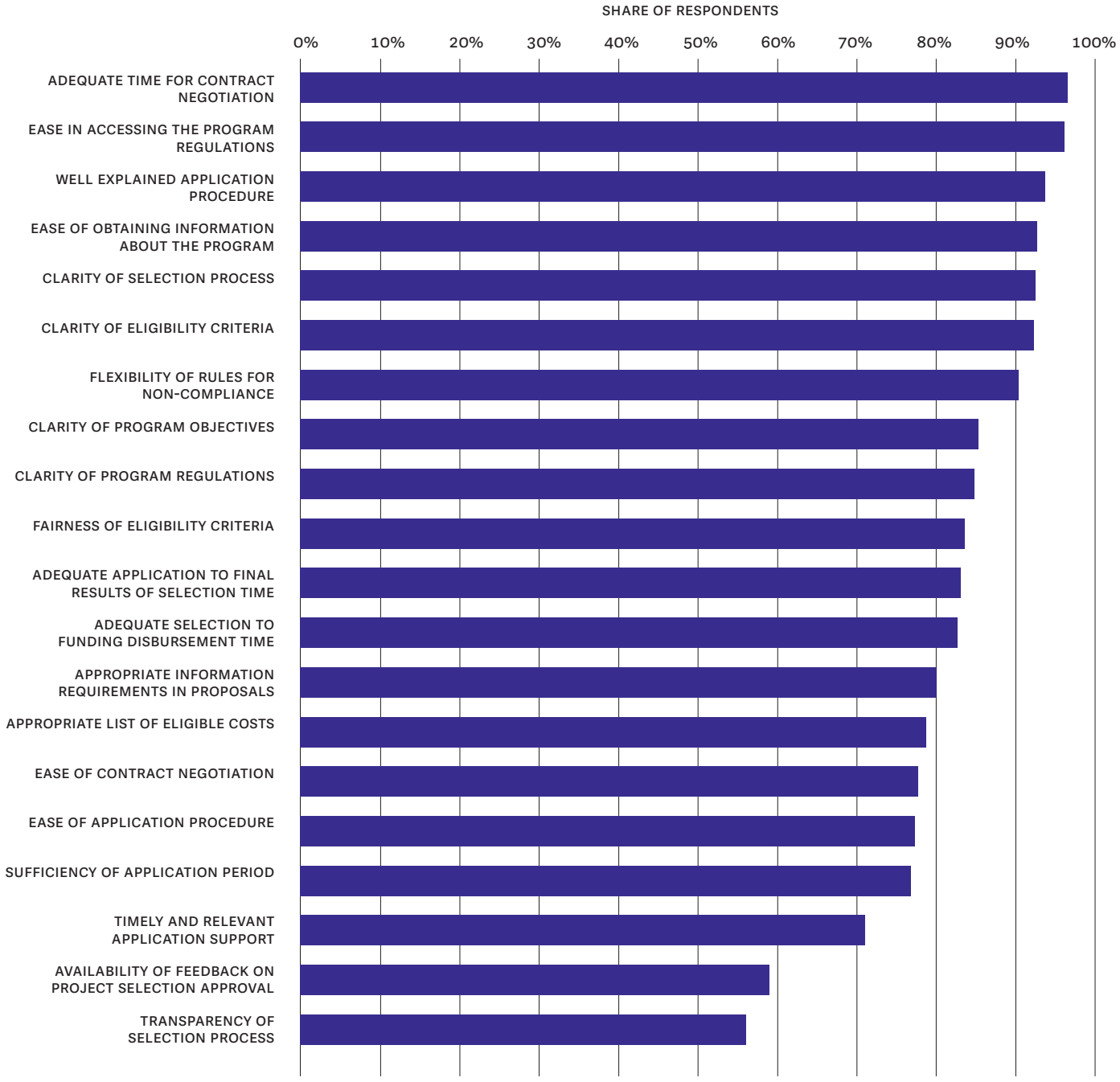
Respondents were generally satisfied with most aspects of the application process, but some expressed concerns about the transparency of the selection process. Less than 70 percent of respondents were satisfied with the transparency of the selection process and feedback on project selection, indicating that a portion of program beneficiaries perceive the selection process to be nontransparent. Fundamental Research respondents also commented that eligibility criteria are focused on institutions, rather than on the principal investigator or research team that will carry out the project, which can make it more difficult for researchers outside of leading Bulgarian institutions to win grants from the program. Respondents generally felt satisfied with program regulations, contract negotiations, and funding disbursement (Figure 3.23).

When asked whether they think any program eligibility criteria should be added, changed, or removed, 19 percent of respondents said they thought changes should be made to the current criteria. Suggested changes included allowing more types of research partners (such as non-profit organizations), allowing more eligible expenditures, removing maximum age requirements, removing criteria focused on academic titles, and allowing technical personnel as part of the project team (currently, technical staff salaries must be covered by the overhead, which is capped at seven percent of the project budget).

When asked about program selection criteria, eight percent respondents said they thought changes should be made. Several respondents said that limitations on the number of programs a researcher can participate in should be removed and that technology transfer impacts should be added to selection criteria.

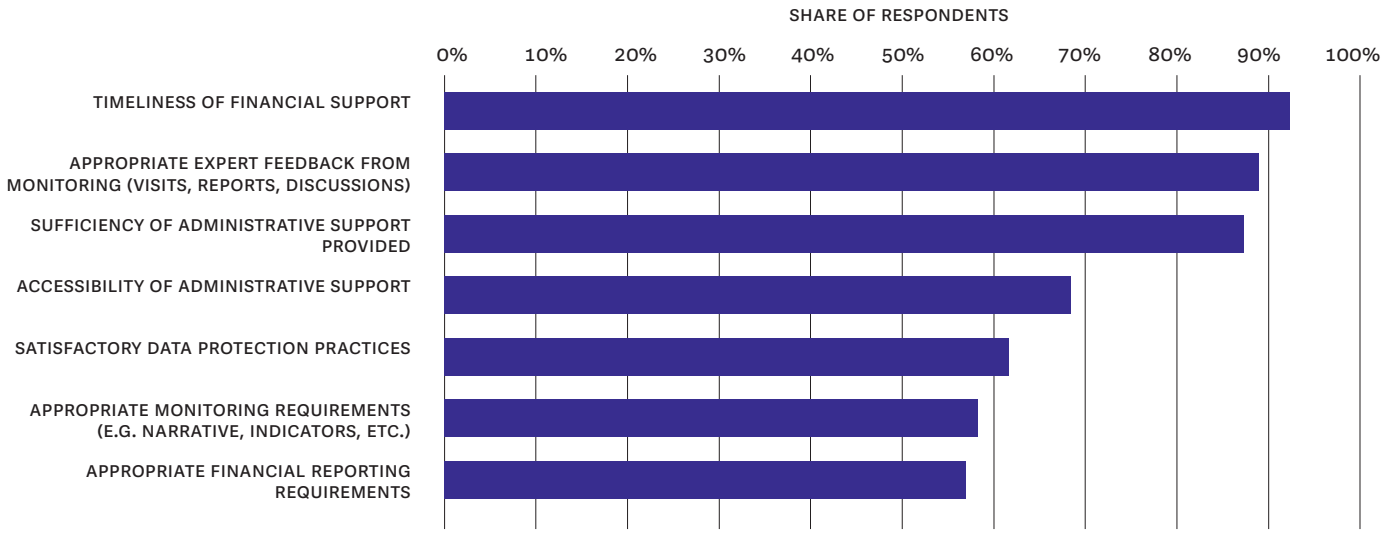
Many respondents were dissatisfied with monitoring requirements. Fewer than 60 percent of respondents were satisfied with the program's monitoring and financial reporting requirements, indicating that at least a portion of respondents felt these requirements were overly burdensome. Fundamental Research respondents noted that NSF requires certified and translated copies of all eligible expenses, including things like plane tickets. Unlike beneficiaries of EU operational programmes, there is no online portal with preloaded report templates for NSF beneficiaries to report on project progress. However, respondents were generally satisfied other implementation and monitoring processes of the program, including the timeliness of financial support, feedback from monitoring, and the administrative support provided (Figure 3.25).

Figure 3.23. Fundamental Research Program Beneficiaries' Satisfaction with the Program Application and Selection Processes



Source: World Bank.

Figure 3.24. Fundamental Research Program Beneficiaries' Satisfaction with Implementation and Monitoring Processes



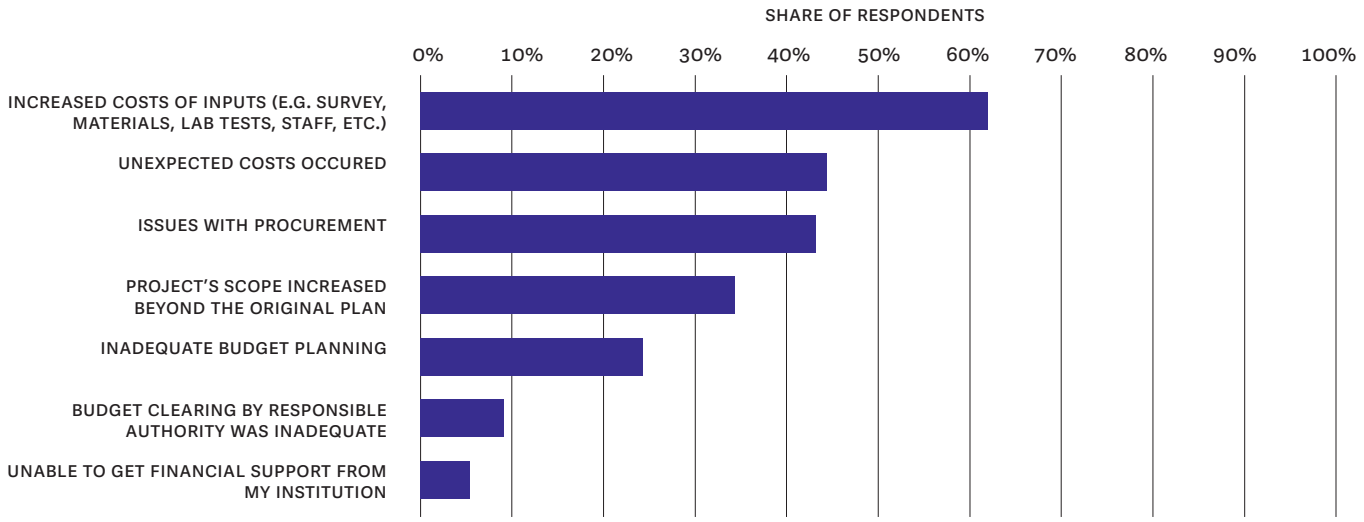
Source: World Bank.
Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with aspects of implementation and monitoring.

Most respondents felt that the financial resources provided by NSF were sufficient, with 78 percent reporting that they had sufficient funding to successfully complete their project. Those respondents who said that financial support was insufficient reported that financial support would need to increase by an average of 74 percent in order to successfully complete their projects. Increased costs of inputs (such as materials, staff, and equipment), unexpected costs, and issues with procurement were cited as the most common reasons why financial support was insufficient (Figure 3.25). This may indicate that the program does not have the flexibility or adaptability to adjust funding to changing external conditions, such as inflation.

Similarly, most respondents felt that the amount of time allowed by the program to complete their project was sufficient, with 85 percent reporting that they had sufficient time to successfully complete their projects. Of those respondents who said they did not have enough time to complete their projects, delays due to COVID work and travel restrictions[7], inability to reduce workload from other projects, and inability to reduce institutional obligations were cited as the most common reasons (Figure 3.26).

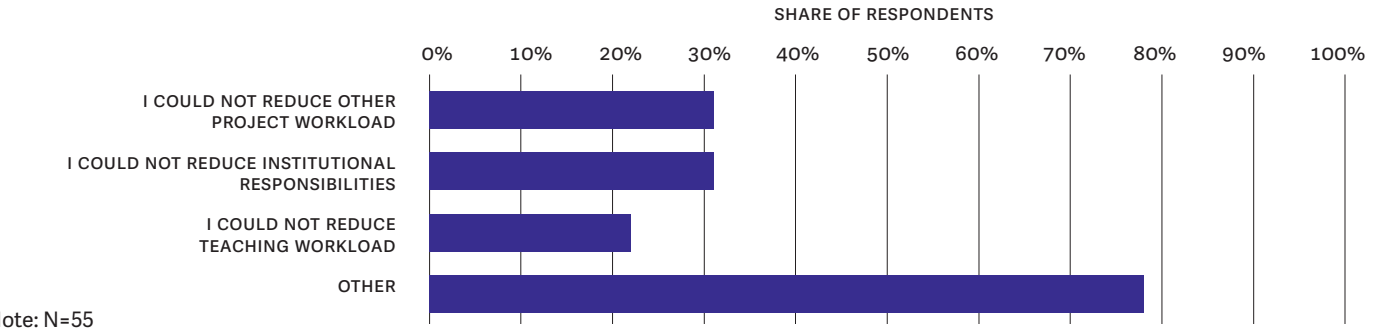
7 Respondents were provided with the option to select "other" among reasons why the time allotted for their projects was not sufficient to successfully complete their projects. Of those respondents who selected "other", delays due to the COVID pandemic and subsequent economic shutdown were the most common reason described.

Figure 3.25. Reasons Why Fundamental Research Financial Support was Insufficient



Note: N=79
Source: World Bank.

Figure 3.26. Reasons Why Time Allotted for Fundamental Research Projects was Insufficient



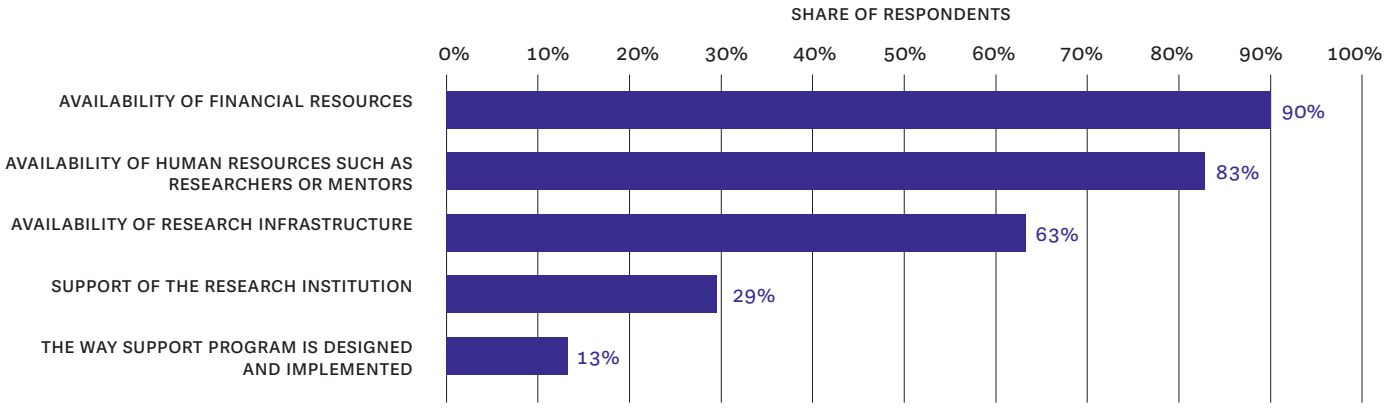
Note: N=55
Source: World Bank.

Financial and human resources were the most common key success factors. The availability of financial resources and human resources were cited as key success factors by 90 percent and 83 percent of respondents respectively. The availability of research infrastructure was also reported as an important factor for success by more than half of respondents (Figure 3.27). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, respondents indicated that they needed a range of additional support from the program. They cited assistance with procurement[8] (by 22 percent of respondents),

8 In the *Functional and Governance Analysis*, public procurement processes were identified as a major challenge to public sector beneficiaries, which are covered by the Public Procurement Act. Timelines for each procurement may last between two and four months (depending on the type of procedure) from opening a procurement to concluding a contract, without including the evaluation process. If there is a litigation in court regarding the granting of the contract (which is relatively common in Bulgaria), the process may take up to a whole year.

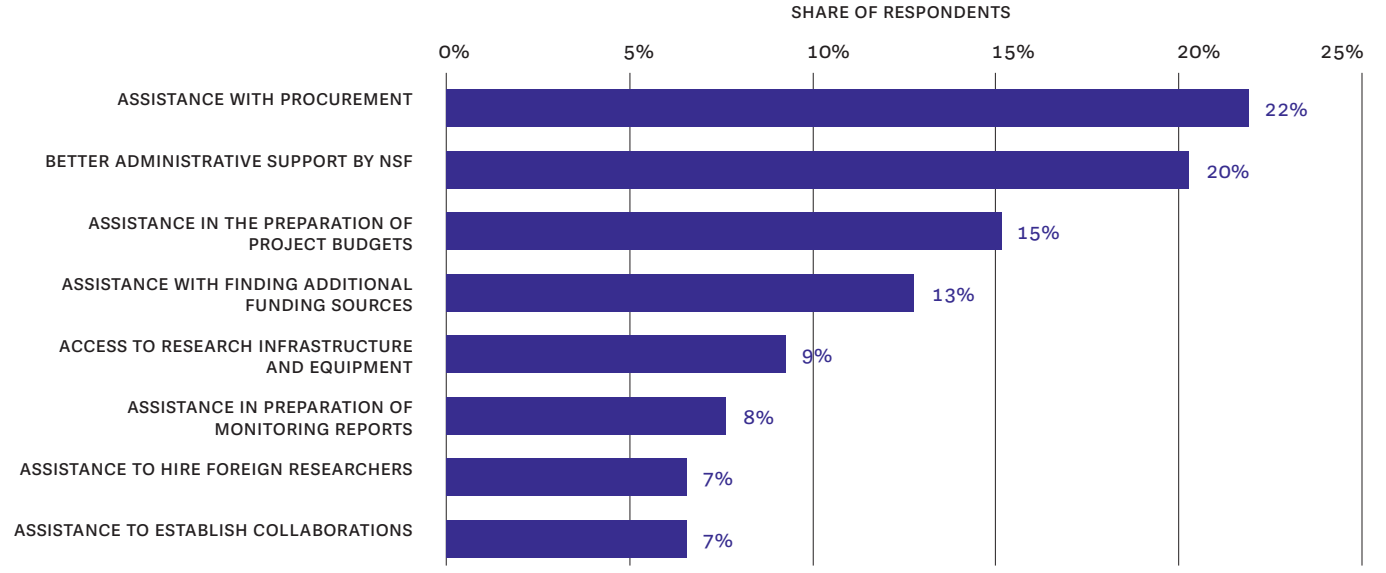
better administrative support from NSF (by 20 percent), assistance with budget preparate (by 15 percent), and assistance with finding additional funding sources (by 13 percent) as the most needed additional supports (Figure 3.28).

Figure 3.27. Key Success Factors for Fundamental Research Projects



Source: World Bank.

Figure 3.28. Additional Support Needed for Fundamental Research Projects

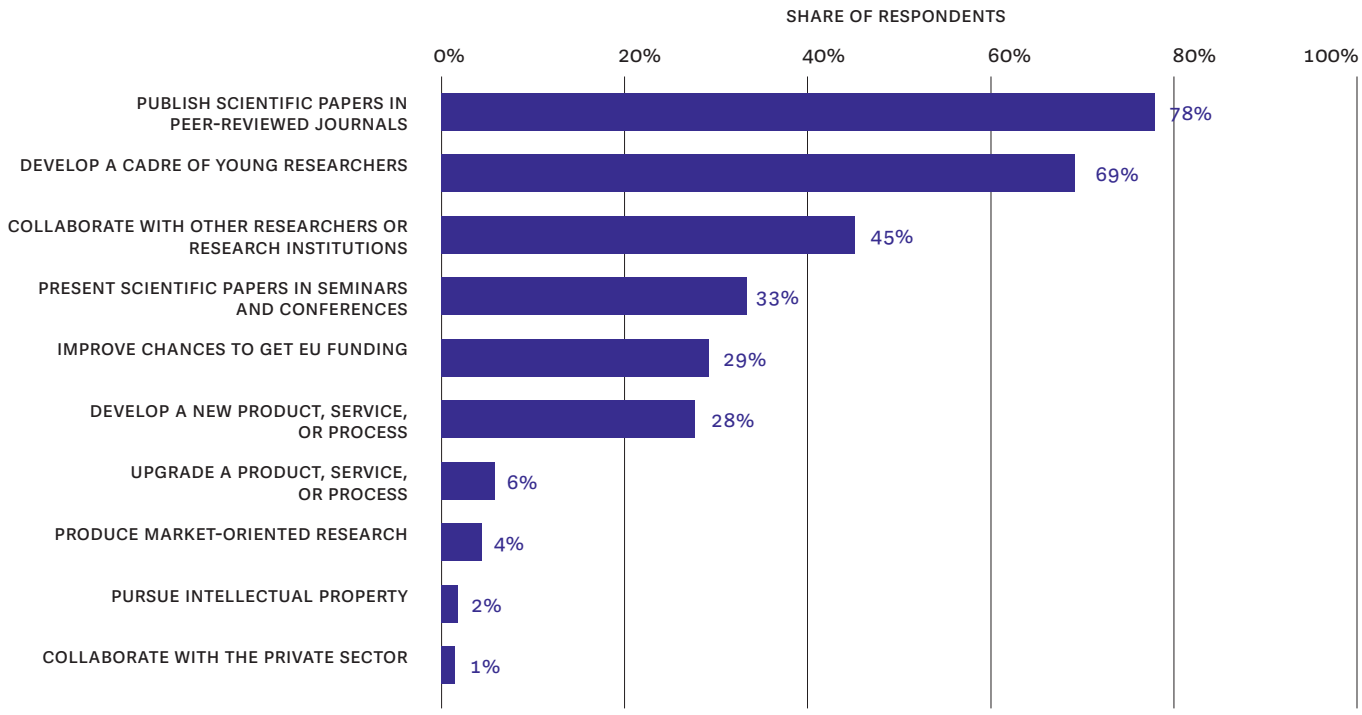


Source: World Bank.

Overall Project Quality

Respondents' project objectives were largely in line with the objectives of the Fundamental Research program. The program focuses on improving the quality and quality of basic research preformed in Bulgaria, increasing the capacity of beneficiary organizations, and increasing connections with scientific community in basic research areas. Over 75 percent of respondents reported publishing scientific papers in peer reviewed journals was a top objective of their project, while 69 percent said developing a cadre of young researchers and 45 percent said presenting papers in seminars and conferences were top objectives – all of which relate to increasing the capacity of beneficiary organizations and improving the quality and quality of basic research. Similarly, 45 percent of respondents reported collaborating with other researchers or institutions as an objective, which relates to the program goal of increasing connections with scientific community in basic research. However, a small share of researchers had objectives outside of the program's core objectives, such as developing a new product or services or producing market-oriented research (Figure 3.29).

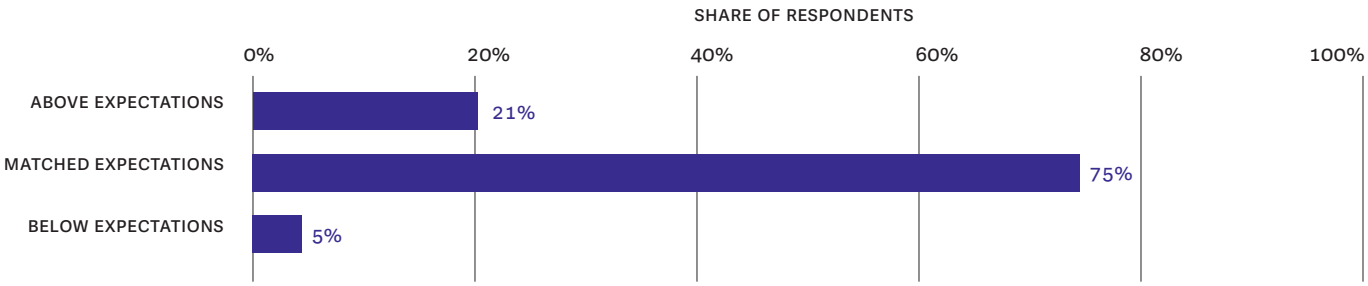
Figure 3.29. Fundamental Research Program Project Objectives



Source: World Bank.

Most respondents felt that the outcomes of their project matched their expectations. Seventy-five percent said so. Over 20 percent felt their project exceeded expectations, while 5 percent said their project outcome was below expectations (Figure 3.30).

Figure 3.30. Match Between Fundamental Research Projects and Beneficiaries' Expectations



Source: World Bank.

4. Vihren

4. Vihren

PROGRAM SUMMARY

The Vihren program was created to address some of the human resource challenges in the public research sector by supporting the development of new research teams formed around leading Bulgarian scientists, with the aim of developing a new generation of public researchers. The program is designed and implemented by the NSF and MoES and funds basic or applied research projects carried out by leading and established scientists and their research teams, with the objective of increasing the capacity of the Bulgarian public research sector to conduct high quality research. It has intended outcomes related to scientific publications in peer reviewed journals and collaborative projects formed after project completion.

Like the Fundamental Research program, external services made up a large share (55 percent) of the administrative costs of implementing the program, while personnel made up only six percent of administrative costs. This cost structure is likely due to the small number of full-time staff at NSF; the small staff at NSF appear to rely heavily on external experts in the implementation of the program.

Most respondents hired postdoctoral researchers and PhD students, which is in line with the core objectives of the Vihren program – to support established and leading scientists to develop new research teams and new researchers capable of producing high quality research. However, it is notable that only two of the eight respondents engaged in training activities as part of their projects, and the Vihren program's per project training output (0.4 per project) was considerably lower than for Fundamental Research.

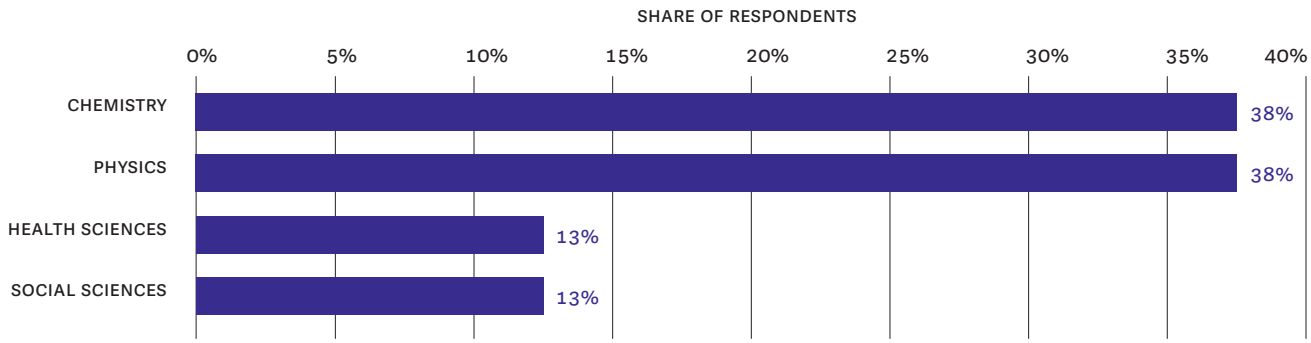
Respondents did not report any research collaborations thus far as part of their projects, despite the fact that the intended results of the program include expanding the scientific contacts and networks of funded researchers and strengthening the scientific networks of participating scientific organizations.

Respondents were largely satisfied with the processes for program application and implementation, with the exceptions of technical monitoring requirements and data protection practices.

The Vihren program has thus far only issued a single call for proposals, funding 10 projects in 2019 for a total of 11.5 million BGN in contracted funding (4.6 million BGN of which has been disbursed). All of the projects funded by the program were still active as of the writing of this report.

The principal investigators (or alternative points of contact) for all 10 projects funded by the program in 2019 were surveyed for this analysis, with 8 beneficiaries responding to the survey for a response rate of 80 percent. Respondents represent 79 percent of the contracted funding for the program with an average grant size of 1.1 million BGN. Respondents' projects were concentrated in one of four scientific fields, led by chemistry and physics (38 percent of projects each), and followed by health sciences and social sciences (13 percent of projects each) (Figure 4.1).

Figure 4.1. Vihren Projects by Scientific Field

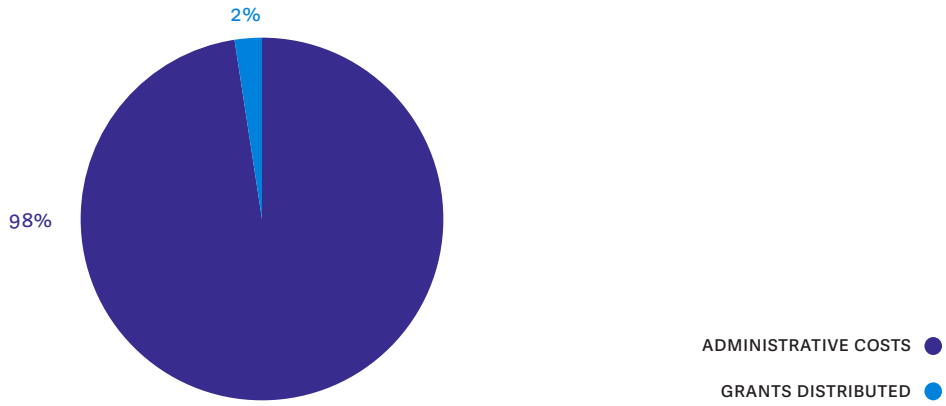


Source: World Bank.

4.1 Efficiency in Use of Inputs

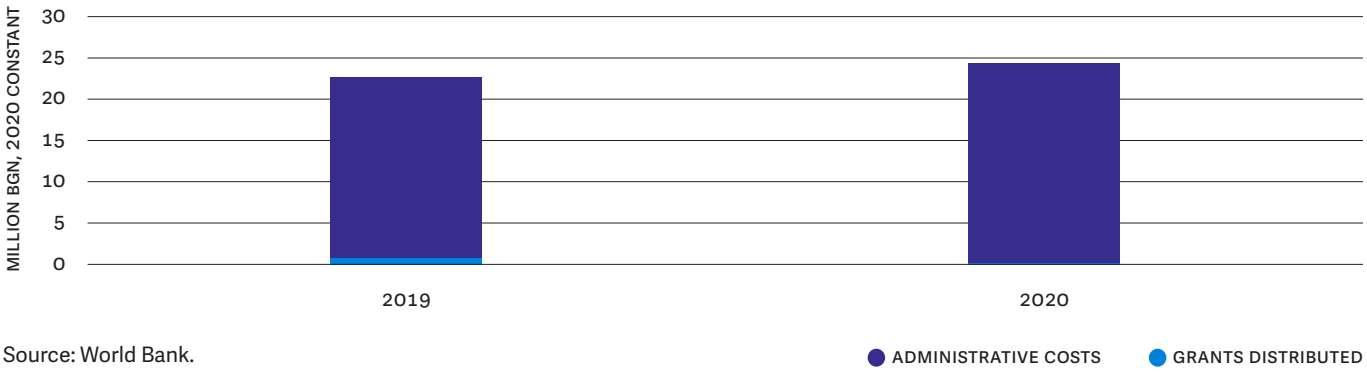
Grants provided to beneficiaries accounted for 98 percent of the costs of the program from 2019 to 2020, while administrative costs made up the remaining 2 percent. (See Figure 4.2.) The bulk of administrative costs of the program occurred in 2019, when the program's single call for proposals was issued and the 10 projects were selected for award, while grants disbursement increased from 2019 to 2020, leading to higher overall program costs in 2020 (Figure 4.3).

Figure 4.2. Vihren Program Costs by Category, 2019–20



Source: World Bank.

Figure 4.3. Vihren Program Costs by Year, 2019–20



Source: World Bank.

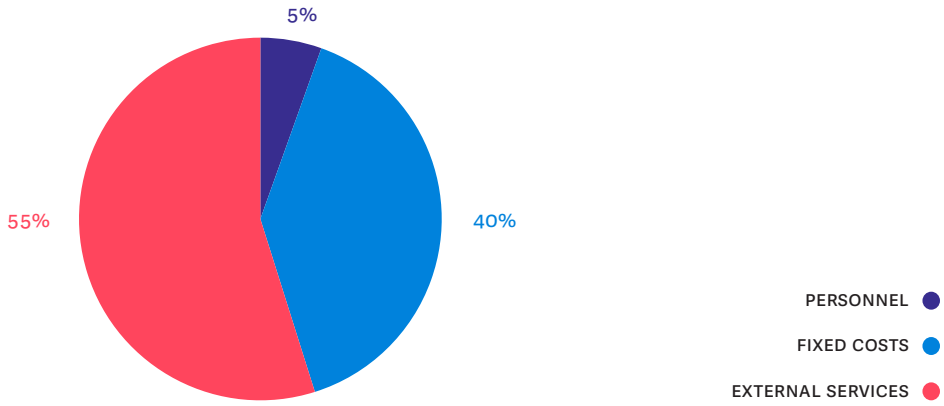
Administrative Costs

External services made up more than half of administrative costs. External services, in the form of contracts to technical experts to evaluate proposals and provide advisory support, made up a relatively large share of program costs (55 percent), while personnel costs only accounted for 6 percent of total administrative costs (Figure 4.4). Most of the costs for external services came in 2019 for contracting technical experts to evaluate proposals. After all 10 projects were awarded in 2019, external services dropped dramatically in 2020. Personnel and fixed costs declined slightly from 2019 to 2020 (Figure 4.5).

Like the Fundamental Research program, the large share of costs for external services and small share for personnel is likely due to the low numbers of full-time staff at the NSF. This arrangement is likely done to compensate for the lack of staff at NSF, whereby the small staff at NSF rely

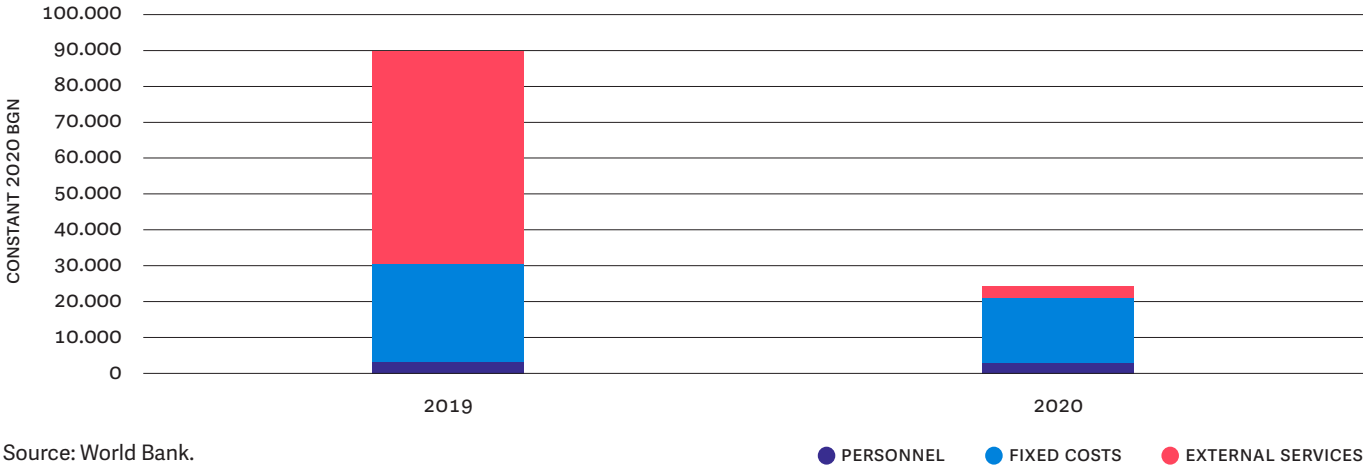
heavily on external experts in the implementation of the program. From the perspective of this efficiency analysis, this is not necessarily an inefficient or ineffective arrangement; however, component 2 of the PER STI project, the *Functional and Governance Analysis,* found that the lack of staff has negatively impacted the implementation of programs at NSF in several areas, including knowledge management and M&E.

Figure 4.4. Vihren Program Administrative Costs by Category, 2019–20



Source: World Bank.

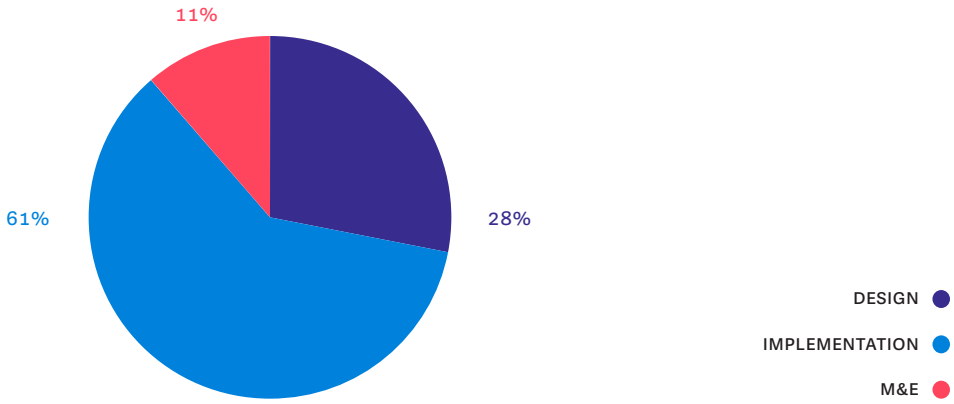
Figure 4.5. Vihren Program Administrative Costs by Year, 2019–20



Source: World Bank.

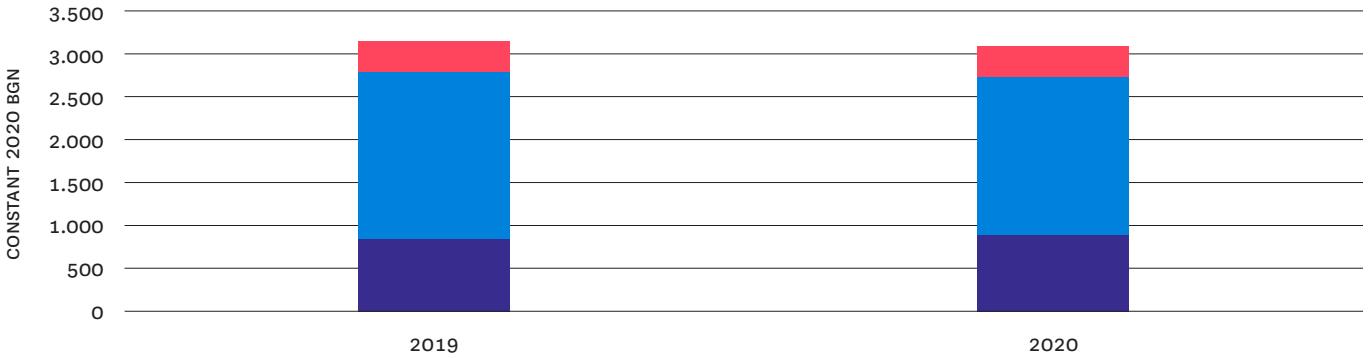
Implementation made up the largest share of personnel costs. Over 60 percent of personnel costs went toward implementation, while 28 percent went to program design, and 11 percent went to M&E (Figure 4.6). Most of the monitoring of Vihren projects is done by external experts, which accounts for the relatively low share of personnel costs in this area. Similarly, the program had no personnel costs for the evaluations of project proposals, which is also done by external experts contracted by the program. Personnel costs remained fairly constant from 2019 to 2020 (Figure 4.7).

Figure 4.6. Vihren Program Personnel Costs by Category, 2019–20



Source: World Bank.

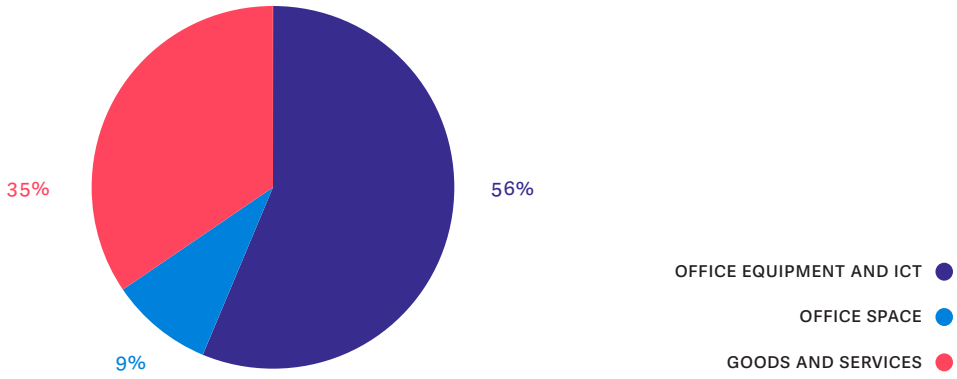
Figure 4.7. Vihren Program Personnel Costs by Year, 2019–20



Source: World Bank.

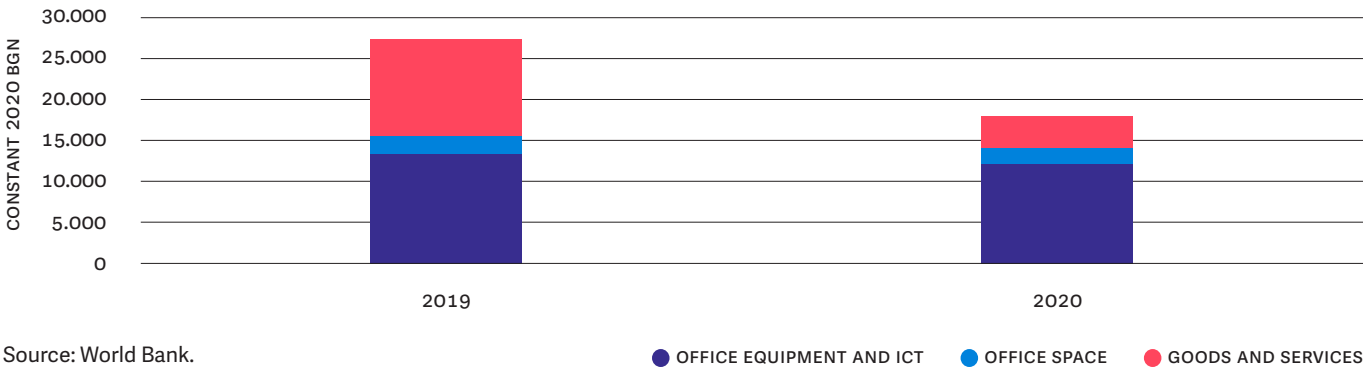
Office equipment and ICT costs made up more than half of the fixed costs for the program. (See Figure 4.8.) While costs related to office equipment, ICT, and office space remained relatively constant from 2019 to 2020, costs related to goods and services were much higher in 2019 (the year all of the Vihren contracts were awarded) (Figure 4.9).

Figure 4.8. Vihren Program Fixed Costs by Category, 2019–20



Source: World Bank.

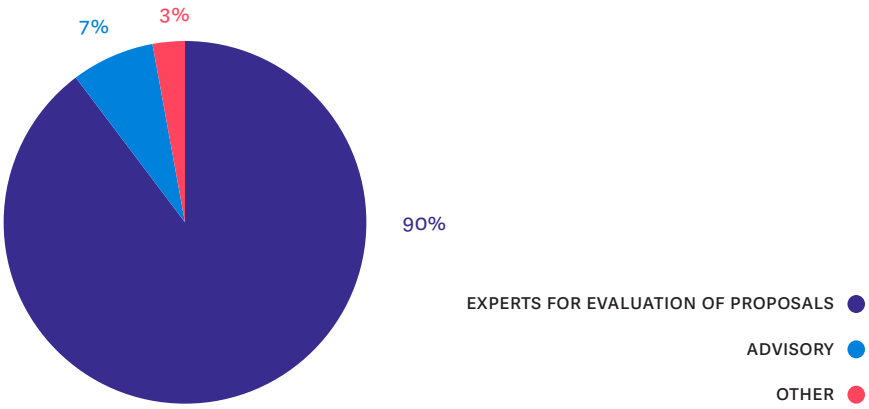
Figure 4.9. Vihren Program Fixed Costs by Year, 2019–20



Source: World Bank.

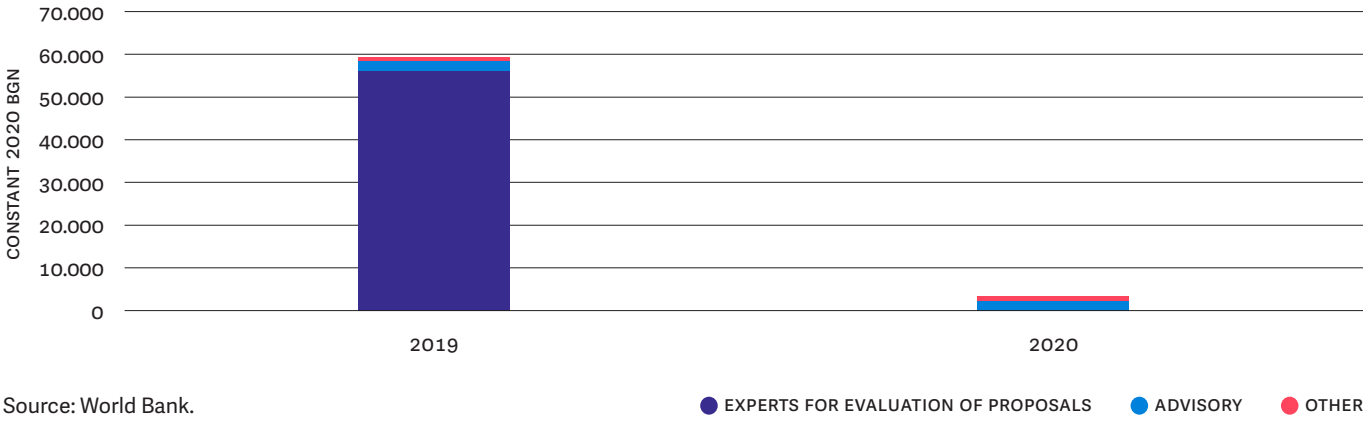
A large majority of costs for external services were related to contracting experts for the evaluation of project proposals. NSF also utilizes external experts on several advisory commissions that provide guidance on its programming, which represented a small share of the costs for external services (Figure 4.10). External services were highest in 2019, when the call for proposals was issued; after all Vihren projects were awarded in 2019, there were no additional costs related to expert evaluators, leading to a dramatic drop in costs related to external services in 2020 (Figure 4.11).

Figure 4.10. Vihren Program External Services Costs by Category, 2019–20



Source: World Bank.

Figure 4.11. Vihren Program External Services Costs by Year, 2019–20



Source: World Bank.

The total administrative costs of implementing the program from 2019 to 2020 was 114,107 BGN, with an average cost per project of 11,411 BGN. In the future, NSF could consider the balance between costs for full-time personnel and external experts in the implementation of its programs – it may ultimately be more effective to allocate more resources to staff and fewer to external services. This may not necessarily lead to cost savings for the program, but it would increase the capacity of NSF as an implementor and allow the program to retain more institutional knowledge.

Table 4.1. Vihren Administrative Costs

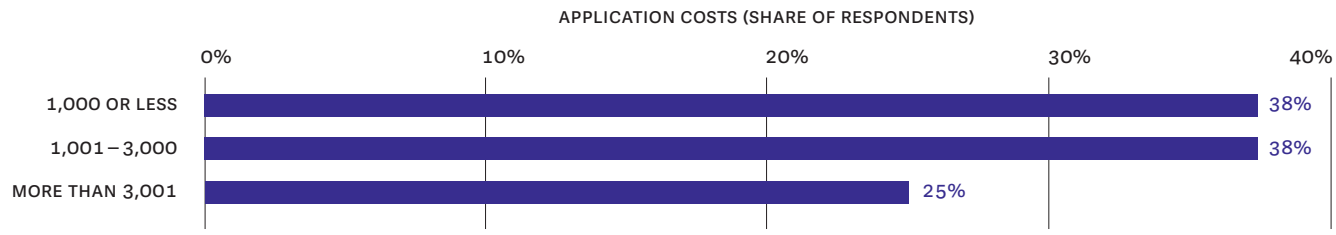
COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	6,232	6,232
Fixed	45,273	45,273
External services	62,601	62,601

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Costs Covered by Beneficiaries

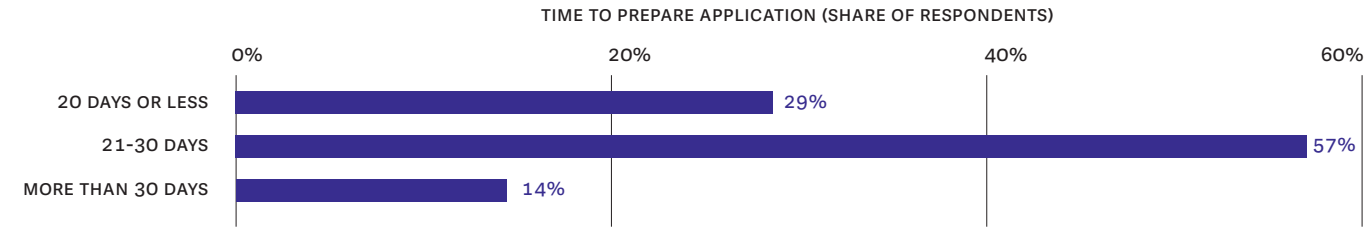
The application process for the Vihren program is slightly costlier and more labor intensive than that of the Fundamental Research program. Respondents reported an average application cost of 2,925 BGN and spent an average of 31 working days preparing their applications. However, the average grant size for Vihren is almost ten times larger than that of Fundamental Research, so application costs as a share of grants contracted is only 0.3 percent for Vihren, compared to 1.9 percent for Fundamental Research. Only two of the eight respondents reported spending more than 3,000 BGN to prepare their applications, while three respondents spent 1,000 BGN or less (Figure 4.12). Only one respondent reported spending more than 30 working days preparing their applications (Figure 4.13).

Figure 4.12. Vihren Program Application Costs



Source: World Bank.

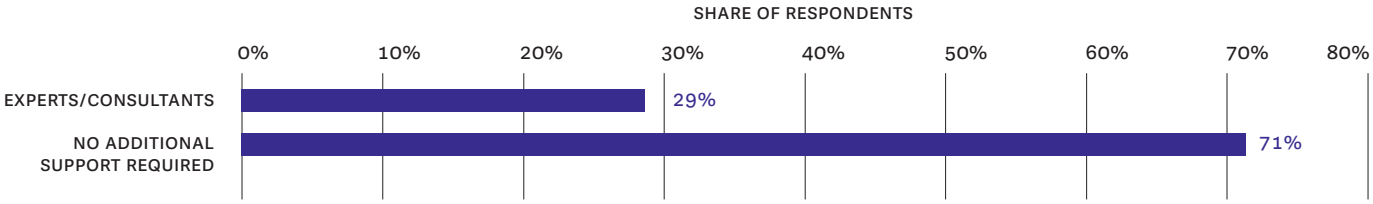
Figure 4.13. Vihren Program Time to Prepare Applications



Source: World Bank. N=7

Most respondents used no external support in preparing applications. Only two of the eight respondents used external support (such as legal, accounting, or other services) to prepare their applications, which likely contributed to the relatively low cost of application preparation when compared to other programs in this analysis. The only type of additional support used by respondents was expert consultants (used by two respondents) (Figure 4.14).

Figure 4.14. Beneficiaries Using External Support in Preparing Applications for the Vihren Program



Source: World Bank.

Although the Vihren program has no requirements for matching contributions from beneficiaries, respondents reported an average of 9,500 BGN in-kind contributions to the implementation of their projects. No applicants made cash contributions. Six respondents made in-kind contributions, while two respondents made no contributions (in kind or cash) to their projects.

On average, the costs covered by the program were 38 times higher than the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 470,559 BGN, while the average cost covered by beneficiaries was 12,425 BGN.

4.2 Efficiency in Generation of Outputs

For every BGN of administrative costs, beneficiaries received an average of 40 BGN. The total program costs from 2019 to 2020 was 4.7 million BGN or 470,559 BGN per project. This includes 4.6 million in disbursed grants to beneficiaries and 114,107 BGN in administrative costs (Table 4.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

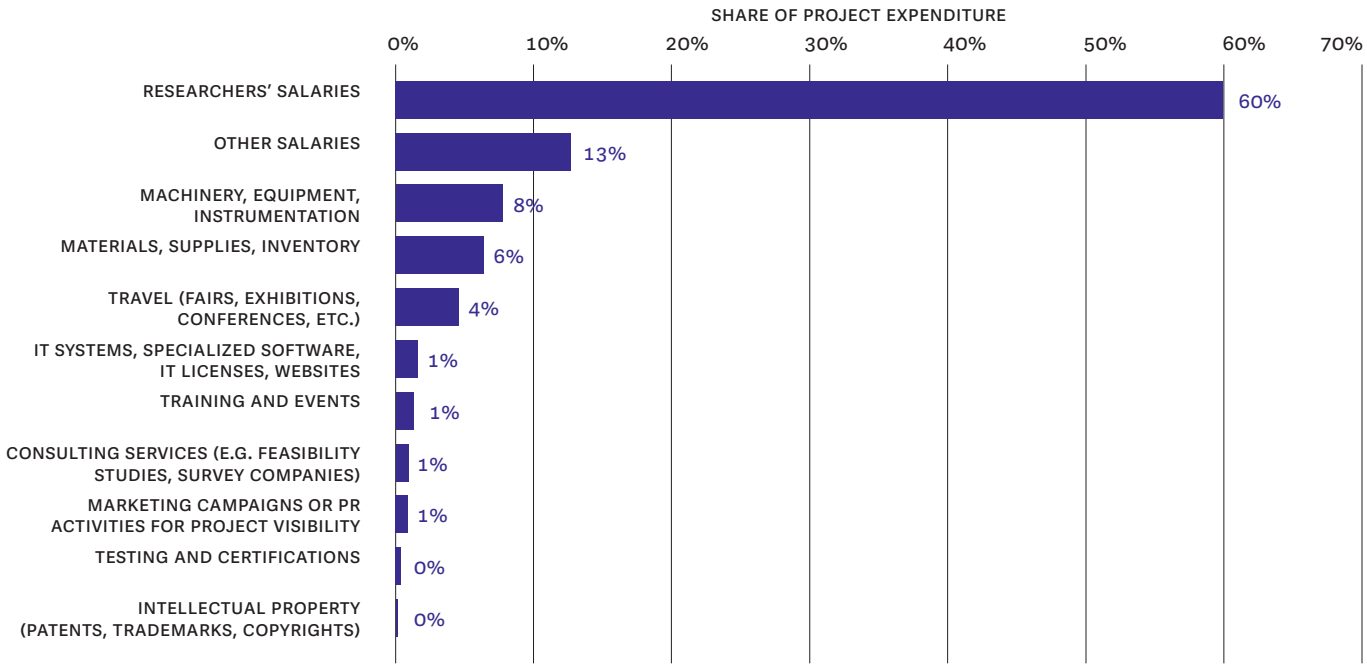
Researcher salaries made up 60 percent of the expenditures of respondents. Other salaries, machinery and equipment, and materials and inventory were the next largest expenses (Figure 4.15). NSF does not allow for grant funding to be used for IP-generation or commercialization activities, which can explain why there were no expenses associated with such activities. It may be worth reconsidering this restriction for the Vihren program, given that the program can support both basic and applied research projects.

Table 4.2. Vihren Program Costs, 2019–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	4,591,480 BGN	459,148 BGN
Administrative and operating costs	114,107 BGN	11,411 BGN
Total program cost	**4,705,587 BGN**	**470,559 BGN**

Source: World Bank. Note: All amounts in constant 2020 BGN.

Figure 4.15. Vihren Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Four outputs were tracked for the Vihren project, based on the program ToC: 1.) project dissemination (in the form of seminars, workshops, and conferences), 2.) training activities, 3.) research collaborations during implementation, and 4.) researchers involved in implementation.

Program respondents generated a total of 47 outputs from 2019 to 2020, or an average of 6.8 outputs per project. Over that period, the program invested an average of 470,559 BGN in beneficiary projects, so respondents generated 1.4 outputs per 100,000 BGN invested.

Seminars, workshops, and conferences were the most common output of Vihren respondents (an average of 3.5 per project), followed by PhDs and postdoctoral researchers hired (2.9 per project), and training activities (0.4) (see Table 4.3).

Table 4.3. Outputs of Vihren Projects

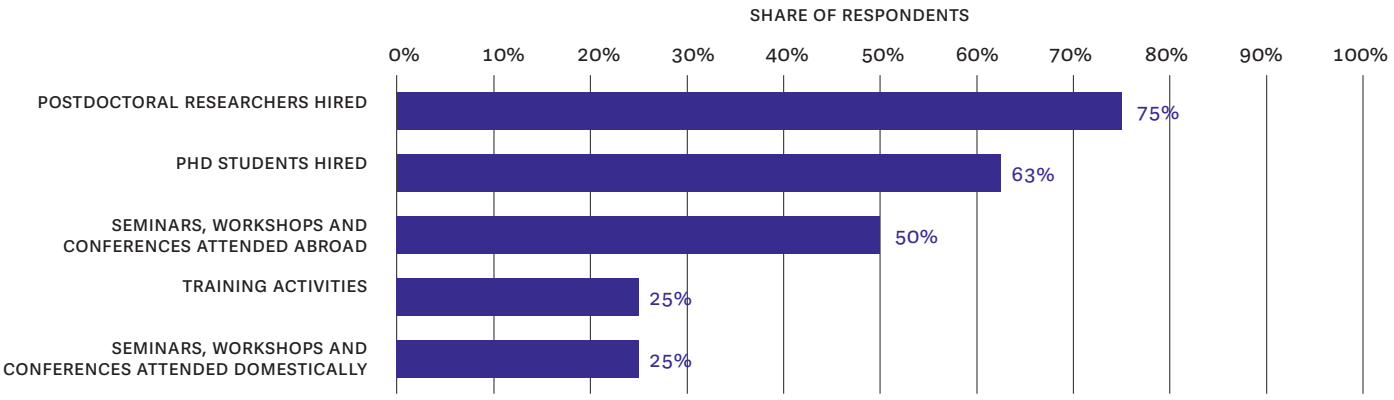
OUTPUT	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTPUT
Seminars, workshops, and conferences	24	3.5	0.8	50%
Training activities	3	0.4	0.1	25%
Collaborations	0	0.0	0.0	0%
PhDs and postdocs hired	20	2.9	0.6	57%

Source: World Bank.

Respondents did not report any research collaborations thus far as part of their projects, despite the fact that the intended results of the program include expanding the scientific contacts and networks of funded researchers and strengthening the scientific networks of participating scientific organizations. It should be noted that the program does not incentivize collaborations (such as awarding additional points to proposals that include research partners) or mandate that beneficiaries collaborate, which may contribute to the lack of collaboration activities of respondents.

Most respondents hired postdoctoral researchers and PhD students. These expenses are in line with one of the core objectives of the Vihren program—to support established and leading scientists to develop research teams capable of producing high quality research. However, given this objective, it is notable that only two of the eight respondents engaged in training activities as part of their projects, and the Vihren programs per project training output (0.4 per project) is considerably lower than for Fundamental Research (1.7 per project) (Figure 4.16).

Figure 4.16. Vihren Program Capacity-Building Activities by Type



Source: World Bank.

4.3 Efficiency in Achievement of Outcomes

Respondents reported a total of 24 outcomes (intended outcomes and other), for an average of three outcomes per project. Over that period, the program invested an average of 470,559 BGN in beneficiary projects, so respondents generated 0.6 outcomes per 100,000 BGN invested.

Two outcomes were tracked for the Vihren program. Based on the program's ToC, the program tracked two outcomes: (1) scientific publications in peer-reviewed journals and (2) research collaborations after project completion. (Because all Vihren projects are ongoing, research collaborations after project completion were not included in this analysis.) Respondents reported an average of 2.3 scientific publications per project (Table 4.4).

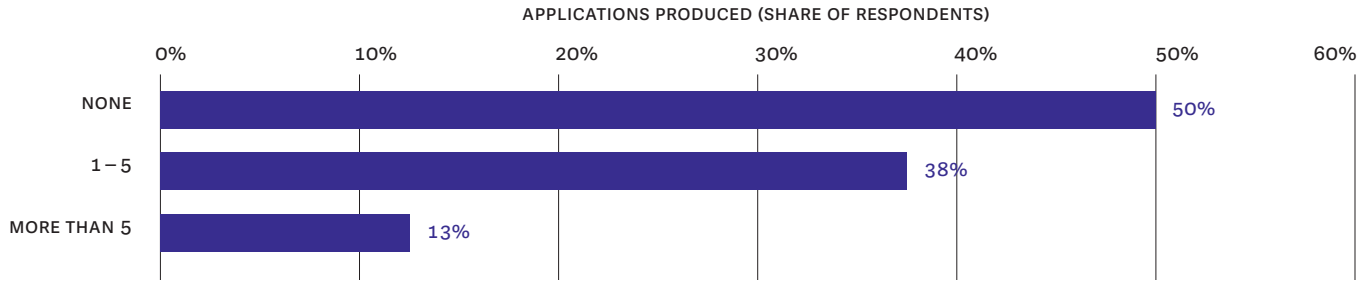
Table 4.4. Intended Outcomes Achieved by Vihren Respondents

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOME PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Scientific publications in peer-reviewed journals	18	2.3	0.5	50%

Source: World Bank.

Half of respondents had not yet produced a publication in a peer reviewed journal as of the time they were surveyed. This low rate of publications is understandable given that all Vihren projects only began in 2019 and the surveys took place in June–July 2021. Almost 40 percent of respondents produced between one and five publications, and 13 percent produced more than five (Figure 4.17).

Figure 4.17. Peer-Reviewed Publications Produced by Vihren Program Beneficiaries



Source: World Bank.

Publications reported by Vihren respondents received few citations. They had lower numbers of year-normalized citations than the Fundamental Research and ICT programs or the average Bulgarian publication indexed in Web of Science between 2016 and 2020 (Table 4.5) However, given the small number of respondents and small number of publications detailed in the survey responses, these findings may not be significant.

Table 4.5. Impact Measures of Vihren Publications

Total publications listed in survey responses	13
Share indexed in Web of Science	38%
Share in journals with impact factor	31%
Average year normalized citations	0.6
Share with international coauthor(s)	40%

Source: World Bank.

Other Results

Vihren projects produced a small number of other outcomes. These other outcomes tracked by the researcher surveys were related to new technology development (Table 4.6), indicating that at least a small share of respondent projects were engaging in innovation activities. At least one respondent reported one or more patent applications, other IP activities (such as industrial designs, copyrights, or transfer agreements), prototype, new software development, or new technology development as part of their project. Like the Fundamental Research results, this suggests that at least a share of Vihren projects generate outputs that could be further developed into new technologies, products, or services.

Table 4.6. Other Outcomes Reported by Vihren Respondents

OTHER OUTCOMES	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Patent applications	1	0.1	0.0	14%
Patents granted	0	0.0	0.0	0%
Other intellectual property activities (industrial designs, copyrights, transfer agreements, etc.)	2	0.2	0.0	14%
Prototype	1	0.1	0.0	14%
New software development	1	0.1	0.0	14%
New technology development	1	0.1	0.0	14%

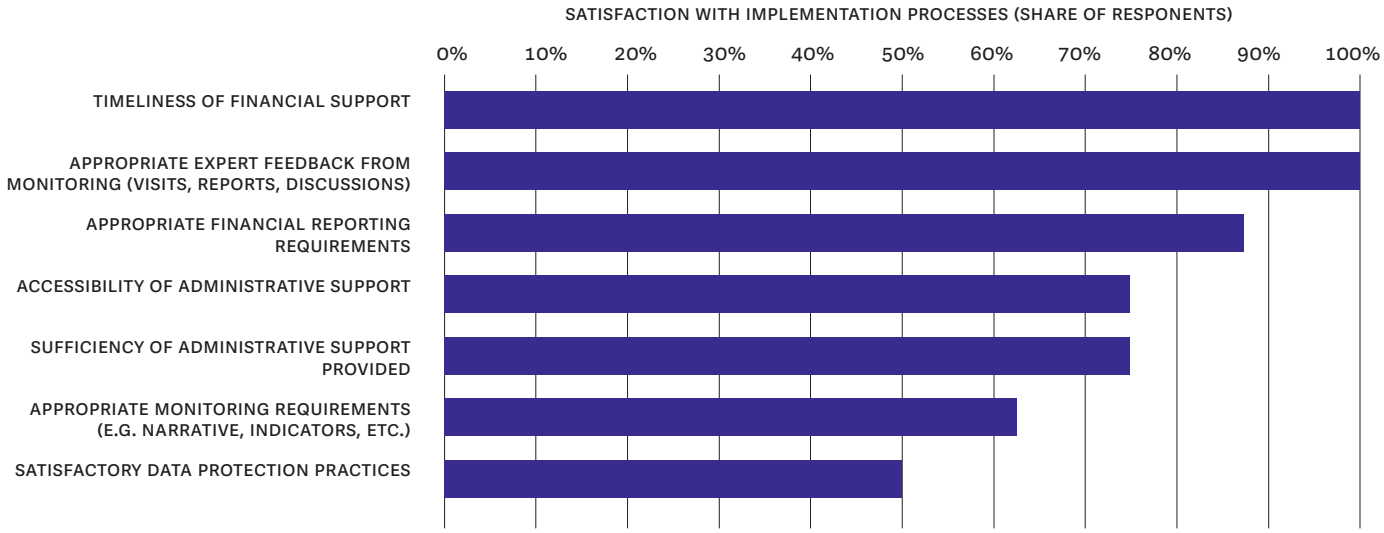
Source: World Bank.

4.4 Perceived Quality

Respondents were largely satisfied with application processes, with 75 percent or more of respondents reporting that they were satisfied with most aspects of project application and selection, with the exceptions of timeliness of application support and the time between selection and funding disbursement. When asked if they think any program selection or eligibility criteria should be added, changed, or removed; one respondent said that eligibility criteria should be altered to broaden the definition of young scientists to include researchers that had recently obtained a PhD. Vihren respondents also noted that the program uses a common selection panel for selecting projects for all the physical sciences (including astronomy, chemistry, materials science, and physics), yet project proposals may be hard to compare across all of these disciplines.

Respondents were also largely satisfied with implementation and monitoring processes. Seventy-five percent or more of respondents reporting that they were satisfied with most aspects of implementation, with the exceptions of technical monitoring requirements (where only 63 percent of respondents were satisfied) and data protection practices (where only 50 percent were satisfied (Figure 4.18). Along with Fundamental Research, Vihren respondents were least satisfied with technical monitoring requirements among the programs included in this analysis, which may indicate that NSF's technical monitoring processes are more burdensome than those or other STI implementors. Unlike beneficiaries of EU operational programmes, NSF beneficiaries do not have access to an online portal with preloaded templates for reporting on project progress.

Figure 4.18. Vihren Program Beneficiaries' Satisfaction with Implementation and Monitoring Processes



Source: World Bank.

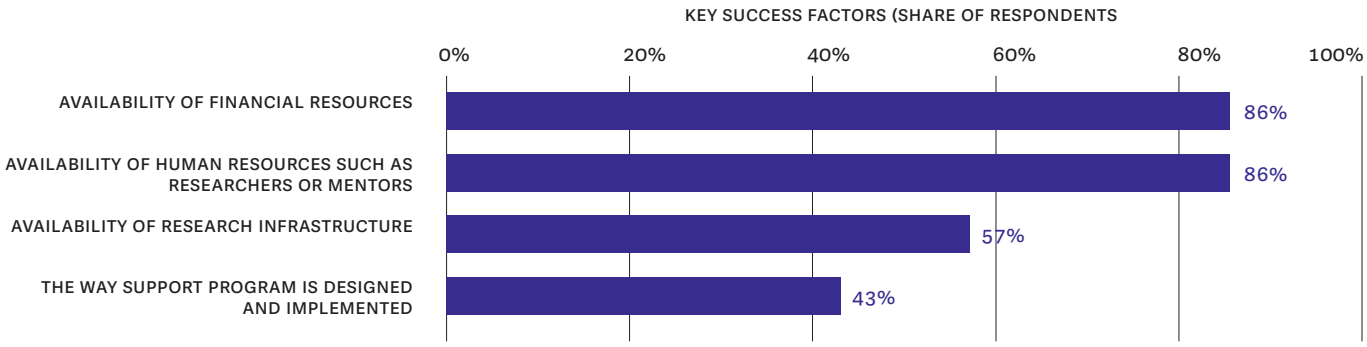
Most respondents felt that the financial resources provided by NSF were sufficient, with 86 percent reporting that they had sufficient funding to successfully complete their projects. The one respondent who said that financial support was insufficient cited inadequate budget cleared by NSF and issues with procurement as reasons why they needed more financial support.

Similarly, most respondents felt that the amount of time allowed by the program to complete their project was sufficient, with 86 percent reporting that they had sufficient time to successfully complete their projects. The one respondent who said the amount of time allowed by the program was insufficient cited difficulties in hiring PhDs students and postdoctoral researchers and lack of support staff as reasons why they required more time.

The availability of financial and human resources were mentioned as the main factors for project success. Each was cited by 86 percent of respondents as one of the top three success factors for

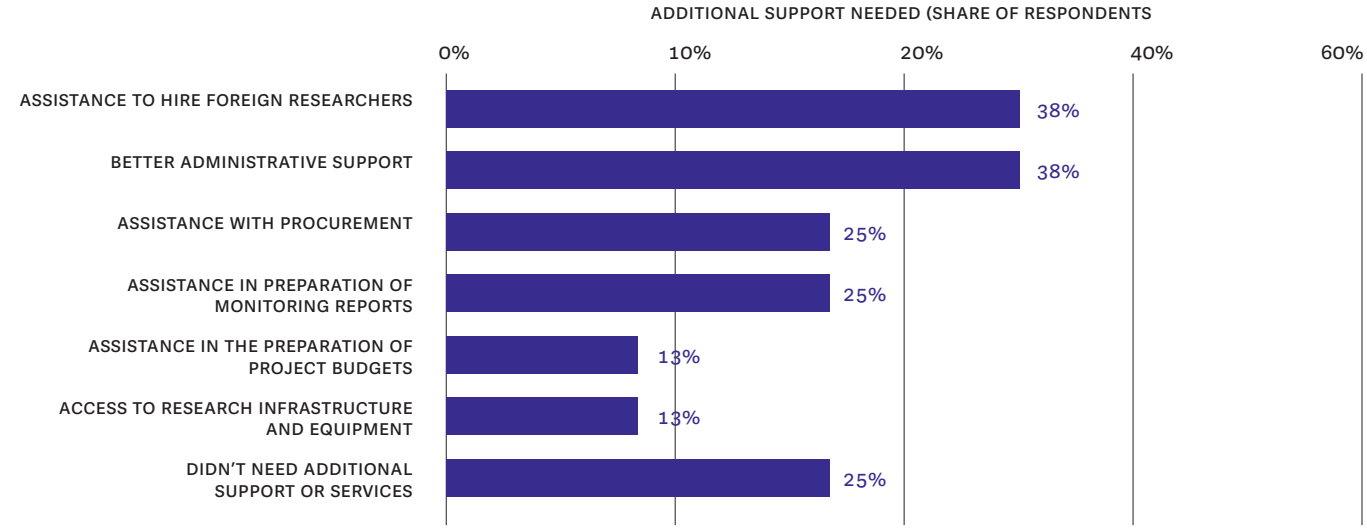
their project. The availability of research infrastructure was also mentioned by more than half of respondents as an important success factor (Figure 4.19). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, respondents cited assistance with the hiring of foreign researchers (by 38 percent of respondents), better administrative support from NSF (by 38 percent), assistance with procurement (by 25 percent), and assistance with the preparation of monitoring reports (by 25 percent) as the most needed additional supports (Figure 4.20). One quarter of respondents felt they did not require any additional support that was not already provided by the program. Given that the program's objectives focus on the development of high-quality research teams led by leading researchers, more assistance for beneficiaries in hiring foreign researchers could help improve project outcomes.

Figure 4.19. Key Success Factors for Vihren Projects



Source: World Bank.

Figure 4.20. Additional Support Needed for Vihren Projects

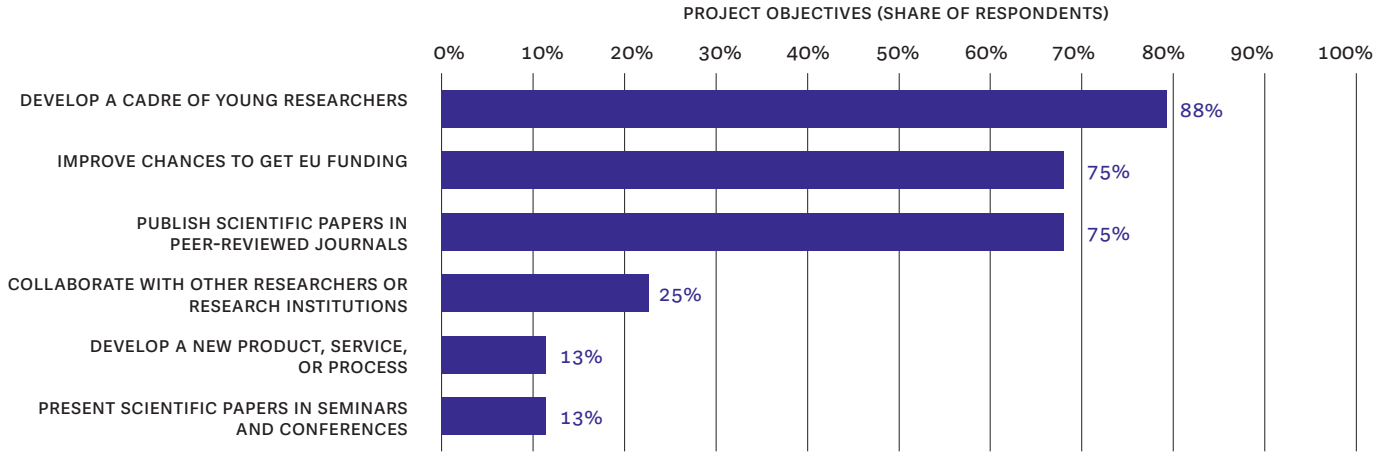


Source: World Bank.

Overall Project Quality

Respondent's project objectives were largely in line with the objectives of the Vihren program. The program focuses on the formation of new research teams around leading and established researchers, and 88 percent of respondents said that one of the key goals of their projects was to develop a cadre of young researchers. A large share of respondents also had objectives related to publishing papers in peer-reviewed journals and improving their chances of obtaining EU funding for their research (Figure 4.21).

Figure 4.21. Vihren Program Project Objectives



Source: World Bank.

5. ICT for a Single Digital Market in Science, Education, and Security

5. ICT for a Single Digital Market in Science, Education, and Security

PROGRAM SUMMARY

ICT for a Single Digital Market in Science, Education, and Security (ICT) is one of the sectoral programs of the National Science Programs 2018–22 portfolio. These programs, implemented by the MoES, are applied research grants focused on addressing identified public challenges in Bulgaria – in the case of the ICT program, it is aimed at building infrastructure, tools, and security for open science. The program funds applied research projects in two core research areas: 1) open science infrastructure and security and 2) digital educational tools. As an applied research program, ICT has intended outcomes related to the development of prototypes, new software, and new technologies.

The sectoral programs of the National Science Programs 2018-2022 portfolio have a different design than traditional research grants: each program provides funding to a consortium of preselected research institutions in a specific scientific field. In the case of the ICT program, the beneficiary consortium is made up of 10 HEIs and PROs, which were preselected based on indicators related to published scientific results in the fields of informatics and data science, so there was no application process or application costs for beneficiaries of the program. MoES also delegates a portion of the administration and monitoring of projects to the consortium, so some of the costs of implementing the overall program are borne by the beneficiaries. In the case of the ICT program, the leading beneficiary of the consortium (the University of Sofia) is responsible for distributing funding to the other members of the consortium, collecting indicators on project progress, and compiling semi-annual technical and financial reports to the ministry.

Administrative costs only made up only 0.2 percent of total program costs; however, the very low share of administrative costs do not represent the full cost of program implementation –a portion of the implementation costs of the program are borne by the beneficiary consortiums. While the beneficiaries

had no costs related to the application processes, respondents reported expending an average of 4.8 percent of grant funding received for management and auditing of their projects.

Scientific publications in peer-reviewed journals were the most common outcome reported by ICT respondents, even though the program's objectives are focused on applied research. Respondents also reported a relatively high number of outcomes related to new software and new technology development, which are the primary intended outcomes of the program. The program generated a relatively high number of collaborations during implementation, which is likely due in part to the design of the program – beneficiaries are members of consortiums that collaborate with each other on individual projects.

Respondent's project objectives differed significantly from the objectives of the ICT program. The program primarily aims to support the development of new digital tools and software in the areas of open science and education, with objectives related to the development of new software, digital tools, and open science repositories. However, the most common project objectives reported by respondents were developing a cadre of young researchers, collaborating with other researchers or research institutions, and publishing scientific papers in peer-reviewed journals. This may explain why respondents produced a higher number of publications per project than might be expected for an applied research program. This misalignment may stem from the fact that there was no application process for the program, and therefore beneficiary projects were not evaluated by the MoES.

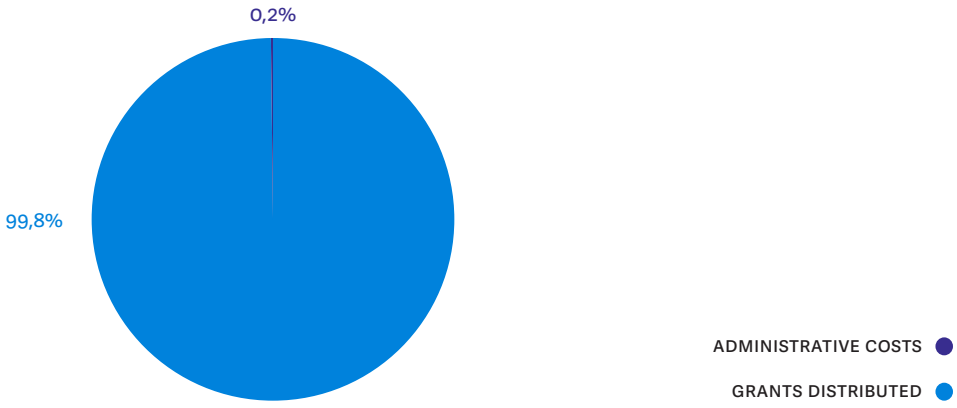
The program was started in 2018 and issued 10 grants to consortium members in 2019, totaling 4.2 million BGN. Disbursements to date total 3.2 million BGN.

The principal investigators (or alternative points of contact) for all 12 lead beneficiaries of the ICT consortium were surveyed for this analysis, with 8 beneficiaries responding to the survey for a response rate of 67 percent. Respondents represent 85 percent of the contracted funding for the program with an average grant size of 444,336 BGN. All respondents had projects in the scientific field of mathematical sciences and informatics.

5.1 Efficiency in Use of Inputs

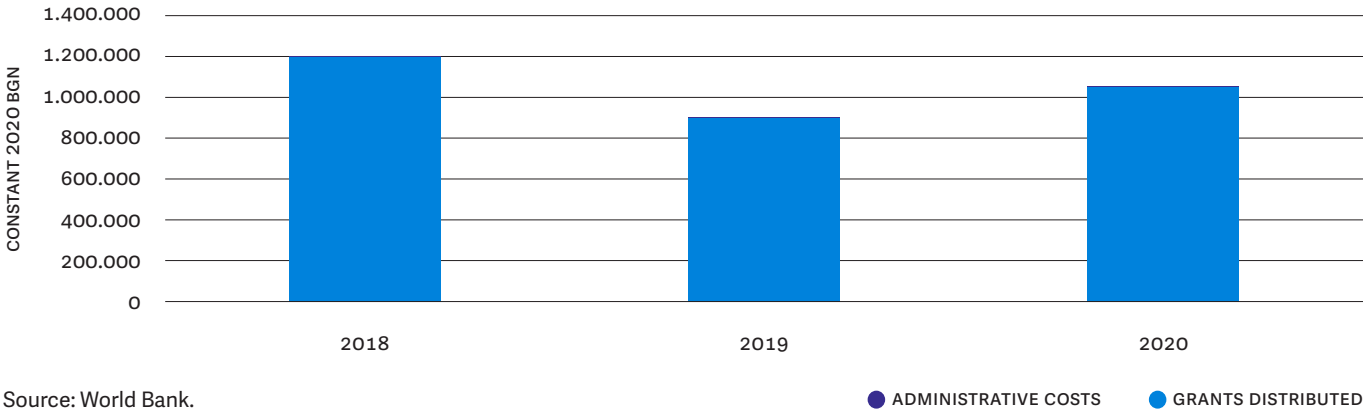
Grants are the lion's share of ICT program costs, which peaked in 2018. Grants distributed to beneficiaries made up 99.8 percent of the costs of the program from 2018 to 2020, while administrative costs made up only 0.2 percent of program costs (Figure 5.1). Grant disbursement was highest in 2018, before dropping in 2019 and rising again slightly in 2020 (Figure 5.2).

Figure 5.1. ICT Program Costs by Category, 2018–20



Source: World Bank.

Figure 5.2. ICT Program Costs by Year, 2018–20

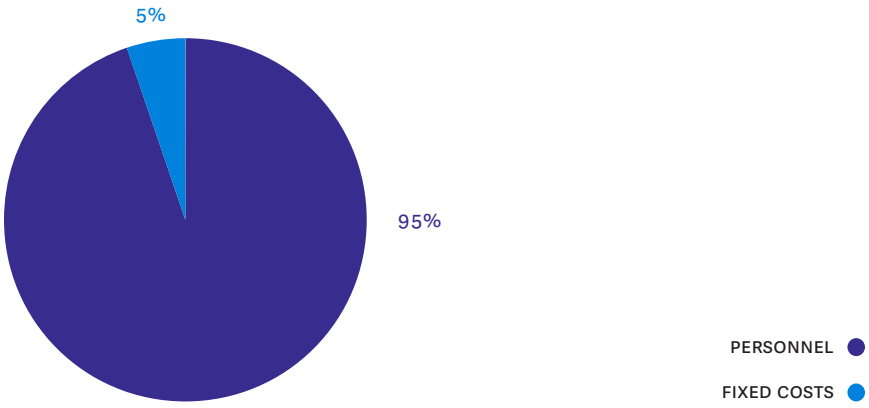


Source: World Bank.

Administrative Costs

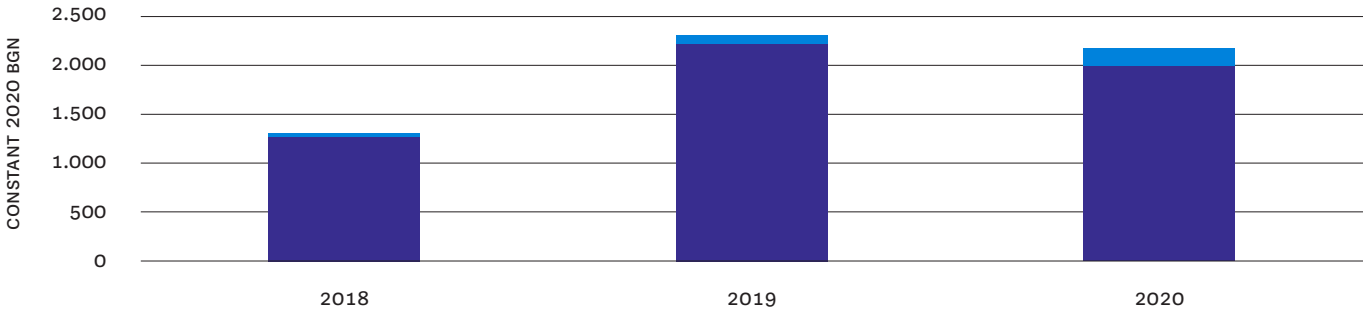
Personnel costs made up 95 percent of total administrative costs, with fixed costs making up the remaining 5 percent of administrative costs. There were no costs related to external services for the program (Figure 5.3). Personnel costs were highest in 2019—the first full year after the 10 projects were active—before declining slightly in 2020 (Figure 5.4).

Figure 5.3. ICT Program Administrative Costs by Category, 2018–20



Source: World Bank.

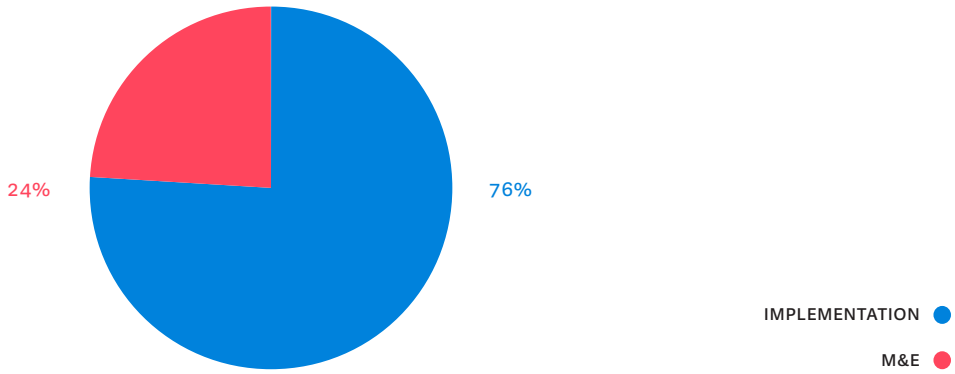
Figure 5.4. ICT Program Administrative Costs by Year, 2018–20



Source: World Bank.

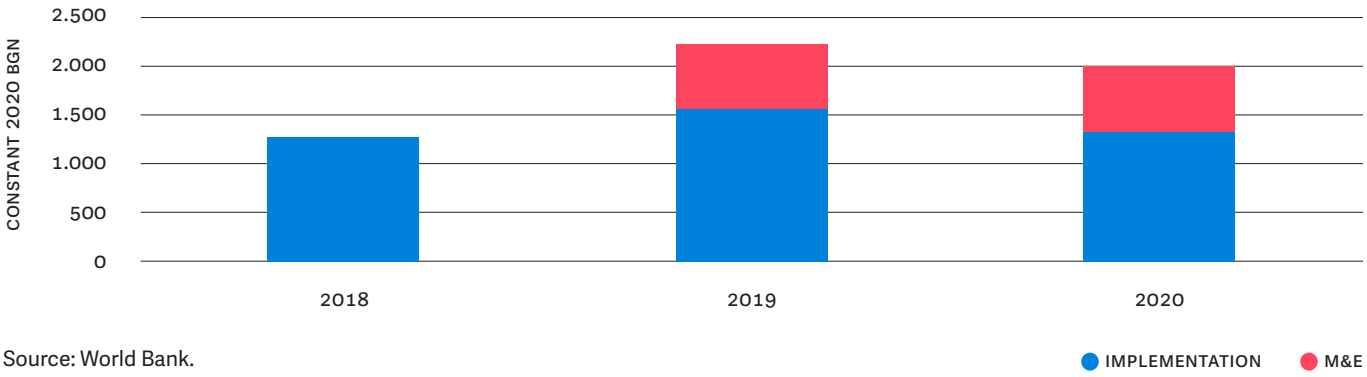
Costs related to implementation made up over 75 percent of personnel costs for the program, with the remainder coming from costs for M&E. (See Figure 5.5.) All of the costs for M&E came after 2018 (the year the projects were awarded and launched), while costs related to implementation have remained relatively constant from 2018 to 2020 (Figure 5.6).

Figure 5.5. ICT Program Personnel Costs by Category, 2018–20



Source: World Bank.

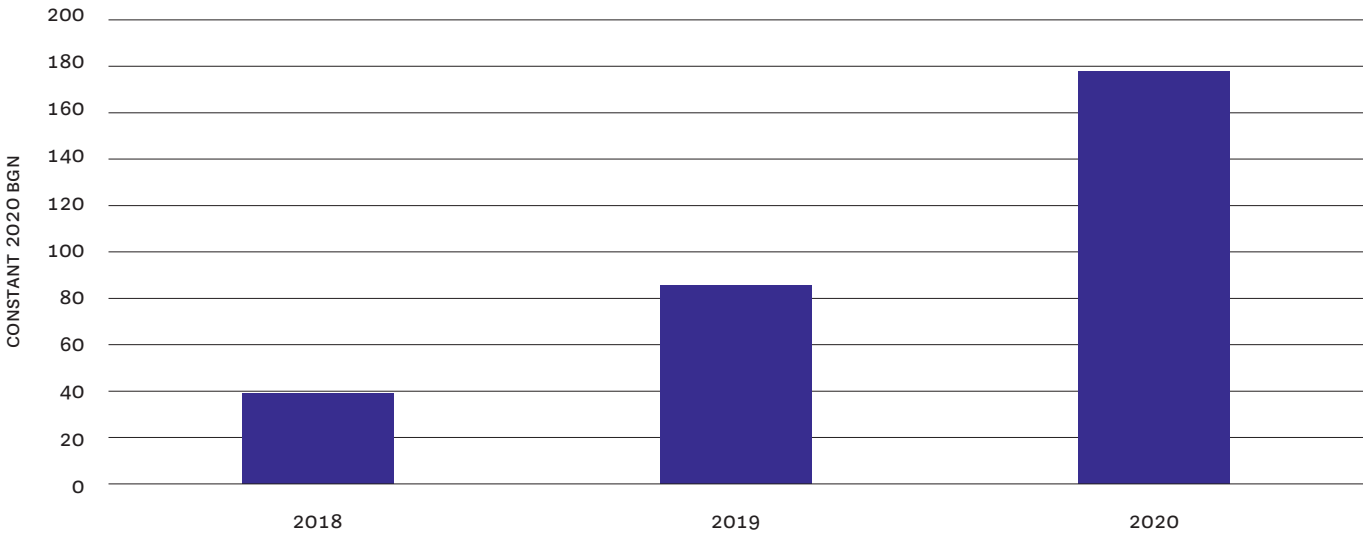
Figure 5.6. ICT Program Personnel Costs by Year, 2018–20



Source: World Bank.

Fixed costs have risen steadily since 2018, although they still represented a very small portion (less than five percent) of total administrative costs (Figure 5.7). Due to data availability, it was not possible to separate out fixed costs by category (such as costs for goods and services, and so on).

Figure 5.7. ICT Program Fixed Costs by Year, 2018–20



Source: World Bank.

The total administrative costs of implementing the program from 2018 to 2020 was 5,790 BGN, with an average cost per project of 483 BGN (Table 5.1). However, the extremely low average administrative cost per project is misleading – as discussed in the next section, a portion of the administrative and implementation costs of the program are borne by the beneficiary consortiums, so the full cost of program implementation is not reflected here. By comparison, the administrative average cost per project was 483 BGN, but respondents spent an average of 21,328 BGN per project on management and auditing costs.

Table 5.1. ICT Administrative Costs

COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	5,487 BGN	457 BGN
Fixed	302 BGN	25 BGN
External services	0 BGN	0 BGN

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Costs Covered by Beneficiaries

As discussed before, the National Science Programs sectoral programs have a different design than traditional grant programs – each provides funding to a preselected consortium of beneficiary HEIs and PROs. Much of the administration, monitoring, and auditing of the program is actually done by the consortium, rather than the MoES. Administration costs to the Ministry are low, but the beneficiaries bear additional costs because of this design.

There were no application costs associated with the program. The ICT program, like the other programs in the National Science Programs 2018-2022 portfolio, has no application process; instead, beneficiaries are preselected to participate based on indicators related to published scientific results in the fields of informatics and data science. Therefore, respondents reported no costs related to preparing their applications.

The ICT program has no matching requirement for beneficiaries, but 63 percent of respondents reported making in-kind contributions to their projects for an average of 34,125 BGN in in kind contributions to the implementation of their projects. In-kind contributions for a project of this kind could take the form of researcher salaries and the usage of facilities, laboratories, and equipment. No respondents made cash contributions to their projects.

Respondents also reported expending an average of 4.8 percent of grant funding received for administration and auditing of their projects, for an average of 21,328 BGN per beneficiary. These additional costs are due to the design of the sectoral programs of the National Science Programs portfolio, which delegate a portion of the administration of the program to the beneficiary consortiums.

On average, the costs covered by the program was 4.7 times higher than the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 262,982 BGN, while the average cost covered by beneficiaries was 55,453 BGN.

5.2 Efficiency in Generation of Outputs

For every BGN of administrative costs, beneficiaries received an average of 544 BGN. The total program costs from 2018 to 2020 was 3.2 million BGN, or 262,982 BGN per project. This includes 3.15 million in disbursed grants to beneficiaries and 5,790 BGN in administrative costs (Table 5.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

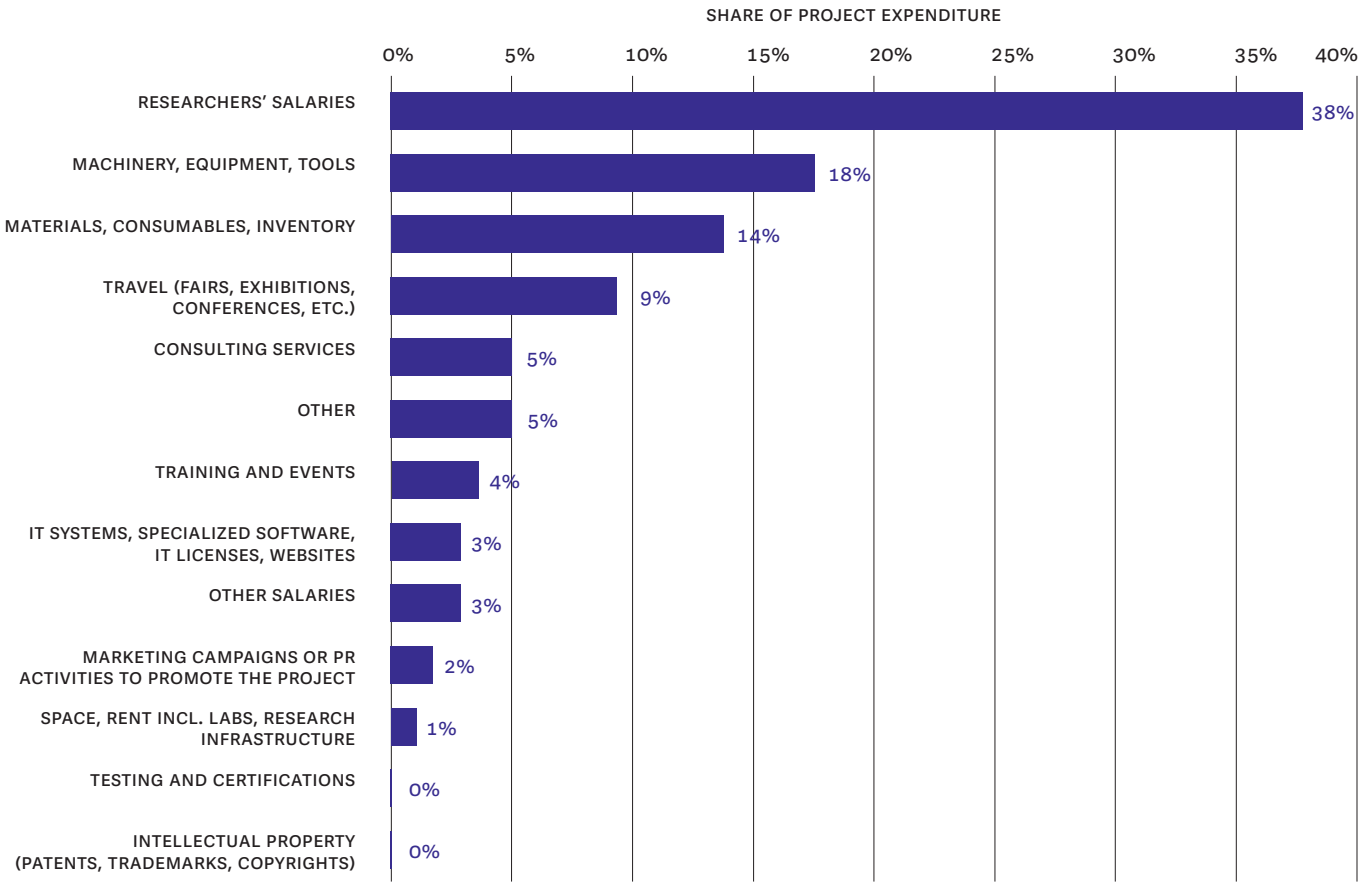
Table 5.2. ICT Program Costs, 2018–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	3,150,000 BGN	262,500 BGN
Administrative and operating costs	5,790 BGN	482 BGN
Total program cost	**3,155,790 BGN**	**262,982 BGN**

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Researcher salaries were the largest expenditure. Respondents reported that researcher salaries made up 38 percent of total project costs. Machinery and equipment (18 percent), materials and consumables (14 percent) and travel (nine percent) were the next largest expenses by size (Figure 5.8).

Figure 5.8. ICT Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Three outputs were tracked for the ICT program, based on the program ToC: 1.) project dissemination (in the form of seminars, workshops, and conferences), 2.) training activities, and 3.) research collaborations during implementation.

Program respondents generated a total of 207 outputs from 2018 to 2020, or an average of 25.9 outputs per project. Over that period, the program invested an average of 262,982 BGN in beneficiary projects, so respondents generated 9.8 outputs per 100,000 BGN invested.

Seminars, workshops, and conferences were the most common output of ICT projects. ICT projects produced an average of 14.4 seminars, workshops, and conferences. Other common outputs were collaborations during implementation (average 6.8 per project), and training activities (4.8 per project) (Table 5.3).

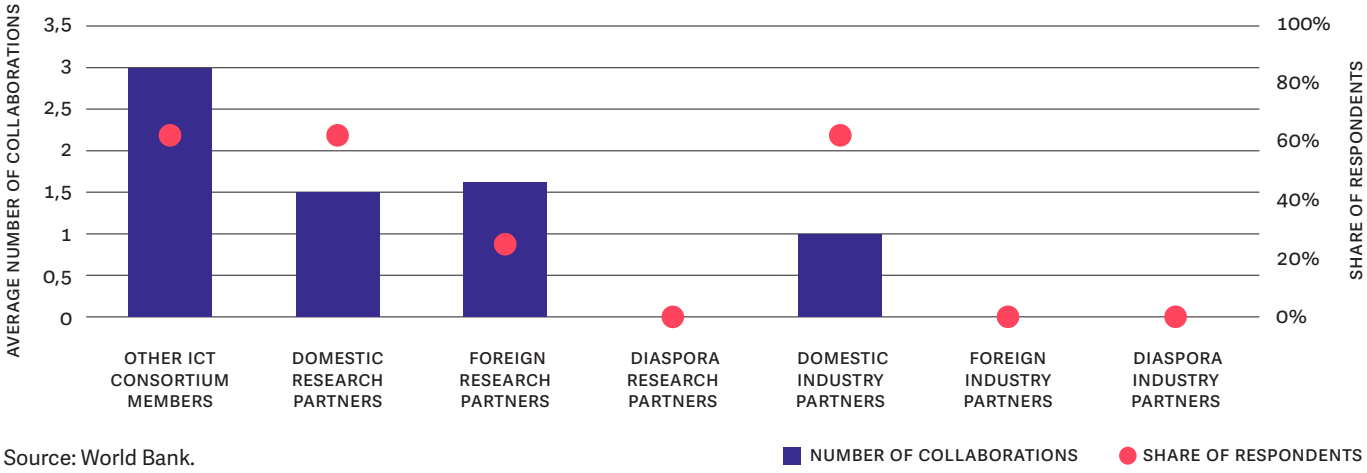
Table 5.3. Outputs Reported by ICT Beneficiaries

INTENDED OUTPUT	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTPUT
Seminars, workshops, and conferences	115	14.4	5.5	88%
Training activities	38	4.8	2.2	88%
Collaborations	54	6.8	2.6	88%

Source: World Bank.

Collaborations with other members of the ICT consortium were most common. The most common type of collaboration during implementation, both by average number of collaborations and share of respondents that engaged in such a collaboration, was with other members of the ICT consortium—understandable, given the design of the program. Other common collaborations were with domestic research partners (outside of the consortium) and domestic industry partners (Figure 5.9).

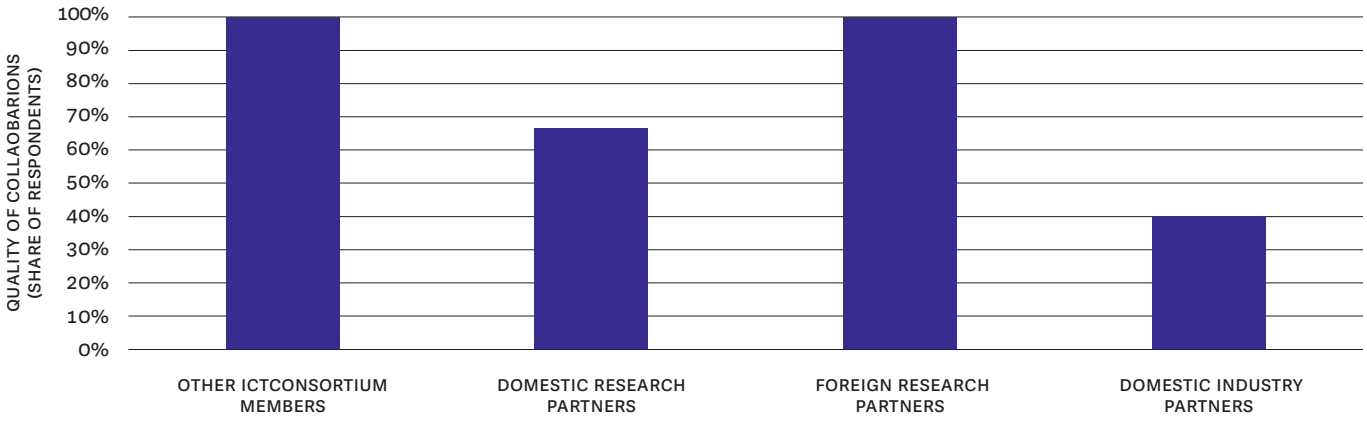
Figure 5.9. ICT Project Collaborations by Type of Partner



Source: World Bank.

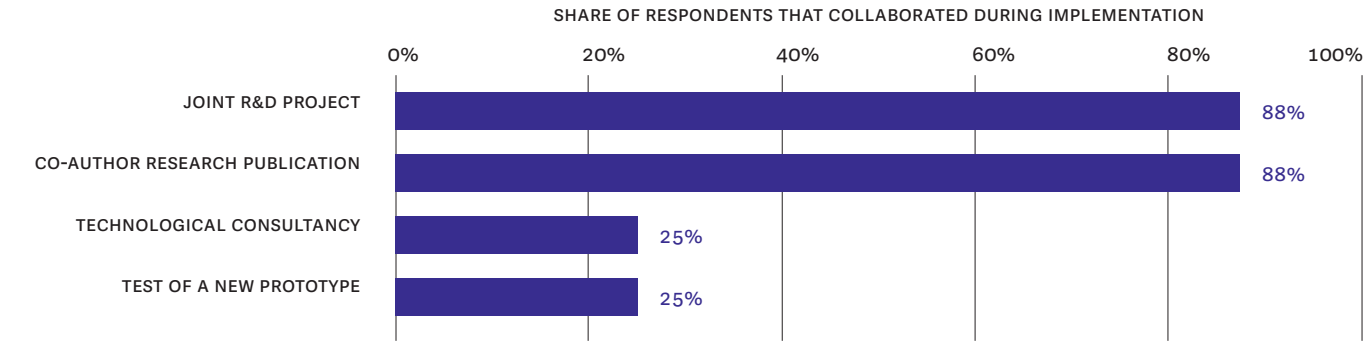
Respondents were generally satisfied with the quality of their collaborations with other members of the consortium and other research partners, but less satisfied with their collaborations with domestic industry partners. All respondents were satisfied with their collaborations with other members of the ICT consortium and foreign research partners, while 67 percent were satisfied with their collaborations with domestic research partners, and only 40 percent were satisfied with collaborations with domestic industry (Figure 5.10). The most common types of collaborations reported were joint R&D projects and co-authoring research publications, while technology consultancies and testing of prototypes were rarer (Figure 5.11).

Figure 5.10. Satisfaction with the Quality of ICT Collaborations



Source: World Bank.
Note: Left figure shows the share of respondents who rated their collaborations as above average or excellent

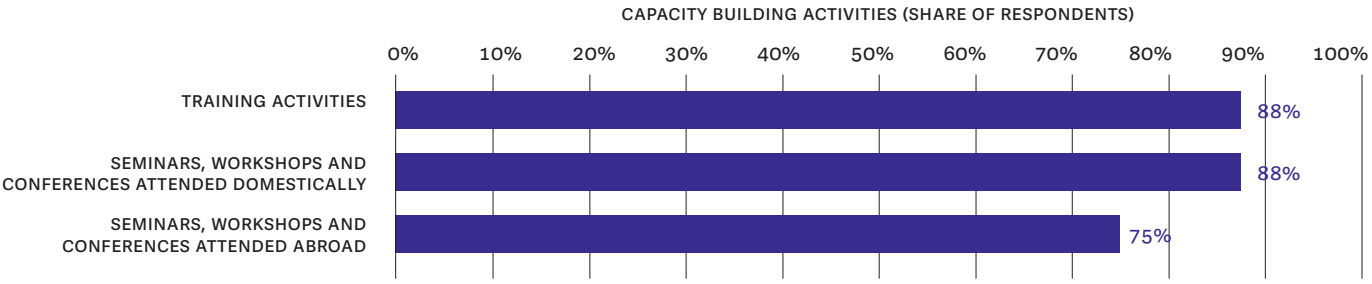
Figure 5.11. ICT Collaborations by Type



Source: World Bank.

Capacity-building activities were common project outputs. The majority of respondents engaged in all three types of capacity building activities tracked by the researcher survey. Three quarters or more of respondents reported that they had completed training activities and attended domestic and international conferences, seminars, and workshops as part of their projects (Figure 5.12).

Figure 5.12. Engagement in Capacity-Building Activities by Type



Source: World Bank.

5.3 Efficiency in Achievement of Outcomes

Respondents reported a total of 254 outcomes (intended outcomes and other), for an average of 31.8 outcomes per project. Over that period, the program invested an average of 262,982 BGN in beneficiary projects, so respondents generated 12.1 outcomes per 100,000 BGN invested.

Six outcomes were included for the ICT program, based on the program's ToC: 1.) Scientific publications in peer-reviewed journals, 2.) prototypes, 3.) new software development, 4.) new technology development, 5.) new open science repositories, and 6.) research collaborations after project completion (not included in this analysis given that all ICT projects are still ongoing).

Scientific publications in peer-reviewed journals was the most common outcome reported at 24.9 per project, followed by new software development (2.4 per project), prototypes (2), new open science repositories (1.6), and new technology development (0.5) (Table 5.4).

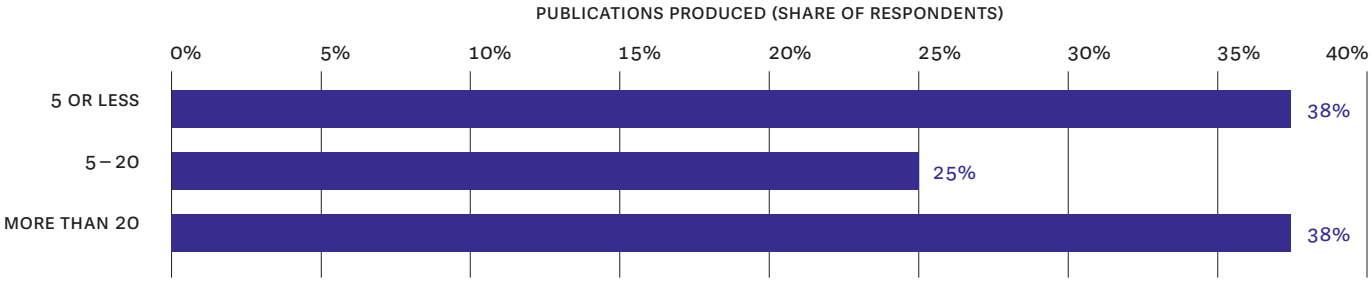
Table 5.4. ICT Intended Outcomes

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOME PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Scientific publications in peer-reviewed journals	199	24.9	9.5	88%
Prototype	16	2	0.8	25%
New software development	19	2.4	0.9	63%
New technology development	4	0.5	0.2	25%
Open science repositories	13	1.6	0.6	50%

Source: World Bank.
Note: Open science repositories were only tracked for the ICT program

An equal share of respondents produced fewer than 5 or more than 20 publications. Almost 40 percent of respondents produced more than 20 publications as part of their project, while 25 percent produced between five and 20 publications, and 38 percent produced less than five (Figure 5.13).

Figure 5.13. Peer-Reviewed Publications Produced by ICT Beneficiaries



Source: World Bank.

Publications reported by ICT respondents had the highest average year-normalized citations and highest share of publications with international coauthors of programs after those reported by Fundamental Research respondents. Almost half of the publications listed by respondents were indexed in Web of Science and 36 percent were in journals with impact factor (Table 5.5). However, ICT publication generally had fewer year-normalized citations than the average Bulgarian publication indexed in Web of Science from 2016 to 2020.

Table 5.5. Impact Measures of ICT Publications

Total publications listed in survey responses	28
Share indexed in Web of Science	46%
Share in journals with impact factor	36%
Average year normalized citations	1.27
Share with international coauthor(s)	54%

Source: World Bank.

Other Results

ICT respondents reported very few outcomes related to IP creation. (See Table 5.6.) The program has no objectives related to patents or technology transfer. Nevertheless, its goals of developing new software and technologies for open science and digital education for public use seem like they would eventually lead to the creation and transfer of IP at some point during project implementation.

Table 5.6. Other Outcomes Reported by ICT Respondents

OTHER OUTCOMES	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOME PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Patents grants	0	0	0.0	0%
Patent applications	0	0	0.0	0%
Other IP activities	3	0.4	0.2	13%

Source: World Bank.
Note: a. Other IP activities includes industrial designs, copyrights, transfer agreements, and so on.

5.4 Perceived Quality

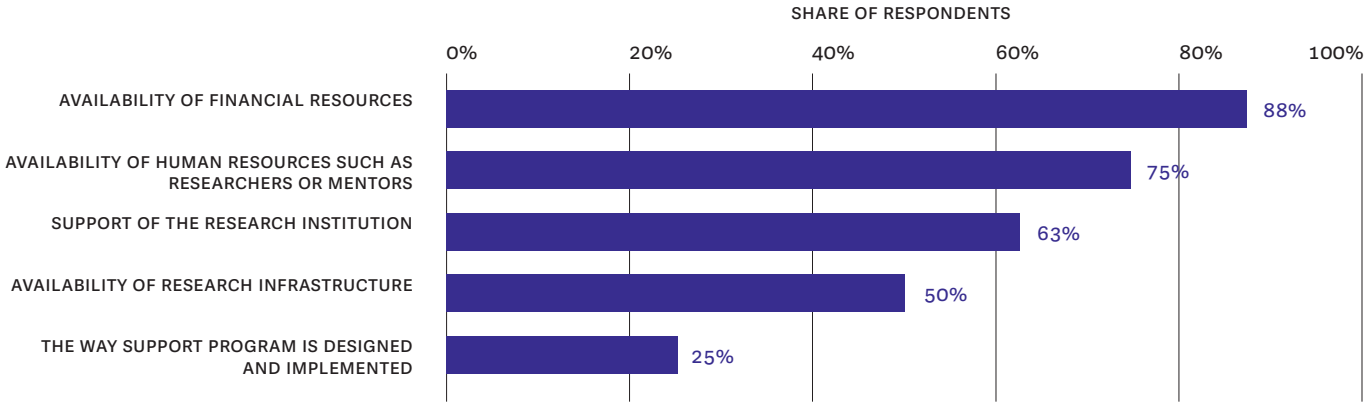
As mentioned earlier, beneficiaries of the program were preselected and there was no application process; therefore, beneficiaries of this program were not questioned about their perceptions of application and selection processes.

Respondents were highly satisfied with the ICT program's implementation and monitoring processes, with more than 80 percent of respondents reporting satisfaction with all implementation processes except for data protection practices, where only 50 percent of respondents were satisfied.

Most respondents felt that the financial resources provided by MoES were sufficient, with 88 percent reporting that they had sufficient funding to successfully complete their project. The one respondent who said that financial support was insufficient cited increased costs of inputs, issues with procurement, and lack of financial support from their institution as the reasons why the financial support provided by the program was not sufficient. Similarly, most respondents felt that the amount of time allowed by the program to complete their projects was sufficient, with 88 percent reporting that they had sufficient time to successfully complete their projects.

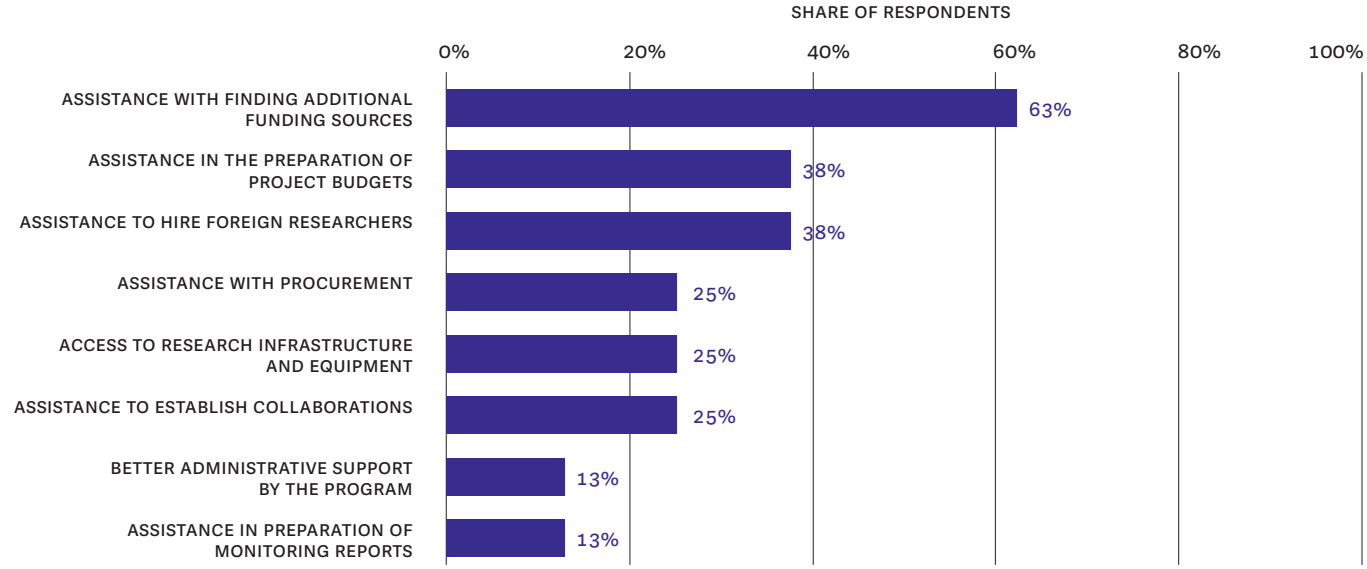
Financial and human resources were commonly cited key success factors, but assistance with additional funding sources was the largest gap in program support. The availability of financial and human resources were cited as key success factors by 88 percent and 75 percent of respondents, respectively. At least half of respondents felt that support from their research institution and the availability of research infrastructure were also key success factors (Figure 5.14). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, respondents cited assistance with finding additional funding sources (by 63 percent of respondents), assistance with the preparation of project budgets (by 38 percent), and assistance to hire foreign researchers (by 38 percent) as the most needed additional support (Figure 5.15).

Figure 5.14. Key Success Factors for ICT Projects



Source: World Bank.

Figure 5.15. Additional Support Needed for ICT Projects

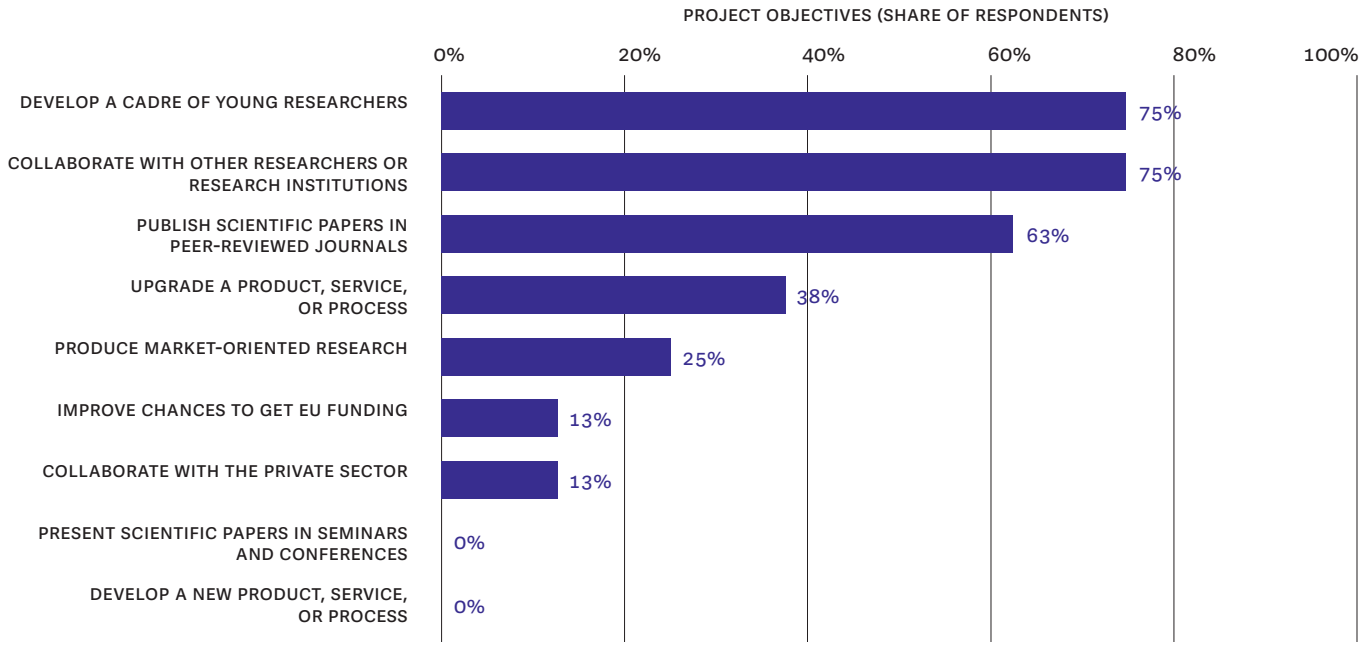


Source: World Bank.

Overall Project Quality

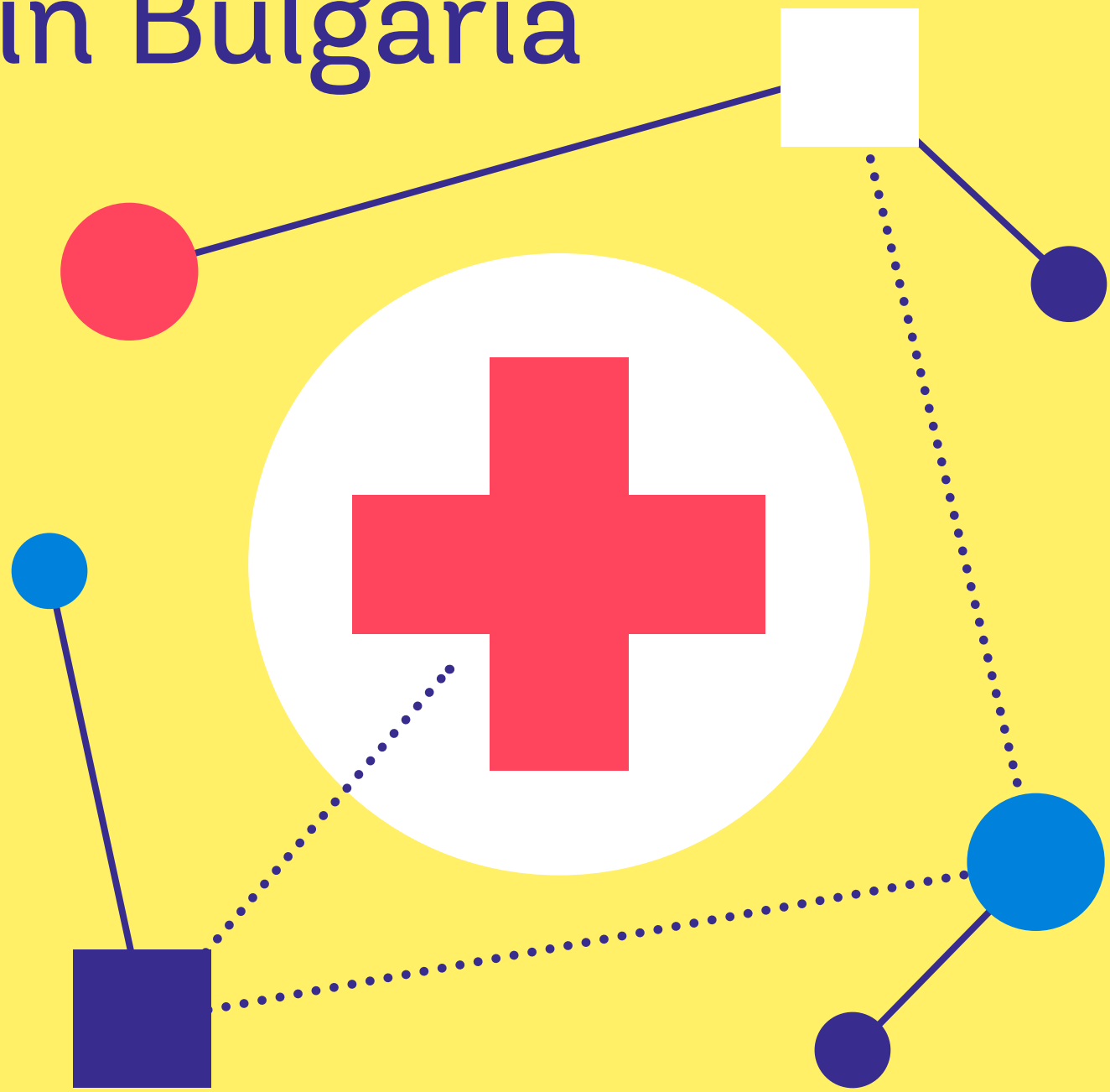
Respondent's project objectives differed significantly from the objectives of the ICT program. The program primarily aims to support the development of new digital tools and software in the areas of open science and education, with objectives related to applied research and the development of new software, digital tools, and open science repositories. However, the most common project objectives reported by beneficiaries were developing a cadre of young researchers (reported by 75 percent of respondents), collaborating with other researchers or research institutions (75 percent), and publishing scientific papers in peer-reviewed journals (63 percent) (Figure 5.16). No respondents said that developing a new product, service, or process was an objective of their project, while only 38 percent said that upgrading a product, service, or process was an objective. This misalignment may stem from the fact that there was no application process for the program, and therefore beneficiary projects were not evaluated by MoES, but rather selected by members of the beneficiary consortium. This may be a weakness of this program management structure.

Figure 5.16. ICT Program Project Objectives



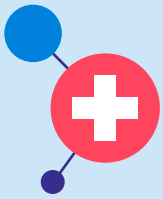
Source: World Bank.

6. Electronic Health in Bulgaria



6. Electronic Health in Bulgaria

PROGRAM SUMMARY



Electronic Health in Bulgaria (eHealth) is one of the sectoral programs of the National Science Programs 2018–22 portfolio. These programs, implemented by MoES, are focused on addressing identified public challenges in Bulgaria – in the case of the eHealth program, it is aimed at building infrastructure and tools collecting, storing, and analyzing health data. The eHealth program is also jointly implemented by the Ministry of Health The program funds applied research projects in two core research areas: 1) the development of a software platform for collection, processing, and analysis of health data and 2) the development of an electronic platform for the management of large health data sets. The program has intended outputs related to the development of prototypes, new software, and new technologies.

Like the other sectoral programs in the National Science Programs portfolio, eHealth provides funding to a consortium of preselected research institutions in specific scientific fields (medical and health sciences and computer and information sciences in the case of eHealth). The beneficiary consortium is made up of four lead research institutions and four secondary partner institutions. There was no application process or application costs for beneficiaries of the program. MoES also delegates a portion of the administration and monitoring of projects to the consortium, so some of the costs of implementing the overall program are borne by the beneficiaries. In the case of the eHealth program, the four leading beneficiaries of the consortium (Medical University – Sofia, University of Sofia, Medical University – Plovdiv, and the Bulgarian Academy of Science) are jointly responsible for distributing funding to the other members of the consortium, collecting indicators on project progress, and compiling semi-annual technical and financial reports to the MoES and the Ministry of Health.

Like the ICT program, administrative costs only made up only 0.2 percent of total program costs; however, but this extremely low share of administrative costs does not include the implementation costs of the program that are borne by the beneficiary consortiums. While the beneficiaries had no costs

related to the application processes, respondents reported expending an average of seven percent of grant funding received for administration and coordination of the consortium and an average of one percent of funding received for auditing (a requirement of the program).

Scientific publications in peer-reviewed journals were the most common outcome reported by eHealth respondents, but respondents also reported a relatively high number of outcomes related to new software and new technology development, which are the primary intended outcomes of the program given its focus on applied research. Like ICT, the eHealth program also generated a relatively high number of collaborations during implementation, which is likely due in part to the design of the program – beneficiaries are members of consortiums that collaborate with each other on individual projects.

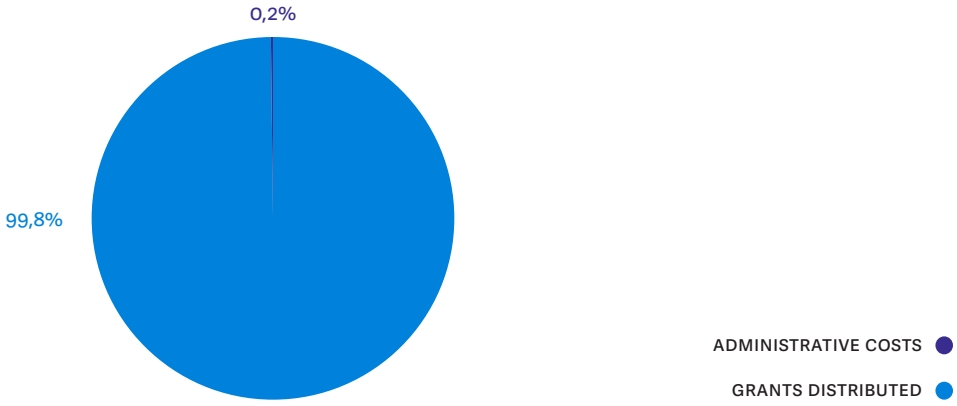
The program was started in 2018 and issued a grant to the consortium in 2019 of 2 million BGN (all of which million BGN of which has been disbursed).

The principal investigators (or alternative points of contact) for the eight of the members of the eHealth consortium were surveyed for this analysis, with four beneficiaries responding to the survey for a response rate of 50 percent. All of the funded projects are in the scientific research areas of mathematical science and informatics and healthcare.

6.1 Efficiency in Use of Inputs

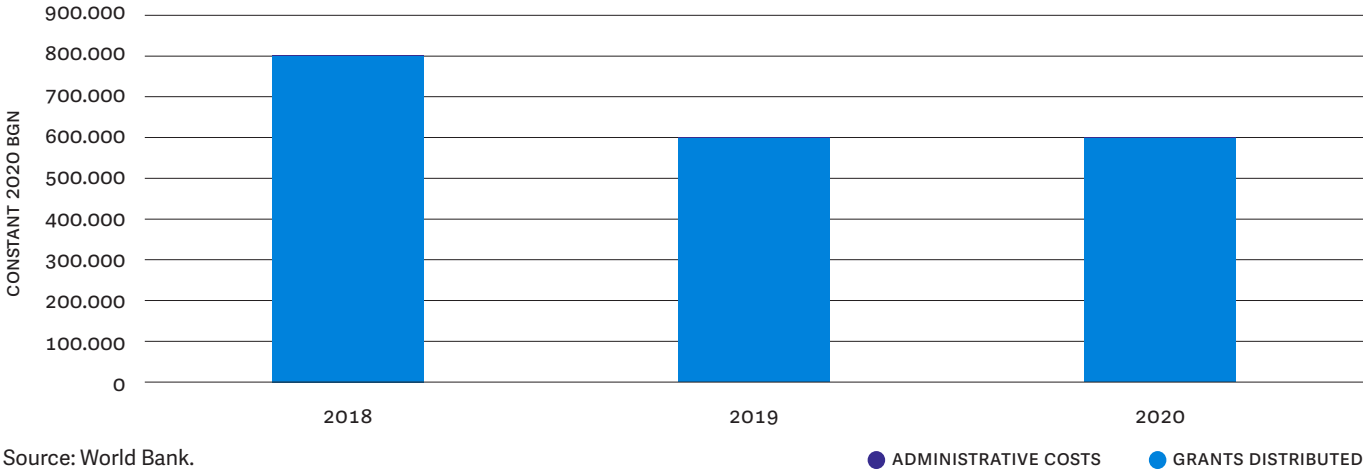
Administrative costs were a very small portion of total program costs, which were highest in the year the program launched. The sectoral programs under the National Science Programs 2018–22 portfolio have similar implementation processes at the ministry level, so the administrative costs for the eHealth program are nearly identical to those of the ICT program. Grants distributed to beneficiaries represented 99.8 percent of the costs of the ICT program from 2018 to 2020, while administrative costs made up only 0.2 percent of program costs (Figure 6.1). Grant disbursement was highest in 2018, before dropping in 2019 and in 2020 (Figure 6.2).

Figure 6.1. eHealth Program Costs by Category, 2018–20



Source: World Bank.

Figure 6.2. eHealth Program Costs by Year, 2018–20

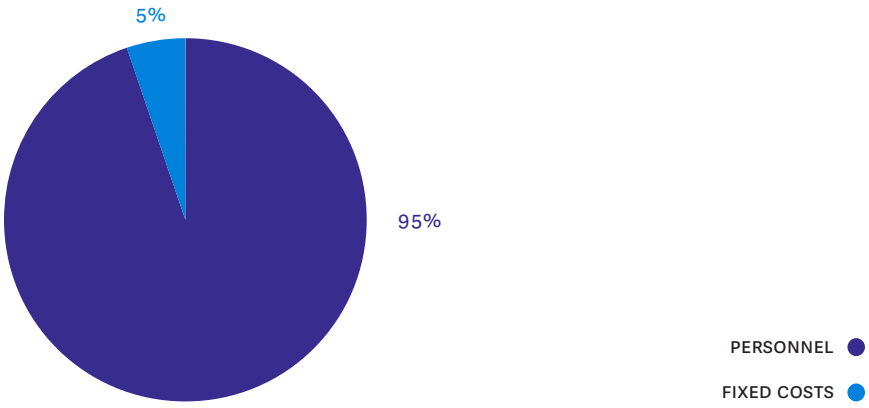


Source: World Bank.

Administrative Costs

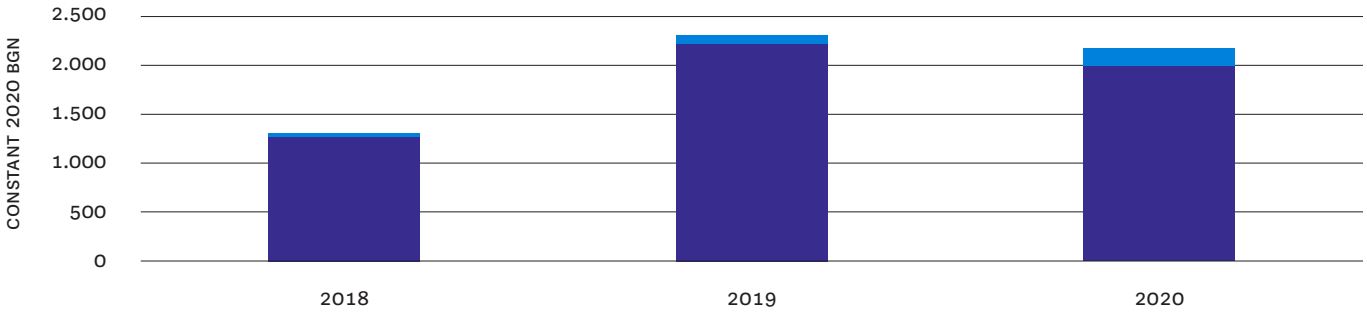
Personnel costs made up 95 percent of total administrative costs, with fixed costs representing the remaining five percent of administrative costs services. There were no costs related to external services for the program (Figure 6.3). Personnel costs were highest in 2019 – the first full year after the 10 projects were active – before declining slightly in 2020 (Figure 6.4).

Figure 6.3. eHealth Program Administrative Costs by Category, 2018–20



Source: World Bank.

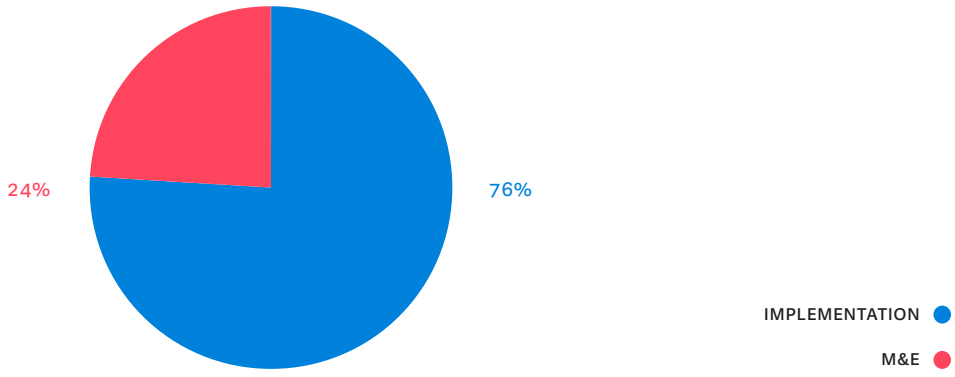
Figure 6.4. eHealth Program Administrative Costs by Year, 2018–20



Source: World Bank.

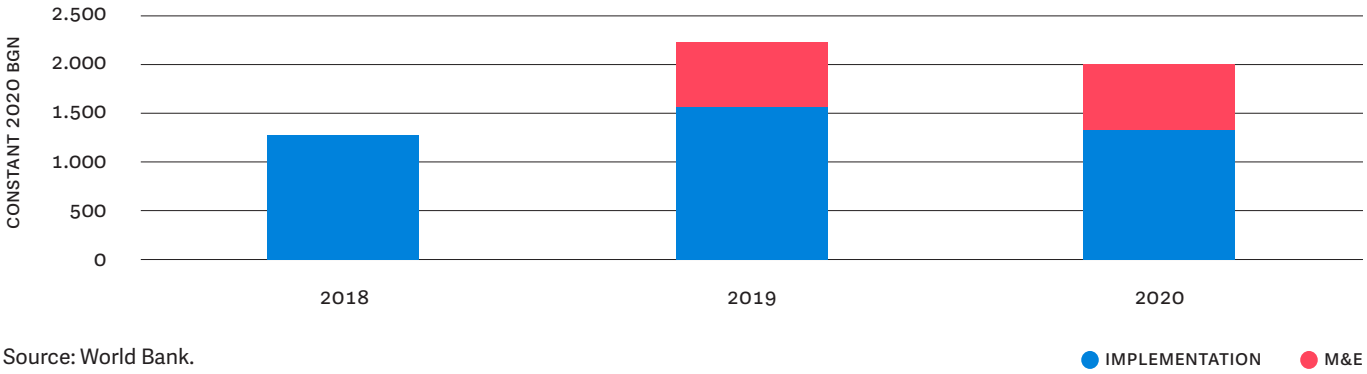
Costs related to implementation made up over 75 percent of personnel costs for the program, with the remainder coming from costs for M&E. (See Figure 6.5.) All of the costs for M&E came after 2018 (the year the projects were awarded and launched), while costs related to implementation have remained relatively constant from 2018 to 2020 (Figure 6.6).

Figure 6.5. eHealth Program Personnel Costs by Category, 2018–20



Source: World Bank.

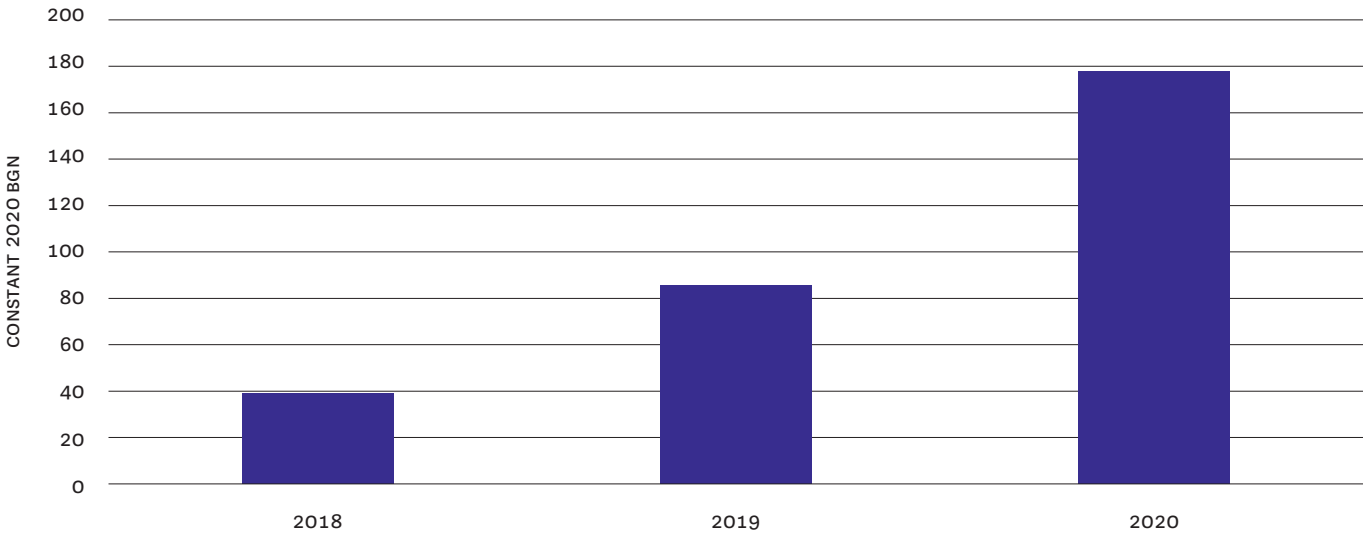
Figure 6.6. eHealth Program Personnel Costs by Year, 2018–20



Source: World Bank.

Fixed costs have risen steadily since 2018, although they are still less than 200 BGN (approximately €102) per year (Figure 6.7). Due to data availability, it was not possible to separate out fixed costs by category (such as costs for office equipment, goods and services, ICT, and so on).

Figure 6.7. eHealth Program Fixed Costs by Year, 2018–20



Source: World Bank.

The total administrative costs of implementing the program from 2018 to 2020 were 5,790 BGN, with an average cost per project of 724 BGN. (See Table 6.1.) However, the extremely low average administrative cost per project is misleading – as discussed in the next section, a portion of the administrative and implementation costs of the program are borne by the beneficiary consortiums, so the full cost of program implementation is not reflected here. By comparison, the administrative average cost per project was 724 BGN, but beneficiaries spent an average of 15,000 BGN per project on management and auditing costs.

Table 6.1. eHealth Administrative Costs

COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	5,487 BGN	686 BGN
Fixed	302 BGN	38 BGN
External services	0 BGN	0 BGN

Source: World Bank.
Note: All amounts in constant 2020 BGN.

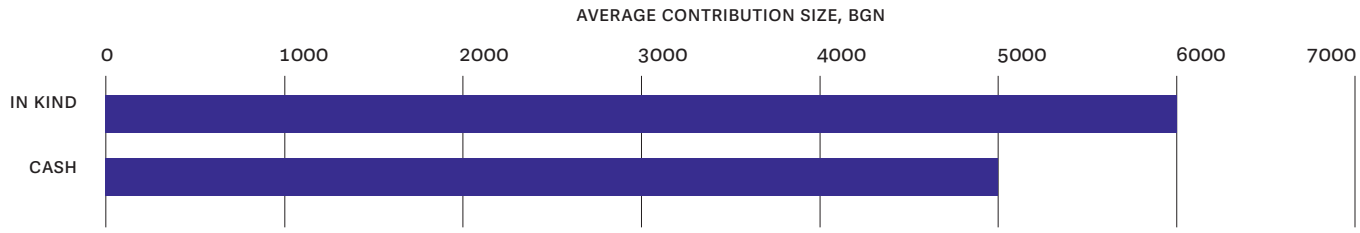
Costs Covered by Beneficiaries

As discussed previously, the National Science Programs have a different design than traditional grant programs—each provides funding to a preselected consortium of beneficiary HEIs and PROs. Much of the administration, monitoring, and auditing of the program is actually done by the consortium, rather than the MoES. Administration costs to the Ministry are low, but the beneficiaries bear additional costs for program management.

There were no application costs associated with the program. The eHealth program, like the other programs in the National Science Programs 2018–22 portfolio, has no application process. Instead, beneficiaries are preselected to participate based on indicators related to published scientific results in the fields of informatics, data science, and healthcare. Respondents reported no costs related to preparing their applications.

Although the eHealth program has no matching requirement, respondents reported an average in kind contribution of 6,000 BGN and an average cash contribution of 5,000 BGN to the implementation of their projects. (See Figure 6.8.) Half of respondents made in kind contributions to their projects, 25 percent made cash contributions, and the remaining 25 percent made no contributions to their projects.

Figure 6.8. Beneficiary Contributions to eHealth Projects



Source: World Bank.

Beneficiaries also used grant funding for administration, coordination, and auditing. Beneficiaries reported expending an average of 7 percent of grant funding received for administration and coordination of the consortium, for an average of 13,125 BGN per beneficiary, and an average of 1 percent of funding received for auditing (a requirement of the program), for an average cost of 1,875 BGN per beneficiary. These additional costs are due to the design of the National Science Programs, which delegate a portion of the management of the program to the beneficiary consortiums.

On average, the costs covered by the program were 9.7 times higher than the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 250,724 BGN, while the average cost covered by beneficiaries was 26,000 BGN.

6.2 Efficiency in Generation of Outputs

For every BGN of administrative costs, beneficiaries received an average of 346 BGN. The total program costs from 2018 to 2020 was 2 million BGN or 501,448 BGN per project. This includes 2 million in disbursed grants to beneficiaries and 5,790 BGN in administrative costs (Table 6.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

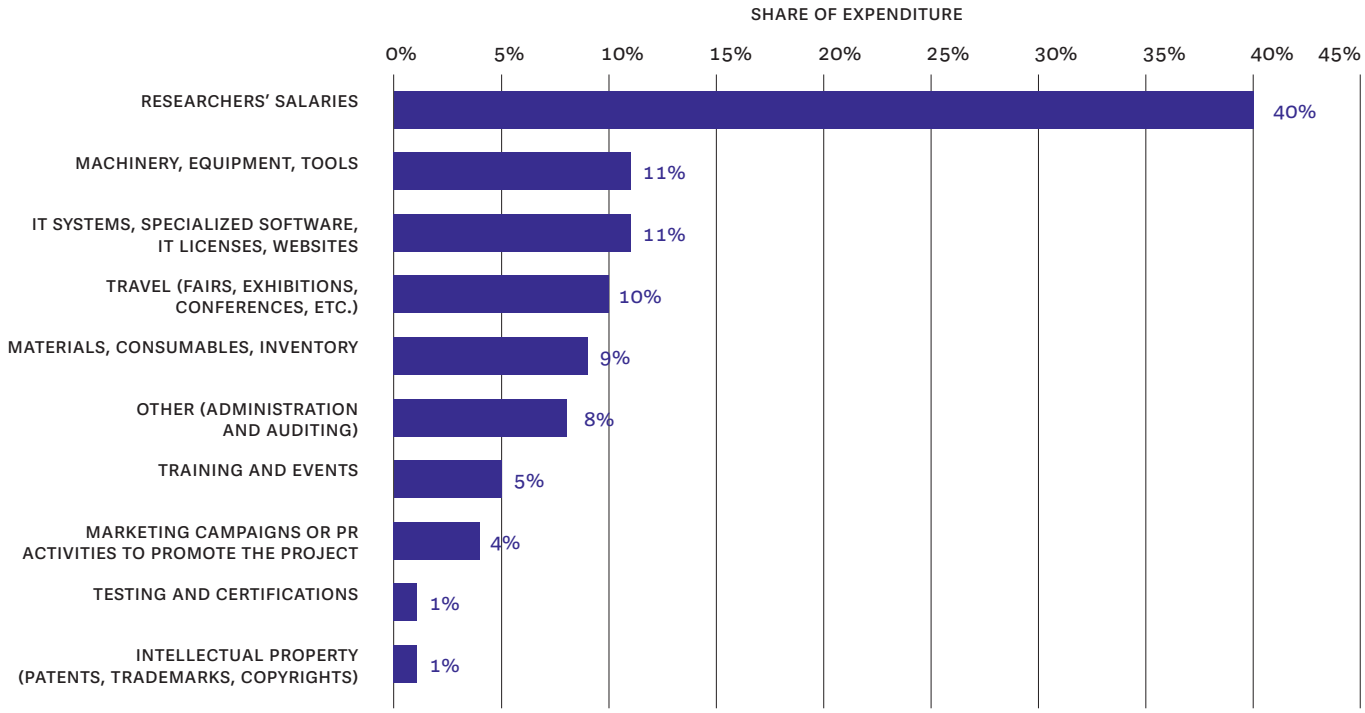
Table 6.2. eHealth Program Costs, 2018–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	2,000,000 BGN	250,000 BGN
Administrative and operating costs	5,790 BGN	724 BGN
Total program costs	**2,005,790 BGN**	**250,724 BGN**

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Researcher salaries were the largest expenditure reported by respondents at 40 percent of total project costs. Machinery and equipment (11 percent), IT systems (11 percent), and travel (10 percent) were the next largest expenses by size (Figure 6.9).

Figure 6.9. eHealth Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Three outputs were tracked for the eHealth program based on the program ToC: 1.) project dissemination (in the form of seminars, workshops, and conferences), 2.) training activities, 3.) and research collaborations during implementation.

Program respondents generated a total of 188 outputs from 2018 to 2020, or an average of 23.6 outputs per project. Over that period, the program invested an average of 250,724 BGN in beneficiary projects, so respondents generated 9.4 outputs per 100,000 BGN invested.

Seminars, workshops, and conferences were the most common output of eHealth respondents (an average of 12.6 per project), followed by collaborations during implementation (10.2), and training activities (0.8) (see Table 6.3).

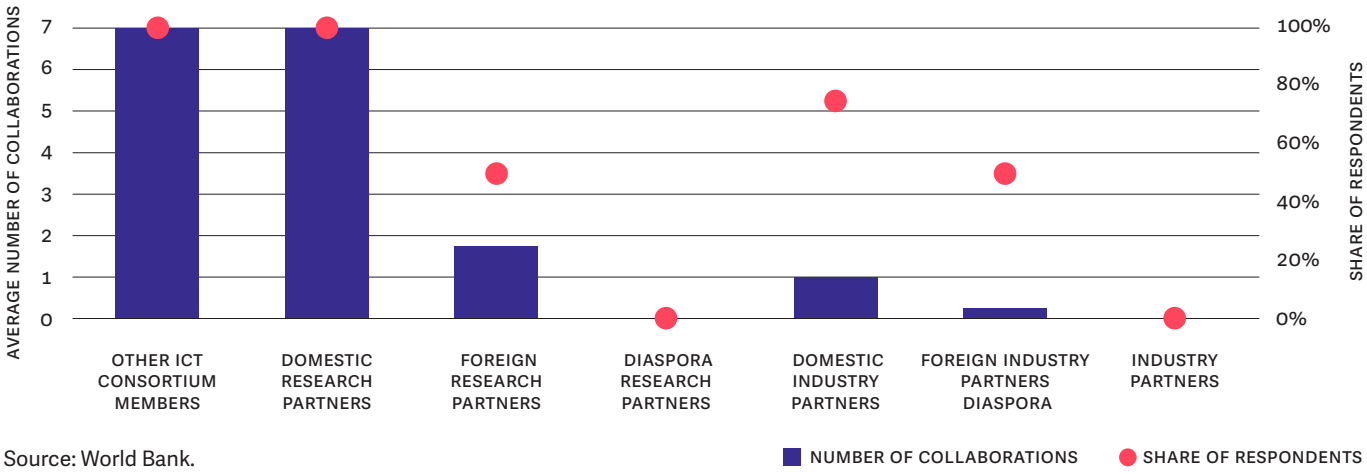
Table 6.3. eHealth Outputs

INTENDED OUTCOME	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST
Seminars, workshops, and conferences	101	12.6	5.0
Training activities	6	0.8	0.3
Collaborations	81	10.2	4.1

Source: World Bank.
Note: Outputs were reported at the level of the entire consortium, not for individual respondents, so it was not possible to calculate the share of respondents that reported a specific output.

Every eHealth respondent engaged in collaborations with other members of the eHealth consortium and with other domestic research partners. Collaborations with domestic industry partners, foreign industry partners, and foreign research partners were also relatively common (Figure 6.10).

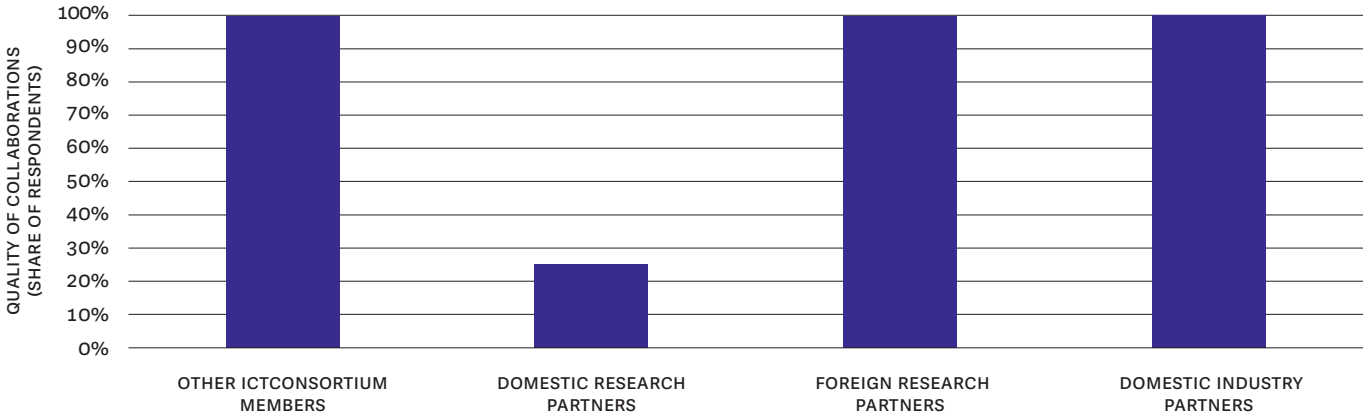
Figure 6.10. eHealth Project Collaborations by Type of Partner



Source: World Bank.

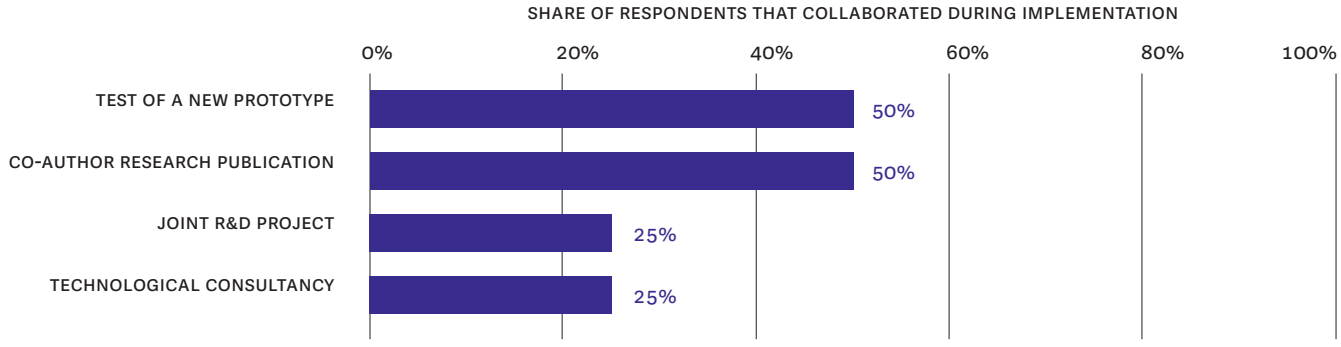
Collaborations were rated highly, except for those with domestic researchers. All respondents expressed satisfaction with collaborations with other members of the eHealth consortium, foreign research partners, and domestic industry partners. However, only 25 percent of respondents were satisfied with their collaborations with domestic research partners (Figure 6.11). Prototypes and co-authorships were the most common type of collaborations. Half of respondents engaged in collaborations related to testing a new prototype and co-authoring a research publication, while 25 percent collaborated in a joint R&D project and technological consultancy (Figure 6.12).

Figure 6.11. Satisfaction with the Quality of eHealth Collaborations



Source: World Bank.
Note: Left figure shows the share of respondents who rated their collaborations as above average or excellent

Figure 6.12. eHealth Collaborations by Type



Source: World Bank.

6.3 Efficiency in Achievement of Outcomes

Respondents reported a total of 135 outcomes (intended outcomes and other), for an average of 16.9 outcomes per project. Over that period, the program invested an average of 501,448 BGN in beneficiary projects, so respondents generated 6.7 outcomes per 100,000 BGN invested.

Five outcomes were included for the eHealth program, based on the program's ToC: 1.) publications in peer-reviewed journals, 2.) prototypes, 3.) new software development, 4.) new technology development, and 5.) research collaborations after project completion (not included in this analysis given that all eHealth projects are still ongoing). Publications in peer-reviewed journals were the most common outcome reported at 11.8 per project, followed by new technology development (2.3 per project), new software development (1.9 per project), and prototypes (1 per project) (Table 6.4).

Table 6.4. Intended Outcomes Reported by eHealth Respondents

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOME PER 100,000 BGN OF PROGRAM COST
Scientific publications in peer-reviewed journals	94	11.8	4.7
Prototype	8	1	0.4
New software development	15	1.9	0.8
New technology development	18	2.3	0.9

Source: World Bank.
Note: Outcomes were reported at the level of the entire consortium, not for individual respondents, so it was not possible to calculate the share of respondents that reported a specific outcome.

A lower share of the publications reported by eHealth respondents were in journals with impact factor than for the publications reported by respondents of the other programs included in this analysis – however, several of the publication listed in survey responses were still under review and may yet be published in high impact journals. None of the indexed publications reported by eHealth respondents have been cited as of the writing of this report (Table 6.5).

Table 6.5. Impact Measures of eHealth Publications

Total publications listed in survey responses	16
Share indexed in Web of Science	38%
Share in journals with impact factor	13%
Average year normalized citations	0
Share with international coauthor(s)	33%

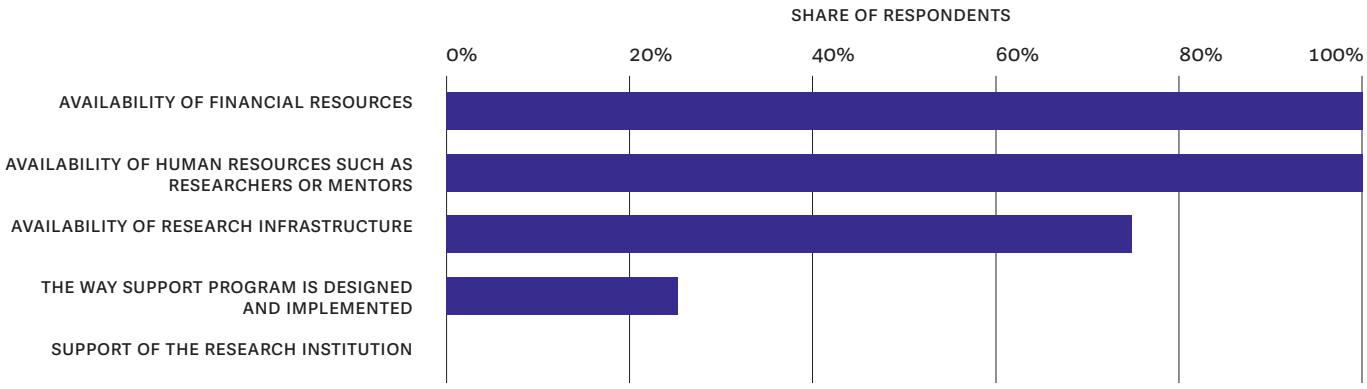
Source: World Bank.

6.4 Perceived Quality

Respondents were highly satisfied with the eHealth program's implementation and monitoring processes. All respondents expressed satisfaction about all processes in the beneficiary survey. All respondents felt that the that the financial resources provided by MoES were sufficient to successfully complete their projects. Similarly, all respondents felt that the allowed by the program to complete their projects was sufficient.

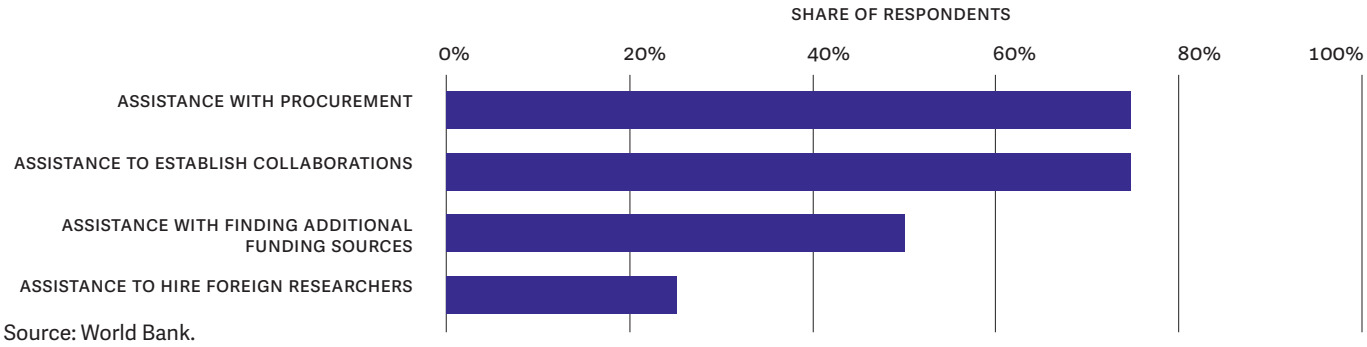
All respondents cited financial and human resources as key success factors for their projects, but assistance with procurement and establishing connections were the most common gaps in support. The availability of research infrastructure was cited by three quarters of respondents as a success factor (Figure 6.13). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, respondents cited assistance in establishing collaborations and assistance with procurement (both cited by 75 percent of respondents) as the most needed additional supports (Figure 6.14). Half of respondents also said they needed support in finding additional funding sources for their projects.

Figure 6.13. Key Success Factors for eHealth Projects



Source: World Bank.

Figure 6.14. Additional Support Needed for eHealth Projects

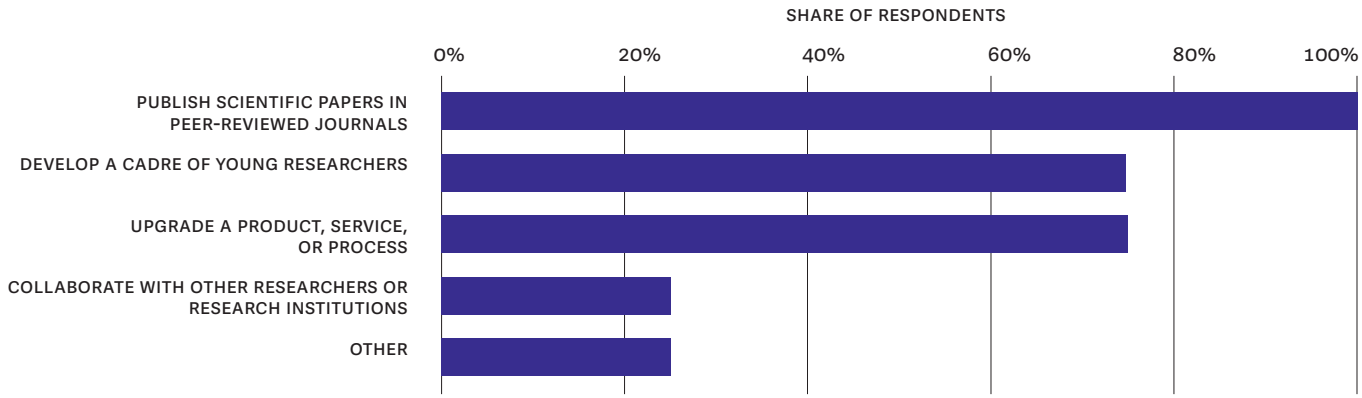


Source: World Bank.

Overall Project Quality

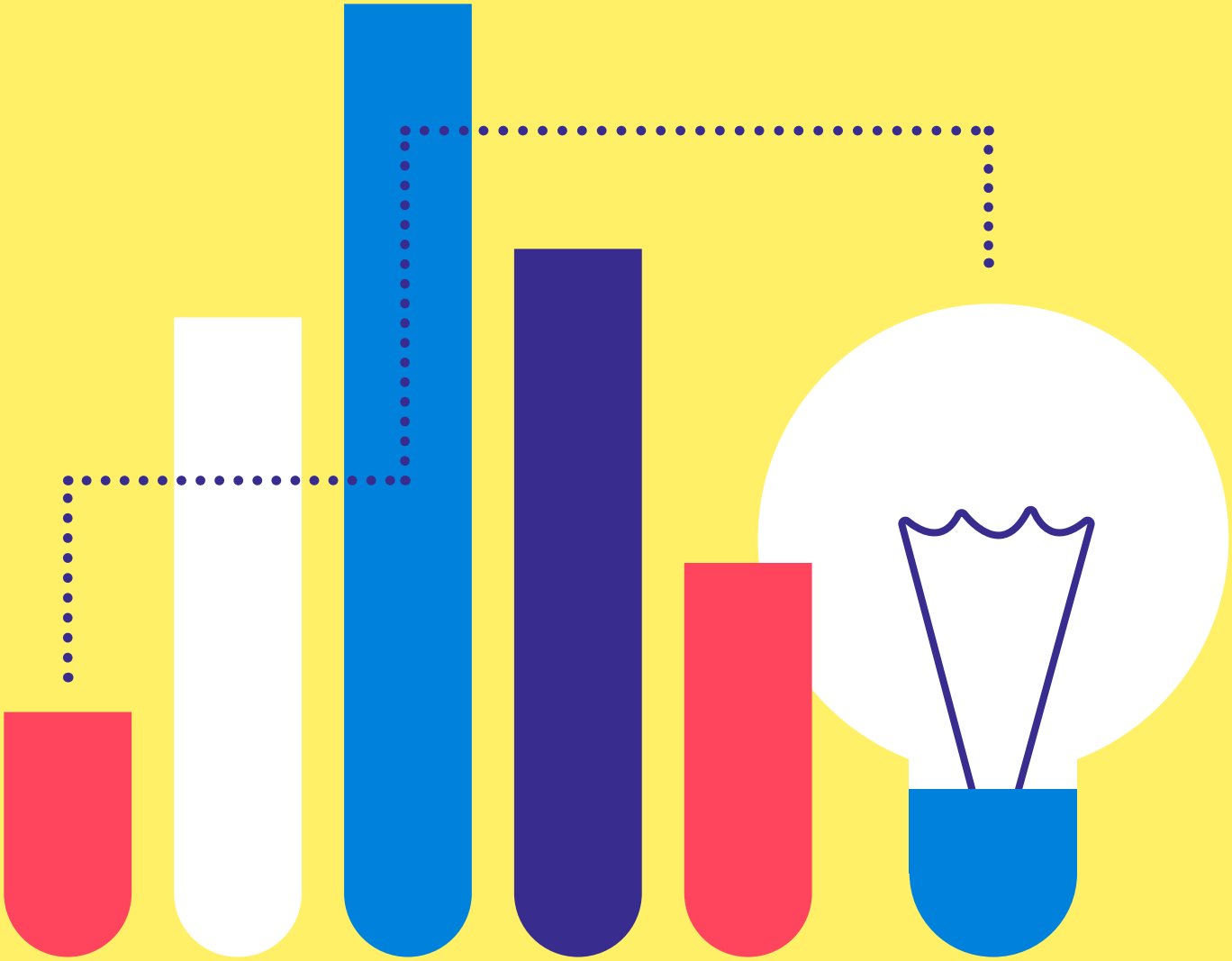
Respondents' project objectives were largely in line with the objectives of the eHealth program. The program supports the development of software, tools, and platforms for the collection, analysis, and management of health data, and 75 percent of respondents said one of the primary objectives of their projects was to develop a new product, service, or process. Other objectives reported by respondents include publishing scientific papers in peer-reviewed journals (reported by 100 percent of respondents), developing a cadre of young researchers (75 percent), collaborating with other researchers or research institutions (25 percent), and establishing links to medical practitioners (25 percent) (Figure 6.15).

Figure 6.15. eHealth Program Project Objectives



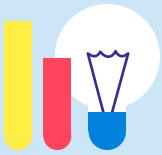
Source: World Bank.

7. National Innovation Fund



7. National Innovation Fund

PROGRAM SUMMARY



The National Innovation Fund (NIF) is a long-running program focused on supporting industrial research in Bulgaria and is also one of the primary instruments of the country's Smart Specialization strategy.

NIF is implemented by the Bulgarian SME Promotion Agency and provides grants for research and development projects and technology feasibility projects. The program provides matching grants to firms for industrial research and early-stage innovation projects and not fund projects beyond the stage of experimental development[9]. It thus has intended outcomes related to IP generation; prototypes; new products, services, and processes; and increased revenues, exports, and employment for beneficiary companies. **Application costs were higher than those reported by research respondents, but lower than the DPPI program.** Higher application costs were likely due to the large share (85 percent) of respondents that used some form external support (such as legal or accounting services) to prepare their applications. When looking at the costs to implement the program, external services made up a large share of total administrative costs (44 percent), compared to personnel costs and fixed costs. This relatively large share of costs for external services is likely due to the low number of full-time staff at SMEPA.

More than half of respondents' projects had results in the early stages of commercialization (such as a prototype or proof of concept), which is likely due to the fact that the program does not fund projects beyond the experimental development stage. Collaborative projects after implementation were the most common outcome reported; followed by employees hired; new products, services, and processes; and prototypes. **Respondents were dissatisfied with several key processes related to project application and selection, including ease of the overall application process, feedback on project selection, and the transparency of the selection process.** However, among respondents that had completed their projects, more than 60 percent of respondents felt that the outcomes of their project matched their expectations

9 According to program documentation, experimental development may include prototyping, demonstration, development of pilot projects, testing and validation of new or improved products, processes, and services in an environment that is representative of real-life operating conditions, where the main goal is further technical improvement. This may include the development of commercially usable prototypes or pilot projects that are necessary for the final commercial product and whose production is too expensive to be used only for demonstrations and validation.

The NIF program started in 2005 and has implemented 10 calls for proposals since its inception. Between 2016 and 2020, NIF funded 81 projects over three calls for proposals for a total 17.1 million BGN in grants contracted (13.9 million BGN has been disbursed).

The designated points of contact for all 82 projects funded by the program from 2016 to 2020 were surveyed for this analysis, with 44 beneficiaries responding to the survey for a response rate of 52 percent. Respondents represent 65 percent of the contracted funding for the program over that period with an average grant size of 259,710 BGN. Administrative cost data were only provided for the years 2018 to 2020, so indicators related to efficiency (outputs/outcomes per cost) only include project results data for those years. The main economic activity areas of responding firms were manufacturing (40 percent of respondents), professional services (19 percent), and healthcare (16 percent) (Figure 7.1), while the main Smart Specialization priority areas of respondents' projects were informatics and ICT (41 percent of respondents) mechatronics (33 percent), and biotechnologies (21 percent) (Figure 7.2).

Figure 7.1. NIF Respondents by Main Economic Activity

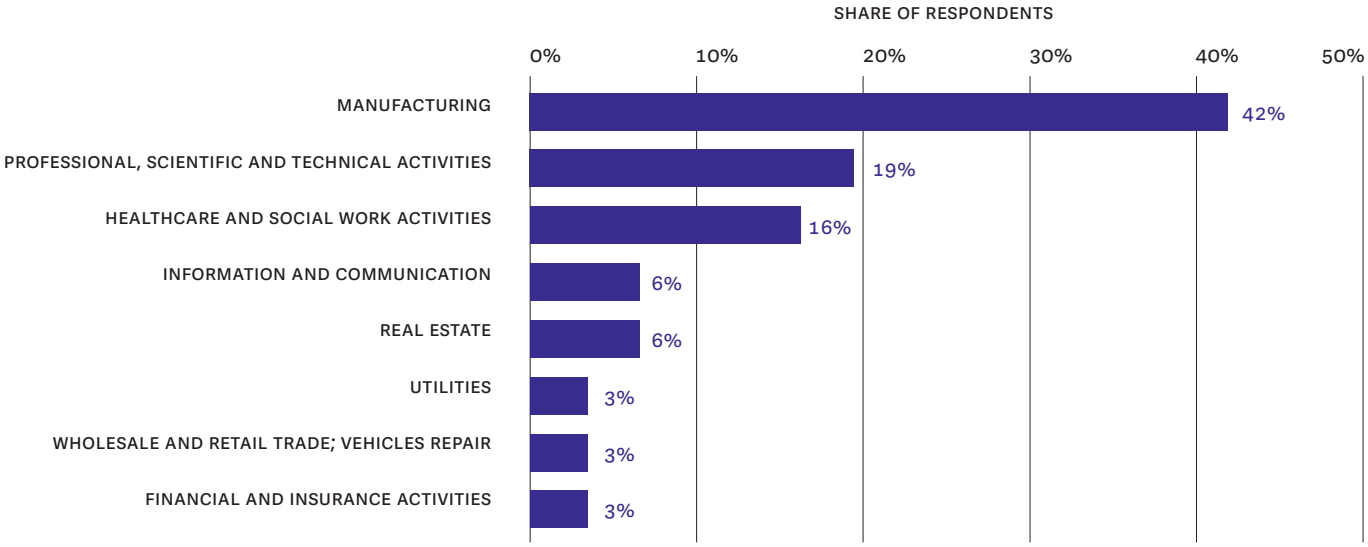
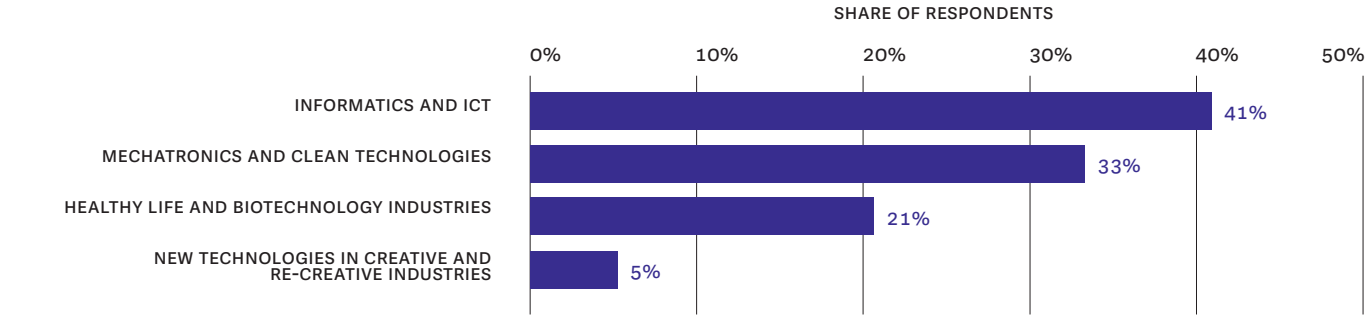


Figure 7.2. NIF Respondents by Smart Specialization Priority Area

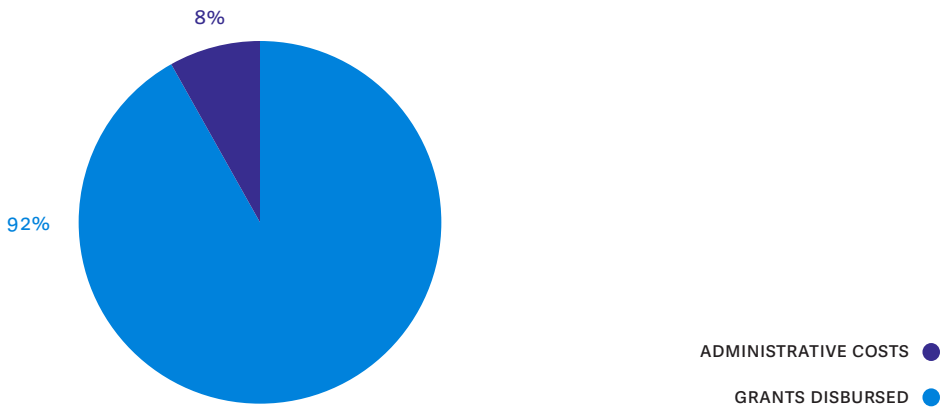


Source: World Bank.

7.1 Efficiency in Use of Inputs

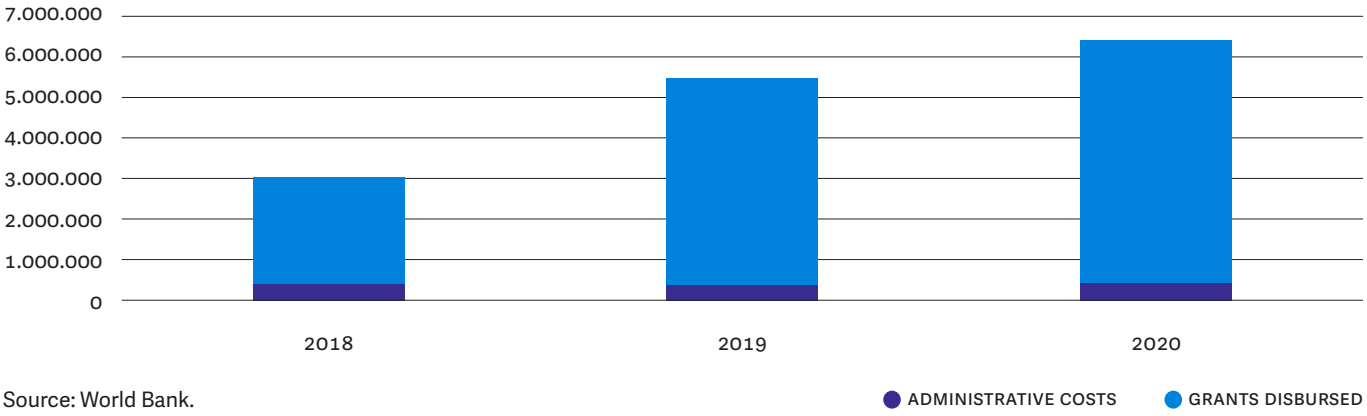
Grants distributed to beneficiaries made up 92 percent of the costs of the program from 2018 to 2020, while administrative costs made up the remaining eight percent (Figure 7.3). Administrative costs have remained relatively constant from 2018 to 2020, while grant disbursements grew steadily from 2018 to 2020, increasing the overall costs of the program (Figure 7.4).

Figure 7.3. NIF Program Costs by Category, 2018–20



Source: World Bank.

Figure 7.4. NIF Program Costs by Year, 2018–20

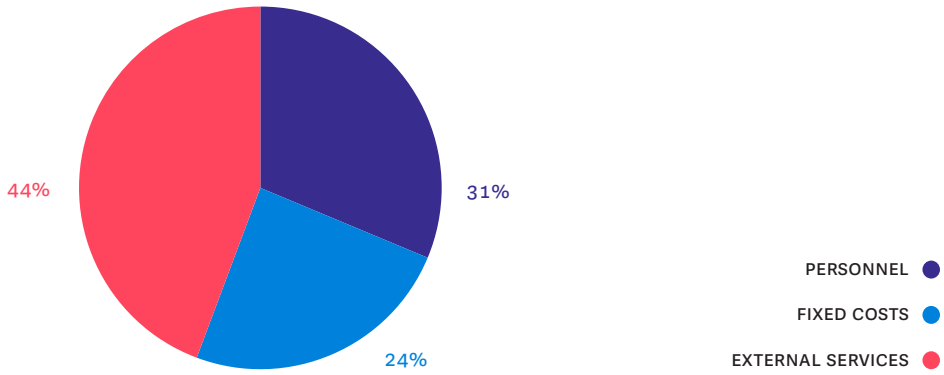


Source: World Bank.

Administrative Costs

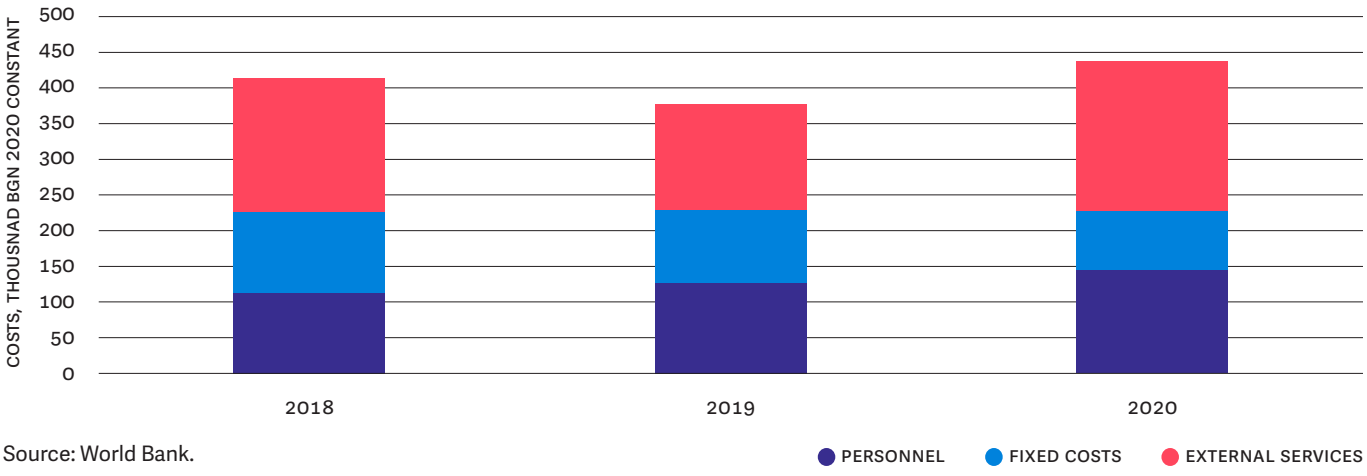
External services made up almost half of administrative costs, which were highest in 2020. External services, in the form of contracts to technical experts to evaluate proposals and monitor project progress, made up 44 percent of program costs, while personnel costs were 31 percent and fixed costs were 24 percent of total administrative costs from 2018 to 2020 (Figure 7.5). Personnel costs increased from 2018 to 2020, while fixed costs were highest in 2018 and 2020 (Figure 7.6).

Figure 7.5. NIF Administrative Costs by Category, 2018–20



Source: World Bank.

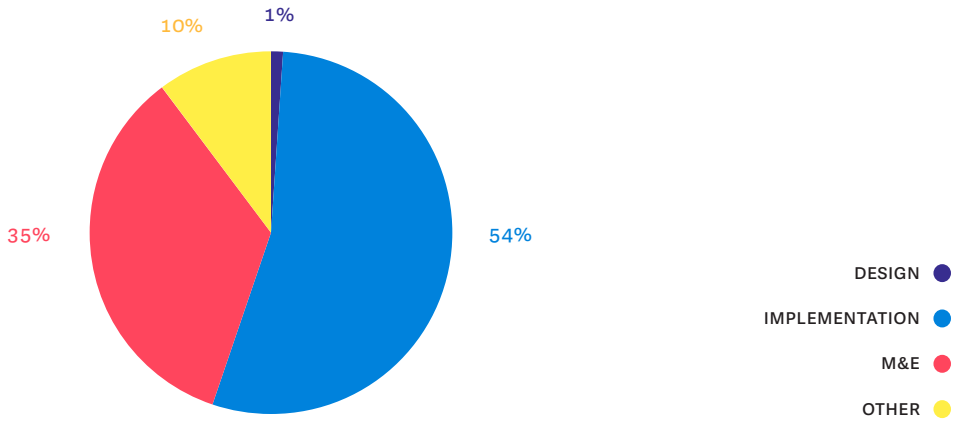
Figure 7.6. NIF Administrative Costs by Year, 2018–20



Source: World Bank.

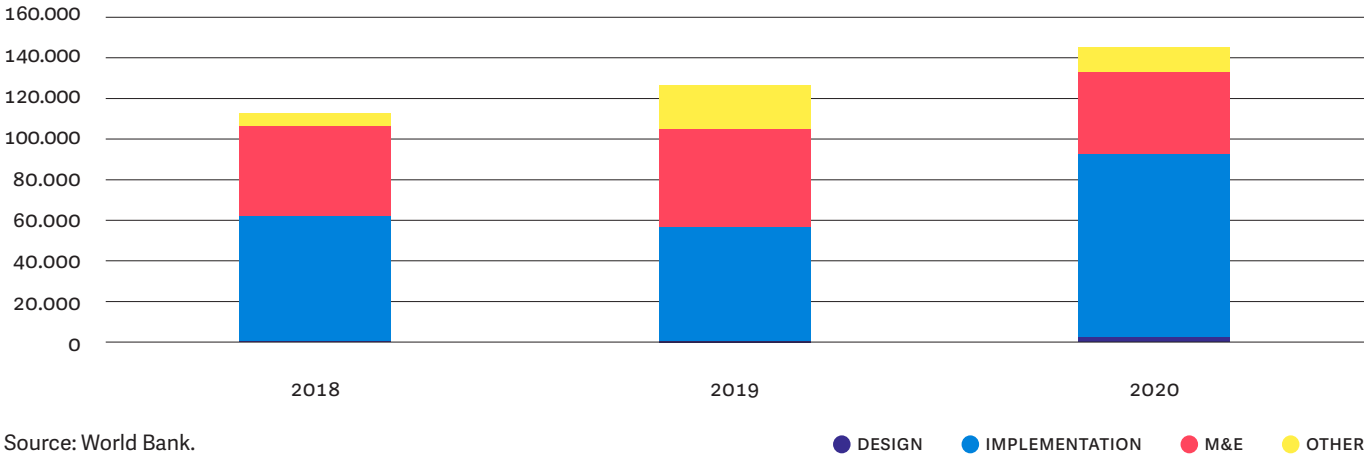
Implementation made up more than half of personnel costs from 2018 to 2020, while M&E made up 35 percent, design made up one percent, and the remaining ten percent went to other personnel costs (such as legal and administrative staff) (Figure 7.7). Personnel costs rose each year from 2018 to 2020, driven by increases in implementation and M&E costs over those years (Figure 7.8).

Figure 7.7. NIF Personnel Costs by Category, 2018–20



Source: World Bank.

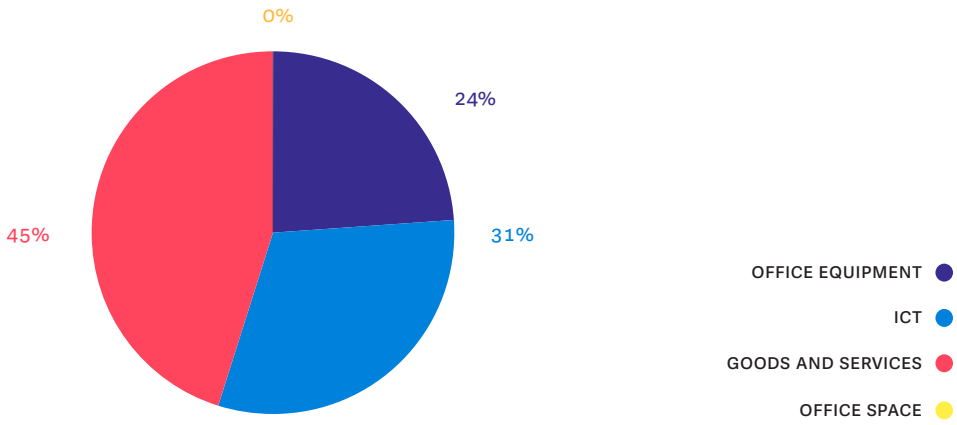
Figure 7.8. NIF Personnel Costs by Year, 2018–20



Source: World Bank.

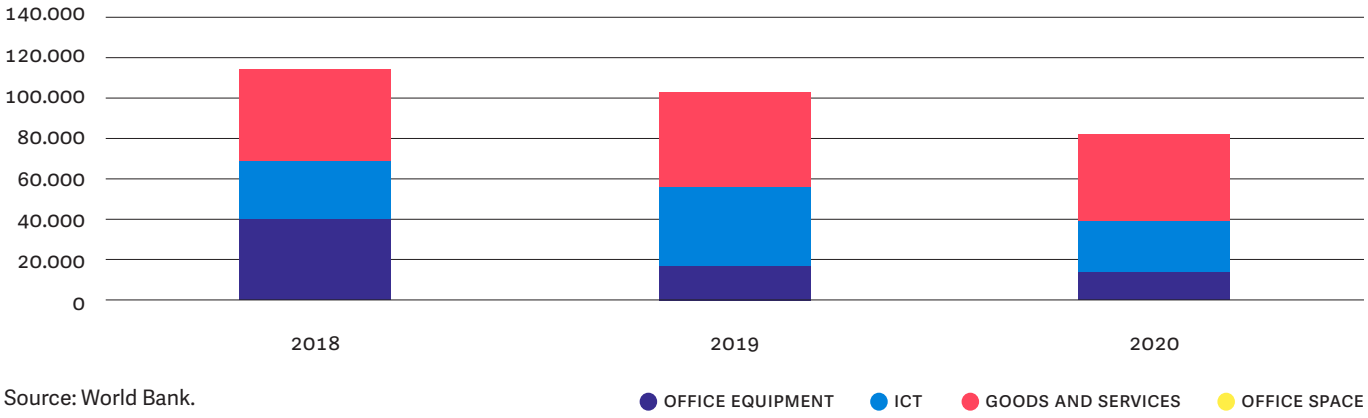
Goods and services was the largest cost category of fixed costs, representing 44 percent of total fixed costs, while ICT software and licenses made up 31 percent and office equipment made up 24 percent of total fixed costs (Figure 7.9). Fixed costs declined every year from 2018 to 2020, driven by lower costs for office equipment in 2019 and 2020 (Figure 7.10.).

Figure 7.9. NIF Fixed Costs by Category, 2018–20



Source: World Bank.

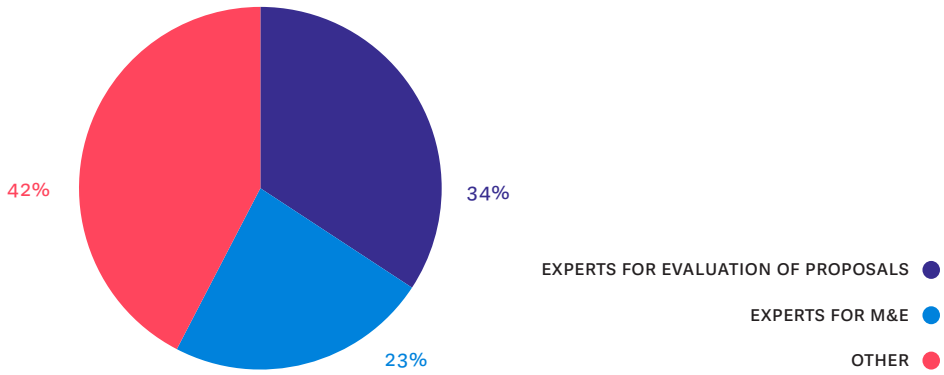
Figure 7.10. NIF Fixed Costs by Year, 2018–20



Source: World Bank.

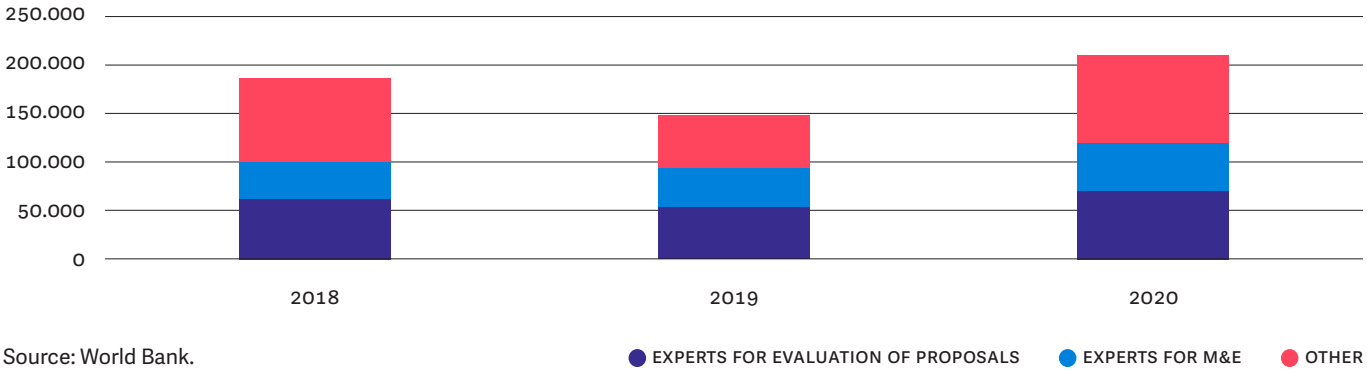
"Other" external services, such as legal and administrative services, made up the largest share of external services costs from 2018 to 2020, followed by costs related to experts for the evaluation of project proposals and experts for M&E of projects (Figure 7.11). Costs for external services were lowest in 2019 due to lower "other" services costs that year, while costs for experts for evaluating proposals and for M&E were relatively constant from 2018 to 2020 (Figure 7.12).

Figure 7.11. NIF External Services Costs by Category, 2018–20



Source: World Bank.

Figure 7.12. NIF External Services Costs by Year, 2018–20



Source: World Bank.

The total administrative cost of implementing the program from 2018 to 2020 was 1.2 million BGN, with an average cost per project of 18,330 BGN (Table 7.1). The average administrative cost per project was significantly higher for NIF than the DPPI program (18,330 BGN per project for NIF vs. 2,308 BGN for DPPI), despite the fact that DPPI grants are considerably larger than NIF grants. This larger administrative cost per project may be due to the fact that NIF issued multiple calls for proposals from 2018 to 2020, while DPPI only issued a single call from proposals in 2019.

Table 7.1. NIF Administrative Costs

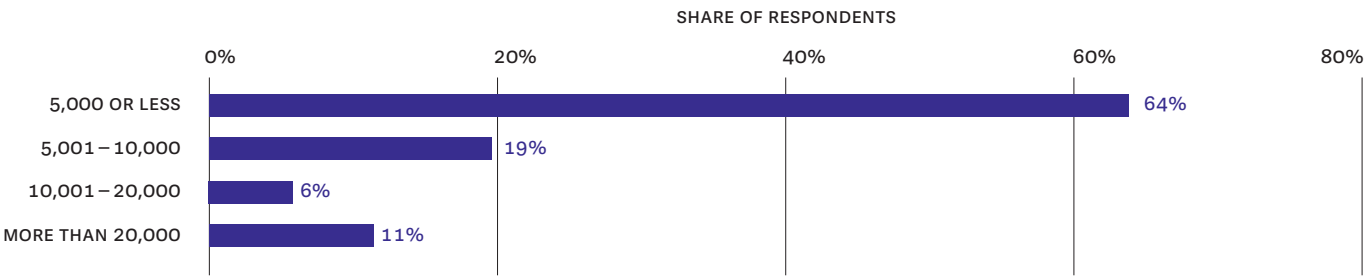
COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	384,346	5,737
Fixed	299,789	4,474
External services	543,956	8,119

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Costs Covered by Beneficiaries

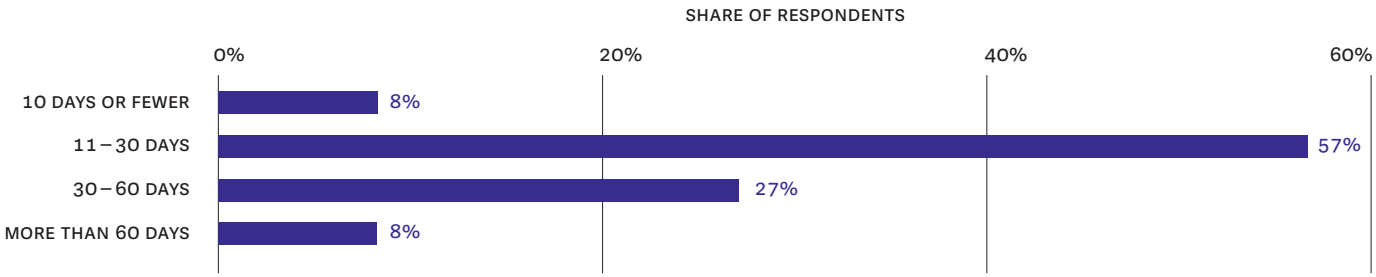
The application process for NIF is slightly less costly and less time intensive than that for the other firm support program included in this analysis (DPPI). Respondents reported an average application cost of 7,195 BGN and spent an average of 31 working days preparing their applications to NIF. However, the average grant size of the DPPI program is significantly larger than NIF, so NIF application costs are actually larger as a share of average contracted grant than DPPI. Over 60 percent of respondents spent less than 5,000 BGN in preparing their application, while 17 percent spent more than 10,000 BGN (Figure 7.13). More than 60 percent of respondents reported spending 30 working days or fewer in preparing their application, while eight percent spent more than 60 working days (Figure 7.14).

Figure 7.13. NIF Program Application Costs



Source: World Bank.

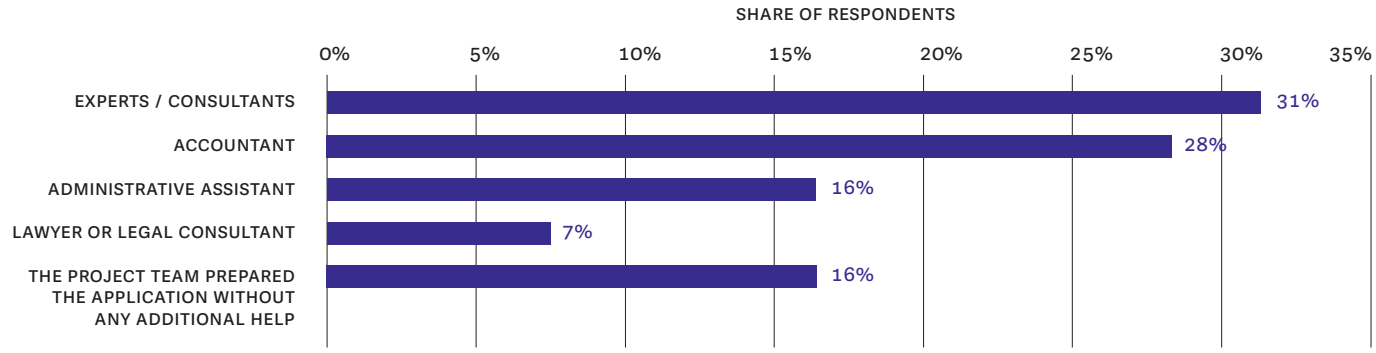
Figure 7.14. NIF Program Application Time



Source: World Bank.

Most respondents used some type of external support to prepare their applications. About 85 percent of respondents reported that they used some type of external support (such as legal, accounting, or other services) to prepare their application, which likely contributed to the relatively higher costs of applying to the program (Figure 7.15). The most common types of support required were experts or consultants (needed by 31 percent of respondents), accountants (28 percent), and administrative assistants (16 percent).

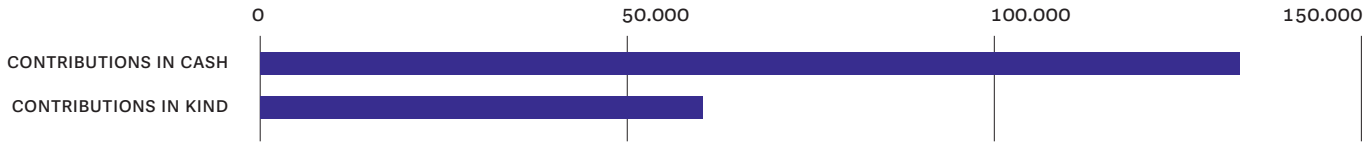
Figure 7.15. External Support Used to Prepare NIF Applications



Source: World Bank.

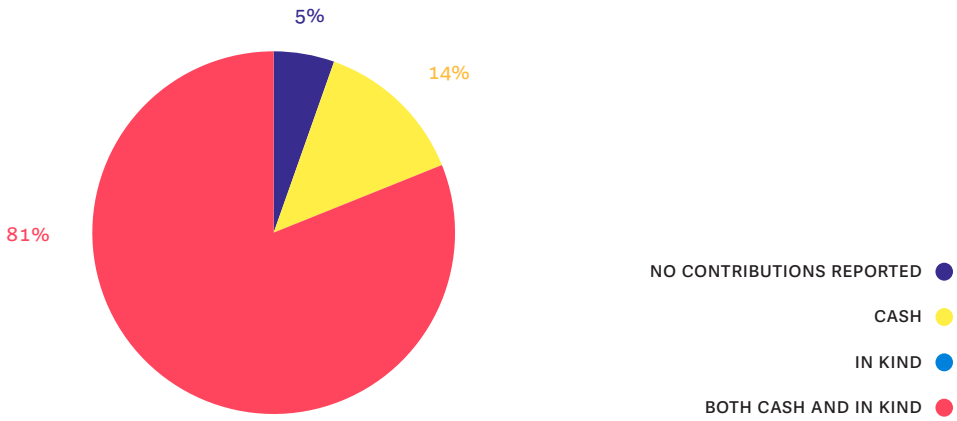
Most beneficiaries made substantial cash and in-kind contributions to their projects. Respondents reported an average of 130,000 BGN cash and 50,000 BGN in kind contributions to the implementation of their projects (Figure 7.16). The NIF program funds between 25 and 80 percent of total project costs, depending on the type of project, size of firm, and other factors, while the firm is responsible for funding the remainder of project costs. More than 80 percent of respondents made both cash and in-kind contributions to the project, while 14 percent made only cash contributions (Figure 7.17).

Figure 7.16. Beneficiary Contributions to NIF Projects by Type and Amount



Source: World Bank.

Figure 7.17. Beneficiary Contributions to NIF Projects by Type and Frequency



Source: World Bank.

On average, the costs covered by the program were slightly higher than the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 222,092 BGN, while the average cost covered by beneficiaries was 201,044 BGN. Therefore, for every BGN that beneficiaries put into the project, the program invested 1.01 BGN. This distribution in project costs is in line with one of the key objectives of the NIF program – to spur private investment in industrial R&D.

7.2 Efficiency in Generation of Outputs

For every BGN the program invested in administrative costs, beneficiaries received an average of 11.1 BGN. The total program costs from 2018 to 2020 was 14.8 million BGN, or 222,092 BGN per project. This includes 13.7 million in disbursed grants to beneficiaries and 1.2 million BGN in administrative costs (Table 7.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

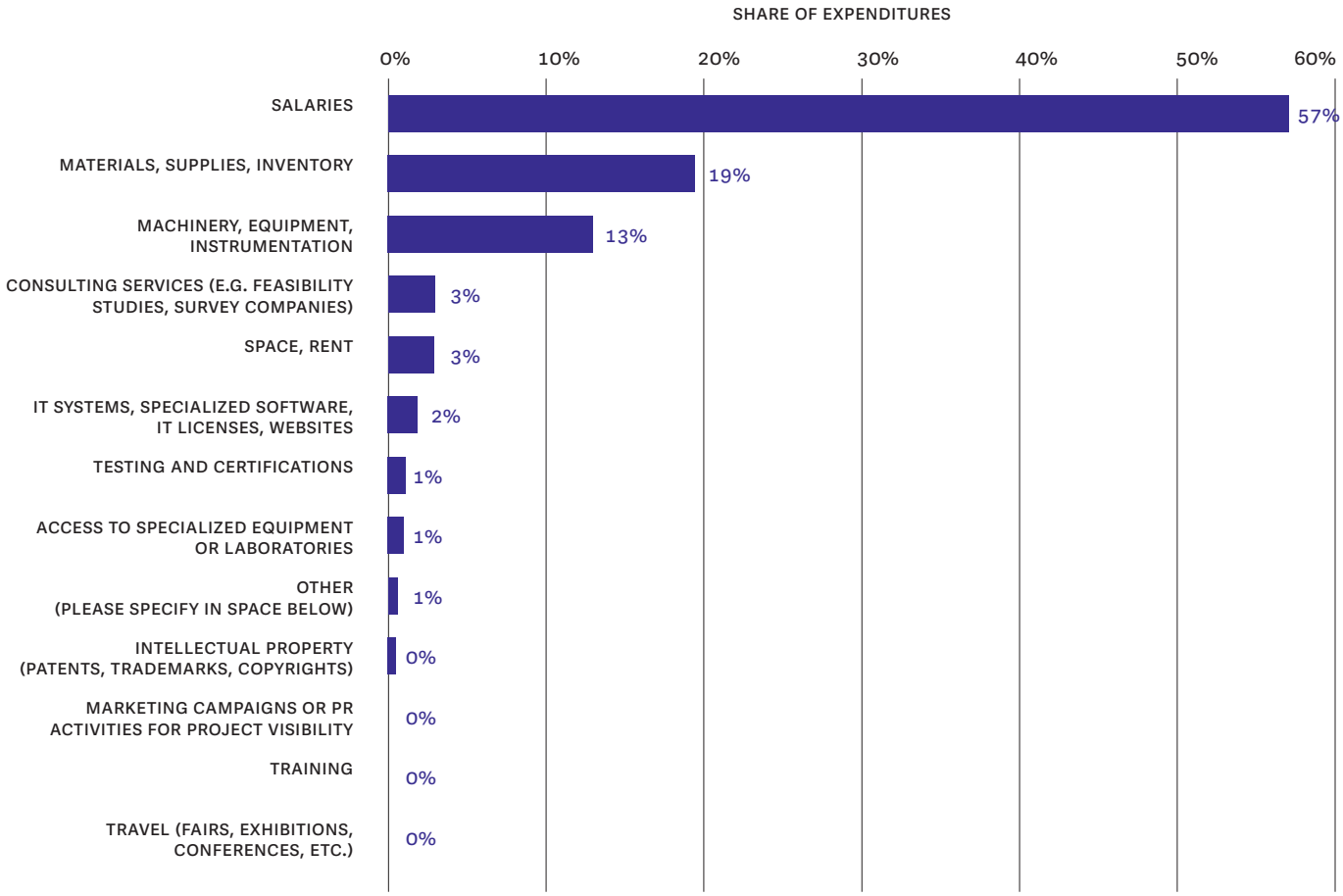
Salaries made up more than 50 percent of expenditures reported by respondents. Materials, supplies, and inventory (19 percent) and machinery, equipment, and instrumentation (13 percent) were also significant expenses reported by respondents (Figure 7.18).

Table 7.2. NIF Program Costs, 2018–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	13,652,088 BGN	203,763 BGN
Administrative and operating costs	1,228,091 BGN	18,329 BGN
Total program cost	**14,880,180 BGN**	**222,092 BGN**

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Figure 7.18. NIF Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Two outputs were tracked for the NIF program, based on the program's ToC: 1.) collaborations during project implementation and 2.) improved capabilities of employees.

Program respondents generated a total of 332 outputs from 2018 to 2020, or an average of 5 outputs per project. Over that period, the program invested an average of 222,092 BGN in beneficiary projects, so respondents generated 1.6 outputs per 100,000 BGN invested.

Improved capabilities of employees were the most common type of output reported (an average of 3 per project), followed by collaborations during implementation (2 per project) (Table 7.3)

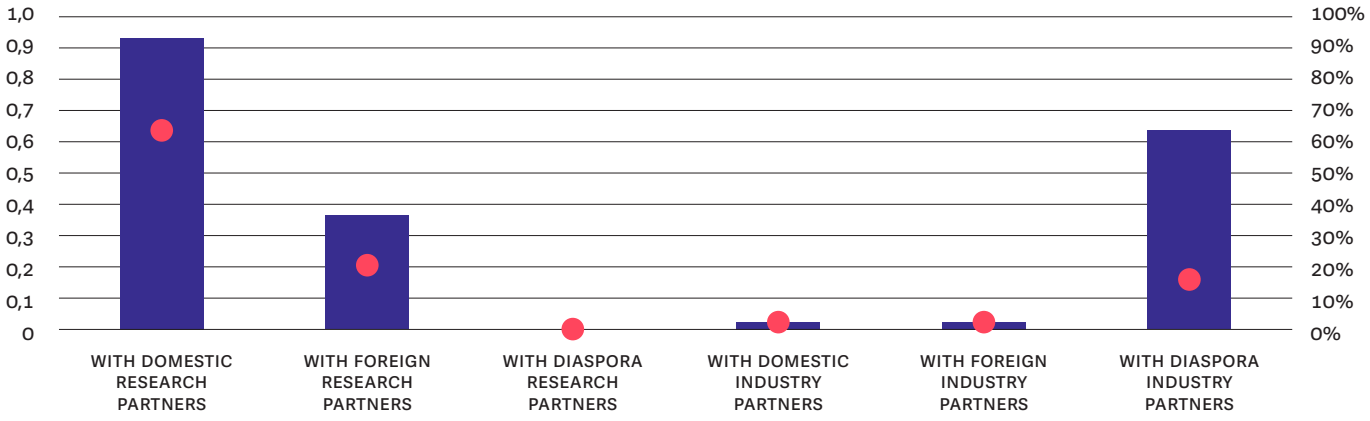
Almost 70 percent of respondents engaged in some type of collaboration during their projects. The most common collaborations, by both average number of collaborations per project and share of respondents who engaged in such a collaboration, were collaborations with domestic researchers. Collaborations with diaspora industry partners and with foreign research partners were also fairly common among respondents (Figure 7.19).

Table 7.3. Outputs of NIF Programs

OUTPUT	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST*	SHARE OF RESPONDENTS REPORTING OUTCOME
Collaborations during implementation	73	2	0.7	68%
Improved capabilities of employees	109	3	0.9	27%

Source: World Bank. *The outputs per 100,000 of program cost indicator only includes data from survey respondents from 2018-2020 because administrative cost data were only available for those years.

Figure 7.19. NIF Project Collaborations by Type of Partner



Source: World Bank.

Over 25 percent of respondents reported improving the capabilities of their employees during project implementation, increasing to 61 percent of respondents improving the capabilities of their employees after project completion.

7.3 Efficiency in Achievement of Outcomes

Eight outcomes were tracked for the NIF program, based on the program's ToC: 1.) Prototypes; 2.) patent applications; 3.) patents granted; 4.) collaborative projects after implementation; 5.) new products, processes, and services; 6.) increased company sales; 7.) improved company export performance; and 8.) new employees hired.

While intended outcomes were generally lower on a per project basis than the DPPI program, NIF respondents were more efficient in producing outcomes per cost due to the higher costs of the DPPI program. Respondents reported a total of 626 outcomes (intended outcomes and other), for an average of 15 outcomes per project. From 2018 to 2020, the program invested an average of 222,092 BGN in beneficiary projects, so respondents generated 5.1 outcomes per 100,000 BGN invested over that time period.

Collaborative projects after implementation were the most common outcome reported, with an average of 2.4 per project; followed by employees hired (1.8 per project); new products, services, and processes (1.3 per project); and prototypes (1.2 per project) (Table 7.4).

Table 7.4. Intended Outcomes of NIF Respondents

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Prototypes	51	1.2	0.4	68%
Patent applications	26	0.6	0.1	30%
Patents granted	23	0.5	0.1	30%
Other IP activitiesa	29	0.7	0.1	30%
Collaborative projects after implementation	105	2.4	1.1	50%
New products, processes, or services	86	1.3	0.7	
Company increased sales	14	4.0% increase	0.1	32%
Company improved export performance	11	4.2% increase	0.1	25%
Company hired additional employees	78	1.8	0.8	32%

Source: World Bank.
Note: a. Other IP activities includes industrial designs, transfer agreements, and so on.

Most respondents had project results in the early stages of commercialization. More than half of respondents had project results in the early stages of commercialization (such as a prototype or proof of concept), which is likely due to the fact that the program does not fund projects beyond the experimental development stage. Thirty-three percent of respondents reported a working prototype, and 28 percent reported a proof of concept as results of their projects. Only 13 percent of respondents said their project resulted in a product or service that is currently being sold, while another 13 percent said they had a product or service that is that is ready to be sold. Ten percent of respondents said their project results were not commercialized nor were likely to be commercialized (Figure 7.20).

However, a significant number of respondents had not taken steps to selling their project results When asked about steps taken toward selling a product or services, 35 percent of respondents had not taken any steps as of the time they were surveyed. Again, this is likely due to the early-stage nature of the projects funded by the NIF program. Over one quarter of respondents had discussions with a vendor or firm to sell their products or services, while 14 percent had presented their product or service on the domestic market (Figure 7.21).

Figure 7.20. NIF Project Results by Stage of Commercialization

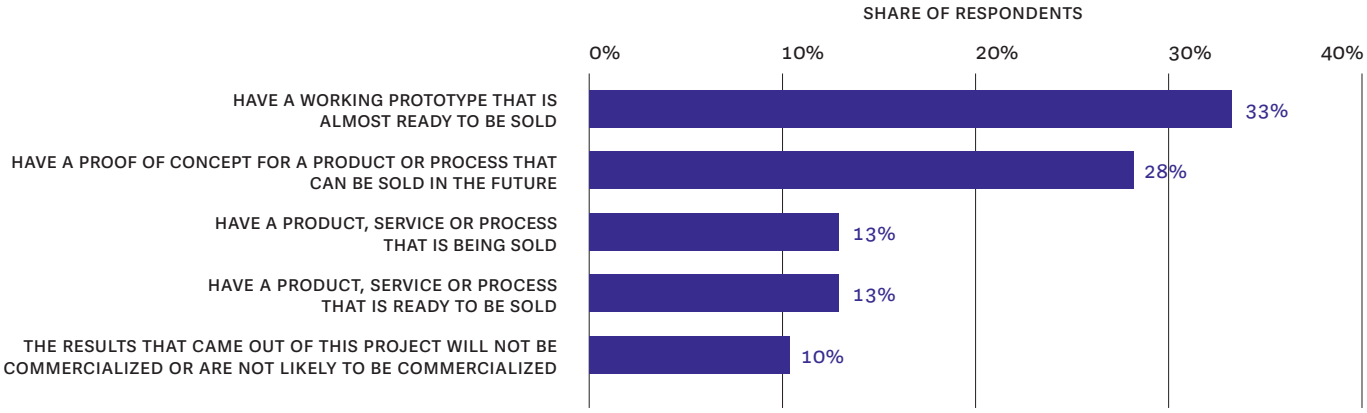
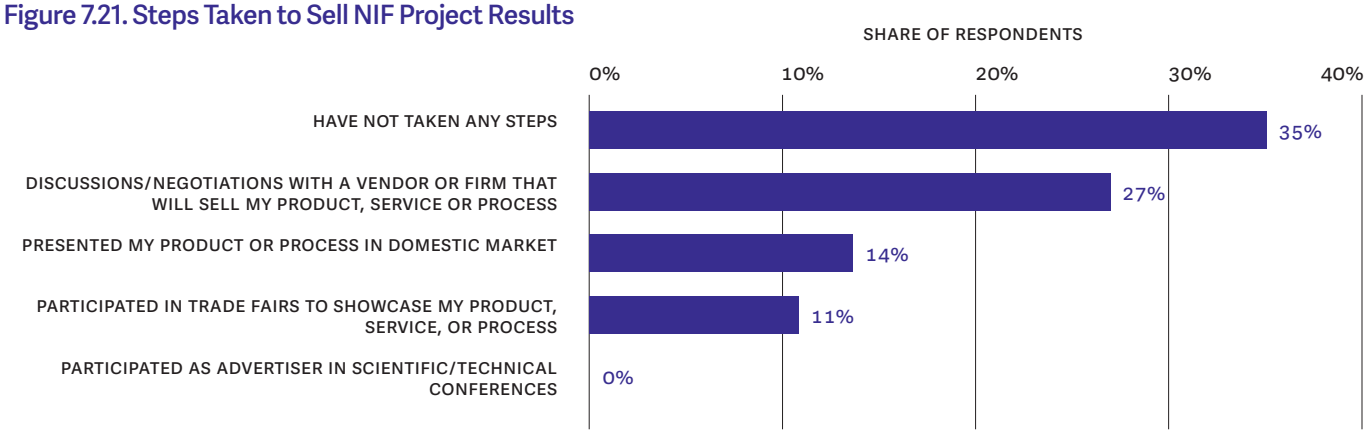


Figure 7.21. Steps Taken to Sell NIF Project Results



Source: World Bank.

Other Results

NIF respondents reported a number of other results not tracked by the program's ToC, including adoption of new technologies, improved productivity, and technology upgrades. The adoption of new technologies was the most common other result reported (1.2 per project), followed by upgraded products, services, and processes (0.9 per project). Respondents also reported an average increase in productivity of 6.5 percent and a reduction in production costs of 1.8 percent (Table 7.5).

Table 7.5. Other Results Achieved by NIF Respondents

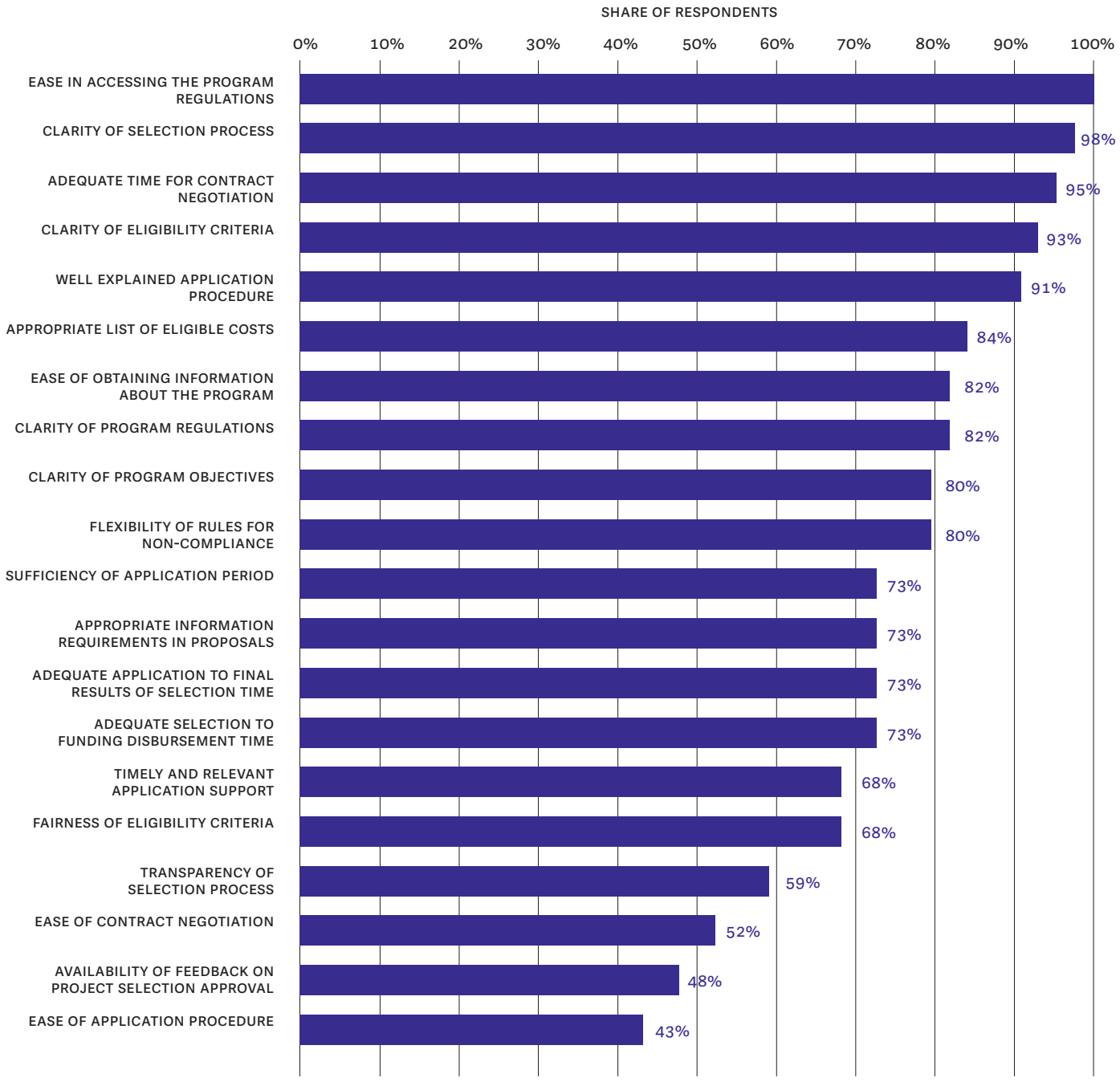
OTHER OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Upgraded products, processes, or services	40	0.9	0.6	
Company adopted a new technology	54	1.2	0.5	68%
New business model	13	0.3	0.1	26%
Expansion to new markets	29	0.7	0.3	59%
Improved Productivity	20	6.5 % improvement	0.2	45%
Reduced production costs	10	1.8% reduction	0.1	23%
New enterprise or business spinoff	15	0.3	0.1	18%
Reorganized the firm or part of the firm	7	0.2	0.1	11%
Develop a new innovation unit in the firm	15	0.3	0.1	61%

Source: World Bank.

7.4 Perceived Quality

Respondents were dissatisfied with several key processes related to project application and selection. Areas of dissatisfaction included ease of the overall application process, feedback on project selection, and the transparency of the selection process. While respondents expressed satisfaction with many of the program's application and selection processes, fewer than 60 percent of respondents were satisfied with selection transparency, contract negotiations, feedback on selection, and the overall application process (Figure 7.22). NIF requires applicants to provide a detailed breakdown of every participating researchers' hours of work for the duration of the project, which can add to the overall time and effort required to apply to the program. The most recent call for proposals for the program did allow applicants to submit their applications electronically (where all previous calls for proposals required paper submissions), which is a positive step in reducing the administrative burden on applicants. Respondents were largely satisfied with program objectives, rules, eligible costs, and other key application and selection processes.

Figure 7.22. Satisfaction with NIF Application and Selection Procedures

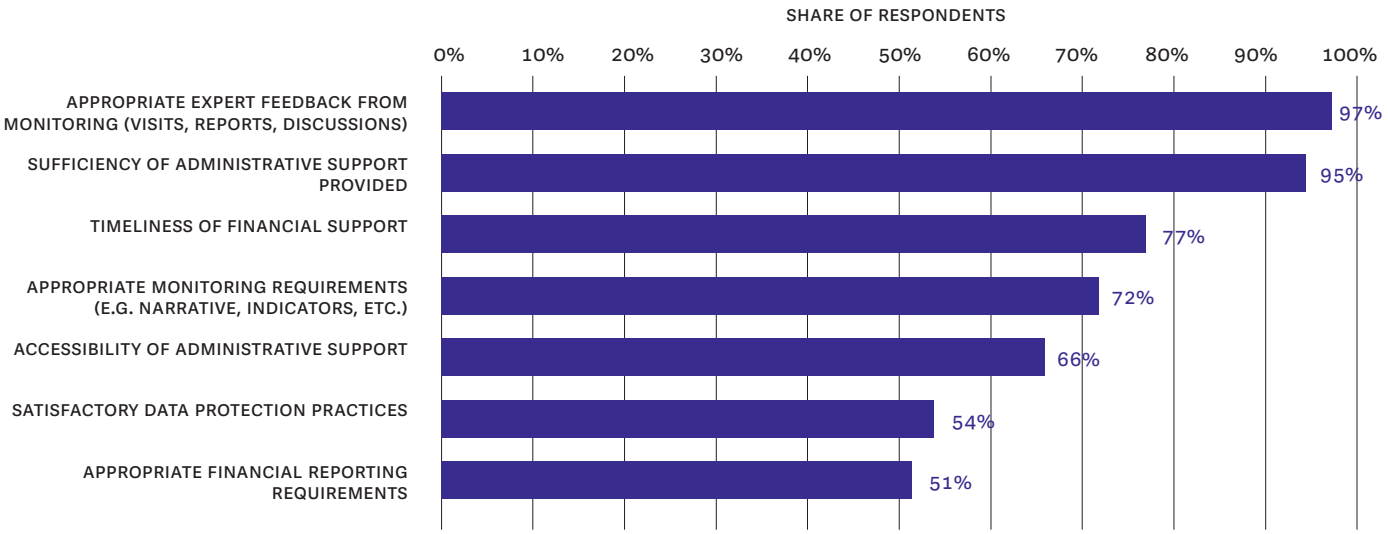


Source: World Bank.
Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with aspects of the application and selection process.

When asked if they think any program selection or eligibility criteria should be added, changed, or removed; five percent of respondents said that program eligibility criteria should be modified, with respondents saying that the criteria be modified to allow more types of research partnerships and that the criteria that provide additional points to firms that had participated in previous calls should be removed.

Respondents were largely satisfied with the program's implementation and monitoring processes, although less than 60 percent of respondents expressed satisfaction with financial reporting requirements and data protection practices. Unlike beneficiaries of EU operational programmes, there is no online portal with preloaded report templates for NIF beneficiaries to report on project progress. Respondents were very satisfied with the expert feedback provided during monitoring visits and the administrative support provided by the program, with more than 90 percent of respondents saying they were satisfied with these aspects of the program (Figure 7.23).

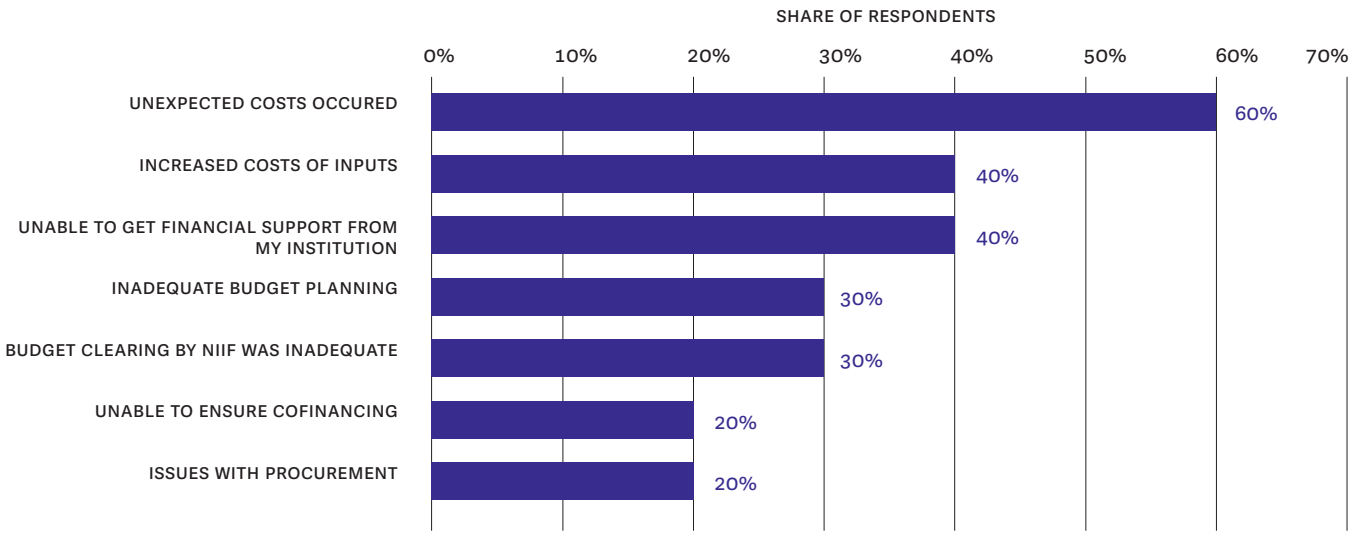
Figure 7.23. Satisfaction with NIF Implementation Processes



Source: World Bank.
Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with program implementation and monitoring processes.

Most respondents felt that the financial resources provided by the program were sufficient, with 70 percent reporting that they had sufficient funding to successfully complete their project. Respondents who said that the financial support provided was not sufficient said that financial support would need to increase by an average of 52 percent in order to successfully complete their project. The occurrence of unexpected costs, increased costs of inputs, and inability to secure co-financing were cited by respondents the most common reasons why the amount of financial support provided by the program was not sufficient (Figure 7.24).

Figure 7.24. Reasons Why NIF Respondents Found That Financial Support Provided was Insufficient



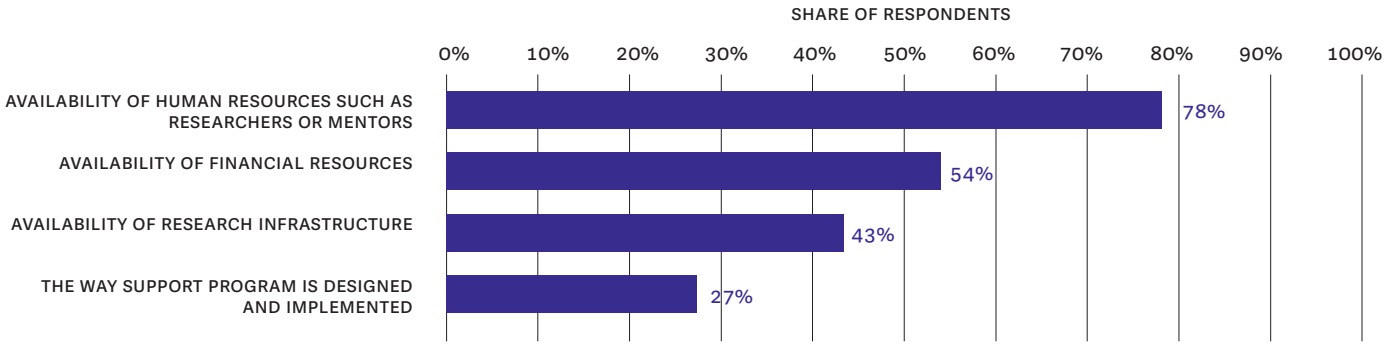
Note: N=10
Source: World Bank.

Similarly, most respondents felt that the amount of time allowed by the program to complete their project was sufficient, with 80 percent reporting that they had sufficient time to successfully complete their projects. Of those respondents who said they did not have enough time to complete their projects, inability to find qualified staff and delays in the supply of raw materials were cited as the most common reasons.

Human and financial resources were commonly cited key success factors, but help finding additional funding was a common gap in support. The availability of human resources was reported as a key factor for project success by more than three quarters of respondents, followed by the availability of financial resources (cited by more than half of respondents). Access to research infrastructure was reported as a key success factor by 43 percent of respondents, while program design and implementation was reported as a success factor by 27 percent (Figure 7.25). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, assistance with finding additional funding sources (19 percent

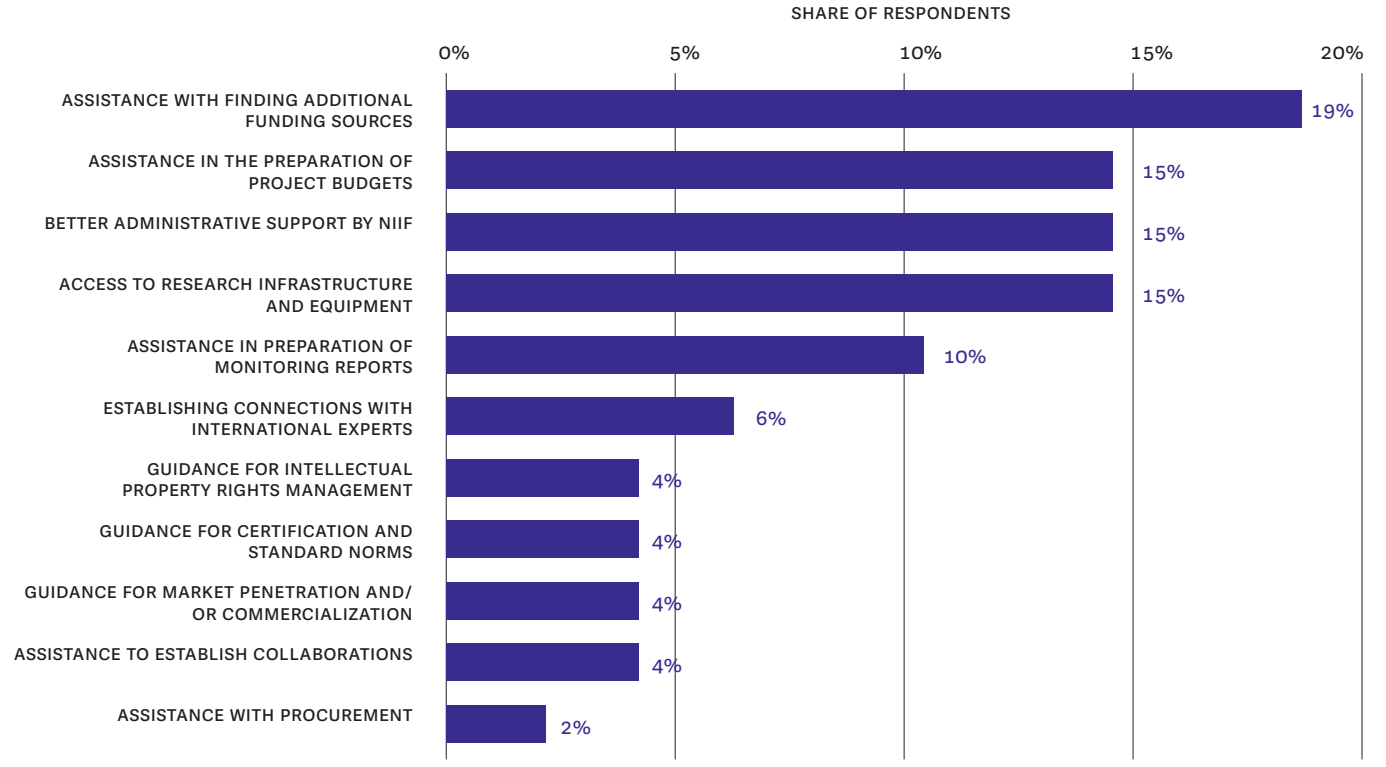
of respondents), assistance with the preparation of project budgets (15 percent), better administrative support from NIF (15 percent), and access to research infrastructure (15 percent) were cited as the most common types of additional support required (Figure 7.26).

Figure 7.25 Key Success Factors for NIF Projects



Source: World Bank.

Figure 7.26. Gaps in Support for NIF Projects

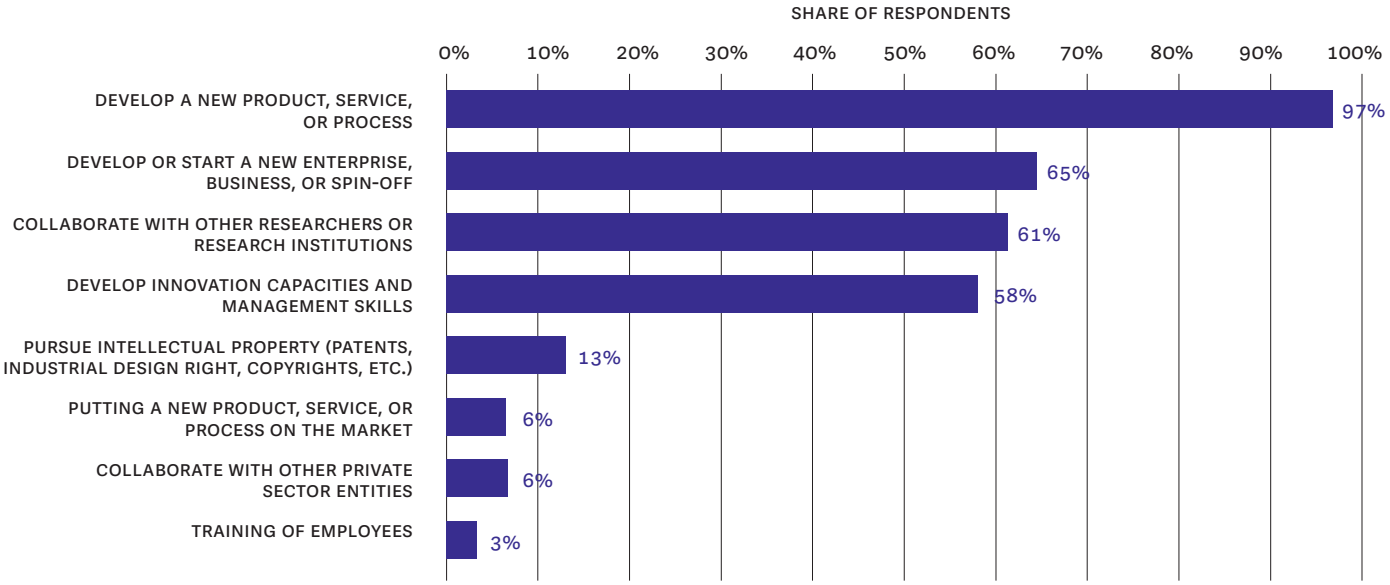


Source: World Bank.

Overall Project Quality

Project objectives—which focused on developing new products, services, and processes—were well aligned with the objectives of the NIF program. The program aims to promote research and development activity in enterprises by funding industrial research and experimental development. In line with this, 97 percent of respondents said one of the top objectives for their project was developing a new product, service, or process. Other project objectives reported by respondents include developing or starting a new enterprise (65 percent of respondents), collaborating with researchers or research institutions (61 percent), and developing the innovation capacities of the firm (58 percent) (Figure 7.27).

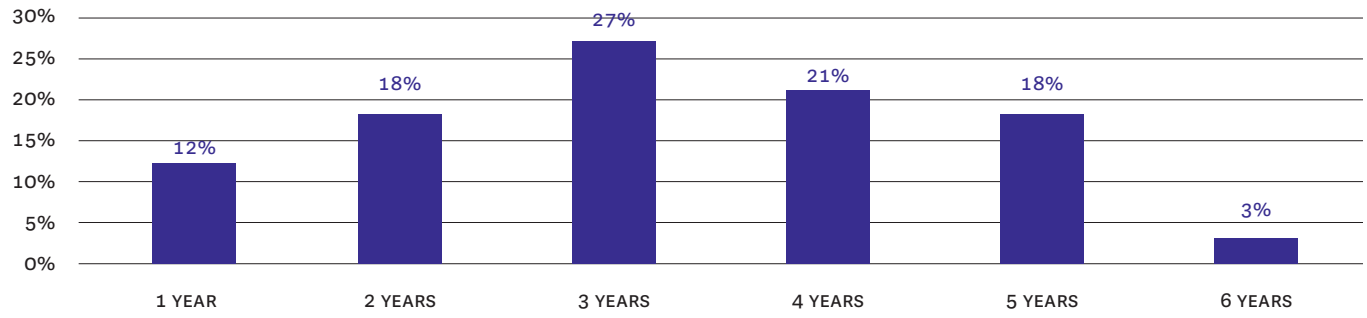
Figure 7.27. NIF Project Objectives



Source: World Bank.

NIF projects had long expected ROI timelines. When asked when respondents expected to recover the investment made in the project, almost 70 percent expected to recover their costs three years or more after the completion of their projects (Figure 7.28). Over 20 percent of respondents did not expect to recover their costs until at least five years after project completion. NIF respondents generally expected longer return on investment timelines than DPPI respondents. This return-on-investment timeline reflects of the nature of the NIF program, which supports industrial research and early-stage development project, rather than projects that are closer to the market.

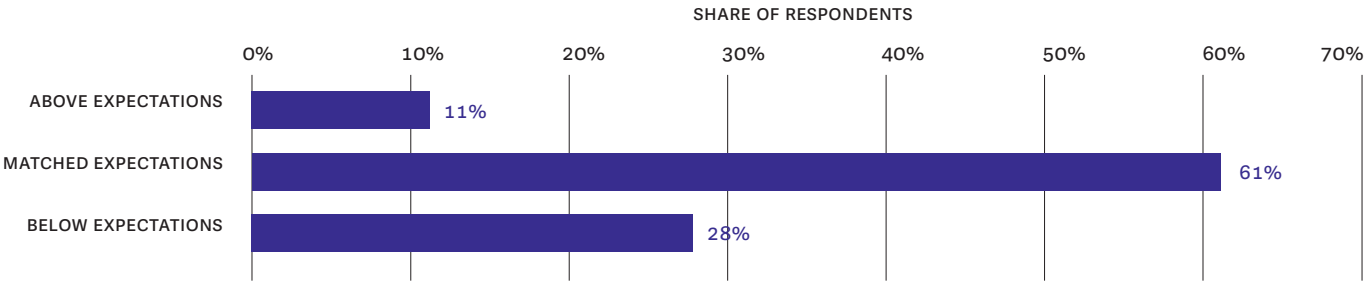
Figure 7.28. Distribution of Expected ROI Timelines for NIF Projects



Source: World Bank.

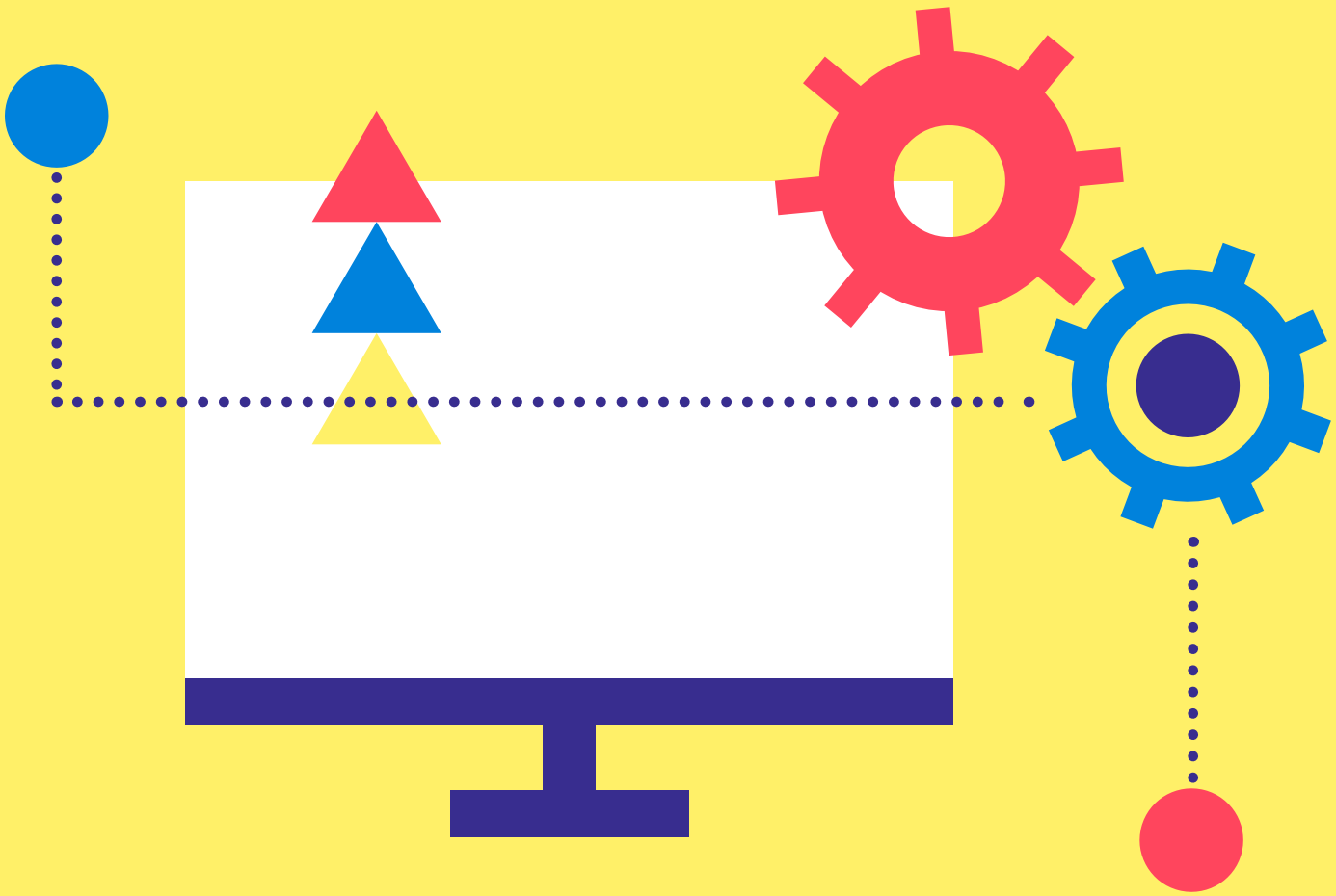
Most project results met expectations. Among respondents that had completed their projects, more than 60 percent felt that the outcomes of their projects matched their expectations (Figure 7.29). Projects exceeded expectations for 11 percent of respondents, while 28 percent said their project outcome was below expectations – the largest share of projects that fell below expectations for any program included in this analysis. This again is likely due to the early-stage nature of the projects supported by the NIF program, which are inherently riskier than academic research projects or later-stage commercialization projects.

Figure 7.29. Match between NIF Project Results and Beneficiary Expectations



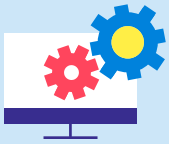
Source: World Bank.

8. Development of Product and Process Innovations



8. Development of Product and Process Innovations

PROGRAM SUMMARY



Development of Product and Process Innovations is a matching grant scheme under the OP Innovation and Competitiveness that provides financing to firms for supporting technology adoption, technology upgrading, and the development of new products, services, and processes. The program is designed and implemented by the Directorate General for OPIC. It has intended outcomes related to IP generation; new products, services, and processes; upgraded products, services, and processes; and increased revenues and employment for beneficiary companies.

DPPI respondents reported the highest application costs of any program (although lower as a share of disbursed grants received than NIF respondents), likely due to the fact that over 90 percent of respondents used some form of external support to prepare their applications. DPPI respondents also made the largest average contributions (cash and in kind) to their projects of any of the programs included in this analysis.

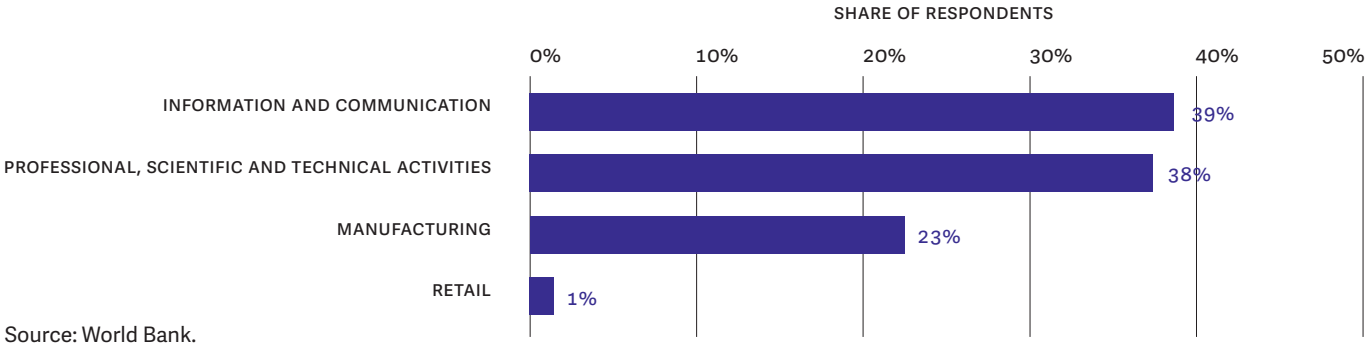
About 35 percent of respondents said that their project has resulted in a product or service that is currently being sold, while another 45 percent said they have a product or service that is that is ready to be sold. New products, services, and processes were the most common outcome reported by respondents; followed by upgraded products, services, or processes; new technologies adopted; and employees hired.

Respondents' satisfaction with program application and selection processes was mixed; few respondents were satisfied with the overall application process, fairness of eligibility criteria, feedback on project selection, and the time between application, selection, and disbursement of funds. Applications for the DPPI program are done entirely electronically through the online UMIS platform, and templates and guidelines are provided to applicants through the platform, which means that applying to these programs should be generally easier than for the other programs in this report. The fact that over 90 percent of applicants used external consultants to prepare their applications (more than any other program included in this analysis) indicates that the application process for the program remains challenging despite the adoption of the UMIS system. However, among respondents that had completed their projects, 80 percent felt that the outcomes of their project matched their expectations.

The program has thus far implemented a single call for proposals, funding a total of 154 projects in 2019 for a total of 70.8 million BGN in contracted funding (69.1 million BGN has been disbursed).

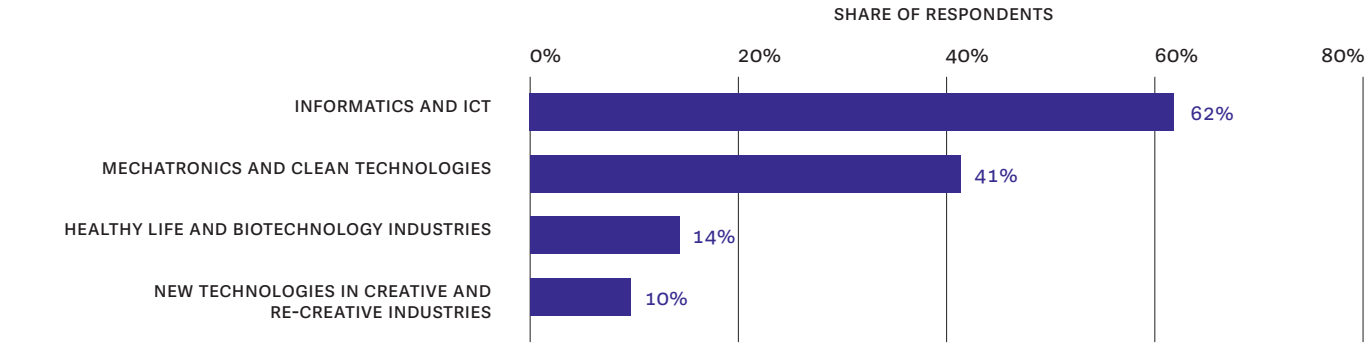
The designated points of contact for all 154 projects funded by the program from 2019 to 2020 were surveyed for this analysis, with 80 beneficiaries responding to the survey for a response rate of 52 percent. Respondents represent 52 percent of the contracted funding for the program over that period, with an average grant size of 460,945 BGN. The main economic activity area of respondent firms were ICT (39 percent of respondents), professional services (38 percent), and manufacturing (23 percent) (Figure 8.1), while the main Smart Specialization priority areas of respondents' projects were informatics and ICT (62 percent of respondents) and mechatronics (41 percent) (Figure 8.2).

Figure 8.1. DPPI Respondents by Main Economic Activity



Source: World Bank.

Figure 8.2. DPPI Respondents by Smart Specialization Priority Area

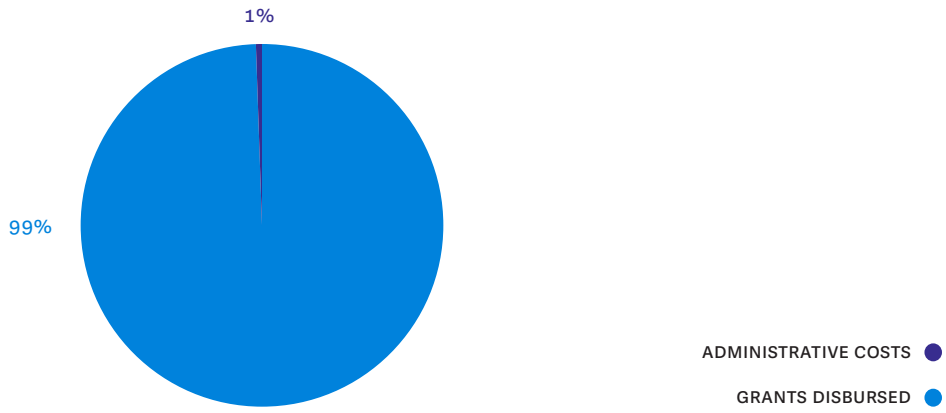


Source: World Bank.

8.1 Efficiency in Use of Inputs

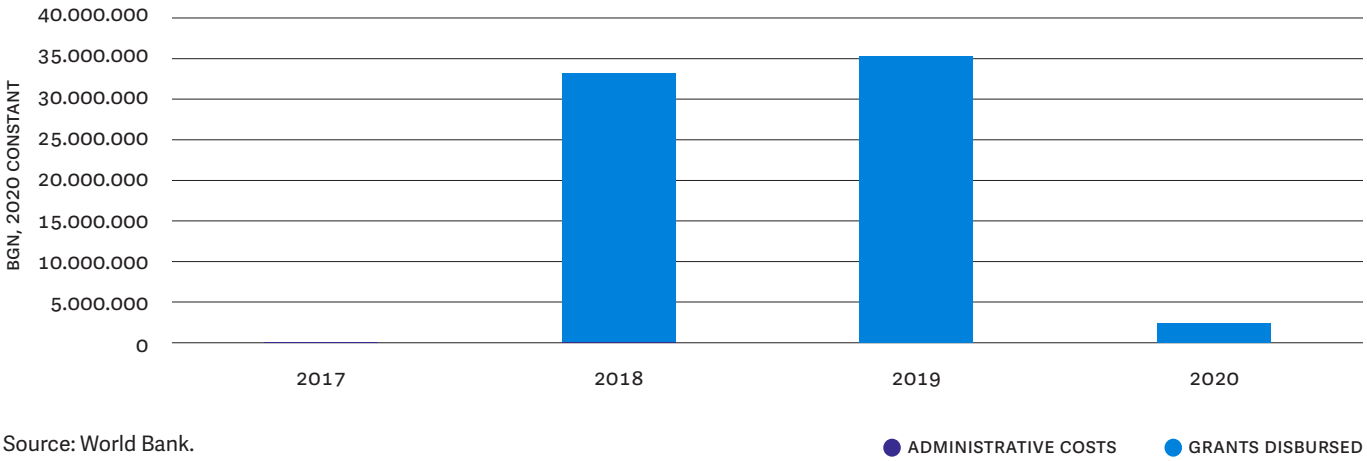
Administrative costs made up less than one percent of total DPPI program costs, which peaked in 2019. Grants distributed to beneficiaries made up 99 percent of the costs of the program from 2017 to 2020 (Figure 8.3). Total program costs were highest in 2019, coinciding with the highest levels of grants disbursed to beneficiaries, before dropping dramatically in 2020. Overall administrative costs were highest in 2018, when the majority of projects were awarded (Figure 8.4). It should be noted, however, that cost data for office equipment and ICT were not available for the program, so administrative costs are likely higher than what is reported in this analysis.

Figure 8.3. DPPI Program Costs by Category, 2017–20



Source: World Bank.

Figure 8.4. DPPI Program Costs by Year, 2017–20

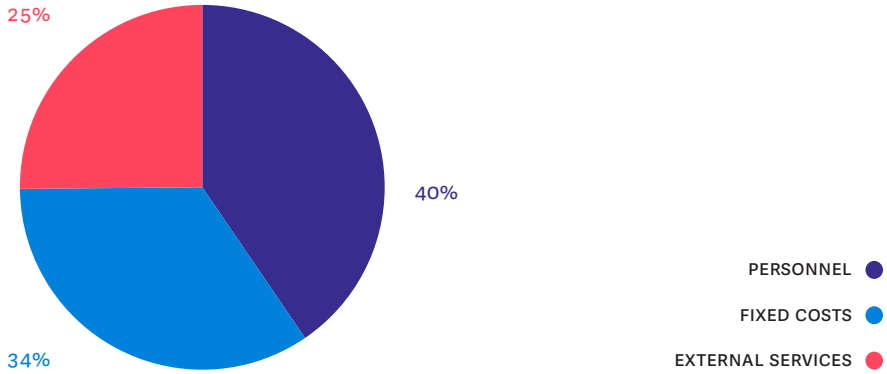


Source: World Bank.

Administrative Costs

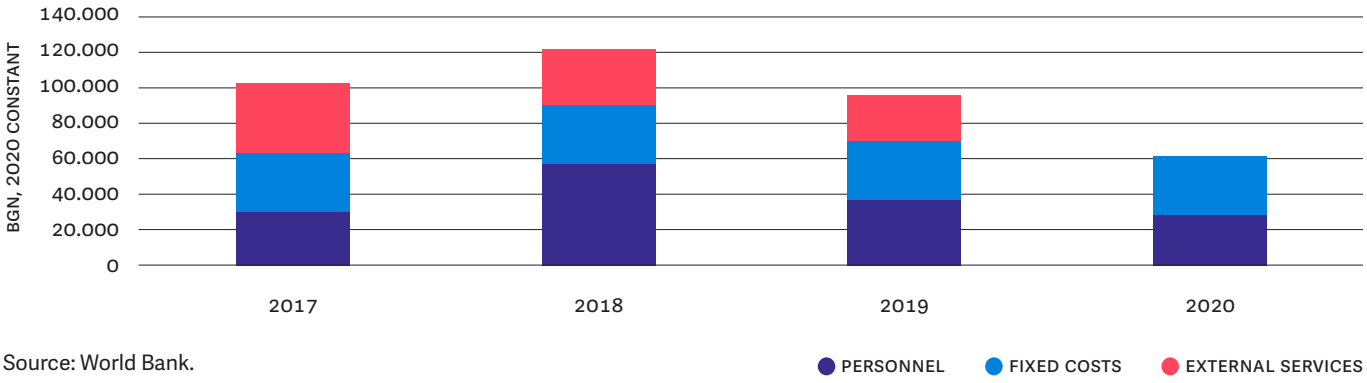
Personnel costs made up the largest share of administrative costs for the program. Personnel costs make up 40 percent of total administrative costs, followed by fixed costs and external services (Figure 8.5). The program's single call for proposals was issued in 2018, and there was a corresponding increase in personnel costs that year, which then decreased in the following years. Fixed costs remained relatively constant from 2017 to 2020, while external services costs were highest in 2017 (Figure 8.6).

Figure 8.5. DPPI Administrative Costs by Category, 2017–20



Source: World Bank.

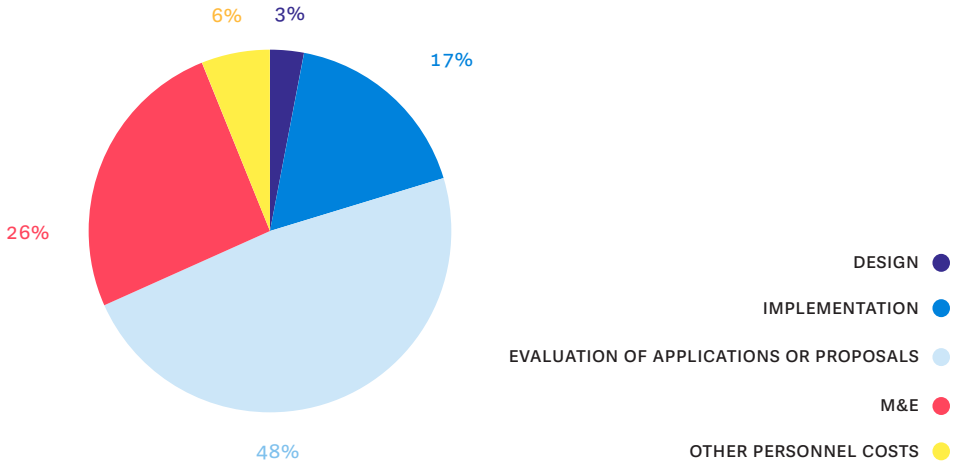
Figure 8.6. DPPI Administrative Costs by Year, 2017–20



Source: World Bank.

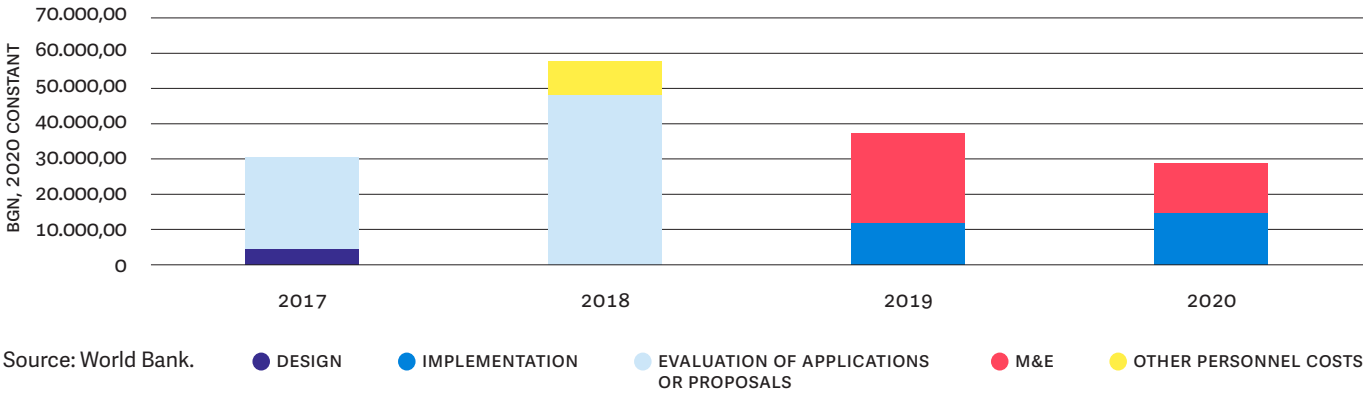
Almost 50 percent of personnel costs went toward the evaluation of project proposals, while monitoring and evaluation made up 25 percent of personnel costs and implementation costs were 17 percent (Figure 8.7). All costs for design and the evaluation of project proposals came in 2017 and 2018 (the bulk of DPPI project awards were made in 2018), while all implementation and M&E costs came in 2019 and 2020 (Figure 8.8).

Figure 8.7. DPPI Personnel Costs by Category, 2017–20



Source: World Bank.

Figure 8.8. DPPI Personnel Costs by Year, 2017–20



Source: World Bank.

As mentioned previously, cost data for office equipment and ICT were not available for the program, so the fixed cost data presented here are likely lower than the actual fixed costs of the program. The fixed costs that were available (goods and services and office space) remained constant from 2017 to 2020 at 32,756 BGN per year.

The DDPI program also had 70,393 BGN in external services costs for the contracting of external experts for the evaluation of proposals. This includes 38,913 BGN in 2017 and 31,480 BGN in 2018 (in constant 2020 BGN). There were no costs related to external services in 2020.

The total administrative cost of implementing the program from 2017 to 2020 was 355,568 BGN, with an average cost per project of 2,308 BGN (Table 8.1). The average administrative cost per project for DPPI was significantly lower than for the NIF program, likely due to the fact that DPPI only issued a single call for proposals from 2018 to 2020, while NIF issued three over the same period.

Table 8.1. DPPI Administrative Costs

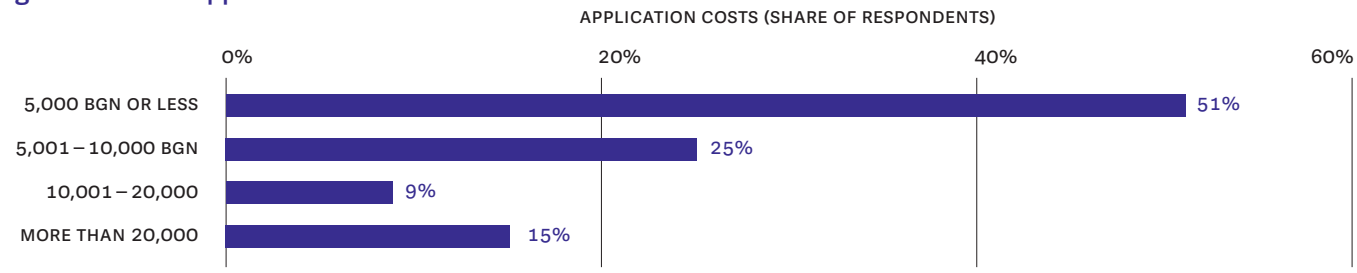
COST CATEGORY	TOTAL COSTS	COST PER PROJECT
Personnel	154,150	1,001
Fixed	131,024	851
External services	70,393	457

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Costs Covered by Beneficiaries

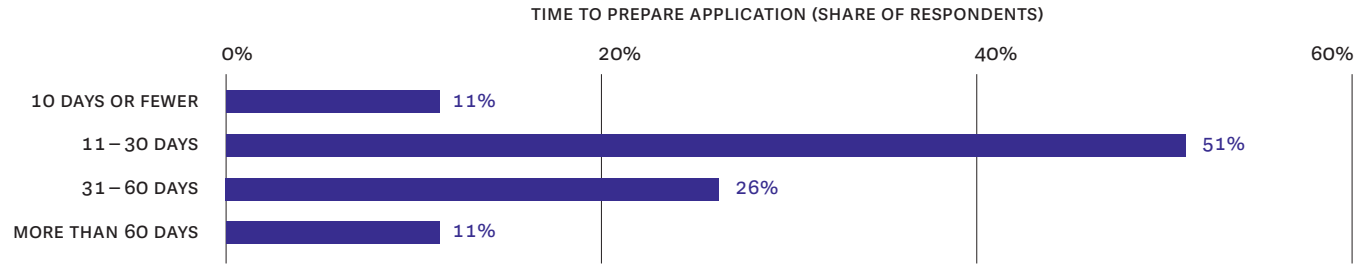
The application process for DPPI is the most costly and time intensive among the programs in this analysis. Respondents reported an average application cost of 10,415 BGN and spent an average of 32 working days preparing their application. More than half respondents spent less than 5,000 BGN in preparing their application, while 9 percent of respondents between 10,001 and 20,000 BGN and 15 percent spent more than 20,000 BGN (Figure 8.9). A majority of respondents reported spending 30 working days or fewer in preparing their application, although 11 percent of respondents reported spending more than 60 days in preparing the application (Figure 8.10).

Figure 8.9. DPPI Application Costs



Source: World Bank.

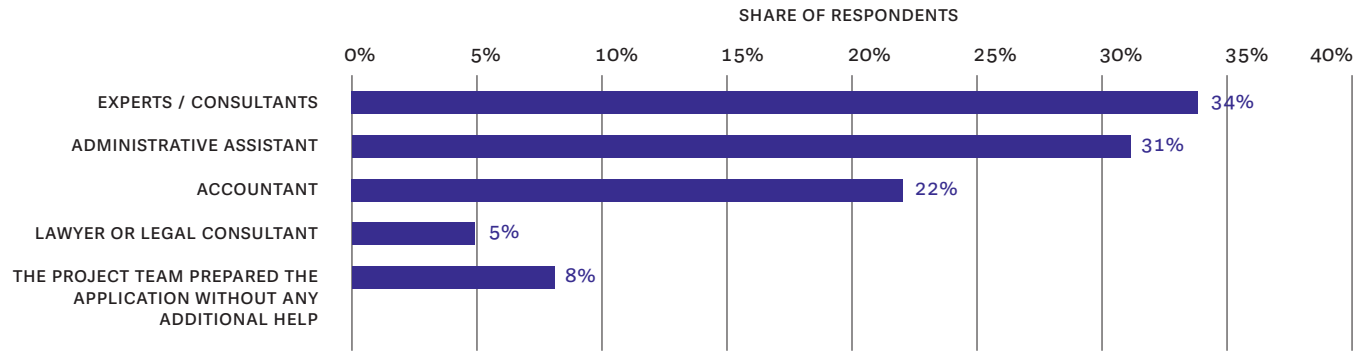
Figure 8.10. Time to Prepare DPPI Applications



Source: World Bank.

DPPI respondents used a range of external support to prepare their applications. About 92 percent of respondents reported that they used some type of external support (such as legal, accounting, or other services) to prepare their application, which likely contributed to the relatively high costs of applying to the DPPI program compared to other programs included in this analysis. The most common types of support used were experts or consultants (needed by 34 percent of respondents), administrative assistants (31 percent), and accountants (22 percent). Eight percent of respondents reported that they did not use any external support in preparing their application (Figure 8.11).

Figure 8.11. External Support Used to Prepare DPPI Applications



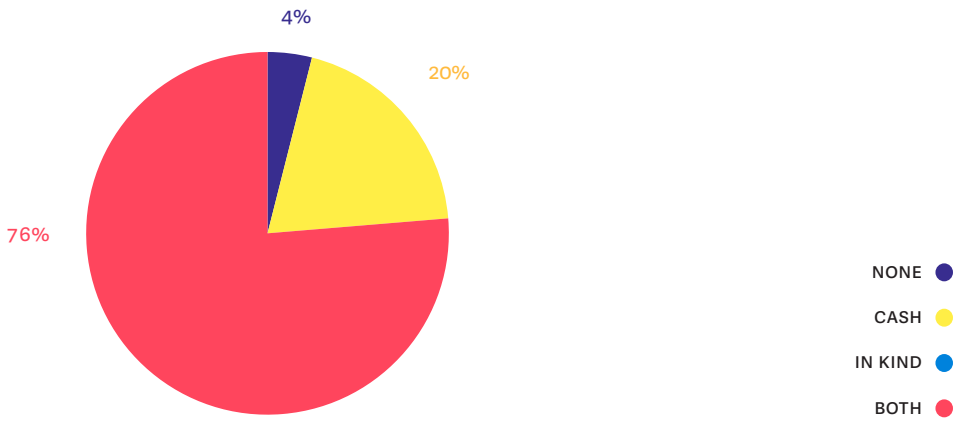
Source: World Bank.

Respondents reported an average of 190,000 BGN cash and 55,000 BGN in kind contributions to the implementation of their projects (Figure 8.12). The DPPI program will fund between 50 and 70 percent of total project costs, depending on the size of the firm, while the firm is responsible for funding the remainder of project costs. Cash contributions were the most common contribution by share of respondents, with 55 percent of respondents making in kind contributions. About three quarters of respondents made both cash and in-kind contributions to the project, while 20 percent made only cash contributions (Figure 8.13).

Figure 8.12. Beneficiary Contributions to DPPI Projects by Type and Amount

Source: World Bank.

Figure 8.13. Beneficiary Contributions to DPPI Projects by Type and Frequency



Source: World Bank.

On average, the costs covered by the program were slightly less than double the costs covered by respondents. The average cost covered by the program, including disbursed grants and administrative costs, was 460,887 BGN, while the average cost covered by beneficiaries was 252,088 BGN. Therefore, for every BGN that beneficiaries put into the project, the program invested 1.83 BGN.

8.2 Efficiency in Generation of Outputs

For every BGN the program invested in administrative costs, beneficiaries received an average of 199 BGN. The total program costs from 2017 to 2020 was 71 million BGN, or 460,887 BGN per project. This includes 69.1 million in disbursed grants to beneficiaries and 1.2 million BGN in administrative costs (Table 8.2). The program did not include any nonfinancial or indirect financial support to beneficiaries.

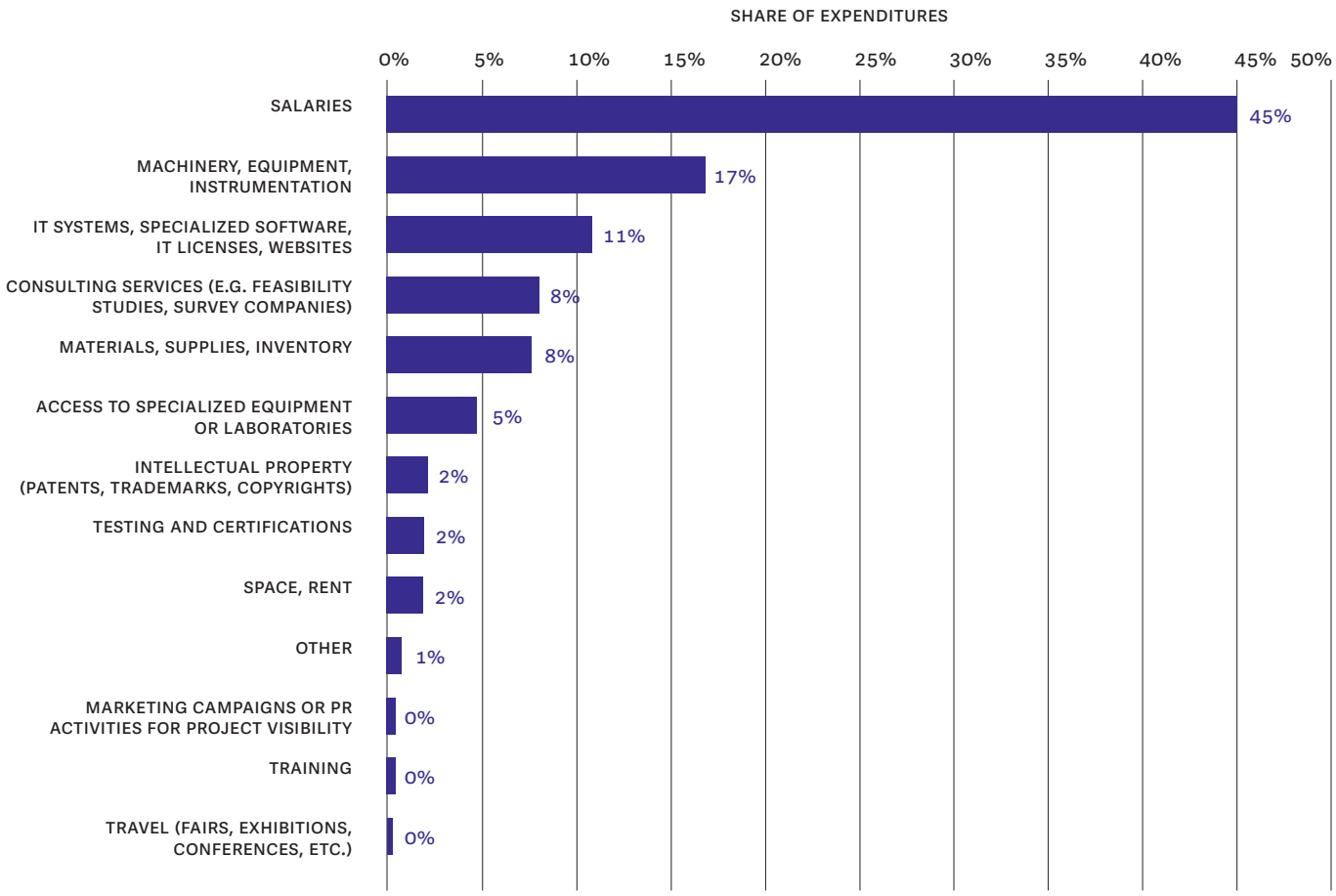
Table 8.2. DPPI Program Costs, 2018–20

	TOTAL	AVERAGE PER PROJECT
Grant funding disbursed	69,088,015 BGN	448,623 BGN
Administrative and operating costs	355,568 BGN	2,308 BGN
Total program cost	**70,976,672 BGN**	**460,887 BGN**

Source: World Bank.
Note: All amounts in constant 2020 BGN.

Salaries made up the largest category of project expenditure; followed by machinery and equipment and IT systems. Consulting services, materials and supplies, and access to specialized equipment also represented major costs (Figure 8.14).

Figure 8.14. DPPI Project Expenditures by Cost Category



Source: World Bank.

Outputs Achieved

Two outputs were tracked for the DPPI program, based on the program's ToC: 1.) collaborations during project implementation and 2.) improved capabilities of employees.

Program respondents generated a total of 289 outputs from 2017 to 2020, or an average of 3.6 outputs per project. Over that period, the program invested an average of 460,887 BGN in beneficiary projects, so respondents generated 0.8 outputs per 100,000 BGN invested.

Improved capabilities of employees were the most common type of output reported (an average of 2.1 per project), followed by collaborations during implementation (1.5 per project) (Table 8.3).

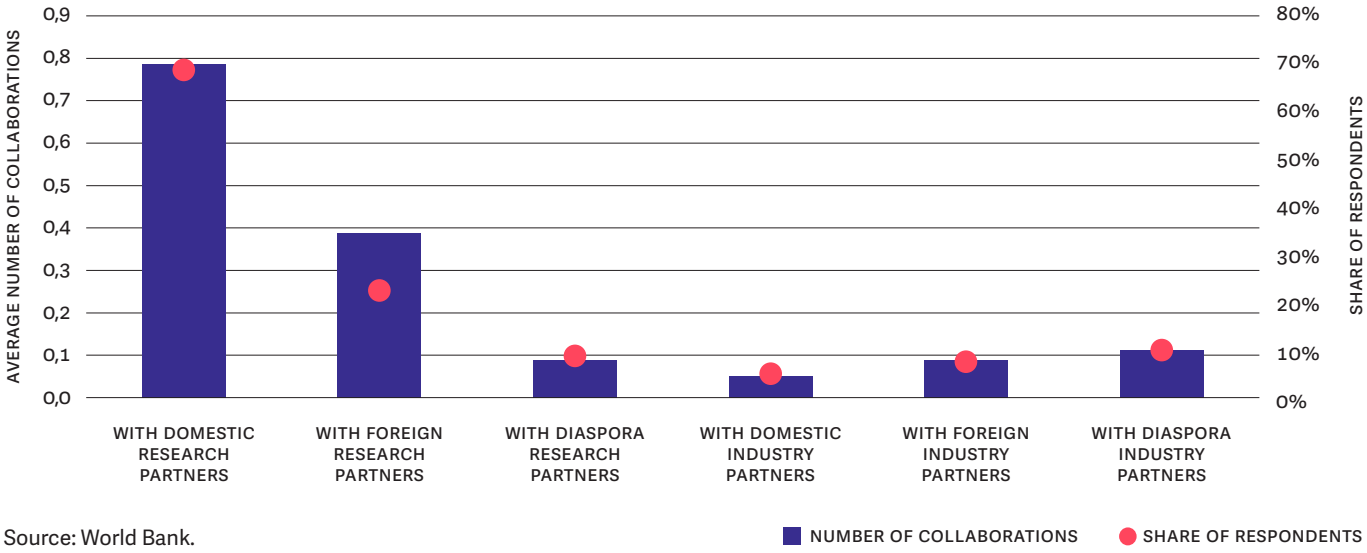
Table 8.3. Outputs Reported by DPPI Respondents

OUTPUT	TOTAL NUMBER OF OUTPUTS ACHIEVED	AVERAGE OUTPUTS PER RESPONDENT	OUTPUTS PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Collaboration	121	1.5	0.3	76%
Improved capabilities of employees	168	2.1	0.5	48%

Source: World Bank.

Over 76 percent of respondents engaged in some types of collaboration during their projects. The most common collaborations, by both average number of collaborations per project and share of respondents who engaged in such a collaboration, were partnerships with domestic research partners, followed by partnerships with foreign research partners (Figure 8.15). Collaborations with industry were less common that collaborations with research entities, with collaborations with industry partners from the Bulgarian diaspora being the most common type of industry partnerships.

Figure 8.15. DPPI Project Collaborations by Type of Partner



Source: World Bank.

Roughly half (48 percent) of respondents reported improving the capabilities of their employees during project implementation, increasing to 60 percent of respondents improving the capabilities of their employees after project completion.

8.3 Efficiency in Achievement of Outcomes

Seven outcomes were tracked for the DPPI program, based on the program's ToC: 1.) Patent applications; 2.) patents granted; 3.) upgraded products, services, and processes; 4.) new products, processes, and services; 5.) new technologies adopted; 6.) increased company sales; and 7.) new employees hired.

DPPI respondents generated more outcomes on a per project basis than NIF respondents, but due to the higher costs of the DPPI program, NIF respondents were generally more efficient in producing outcomes on a per cost basis. Respondents reported a total of 1,243 outcomes (intended outcomes and other), for an average of 15 outcomes per project. From 2018 to 2020, the program invested an average of 460,887 BGN in beneficiary projects, so respondents generated 3.3 outcomes per 100,000 BGN invested over that time period.

New products, services, and processes were the most common outcome reported, with an average of 2.6 per project; followed by upgraded products, services, or processes (2.2 per project); new technologies adopted (1.9 per project); and employees hired (1.8 per project) (Table 8.4).

Table 8.4. Intended Outcomes Reported by DPPI Respondents

INTENDED OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF PROGRAM COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Patent applications	70	0.9	0.2	88%
Patents granted	57	0.7	0.2	71%
Upgraded products, processes, or services	178	2.2	0.5	45%
New products, processes, or services	211	2.6	0.6	85%
Company adopted a new technology	152	1.9	0.4	78%
Company increased sales	34	6.7% increase	0.1	43%
Company hired additional employees	144	1.8	0.4	46%

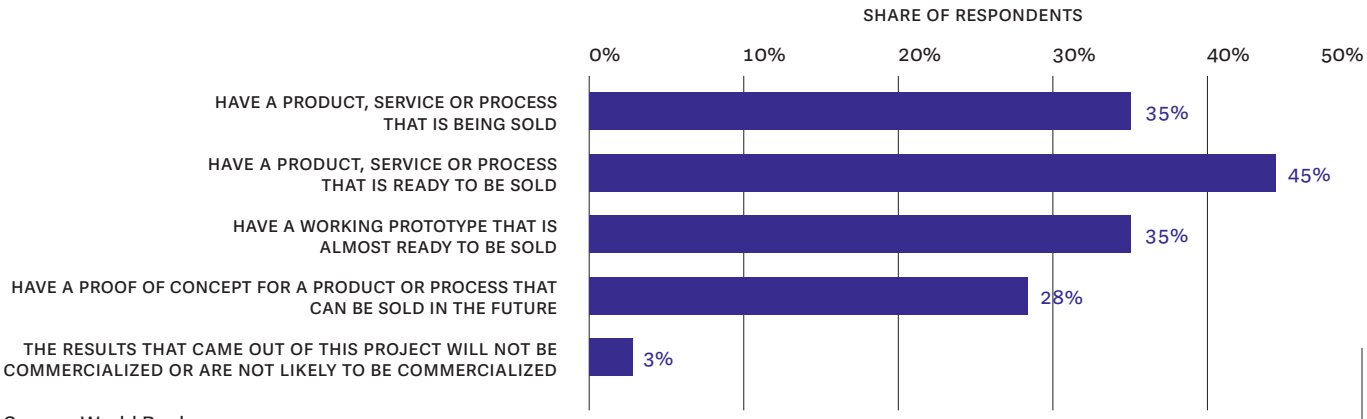
Source: World Bank.

Nearly half of respondents had a product, services, or process that is ready to be sold. About 35 percent of respondents said that their project has resulted in a product or service that is currently being sold, while another 45 percent said they have a product or service that is that is ready to be sold. A sizeable share of respondents also have project results that are still in earlier stages of commercialization, with 35 percent saying they have a working prototype and 28 percent reporting they have a proof of concept. Only three percent of respondents said their project results

were not commercialized nor were likely to be commercialized (Figure 8.16). The higher share of DPPI projects that result in market ready products and services when compared to NIF is likely due to the fact that NIF only funds project up to the experimental stage of development, while DPPI will fund projects in later stages of commercialization.

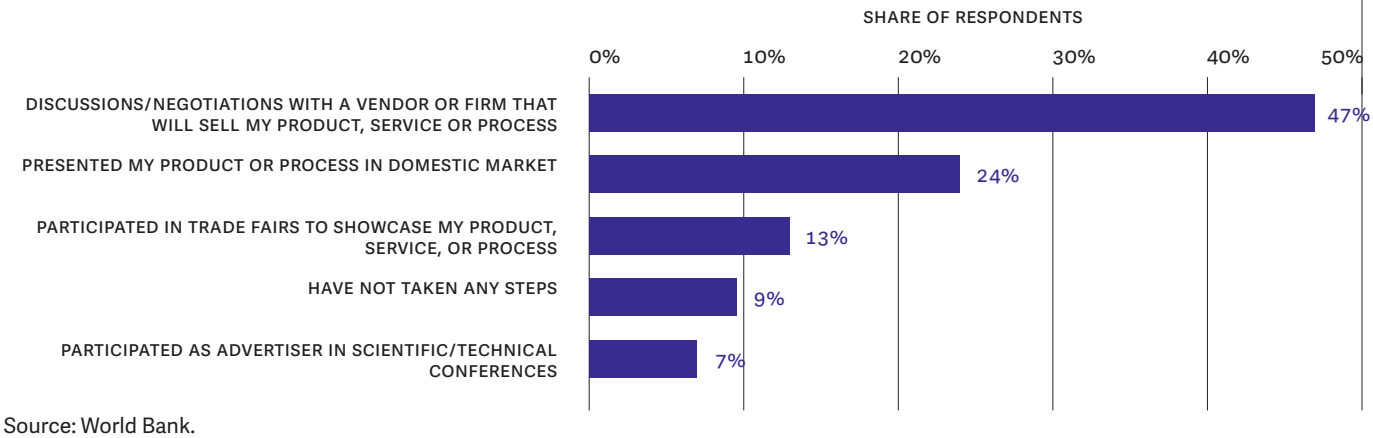
One quarter of respondents had introduced a product or service to the domestic market. Almost half of respondents have engaged in discussions with vendors about selling their product or service, while 24 percent had presented their product or service in the domestic market. Only nine percent of respondents had not yet taken steps toward selling their product or service (Figure 8.17. Steps Taken to Sell DPPI Project Results).

Figure 8.16. DPPI Project Results by Stage of Commercialization



Source: World Bank.

Figure 8.17. Steps Taken to Sell DPPI Project Results



Source: World Bank.

Other Results

DPPI respondents reported several results not tracked by the program's ToC, including prototypes, collaborative projects after implementation, and expansion to new markets. Prototypes were the most common other result reported (2.8 per project), followed by collaborative projects after implementation (2.6 per project), and expansion to new markets (1.5 per project). Respondents also reported an average increase in productivity of 9.6 percent and a reduction in production costs of 3.6 percent (Table 8.5).

Table 8.5. Other Results Achieved by DPPI Respondents

OTHER OUTCOME	TOTAL NUMBER OF OUTCOMES ACHIEVED	AVERAGE OUTCOMES PER RESPONDENT	OUTCOMES PER 100,000 BGN OF COST	SHARE OF RESPONDENTS REPORTING OUTCOME
Other IP activitiesa	29	0.5	0.1	45%
Prototype	221	2.8	0.6	71%
New business model	50	0.6	0.1	26%
Expansion to new markets	116	1.5	0.3	59%
Improved their export performance (%)	32	7.0%	0.1	40%
Improved Productivity	45	9.6% increase	0.1	56%
Reduced production costs	27	3.9% reduction	0.1	34%
New enterprise or business spinoff	4	0.1	0.0	5%
Reorganized the firm or part of the firm	16	0.2	0.0	19%
Develop a new innovation unit in the firm	39	0.5	0.1	69%
Collaborative projects after implementation	208	2.6	0.6	55%

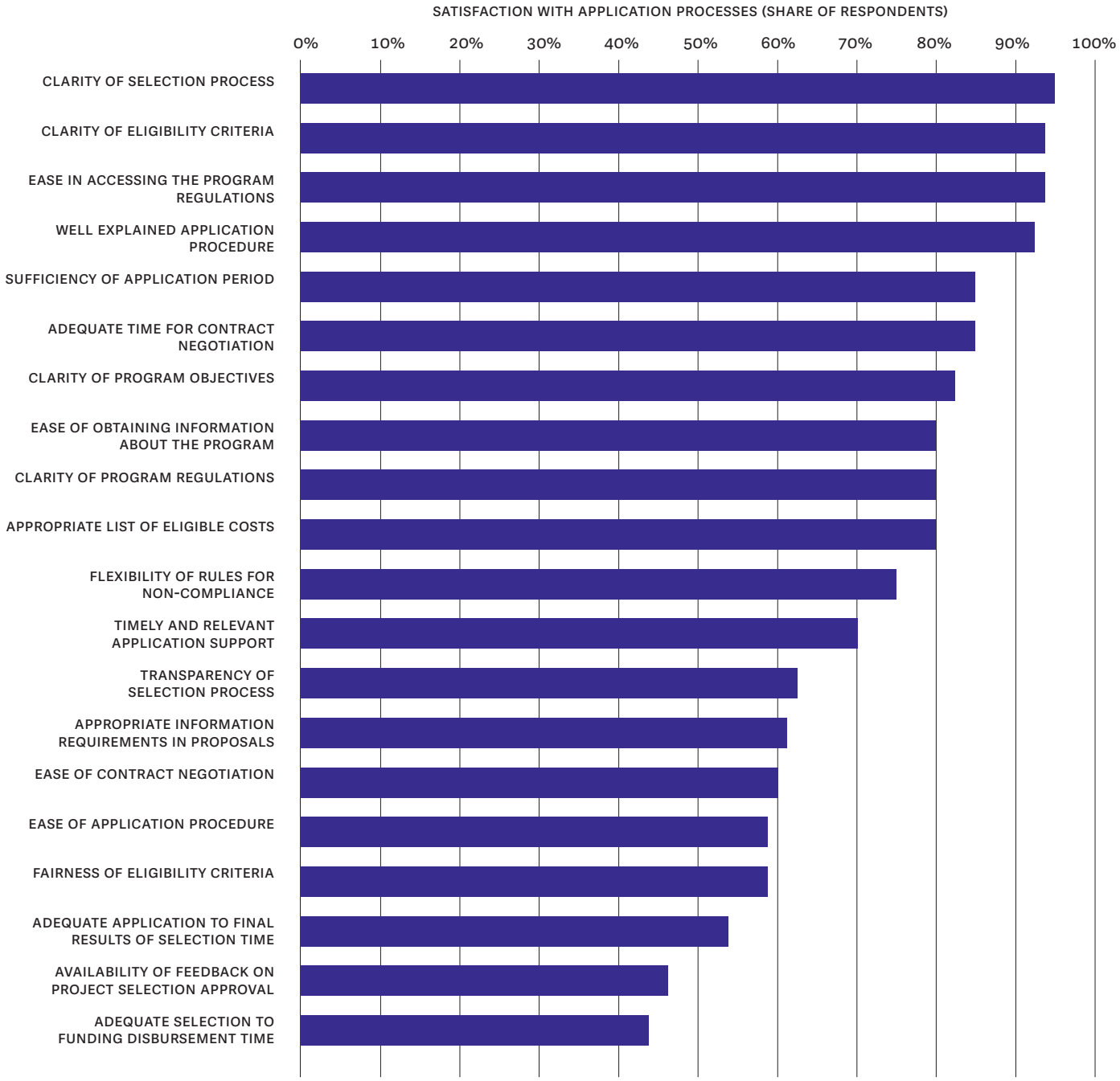
Source: World Bank.
Note: a. Other IP activities includes industrial designs, transfer agreements, and so on.

8.4 Perceived Quality

Respondents' satisfaction with program application and selection processes was mixed. Less than 60 of respondents reported that they were satisfied with the overall application process, fairness of eligibility criteria, feedback on project selection, and the time between application, selection, and disbursement of funds. On the other hand, respondents were largely satisfied with program objectives, regulations, availability of program information, and other program elements (Figure 8.18). Applications for the DPPI program are done entirely electronically through the online UMIS platform, and templates and guidelines are provided to applicants through the platform, which means that applying to these programs should be generally easier than for nationally funded

programs. The fact that over 90 percent of applicants used external consultants to prepare their applications (more than any other program included in this analysis) indicates that the application process for the program remains challenging despite the adoption of the UMIS system.

Figure 8.18. DPPI Respondents' Satisfaction with Application Processes

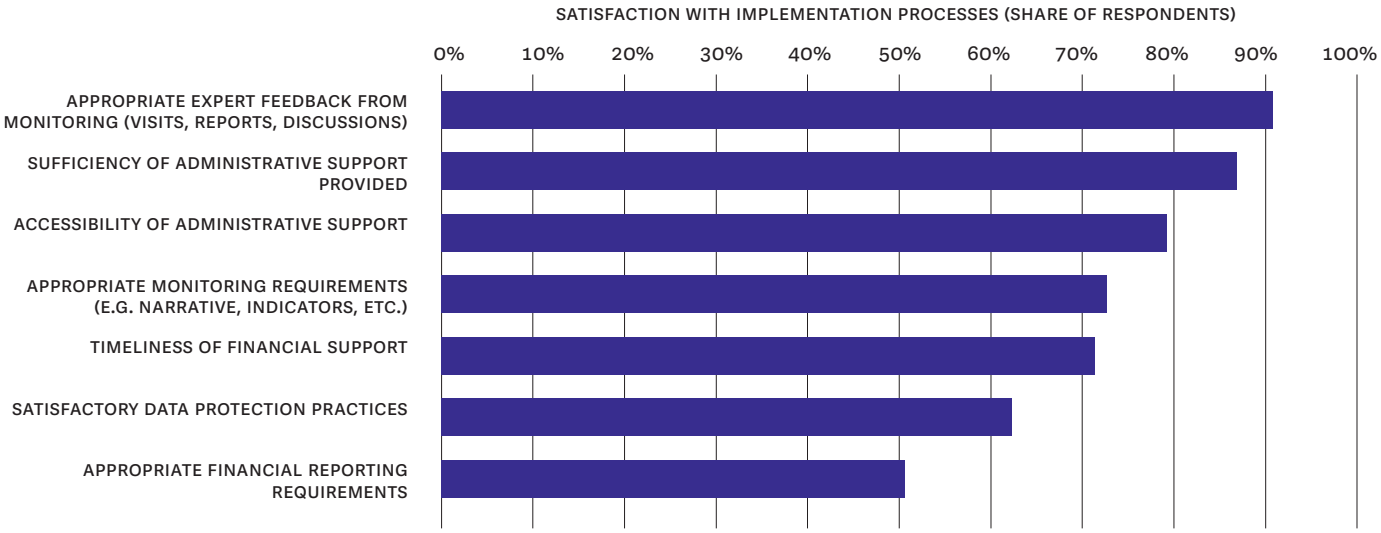


Source: World Bank.

When asked if they think any program selection or eligibility criteria should be added, changed, or removed; four percent of respondents said they thought that program eligibility criteria should be modified. Suggested changes included allowing more types of research partnerships and using a different definition of innovation that what is currently used by the program. Similarly, five percent of respondents said they thought that program eligibility criteria should be modified, with suggested changes including removing the requirement to provide evidence for the type of economic activity of the project and removing the criteria that provides extra points based on a firm's location.

Respondents were largely satisfied with the DPPI program's implementation and monitoring processes, with the exception of financial reporting requirements and data protection practices. In the latter two areas, less than 65 percent of respondents reported they were satisfied (Figure 8.19). Financial reporting requirements, in particular, appear to be a source of dissatisfaction for respondents, and this may be an area to look for opportunities to lessen the administrative burden on firms.

Figure 8.19. DPPI Respondents' Satisfaction with Program Implementation and Monitoring



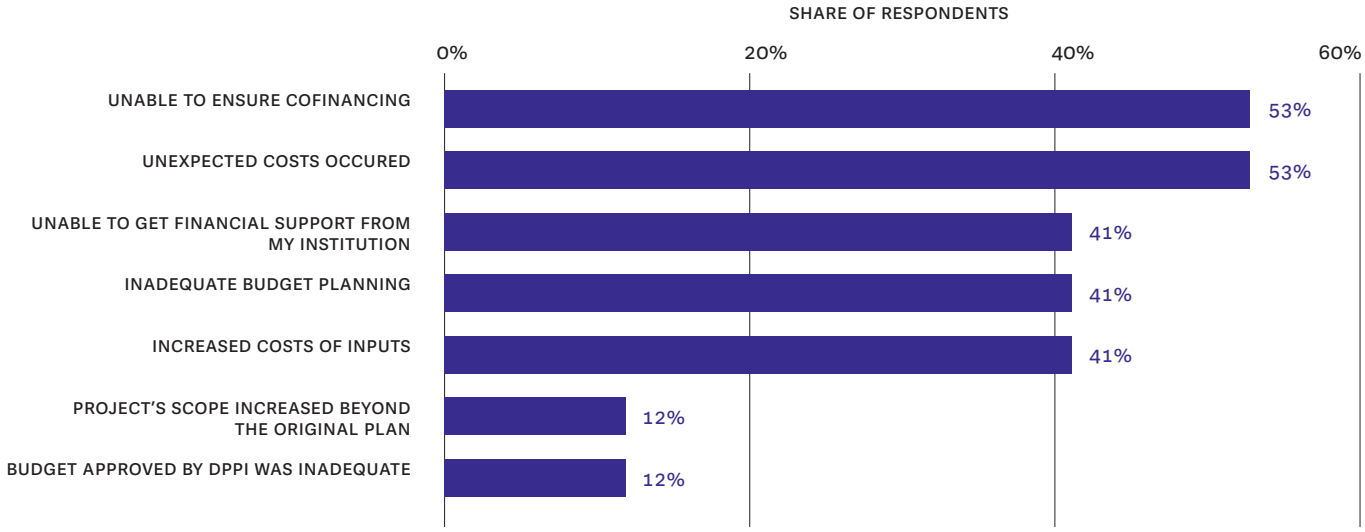
Source: World Bank.
Note: Figure shows percentage of respondents who agreed or strongly agreed with the statements asking about their satisfaction with program implementation and monitoring processes.

Most respondents felt that the financial resources provided by the program were sufficient. Eighty percent reported that they had sufficient funding to successfully complete their project. Respondents who said that the financial support provided was not sufficient said that financial support would need to increase by an average of 46 percent in order to successfully complete their project. Inability to ensure co-financing and the occurrence of unexpected costs were cited

by the most common reasons why the amount of financial support provided by the program was not sufficient (Figure 8.20).

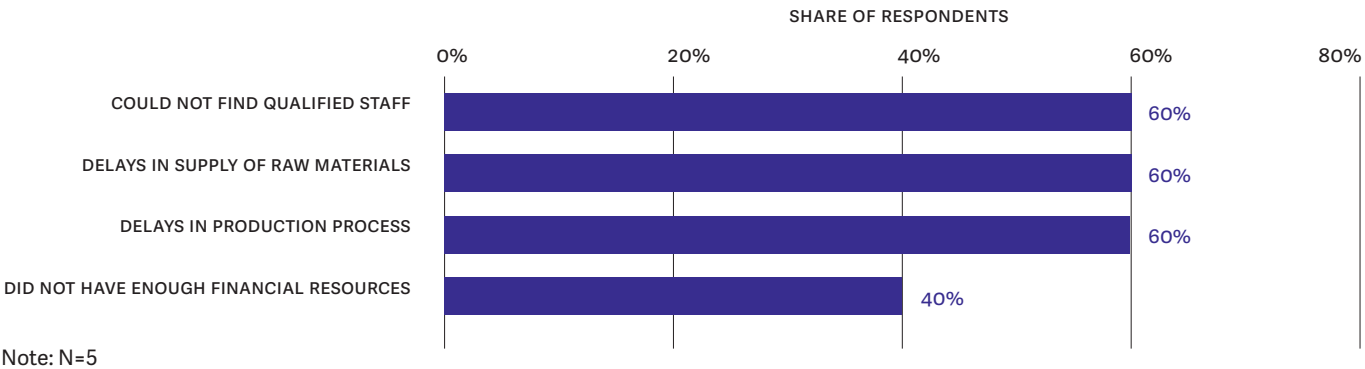
Similarly, most respondents felt that the amount of time allowed by the program to complete their project was sufficient. Ninety percent reported that they had sufficient time to successfully complete their projects. Of those respondents who said they did not have enough time to complete their projects, inability to reduce workload from other projects and inability to reduce institutional obligations were cited as the most common reasons (Figure 8.21).

Figure 8.20. Reasons Why DPPI Respondents Found That Financial Support was Insufficient



Note: N=17
Source: World Bank.

Figure 8.21. Reasons Why DPPI Respondents Found That the Time Allotted for Implementation was Insufficient



Note: N=5
Source: World Bank.

Human and financial resources were commonly cited success factors. The availability of financial resources and human resources were cited as the main factors for project success by 75 percent and 71 percent of respondents respectively. The availability of research infrastructure and program design were also cited as important success factors by more than 40 percent of respondents (Figure 8.22). When asked about any additional support needed during implementation that would have improved the outcomes of their projects, assistance with finding additional funding sources (by 11 percent of respondents), guidance for IP management (10 percent), and access to research infrastructure (9 percent) were cited as the most common types of additional support required (Figure 8.23). One quarter of respondents felt they did not need any additional support not already provided by the program.

Figure 8.22. Key Success Factors for DPPI Projects

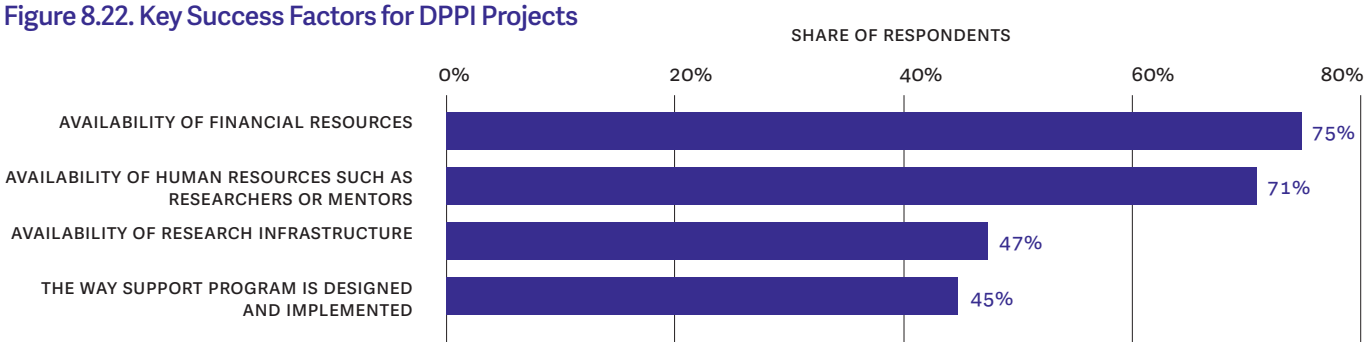
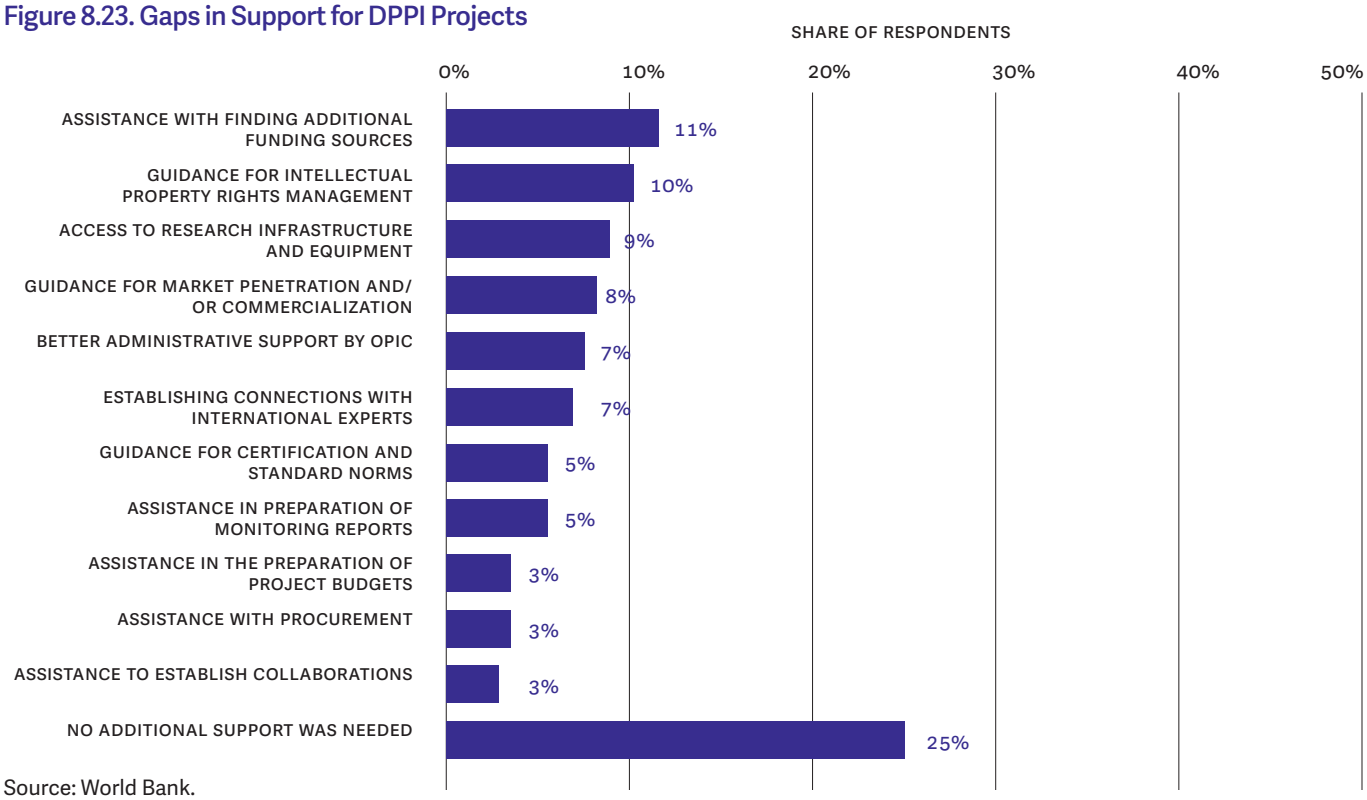


Figure 8.23. Gaps in Support for DPPI Projects

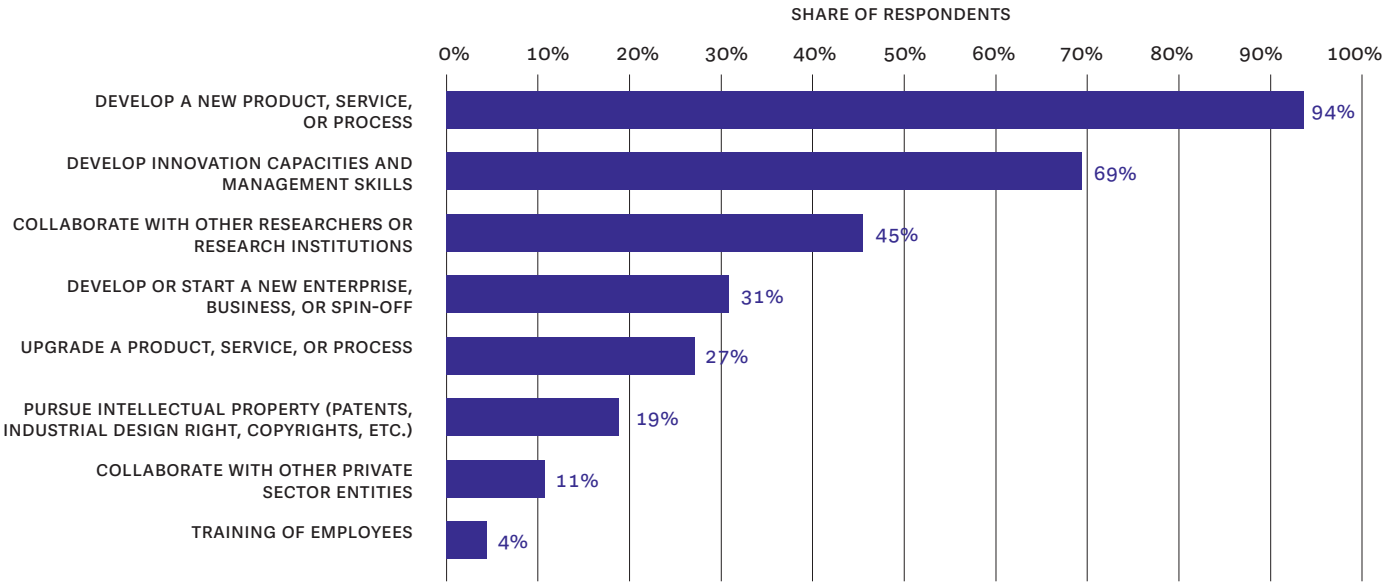


Source: World Bank.

Overall Project Quality

Respondents' objectives for their projects were largely in line with the objectives of the DPPI program. The program aims to support firms in the production and marketing of innovative products, processes and services, and 94 percent of respondents said one of the top objectives for their project and 27 percent said upgrading a product, service, or process was a top goal. Other top objectives of respondent projects included developing innovation capacities (69 percent of respondents) and engaging in research collaborations (45 percent), which are activities associated with technology development and upgrading (Figure 8.24).

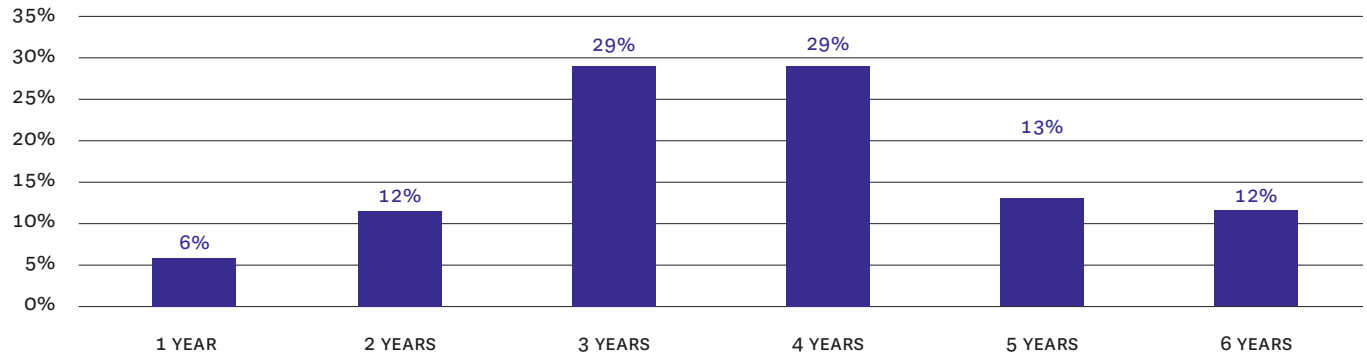
Figure 8.24. DPPI Project Objectives



Source: World Bank.

DPPI respondents expected shorter ROI timelines than NIF respondents. When asked when respondents expected to recover the investment made in the project, 46 percent of respondents said 3 years or fewer and 56 percent said 4 years or more after the completion of their projects (Figure 8.25). On average, expected return on investment timelines were shorter for DPPI respondents than for NIF respondents, which is likely due to the fact that DPPI funds projects that are closer to the market than the NIF program.

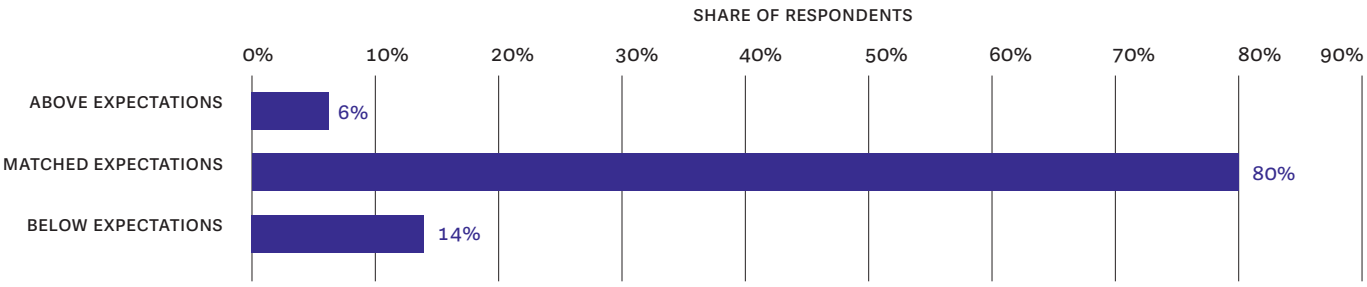
Figure 8.25. Distribution of Expected ROI Timelines for DPPI Projects



Source: World Bank.

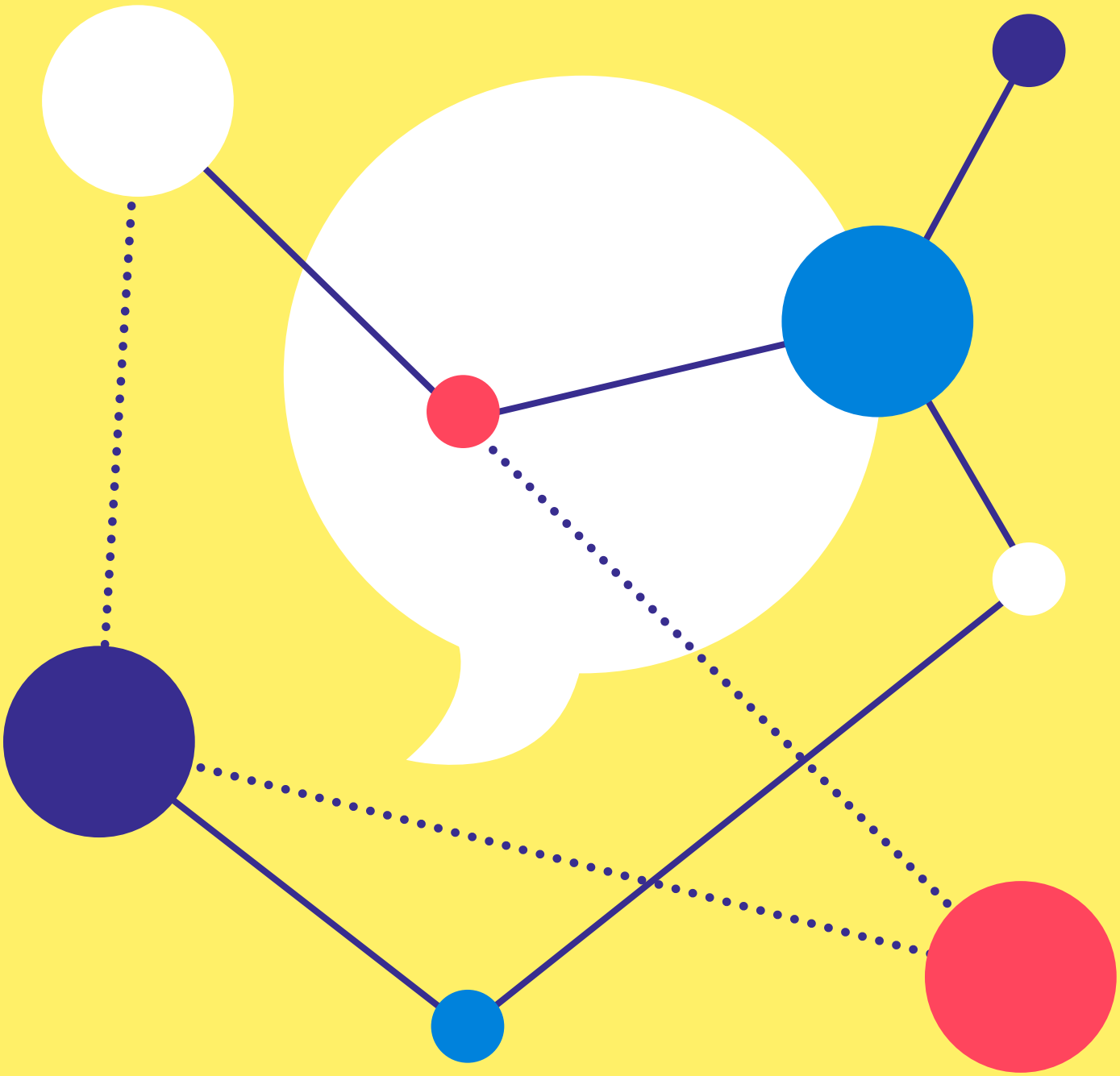
A large majority of respondents felt their project results matched expectations. Among respondents that had completed their projects, 80 percent felt that the outcomes of their project matched their expectations. Six percent felt their project exceeded expectations, while 14 percent said their project outcome was below expectations (Figure 8.26).

Figure 8.26. Match between DPPI Project Results and Beneficiary Expectations



Source: World Bank.

9. Recommendations



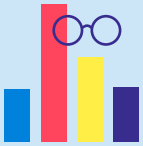
9. Recommendations

This section describes recommendations in two key areas:

1. **Improving the efficiency of STI support in Bulgaria**
2. **Strengthening M&E practices for new and existing STI programs**

These recommendations are based on the finding from this efficiency analysis and also build and expand upon the findings and recommendations from the previous components of this PER STI project.

9.1 Recommendations for Improving the Efficiency and Effectiveness of STI Support



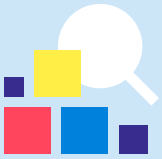
STI IMPLEMENTORS SHOULD CONSIDER THE COSTS AND BENEFITS OF THE MANAGEMENT AND COST STRUCTURES USED FOR PROGRAM IMPLEMENTATION

Priority timeline: Mid-term

Findings: The programs included in this analysis have differing arrangements and responsibilities in program implementation, which has resulted in radically different administrative costs, in terms of scale and composition. The Fundamental Research and Vihren programs (implemented by NSF), and to a lesser extent NIF (implemented by SMEPA), rely heavily on external experts in program implementation to make up for the lack of full-time staff at the implementing institutions. ICT and eHealth (both sectoral programs of the National Science Programs 2018–22 portfolio) are partially implemented by the beneficiary consortiums formed for these programs, an arrangement that comes with minimal administrative costs on the part of the Ministry but likely does not result in overall lower costs in implementing the programs due to the costs borne by the beneficiary consortiums.

Approach: Increasing full-time program staff and making more of the responsibilities related to program implementation internal would increase the capacity of implementing institutions (identified as a major challenge in previous components of this PER STI project) and could lead to more effective program delivery.

Key Implementing Stakeholder(s): MoES (Fundamental Research, Vihren, ICT, and eHealth programs), MoE (NIF and DPPI programs)



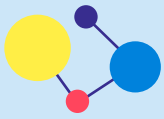
ANALYZE THE QUALITY OF PROGRAM OUTCOMES, WERE POSSIBLE, TO UNDERSTAND WHICH PROGRAMS AND PROJECTS ARE MOST IMPACTFUL

Priority timeline: Short-term

Findings: Publications reported by research respondents generally had lower numbers of year-normalized citations than the average Bulgarian publication indexed in the Web of Science from 2016 to 2020, indicating that the research being funded is generating low impacts on the scientific community. All research programs included in this report track the number of publications generated by beneficiaries but do not track citations or other impact measures of the individual publications produced by beneficiaries.

Approach: Additional bibliometric analyses can reveal which of these publications are most impactful and influential on the scientific community. This data can be used not just to understand the impact of individual projects but also to identify which programs and which scientific fields produce the most impactful research with public support.

Key Implementing Stakeholder(s): NSF (Fundamental Research, Vihren), MoES (ICT and eHealth)



PROVIDE INCENTIVES FOR COLLABORATION IN PROGRAMS WITH THE OBJECTIVE OF IMPROVING COLLABORATION AND THE CONNECTIONS OF BENEFICIARIES

Priority timeline: Short-term

Findings: Fundamental Research and Vihren respondents generated relatively few collaborations during project implementation, despite the fact that increasing collaboration activity among beneficiaries is a goal of these programs.

Approach: Increasing collaboration activities during implementation could be done by building collaborations into the design of programs (for example, making collaborative agreements preconditions for grant awards), accounting for the transaction costs of collaboration in program funding, providing additional

points on applications that include research partners, and broadening eligibility criteria to allow beneficiaries to collaborate with a broader range of organizations (such as non-profit organizations) during project implementation.

Key Implementing Stakeholder(s): NSF

EXPLORE DEVELOPING FOLLOW-UP GRANT SCHEMES FOR BENEFICIARIES OF NSF PROGRAMS

Priority timeline: Mid-term

Findings: A small share of Fundamental Research and Vihren respondents reported outcomes related to prototyping, new software development, and new technology development. The *Country Needs and Policy Mix Assessment* showed a gap in applied research funding programs to public research institutions: at present, NSF regulations do not allow for funding to be used for commercialization, IP development, or technology transfer activities, and there are few applied research programs that public researchers can access outside of NSF that could support such follow-on projects.

Approach: These findings suggest that some NSF project results could be further developed and potentially commercialized if there were applied research grant schemes that their projects could "graduate" to for additional funding and support. The new State Agency for Research & Innovation (SARI) would be a logical implementor to develop such grant schemes.

Key Implementing Stakeholder(s): SARI

REDUCE APPLICATION COSTS FOR FIRM SUPPORT PROGRAMS

Priority timeline: Short-term

Findings: Application costs were higher for firm respondents, likely due to the fact that roughly 90 percent of firms used some form of external support (such as consultants, legal services, and accountants) to prepare their applications. The *Functional and Governance Analysis* found that application processes for firms are indeed burdensome, particularly the supporting documentation firms must provide to support their applications. The *Functional and Governance Analysis* also found that reporting processes were much easier for beneficiaries of programs funded under EU operational programmes than for nationally funded programs.

Approach: Programs outside of the EU operational programmes (OPs) would greatly benefit from an online portal similar to that used by Bulgarian OPs where beneficiaries can submit and receive information throughout the application and contracting process. Additionally, implementing bodies should acquire documentation (tax documents, criminal records, etc.) ex officio, where possible, and submission requirements of any documents that are not essential to the application process should be deferred until the contracting phase of the project. These changes would likely lower the need for firms to hire external consultants and services to prepare their applications and reduce the overall application costs to firms.

Key Implementing Stakeholder(s): SMEPA (NIF), MoE (DPPI)

REDUCE THE ADMINISTRATIVE BURDENS ON BENEFICIARIES DURING IMPLEMENTATION

Priority timeline: Mid-term

Findings: Financial monitoring requirements were an issue for respondents across research and firm support programs, with fewer than 60 percent of respondents from Fundamental Research, NIF, and DPPI saying they were satisfied with financial reporting requirements. Financial reporting rules require beneficiaries to provide certified and translated copies of all eligible expenses, including things like plane tickets. The *Functional and Governance Analysis* found that reporting processes were much easier for beneficiaries of programs funded under EU operational programmes than for nationally funded programs because beneficiaries of OP-funded programs report using an online portal with preloaded templates for reports.

Approach: The creation of an online portal and technical and financial reporting templates would reduce the burden of reporting on beneficiaries of programs outside of the OPs. Financial reporting requirements could be simplified by approving R&D project expenditure plans in advance, reversing the current approach in which each expense item must be reported when incurred. For programs supporting R&D activities, R&D activities can be presumed to be eligible when reported and then verified later. In such a system, applicants self-report whether they are eligible, and implementors conduct audits later to verify eligible costs.

Key Implementing Stakeholder(s): NSF (Fundamental Research and Vihren), SMEPA (NIF), MoE (DPPI)

9.2 Recommendations for Strengthening M&E Practices for New and Existing STI Programs

TRACK PROGRAM-LEVEL COST DATA

Priority timeline: Short-term

Findings: Currently, no STI implementors systematically track all costs related to the implementation of the programs (such as personnel costs, fixed costs, and the costs of external services), making it extremely difficult to understand the true costs of program implementation. The programs implemented by NSF (Fundamental Research and Vihren) could only provide an estimation of administrative costs based on both programs' share of the NSF budget. For the ICT, eHealth, and DPPI programs, the implementing institutions could not provide detailed data on fixed costs.

Approach: Implementors can adopt the administrative cost data templates used for this analysis to begin more systemically collecting and analyzing this information.

Key Implementing Stakeholder(s): All STI implementors – MoES, NSF, SARI, MoE, DG OPIC, SMEPA

CONDUCT REGULAR SURVEYS OF BENEFICIARIES OF STI PROGRAMS

Priority timeline: Short-term

Findings: Beneficiaries from STI programs generally submit mid-term and end-of-project monitoring reports and may receive site visits from program monitoring staff, but no STI programs regularly survey their beneficiaries.

Approach: Beneficiary surveys will allow implementors to collect information on outputs and outcomes that is comparable across projects and programs to better understand the performance of their policy portfolios (rather than

just the performance of individual projects), as well as provide information on beneficiaries' perceptions of their programs. The survey questionnaires in the appendices of this report can be adapted for beneficiaries of a range of STI support programs.

Key Implementing Stakeholder(s): MoES, SARI, MoE

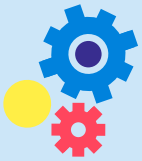
CONDUCT REGULAR EFFICIENCY ANALYSES OF STI PROGRAMS

Priority timeline: Short-term

Findings: No analyses of the efficiency of STI programs were performed in the most recent programming period.

Approach: Through systematic tracking of program cost data and regular beneficiary surveys, STI implementors will be able to regularly assess programs' efficiency in the use of inputs and generation of outputs and outcomes.

Key Implementing Stakeholder(s): MoES, SARI, MoE



WITH MORE COMPLETE DATA ON COSTS AND RESULTS, POLICYMAKERS SHOULD USE FINDINGS TO IMPROVE THE EFFICIENCY OF STI PROGRAMS IN GENERATING DESIRED RESULTS WITH PUBLIC FUNDS

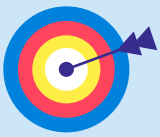
Priority timeline: Short-term

Findings: Due to the lack of data on the costs of program implementation and comparable data on project results across programs, STI implementors are generally unable to make decisions based on the efficiency of programs in producing desired results.

Approach: This report, along with future efficiency analyses, can be used to define benchmarks and targets for STI programs, understand which programs

are achieving their objectives, and make informed decisions to improve the efficiency of public funding for STI.

Key Implementing Stakeholder(s): MoES, SARI, MoE



CONDUCT IMPACT EVALUATIONS OF STRATEGICALLY IMPORTANT PROGRAMS

Priority timeline: Short-term

Findings: Few evaluations of any kind were done of STI programs in the most recent programming period.

Approach: Efficiency analyses should be complemented by impact analyses, at least for strategically important programs. Guidelines for when to evaluate individual programs can be determined by a national-level evaluation framework, such as that used in the Republic of Korea (detailed in World Bank 2021a), or by frameworks at the institutional or programmatic level. World Bank 2009 and Menon et al. (2009) can also serve as useful references for developing M&E frameworks. Impact analyses supplement data on program efficiency by establishing which changes or impacts can be attributed to a given intervention, allowing for a more complete picture of program impact and effectiveness. Instruments that are strategically important (for example, those with large budgets, supporting a large number of beneficiaries, with large expected impacts, and so on) should undergo at least one performance evaluation and one external impact evaluation per programming period. Ideally, these evaluations should be conducted by a third parties (that is, by evaluators outside of the implementing body) that do not have conflicts of interest with the instrument being evaluated.

Key Implementing Stakeholder(s): MoES, SARI, MoE

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Appendices

Appendix A
Theories of Change for Analyzed Programs

A theory of change (ToC) is a detailed description of the mechanisms through which a change is expected to occur in an intervention to achieve its objectives. As such, a ToC explicitly depicts the "pathways of change," connecting inputs (for example, funding, human resources, and time) to conduct various activities (or interventions), which produce outputs, and together these are expected to lead to short-term and longer-term outcomes. The ToC establishes the preconditions, requirements, and assumptions needed for the inputs and activities to be logically linked to the goals. The ToC is not only a useful program design and planning tool, but it is also the essential blueprint for building a rigorous framework for results measurement, particularly by helping develop indicators for identified ToC elements.

The development of a ToC begins with identification of the "focal problem" – that is, the key challenge(s) the program is trying to solve – and then identifying the "root causes" of this challenge. The root causes are important because this is the level at which activities can be designed, while the focal problem is merely a symptom of the root causes. Root causes may also have one or more factors that contribute to them.

For each program included in this analysis, a ToC diagram was developed by first mapping the information available in various program documents, which was supplemented by interviews with program staff conducted during component 2 of this project, the *Functional and Governance Analysis*. This mapping exercise enables a systematic assessment of the key causal pathways envisaged by the program in achieving the stated objective(s) with the activities the program finances. Once these pathways are identified, they are then used to create a ToC diagram to depict the linkages between inputs, activities, outputs, and outcomes, add missing elements and assumptions, and harmonizing the indicators across similar programs. After a ToC is developed, a results framework was then created. A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified.

A.1 Fundamental Research

PROGRAM OBJECTIVE(S)

Increasing the quantity and quality of basic research related to issues of regional and national importance; improving the quantity and quality of Bulgaria's internationally visible scientific products; expanding the Bulgarian scientific community's participation in the European Research Area and expanding international scientific cooperation; and significant intensification of the connections of science with education, business, state bodies, and society as a whole.

ACTIVITIES

Funding of basic research projects in one of ten scientific areas

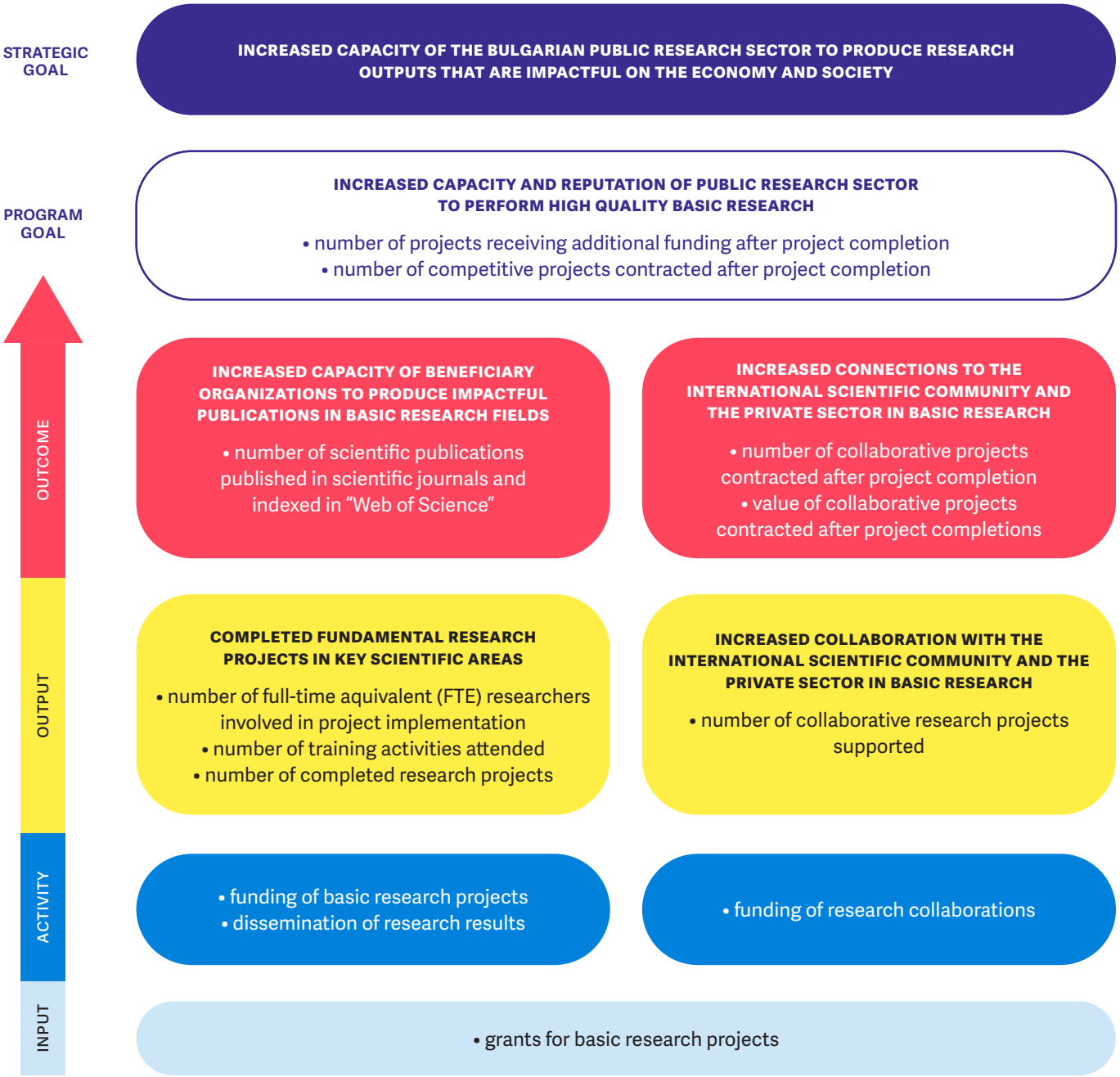
THEORY OF CHANGE

As illustrated in the ToC diagram (Figure A.1), the program is designed with the program-level goal of increased the capacity and reputation of the Bulgarian public research sector to perform high quality basic research. It is important to note that grant funding from NSF cannot be used for any direct commercial application or use, so the ToC does not include any activities or outputs related to IP generation, technology transfer, or commercialization.

To achieve the program goal, the ToC relies on the following pathways of change:

- **Increasing the capacity of beneficiary organizations to produce impactful publications in basic research fields:** the program seeks to support beneficiaries in completing fundamental research projects in key scientific areas. As beneficiaries and their research staff complete basic research projects in key areas, they will gain competencies in these areas and be able to produce higher quality basic research outputs.
- **Increased connections to the international scientific community and the private sector in basic research:** the program supports research collaborations with the international scientific community and the private sector in basic research. As beneficiaries perform collaborative research projects, they should form lasting connections to their partnering organizations

Figure A.1. Fundamental Research Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles[10]. As the theory of change and results framework is developer further, will need to be defined for each indicator, as well as the processes of collecting and verifying the data (including indicator verification period, process, and frequency).

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Number of project proposals receiving additional funding after project completion	**Definition**: Additional funding (grants) for continuation of research activities received by project beneficiaries, as the main applicant (coordinator, manager), or as a partner (associate). Funding sources can be national, EU (Horizon 2020, ERC, FP8, ESI Funds), or other (public or private). **Disaggregation**: By success (approved, rejected); By funding sources (national, Horizon 2020, ERC, FP8, ESI Funds, other); by project role (lead beneficiary, partner)
OBJECTIVE	Number of competitive projects contracted after project completion	**Definition**: Competitive research projects awarded to project beneficiaries as the main applicant (coordinator, manager), or as a partner (associate). Funding sources can be national, EU (Horizon 2020, ERC, FP8, ESI Funds), or other (public or private). **Disaggregation**: Funding source (national, Horizon 2020, ERC, FP8, ESI Funds, other); project role (lead beneficiary, partner)
OUTCOME	Number of scientific publications published in scientific journals and indexed in 'Web of Science'	**Definition**: Scientific papers and reports published, describing original results and research conducted within this project with the aim of informing the scientific community and society as a whole. Scientific papers need to be indexed in Web of Science platform (core collection), and may include articles, reviews, proceedings papers, letters, and book chapters. **Disaggregation**: Rank of journal where publication was published (first and second-quartile journals, other); by scientific areas; by scientific fields; by S3 thematic priority areas • Out of which: Number of publications with impact factor[11] • Out of which: Number of joint publications with international coauthors ((Publications with at least one author from a Bulgarian organization and one author from an international organization [public or private])

10 See more on the CART principles here: https://www.poverty-action.org/right-fit-evidence/principles

11 Impact factor is a Web of Science metric that measures the ratio between citations and recent citable items published in a given journal or publication.

OUTPUT	Number of full-time equivalent (FTE) researchers involved in project implementation	**Definition**: Number of researchers that directly carry out research and development activities related to the implementation of the project. Workforce may be existing or new, employed at the beneficiary and partners, or contracted from third parties. Auxiliary staff for R&D activities (jobs that are not directly involved in R&D activities) are not included in this indicator and should not be counted. The measurement unit is "Full-time equivalent". Engagement of researchers employed on the research activities supported by the project less than full-time should be converted to the number of FTE employees by dividing the researchers' scheduled hours with hours of the full-time workweek. **Disaggregation**: Employment duration (existing researchers, newly employed researchers); employment origin (researchers employed at the beneficiary/partner institutions, external/contracted, and visiting researchers); field/academic discipline; gender; seniority (PhD students, post-doctoral researchers, senior researchers, other) • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUT	Number of training activities attended	**Definition**: The number of training activities (lectures, workshops, training sessions, etc.) attended by researchers participating in the implementation during the project implementation period and financed by the program. In order to be taken into account as 'training', minimum half-day duration (four hours) of a capacity-building activity is required. **Disaggregation**: By field/academic discipline; by gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUT	Number of completed research projects	**Definition**: Number of R&D projects conducted by grantees with the grant awarded under the program. This indicator will capture only completed projects, which is defined as approval of the grantee's final project implementation report and grantee receiving the final payment. **Disaggregation**: Research field; S3 thematic priority areas
OUTCOME	Number of collaborative projects contracted after project completion	**Definition**: The number of new collaborative research projects, involving the beneficiary of the supported project and at least one another entity, and contracted after the end of implementation of the supported project. Beneficiary organization is involved as either the main beneficiary or partner in the implementation of the new projects contracted. **Disaggregation**: Collaboration novelty (new, existing); type of partner (research organization, enterprise, other); partner location (domestic, foreign, diaspora); type of research (basic, applied, experimental development); science area; science field; funding source (national, EU, private, other); S3 thematic priority area

OUTPUT	Value of collaborative projects contracted after project completion	**Definition**: The value of new collaborative research projects, involving the beneficiary of the supported project and at least one another entity, and contracted after the end of implementation of the supported project. Beneficiary organization is involved as either the main beneficiary or partner in the implementation of the new projects contracted. **Disaggregation**: Collaboration novelty (new, existing); type of partner (research organization, enterprise, other); partner location (domestic, foreign, diaspora); type of research (basic, applied, experimental development); science area; science field; funding source (national, EU, private, other); S3 thematic priority area.
OUTPUT	Number of collaborative research projects supported	**Definition**: The number of collaborative R&D projects conducted by grantees with the grant awarded under the program. Projects that are counted are implemented by research organizations, in partnership with other research organizations. This indicator will capture only completed projects, which is defined as approval of the grantee's final project implementation report and grantee receiving the final payment. For monitoring purposes, the indicator should track the projects that are contracted, ongoing and that have been completed. **Disaggregation**: Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons); research field; by S3 thematic priority areas; region; novelty of collaboration (new, existing); type of partner (research organization, enterprise, other); partner origin (Bulgarian, foreign).

A.2 Vihren

PROGRAM OBJECTIVE(S)

The long-term goal of the Vihren program is to significantly increase the quality of human resources for conducting research in Bulgaria at the highest level, along with the implementation of a lasting positive change in the institutional culture to support research.

The program has the following specific objectives:

- Support the individual potential for high-level research and to attract additional research funding; to achieve this goal and in accordance with the principles of the ERC program of excellence, the Vihren program does not pre-set the topics and scientific areas of the proposed projects (bottom-up approach);
- Create a supportive institutional environment for the work of the research team, formed and led by the principal investigator of the project;
- Improve the administrative and technical capacity of the host organization to support the preparation and implementation of national, European, and international projects.

ACTIVITIES

Funding of research projects carried out by leading and established scientists and the teams formed by them.

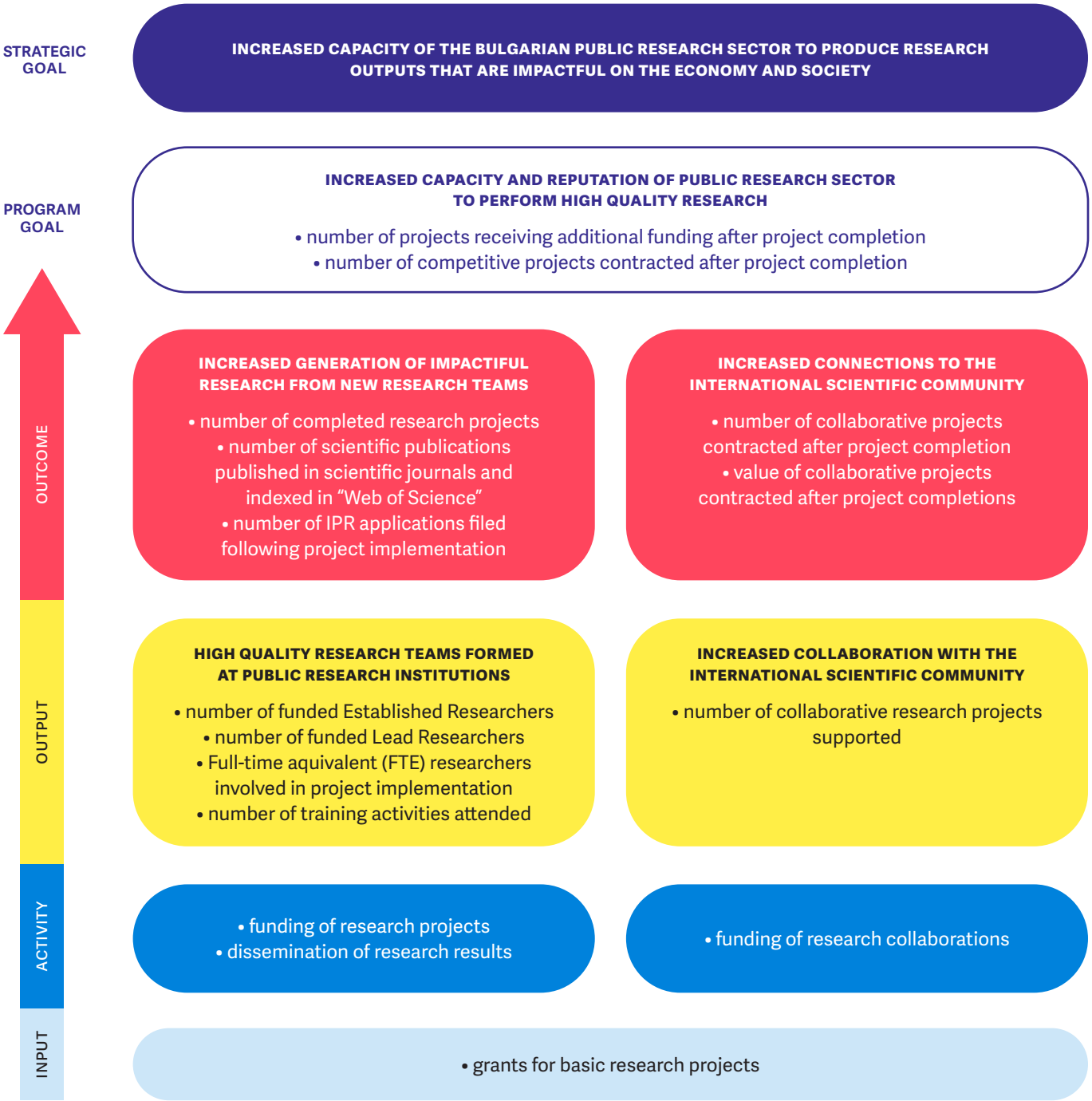
THEORY OF CHANGE

As illustrated in the ToC diagram (Figure A.2), the program is designed with the program-level goal of increasing the capacity of the public research sector for conducting high quality research. It is important to note that grant funding from NSF cannot be used for any direct commercial application or use, so the ToC does not include any activities or outputs related to IP generation, technology transfer, or commercialization.

To achieve this goal, the ToC relies on the following pathways of change:

- **Increased generation of impactful research from new research teams:** the program supports established scientists in forming high quality research team around a funded research project. These high-quality research teams will, in turn, generate impactful research while working in Bulgarian public research institutions.
- **Increased connections to the international scientific community and the private sector in research:** the program supports the recruitment of established researchers from abroad, who will engage in research collaborations with the international scientific community. As these established researchers are recruited, they will bring with them international connections and form new connections through new collaborative research projects.

Figure A.2. Vihren Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured, and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles. As the theory of change and results framework is developer further, will need to be defined for each indicator, as well as the processes of collecting and verifying the data (including indicator verification period, process, and frequency).

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Number of project proposals receiving additional funding after project completion	**Definition**: Additional funding (grants) for continuation of research activities received by project beneficiaries, as the main applicant (coordinator, manager), or as a partner (associate). Funding sources can be national, EU (Horizon 2020, ERC, FP8, ESI Funds), or other (public or private). **Disaggregation**: By success (approved, rejected); By funding sources (national, Horizon 2020, ERC, FP8, ESI Funds, other); by project role (lead beneficiary, partner)
OBJECTIVE	Number of competitive projects contracted after project completion	**Definition**: Competitive research projects awarded to project beneficiaries as the main applicant (coordinator, manager), or as a partner (associate). Funding sources can be national, EU (Horizon 2020, ERC, FP8, ESI Funds), or other (public or private). **Disaggregation**: Funding source (national, Horizon 2020, ERC, FP8, ESI Funds, other); project role (lead beneficiary, partner)
OUTCOME	Number of scientific publications published in scientific journals and indexed in 'Web of Science'	**Definition**: Scientific papers and reports published, describing original results and research conducted within this project with the aim of informing the scientific community and society as a whole. Scientific papers need to be indexed in Web of Science platform (core collection), and may include articles, reviews, proceedings papers, letters, and book chapters. **Disaggregation**: Rank of journal where publication was published (first and second-quartile journals, other); by scientific areas; by scientific fields; by S3 thematic priority areas • Out of which: Number of joint publications with industry partners (Publications with at least one author from a research organization and one author from the industry) • Out of which: Number of joint publications with international coauthors ((Publications with at least one author from a Bulgarian organization and one author from an international organization [public or private])

OUTCOME	Number of IPR applications filed following project implementation	**Definition**: The number of IPR applications (including patents, trademarks, industrial design, etc.) by the project beneficiary and partners involved in project implementation, related to the research activities conducted in the scope of the financed project. Applicant should state the expected number of IPR applications in the project application. In the post-implementation reporting phase, applicant should provide a description of a clear link between the conducted research activities and the IPR protection filed. **Disaggregation**: Type of IPR (patents, industrial design, trademarks); application status (filed, registered/approved); filing location (national, international)
OUTPUT	Number of funded Established Researchers	**Definition**: The number of R3 Established Researchers receiving funding, as defined in the European Commission's communication "Towards a European Framework for Research Careers" **Disaggregation:** Employment duration (existing researchers, newly employed researchers); employment origin (researchers employed at the beneficiary/partner institutions, external/contracted and visiting researchers); field/academic discipline; gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUT	Number of funded Lead Researchers	**Definition**: The number of R4 Lead Researchers receiving funding, as defined in the European Commission's communication "Towards a European Framework for Research Careers" **Disaggregation:** Employment duration (existing researchers, newly employed researchers); employment origin (researchers employed at the beneficiary/partner institutions, external/contracted and visiting researchers); field/academic discipline; gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUT	Number of full-time equivalent (FTE) researchers involved in project implementation	**Definition**: Number of researchers that directly carry out research and development activities related to the implementation of the project. Workforce may be existing or new, employed at the beneficiary and partners, or contracted from third parties. Auxiliary staff for R&D activities (jobs that are not directly involved in R&D activities) are not included in this indicator and should not be counted. The measurement unit is "Full-time equivalent". Engagement of researchers employed on the research activities supported by the project less than full-time should be converted to the number of FTE employees by dividing the researchers' scheduled hours with hours of the full-time workweek. **Disaggregation**: Employment duration (existing researchers, newly employed researchers); employment origin (researchers employed at the beneficiary/partner institutions, external/contracted and visiting researchers); field/academic discipline; gender; seniority (PhD students, post-doctoral researchers, senior researchers, other) • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)

OUTPUT	Number of training activities attended	**Definition**: The number of training activities (lectures, workshops, training sessions, etc.) attended by researchers participating in the implementation during the project implementation period and financed by the program. In order to be taken into account as 'training', minimum half-day duration (four hours) of a capacity-building activity is required. **Disaggregation**: By field/academic discipline; by gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUT	Number of completed research projects	**Definition**: Number of R&D projects conducted by grantees with the grant awarded under the program. This indicator will capture only completed projects, which is defined as approval of the grantee's final project implementation report and grantee receiving the final payment. **Disaggregation**: Research field; S3 thematic priority areas
OUTCOME	Number of collaborative projects contracted after project completion	**Definition**: The number of new collaborative research projects, involving the beneficiary of the supported project and at least one another entity, and contracted after the end of implementation of the supported project. Beneficiary organization is involved as either the main beneficiary or partner in the implementation of the new projects contracted. **Disaggregation**: Collaboration novelty (new, existing); type of partner (research organization, enterprise, other); partner location (domestic, foreign, diaspora); type of research (basic, applied, experimental development); science area; science field; funding source (national, EU, private, other); S3 thematic priority area
OUTPUT	Value of collaborative projects contracted after project completion	**Definition**: The value of new collaborative research projects, involving the beneficiary of the supported project and at least one another entity, and contracted after the end of implementation of the supported project. Beneficiary organization is involved as either the main beneficiary or partner in the implementation of the new projects contracted. **Disaggregation**: Collaboration novelty (new, existing); type of partner (research organization, enterprise, other); partner location (domestic, foreign, diaspora); type of research (basic, applied, experimental development); science area; science field; funding source (national, EU, private, other); S3 thematic priority area.
OUTPUT	Number of collaborative research projects supported	**Definition**: The number of collaborative R&D projects conducted by grantees with the grant awarded under the program. Projects that are counted are implemented by research organizations, in partnership with other research organizations. This indicator will capture only completed projects, which is defined as approval of the grantee's final project implementation report and grantee receiving the final payment. For monitoring purposes, the indicator should track the projects that are contracted, ongoing and that have been completed. **Disaggregation**: Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons); research field; by S3 thematic priority areas; region; novelty of collaboration (new, existing); type of partner (research organization, enterprise, other); partner origin (Bulgarian, foreign).

A.3 ICT for a Single Digital Market in Science, Education, and Security

PROGRAM OBJECTIVE(S)

The program was created with the specific goals of:

- Ensuring free access to electronic infrastructure for teams of students and doctoral students from various scientific disciplines;
- Identifying opportunities for scientific applications in key areas such as medicine and bioinformatics, ecology and biodiversity, new materials, transport, energy efficiency, humanities and social sciences, etc.;
- Formation of interdisciplinary teams corresponding to the best achievements in information technology;
- Modeling of products and phenomena with processing of large volumes of data and complex mathematical and computer models;
- Expanding the participation of Bulgarian research teams in European projects and in research programs.

ACTIVITIES

1. Developing electronic infrastructure for open science and open access to scientific results
   a. Development of the Center for High Performance and Distributed Computing as national electronic infrastructure
   b. Computer modeling of problems and tasks in the field of natural sciences with technological applications
   c. Creation of a national electronic library for open scientific results
   d. Creating a modern infrastructure for three-dimensional digitization
   e. Storage and analysis of large volumes of data and technologies for the application of AI Development of the Center for Grid and Cloud Technologies built at Sofia University
2. Creating digital technologies in education
   a. Creating national publicly available educational resources with materials created with public funding
   b. Language and content-based technologies for the better education Development of language and content-based technologies modern means to improve formal and non - formal learning
   c. Introduction of augmented virtual reality and three - dimensional models (real and virtual) for illustrating learning material that offers a new, more attractive approach to learning of new knowledge

3. Improving information security related to open science
   a. Security of the electronic infrastructure for open science. The national electronic infrastructure managed by the consortium operating in this national program will implements policies and good practices of European initiatives for access to electronic infrastructures, including the certified access system.
   b. Establishment of a research center for monitoring and development of preventive measures information security and incident response policies.

THEORY OF CHANGE

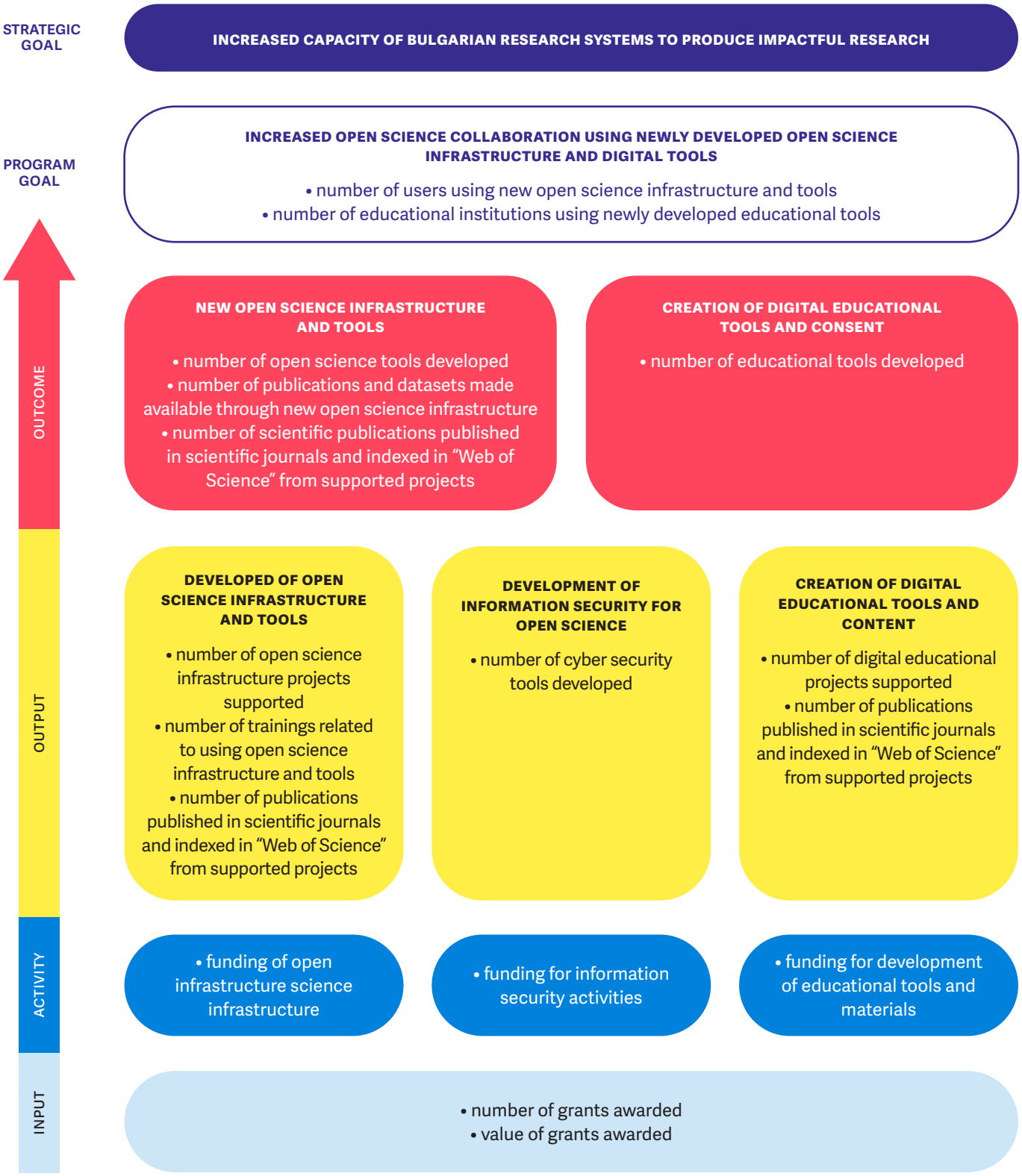
The *ICT for a Single Digital Market in Science, Education, and Security* program is somewhat difficult to fit into a single theory of change, given the number and diversity of activities supported by the program. The ToC described in this report puts all of these activities into a single ToC, but an alternative could be considering the program as two separate activities with separate ToCs – (i) open science infrastructure and security and (ii) digital educational tools.

As illustrated in the ToC diagram below (Figure A.3), the program is designed with the program-level goal of increasing the capacity of the Bulgarian public research sector to perform high quality research.

To achieve this goal, the ToC relies on the following pathways of change:

- **Improved open science infrastructure through the development of open science infrastructure and tools:** the program seeks to improve research collaboration (domestically and internationally) and research excellence through the creation of electronic infrastructure for open science and open access to scientific results, developing new digital tools, and improving information security related to open science.
- **Improved use of digital technologies in the Bulgarian education system:** the program seeks to improve the use of digital technologies in the Bulgarian education system (and thus improve the digital skills of the future workforce) through the development of digital educational resources and content for use in education, and by improving information security related to digital educational tools.

Figure A.3. ICT Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles. As the theory of change and results framework is developer further, will need to be defined for each indicator, as well as the processes of collecting and verifying the data (including indicator verification period, process, and frequency).

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Number of users using new open science infrastructure and tools	**Definition**: Number of users of open science infrastructure and tools whose development was supported by this project. **Disaggregation**: Type of user (public researcher, student, general public); user origin (domestic, foreign, diaspora); field/academic discipline • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OBJECTIVE	Number of educational institutions using newly developed educational tools	**Definition**: Number of educational institutions using newly developed educational tools. **Disaggregation**: Type of institution (HEI, secondary education institution, primary education institution, other); type of educational material (tool, educational module, other)
OUTCOME	Number of open science tools and applications developed	**Definition**: Number of computational tools and applications developed with the support of the program. The tools and applications must be accessible through open science protocols. **Disaggregation**: Scientific field; type of research (basic, applied, experimental development); type of tool (software, technology)
OUTCOME	Number of publications and datasets made available through new open science infrastructure	**Definition**: Number of scientific publications, datasets, and other documents made available through new open science infrastructure developed with support of the project. **Disaggregation:** Type (publication, dataset, other); scientific field; S3 thematic priority area

OUTCOME	Number of scientific publications published in scientific journals and indexed in 'Web of Science' from supported projects	**Definition**: Scientific papers and reports published, describing original results and research conducted within this project with the aim of informing the scientific community and society as a whole. Scientific papers need to be indexed in Web of Science platform (core collection), and may include articles, reviews, proceedings papers, letters, and book chapters. **Disaggregation**: Rank of journal where publication was published (first and second-quartile journals, other); by scientific areas; by scientific fields; by S3 thematic priority areas • Out of which: Number of joint publications with industry partners (Publications with at least one author from a research organization and one author from the industry) • Out of which: Number of joint publications with international coauthors ((Publications with at least one author from a Bulgarian organization and one author from an international organization [public or private])
OUTCOME	Number of educational tools and applications developed	**Definition**: The number of digital educational tools and applications developed by the program. To be counted, the tool or application must have reached the pilot stage of development and been tested by at least five users. **Disaggregation**: Type of tool (software, technology)
OUTPUT	Number of open science projects supported	**Definition**: The number of open science projects conducted by grantees with the grant awarded under the program. For monitoring purposes, the indicator should track the projects that are contracted, ongoing, and completed. **Disaggregation:** Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons)
OUTPUT	Number of users trained on using open science infrastructure and tools	**Definition**: The number of users participating in trainings (lectures, workshops, training sessions, etc.) on the use of new open science infrastructure and tools organized by the program. "Training" sessions must be a minimum half-day duration (four hours) to be counted. **Disaggregation**: Field/academic discipline; gender; seniority (Non-PhD students, PhD students, post-doctoral researchers, senior researchers, other) Out of which: Number of young researchers (research students, PhD students, early-stage researchers) receiving capacity-building support Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)

OUTPUT	Number of cyber security tools developed	**Definition:** The number of cyber security tools and applications developed by the program. To be counted, the tool or application must have reached the pilot stage of development and been tested by at least five users. **Disaggregation:** Type of tool (software, technology)
OUTPUT	Number of digital education projects supported	**Definition:** The number of digital projects conducted by grantees with the grant awarded under the program. For monitoring purposes, the indicator should track the projects that are contracted, ongoing, and completed. **Disaggregation:** Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons)

A.4 eHealth

PROGRAM OBJECTIVE(S)

Improving the quality and timeliness of medical care while optimizing the costs of computerized activities and reducing the workload of medical staff with technical and administrative tasks. The program follows the guidelines of the European Action Plan for the introduction of e-health by 2020 and is established in implementation of the National Strategy for Research Development (NRNI) 2030 to achieve specific objectives:

- Encouragement of problem-oriented scientific research in the priority areas of the Innovation Strategy for Smart Specialization (ISIS);
- Significant intensification of the connections of science with education, with business, with state bodies and with the society as a whole;
- Avoiding fragmentation in Bulgarian science by promoting integration and interaction between different public research institutes and universities in order to build a critical mass and avoid overlapping and duplication of resources.

ACTIVITIES

Creating preconditions for overcoming the fragmentation of the data generated in healthcare:

1. A set of defined essential requirements for systems for processing and exchange of clinical data;
2. A formal model of systems for processing and exchange of clinical data;
3. Building primary pseudonymous anonymous databases;
4. Creating prototypes and demonstrations of semantic interoperability of information health services;

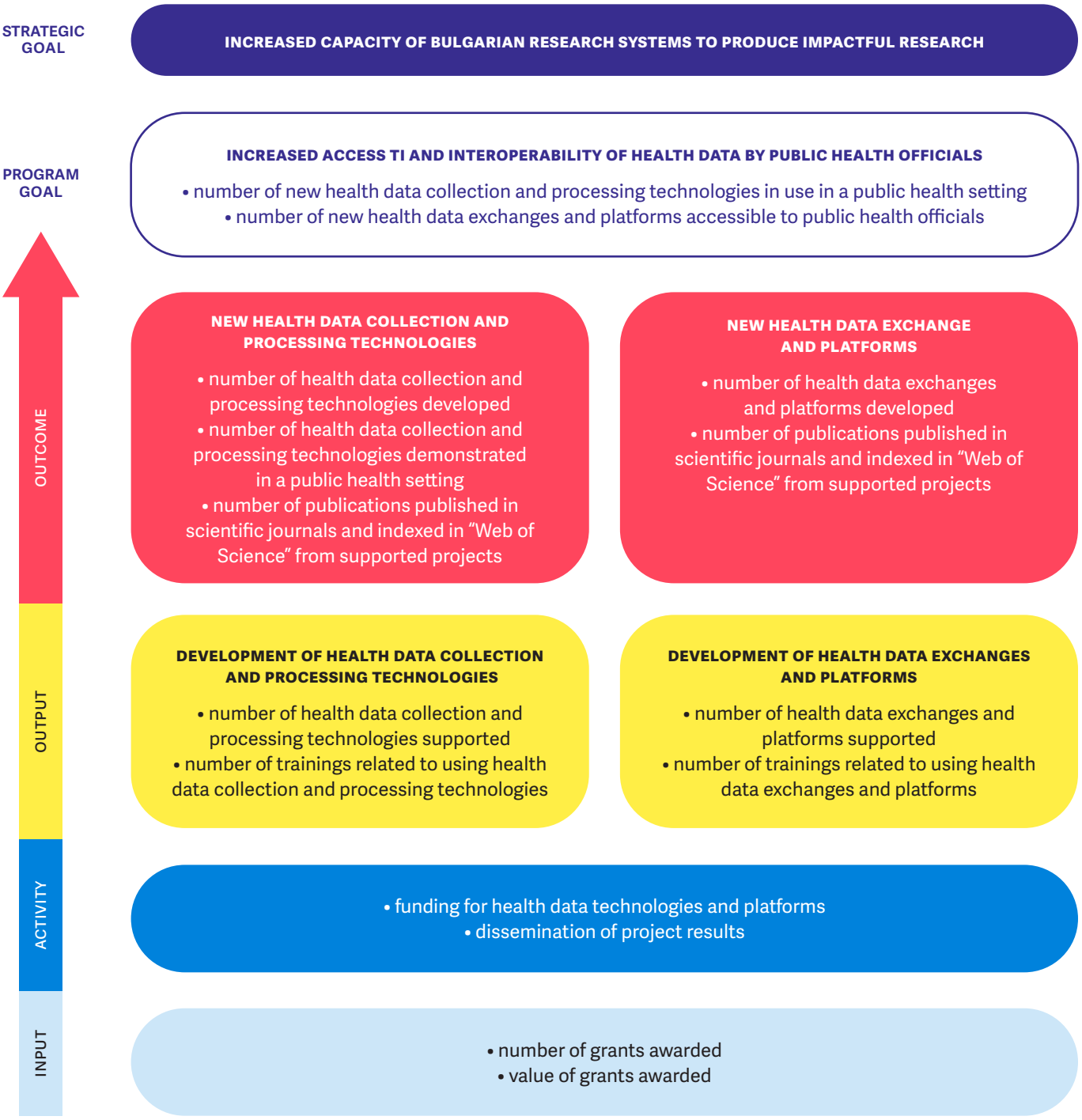
THEORY OF CHANGE (TOC)

As illustrated in the ToC diagram (Figure A.4), the program is designed with the program-level goal of increasing the capacity of the public research sector for conducting high quality research

To achieve this goal, the ToC relies on the following pathways of change:

- **Improved interoperability of health information through the development of health data collection and processing tools and technologies:** the program seeks to improve tools and techniques for the collection and sharing of health data though research projects aimed at developing new tools and technologies for collecting, analyzing, and processes health data and the demonstration of such technologies to public health officials.
- **Improved access to health data through the development of health data exchanges and platforms:** the program seeks to improve access to health data through research projects aimed at the development of new health data exchanges and platforms and training public health officials and researchers in their use.

Figure A.4. eHealth Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles.

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Number of new health data collection and processing technologies in use in a public health setting	**Definition**: Number of health data collection tools and technologies whose development was supported by this project that are deployed for practical use (i.e., non-experimental use) in a public health setting (such as a hospital, clinic, laboratory, or other medical setting) **Disaggregation**: Type of public health setting (hospital, clinic, laboratory, or other medical setting)
OBJECTIVE	Number of new health data exchanges and platforms accessible to public health officials	**Definition**: Number of users of new health data exchanges and platforms whose development was supported by this project. **Disaggregation**: Type of user (researcher, medical practitioner, student, other); user origin (domestic, foreign, diaspora) • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTCOME	Number of health data collection and processing technologies developed	**Definition**: Number of health data collection and processing technologies developed with the support of the program. **Disaggregation**: Scientific field; type of research (basic, applied, experimental development); type of tool (software, technology)
OUTCOME	Number of health data collection and processing technologies demonstrated in a public health setting	**Definition**: Number of health data collection and processing technologies developed with support of the project that have been demonstrated in a public health setting (such as a hospital, clinic, laboratory, or other medical setting). **Disaggregation:** Type of public health setting (hospital, clinic, laboratory, or other medical setting)
OUTCOME	Number of health data exchanges and platforms developed	**Definition**: Number of health data exchanges and platforms developed with the support of the program. **Disaggregation:** Type of access (restricted, open)

OUTCOME	Number of scientific publications published in scientific journals and indexed in 'Web of Science' from supported projects	**Definition**: Scientific papers and reports published, describing original results and research conducted within this project with the aim of informing the scientific community and society as a whole. Scientific papers need to be indexed in Web of Science platform (core collection), and may include articles, reviews, proceedings papers, letters, and book chapters. **Disaggregation**: Rank of journal where publication was published (first and second-quartile journals, other); by scientific areas; by scientific fields; by S3 thematic priority areas • Out of which: Number of joint publications with industry partners (Publications with at least one author from a research organization and one author from the industry) • Out of which: Number of joint publications with international coauthors ((Publications with at least one author from a Bulgarian organization and one author from an international organization [public or private])
OUTPUT	Number of eHealth projects supported	**Definition**: The number of eHealth projects conducted by grantees with the grant awarded under the program. For monitoring purposes, the indicator should track the projects that are contracted, ongoing, and completed. **Disaggregation:** Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons)
OUTPUT	Number of training activities related to eHealth technologies and platforms	**Definition**: The number of training activities (lectures, workshops, training sessions, etc.) on the use of eHealth technologies and platforms organized or attended by the program. "Training" sessions must be a minimum half-day duration (four hours) to be counted. **Disaggregation**: Field/academic discipline; gender • Out of which: Number of young researchers (research students, PhD students, early-stage researchers) receiving capacity-building support • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)

A.5 National Innovation Fund

PROGRAM OBJECTIVE(S)

The main goal of NIF is to promote the research and development activity for increasing the competitiveness of the enterprises.

ACTIVITIES

Grants to support scientific and research and development projects for a period of implementation from 12 to 36 months. Grants should not exceed 50 percent of project costs.

Grants for technical feasibility projects for a period of implementation up to 1 year. Grants should not exceed 25 percent of project costs.

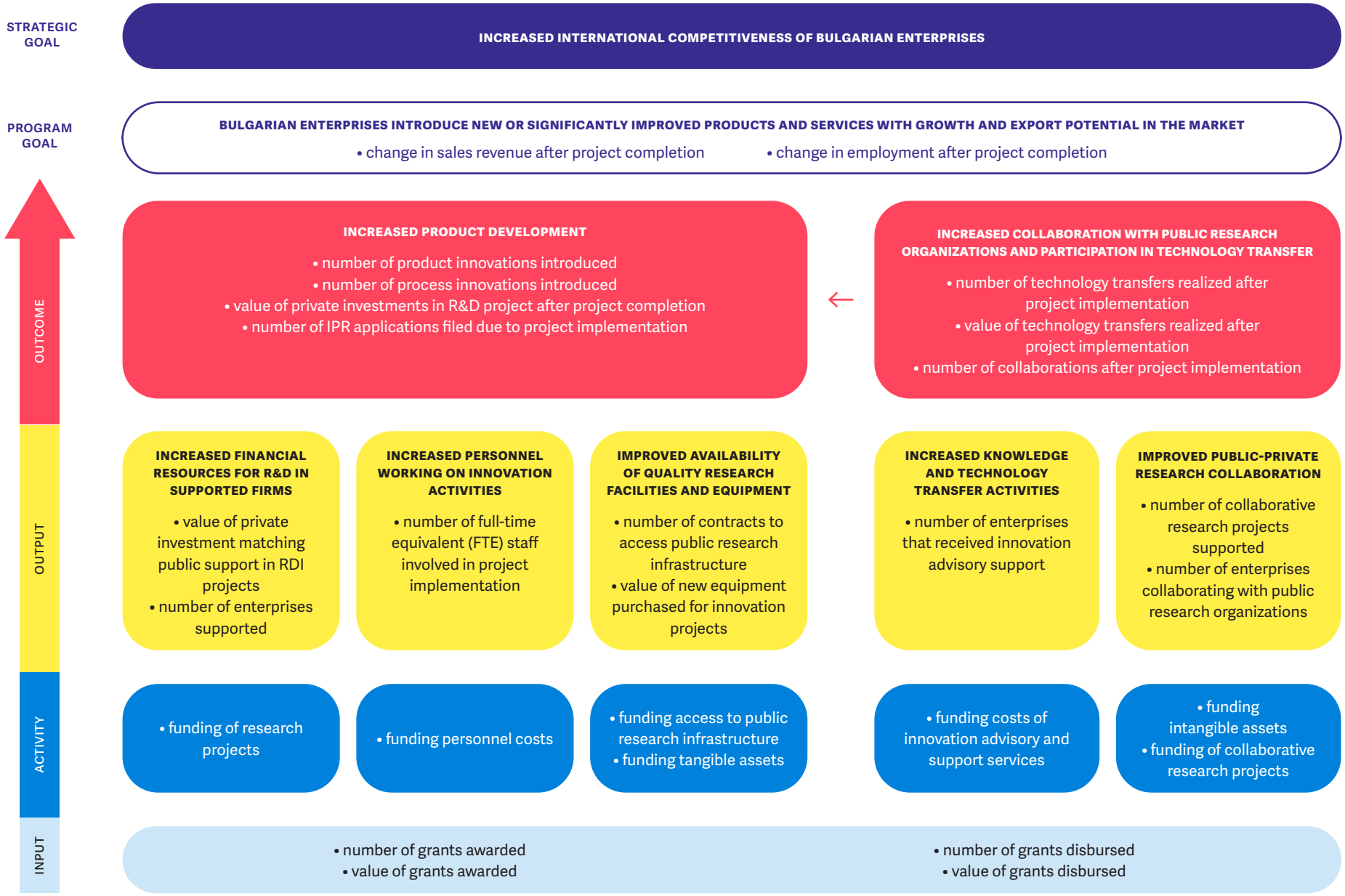
THEORY OF CHANGE

As illustrated in the ToC diagram (Figure A.5), the program is designed with the program-level goal of promoting the research and development activity in enterprises for increased competitiveness of the economy.

To achieve this goal, the ToC relies on the following pathways of change:

- Increase in product development: The program aims to support firms to develop new products and services by providing grants that support R&D projects, fund research staff, and provide access to improved research equipment and facilities.
- Increased collaboration with public research organizations and participation in technology transfer: the program supports firms to engage in knowledge and technology transfer with public sector research organizations by providing grant funding for collaborative public-private research projects and innovation advisory support services (from public research organizations).

Figure A.5. National Innovation Fund Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles. As the theory of change and results framework is developer further, will need to be defined for each indicator, as well as the processes of collecting and verifying the data (including indicator verification period, process, and frequency).

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Change in sales revenue after project completion	**Definition**: The change in sales revenue of the supported enterprises after project completion. The indicator is calculated as the difference between the value of sales revenue of the supported enterprises in the year preceding the submission of the project application (baseline value) and the annual value of sales revenue up to five years after project completion (target value), expressed in absolute numbers. Sales revenue is taken as annual gross sales revenue, which should not include any grant support received by the enterprise. **Disaggregation**: Change in revenue from sales abroad (export)
OBJECTIVE	Change in employment after project completion	**Definition**: The change in the gross number of full-time equivalent (FTE) employees of the supported enterprises after project completion. The indicator is calculated as the difference between the number of employees (FTE) in the year preceding the submission of the project application (baseline value) and the number of employees (FTE) up to five years after project completion (target value). **Disaggregation**: S3 thematic priority area; gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTCOME	Number of product innovations introduced	**Definition**: The number of new product innovations introduced by supported entities, during and after project implementation period. A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Product innovations can utilize new knowledge or technologies or can be based on new uses or combinations of existing knowledge or technologies. The term 'product' is used to cover both goods and services. Product innovations include both the introduction of new goods and services and significant improvements in the functional or user characteristics of existing goods and services (Source: OECD/Eurostat). The number of product innovations is reported cumulatively, up to a data collection point set in the post-implementation period. **Disaggregation**: S3 thematic priority area; industry; market (domestic, international); type (goods, services); novelty (new, improved)

OUTCOME	Number of process innovations introduced	**Definition**: The number of new process innovations introduced by supported entities, during and after project implementation period. A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products. Process innovations include new or significantly improved methods for the creation and provision of services. They can involve significant changes in the equipment and software used in services-oriented firms or in the procedures or techniques that are employed to deliver services. Process innovations also cover new or significantly improved techniques, equipment, and software in ancillary support activities, such as purchasing, accounting, computing, and maintenance (Source: OECD/Eurostat). The number of process innovations is reported cumulatively, up to a data collection point set in the post-implementation period. **Disaggregation**: S3 thematic priority area; industry; type of process
OUTCOME	Value of private investment in R&D projects after project completion	**Definition**: the total value of private investment by supported enterprises to undertake R&D activities after the end of the supported project. This amount reflects the increase in private sector expenditure in R&D after project completion, measured on annual basis up to 5 years after the grant period, excluding future grants awarded to the enterprise. **Disaggregation**: Investment purpose (cost category); S3 thematic priority area; industry
OUTCOME	Number of IPR applications filed following project implementation	**Definition**: The number of IPR applications (including patents, trademarks, industrial design, etc.) by the project beneficiary and partners involved in project implementation, related to the research activities conducted in the scope of the financed project. Applicant should state the expected number of IPR applications in the project application. In the post-implementation reporting phase, applicant should provide a description of a clear link between the conducted research activities and the IPR protection filed. **Disaggregation**: Type of IPR (patents, industrial design, trademarks); application status (filed, registered/approved); filing location (national, international)
OUTCOME	Number of collaborative projects contracted after project completion	**Definition**: The number of new collaborative research projects, involving the beneficiary of the supported project and at least one another entity, and contracted after the end of implementation of the supported project. Beneficiary organization is involved as either the main beneficiary or partner in the implementation of the new projects contracted. **Disaggregation**: Collaboration novelty (new, existing); type of partner (research organization, enterprise, other); partner location (domestic, foreign, diaspora); type of research (basic, applied, experimental development); science area; science field; funding source (national, EU, private, other); S3 thematic priority area

OUTPUT	Value of private investment matching public support in RDI projects	**Definition**: the total value of private contribution in supported RDI projects, including non-eligible parts of the project. The amount is an addition to the public funds received from the program. The amount is calculated by subtracting the public funds (including the grant value and other contributions from public sources, if applicable) from the total project value (including eligible and non-eligible project costs). **Disaggregation**: S3 thematic area; industry
OUTPUT	Number of enterprises supported	**Definition**: The number of enterprises supported by grants awarded through the program, in order to develop and launch new or improved products (including goods and services) on the market. Double counting is avoided, meaning a single enterprise is counted only once, regardless of the number of projects it is supported through. If an enterprise is supported to develop more than one product, either through a single or more than one projects, it is counted as one. Indicator achievement is subject to project completion. **Disaggregation**: S3 thematic priority areas; industry; type of product (goods, services); product novelty (new, improved)
OUTPUT	Number of full-time equivalent (FTE) staff involved in project implementation	**Definition**: The number of staff that directly carry out activities related to the implementation of the project. Workforce may be existing or new. The measurement unit is "Full-time equivalent". Engagement of staff employed on the activities supported by the project less than full-time should be converted to the number of FTE employees by dividing the employees' scheduled hours with hours of the full-time workweek. **Disaggregation**: Employment duration (existing, newly employed); gender • Out of which: Number of full-time equivalent (FTE) researchers involved in the project (employed in enterprises) • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)
OUTPUTS	Number of contracts to access public research infrastructure	**Definition**: The number of contracts between supported enterprises and public research organizations to provide access to public research infrastructure **Disaggregation**: S3 thematic area; industry
OUTPUTS	Value of new equipment purchased for innovation projects	**Definition**: The value of innovation equipment or machinery purchased with the support of the program. The machinery or equipment must be used for product development or customization of innovative products. **Disaggregation**: S3 thematic priority area; industry

OUTCOME	Number of technology transfers realized after project implementation	**Definition**: Transfers of research results (knowledge and technology) realized due to project implementation, with purpose of their further development and/or their use in development and commercialization of new products (goods or services). Project results can be transferred from project beneficiary and/or partners to third parties in the form of signed R&D agreements or contracts and intellectual property (IP) licensing agreements or the transfer can be realized through establishment of new enterprises. More specifically, the following are the types of technology transfer models captured (and disaggregated) by the indicator: • Number of new start-ups/spin-offs/spinouts originating out of supported projects: Number of new enterprises (start-up/spin-off/spin-out) established by project beneficiary and/or project partners as a result of funded project. Start-up is an enterprise less than 3 years old. Spin-off is an enterprise that has been started by a University group, but which has never left the university environment and perhaps exists to offer specialist consultancy services without the intension for any further expansion or full technology transfer. Spin-out is an enterprise in which the university or Institute has an equity stake. • Number of licensing agreements signed with the industry: The licensing agreement is a contract to be used by enterprises for technology transfer through granting rights of industrial ownership (license of patents and trademarks). • Number of other technology transfer agreements signed with the industry: Any other forms of technology transfer/commercialization agreements signed with the enterprises. • Number of contract research agreements with the industry. **Disaggregation**: Type of technology transfer activity (as listed in the definition)
OUTCOME	Value of technology transfers realized due to project implementation	**Definition:** The value of contractual research conducted (research services acquired by enterprises from research organizations), or knowledge and patents bought or licensed by supported entities from outside sources, under market conditions and for the purposes of implementation of the project supported. **Disaggregation**: Type of transfer supported (IPR acquisition or licensing, contractual research); for contractual research: type service provided (product and process testing, demonstration activities, professional and technical knowledge for the purpose of product and process development etc.)
OUTPUT	Number of enterprises that received innovation advisory support	**Definition:** the number of enterprises that received innovation advisory support, such as advisory support in acquisition, protection and exploitation of intangible assets, application of norms and regulations that cover them, product development, design and testing, market research and analysis, development of marketing plans, preparation of feasibility studies or similar activities related to product innovation specifically related to the activities conducted through the supported project. **Disaggregation**: Innovation advisory support purpose

OUTPUT	Number of collaborative research projects supported	**Definition:** The number of collaborative R&D projects conducted by grantees with the grant awarded under the program. Projects that are counted are implemented by research organizations, in partnership with other research organizations. This indicator will capture only completed projects, which is defined as approval of the grantee's final project implementation report and grantee receiving the final payment. For monitoring purposes, the indicator should track the projects that are contracted, ongoing and that have been completed. **Disaggregation**: Project status (awarded/ongoing, completed); project results (projects which achieved their objectives, projects with objectives partially achieved, projects which were discontinued due to irregularities and/or other reasons); research field; by S3 thematic priority areas; region; novelty of collaboration (new, existing); type of partner (research organization, enterprise, other); partner origin (Bulgarian, foreign)
OUTPUT	Number of enterprises collaborating with public research organizations	**Definition:** The number of supported enterprises collaborating with public research organizations in R&D projects. At least one enterprise and one research organization must collaborate in the project. The collaboration may be new or a continuation of existing collaboration and must last at least as long as the project. All enterprises participating in the project as partners are counted as contributing to the indicator. Double counting is avoided, meaning a single enterprise is counted only once regardless of the number of projects it is participating in. **Disaggregation**: S3 thematic priority areas; region; novelty of collaboration (new, existing)

A.6 Development of Product and Process Innovations

PROGRAM OBJECTIVE(S)

The main goal of the procedure is to provide integrated consulting and investment support to Bulgarian enterprises in the implementation of successful projects for implementation in the production and marketing of innovative products, processes, and services (the services should be the result of implemented innovative process or product).

ACTIVITIES

1. Investments
   a. Purchase of new equipment necessary for implementation in the production of innovative products, processes or services created by the applicant or contributed to the applicant's capital by the patent holder / holder of the utility model certificate or created on the basis of a contract under which the applicant is a contracting authority;
   b. Purchase of complete units, aggregates and details, which are assigned when creating parts of or the entire production line for the production of the innovative product / realization of the innovative process;
   c. Improving the functional characteristics of existing buildings and / or production facilities through construction and installation works (construction and installation works), leading

to an increase in their value, when this is directly related to the investments in the element and is necessary for their commissioning. Construction and installation costs must not exceed 30% of the total eligible costs of the project;

d. Acquisition of intangible fixed assets directly related to the implementation of innovative products, processes, or services - purchase of specialized software related to the implementation of the innovative product, process, or service.

2. Services
   a. Services related to the optimization of production technologies, respectively for the creation or implementation of the innovative product, process or service;
   b. Development of specialized software related to the implementation of the innovative product, process or service;
   c. Development of business and marketing strategies for the implementation of innovative products, processes, services implemented in production - conducting marketing research and analysis, planning channels for communication with the market and customers, development of distribution networks;
   d. Consulting and legal services related to the protection of intellectual property rights intellectual property on the innovative products / processes / services implemented under the project. These services can be financed under the project only if they concern the granting of the rights of the applicant for intellectual property over the innovation implemented by the project to other economic entities (for example, licensing). Consulting and legal services do not concern initial protection related to filing applications before a patent office or legal protection in case of contesting intellectual property rights;
   e. Consulting services of engineering and technical nature related to the process of implementation of the innovative product, process or service.

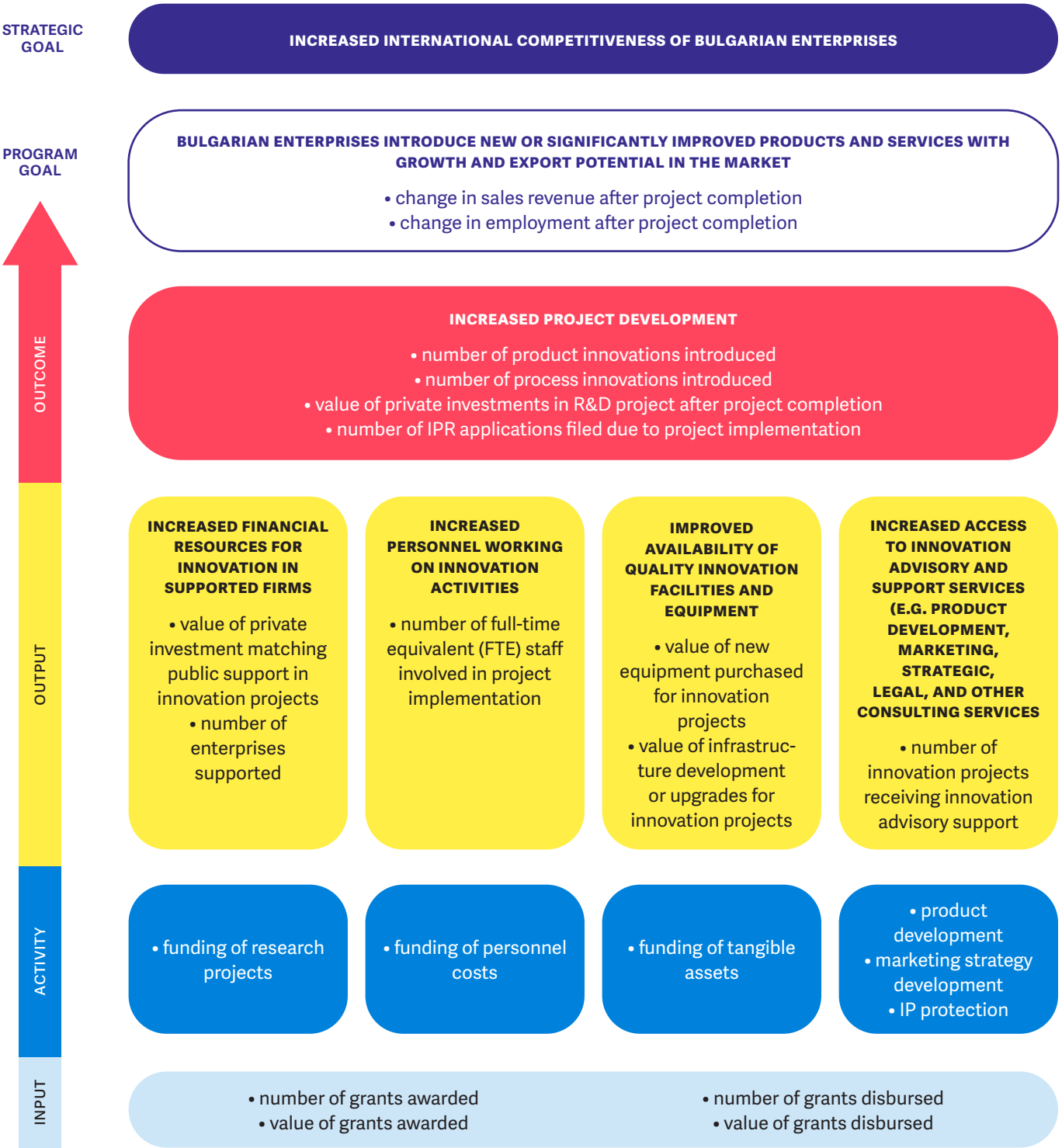
THEORY OF CHANGE

As illustrated in the ToC diagram (Figure A.6), the program is designed with the program-level goal of supporting firms in introducing new or significantly improved products and services with growth and export potential in the market.

To achieve this goal, the ToC relies on the following pathways of change:

- **Increased product development:** The program aims to support firms to develop new products and services by providing grants that support innovation projects, funding research staff, investments in equipment and facilities, and support for consulting and advisory services.

Figure A.6. DPPI Theory of Change Diagram



Results Framework

A results framework aims to identify and define the indicators underlying the theory of change for the program. As such, the results framework identifies indicators for all the ToC elements so that program "success", in terms of whether the intended change(s) occurred, can be measured and verified. In this section, the proposed results framework is built from, and indexed to, the ToC elements, and revised (where necessary) according to the CART principles. As the theory of change and results framework is developer further, will need to be defined for each indicator, as well as the processes of collecting and verifying the data (including indicator verification period, process, and frequency).

LEVEL	INDICATOR	DEFINITION
OBJECTIVE	Change in sales revenue after project completion	**Definition**: The change in sales revenue of the supported enterprises after project completion. The indicator is calculated as the difference between the value of sales revenue of the supported enterprises in the year preceding the submission of the project application (baseline value) and the annual value of sales revenue up to five years after project completion (target value), expressed in absolute numbers. Sales revenue is taken as annual gross sales revenue, which should not include any grant support received by the enterprise. **Disaggregation**: Change in revenue from sales abroad (export)
OBJECTIVE	Change in employment after project completion	**Definition**: The change in the gross number of full-time equivalent (FTE) employees of the supported enterprises after project completion. The indicator is calculated as the difference between the number of employees (FTE) in the year preceding the submission of the project application (baseline value) and the number of employees (FTE) up to five years after project completion (target value). **Disaggregation**: S3 thematic priority area; gender • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)

OUTCOME	Number of product innovations introduced	**Definition**: The number of new product innovations introduced by supported entities, during and after project implementation period. A product innovation is the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics. Product innovations can utilize new knowledge or technologies or can be based on new uses or combinations of existing knowledge or technologies. The term 'product' is used to cover both goods and services. Product innovations include both the introduction of new goods and services and significant improvements in the functional or user characteristics of existing goods and services (Source: OECD/Eurostat). The number of product innovations is reported cumulatively, up to a data collection point set in the post-implementation period. **Disaggregation**: S3 thematic priority area; industry; market (domestic, international); type (goods, services); novelty (new, improved)
OUTCOME	Number of process innovations introduced	**Definition**: The number of new process innovations introduced by supported entities, during and after project implementation period. A process innovation is the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products. Process innovations include new or significantly improved methods for the creation and provision of services. They can involve significant changes in the equipment and software used in services-oriented firms or in the procedures or techniques that are employed to deliver services. Process innovations also cover new or significantly improved techniques, equipment, and software in ancillary support activities, such as purchasing, accounting, computing, and maintenance (Source: OECD/Eurostat). The number of process innovations is reported cumulatively, up to a data collection point set in the post-implementation period. **Disaggregation**: S3 thematic priority area; industry; type of process
OUTCOME	Value of private investment in R&D projects after project completion	**Definition**: the total value of private investment by supported enterprises to undertake R&D activities after the end of the supported project. This amount reflects the increase in private sector expenditure in R&D after project completion, measured on annual basis up to 5 years after the grant period, excluding future grants awarded to the enterprise. **Disaggregation**: Investment purpose (cost category); S3 thematic priority area; industry

OUTCOME	Number of IPR applications filed following project implementation	**Definition**: The number of IPR applications (including patents, trademarks, industrial design, etc.) by the project beneficiary following project implementation, related to the innovation activities conducted in the scope of the financed project. Applicant should state the expected number of IPR applications in the project application. In the post-implementation reporting phase, applicant should provide a description of a clear link between the conducted research activities and the IPR protection filed. **Disaggregation**: Type of IPR (patents, industrial design, trademarks); application status (filed, registered/approved); filing location (national, international)
OUTPUT	Value of private investment matching public support in RDI projects	**Definition**: the total value of private contribution in supported RDI projects, including non-eligible parts of the project. The amount is an addition to the public funds received from the program. The amount is calculated by subtracting the public funds (including the grant value and other contributions from public sources, if applicable) from the total project value (including eligible and non-eligible project costs). **Disaggregation**: S3 thematic area; industry
OUTPUT	Number of enterprises supported	**Definition**: The number of enterprises supported by grants awarded through the program, in order to develop and launch new or improved products (including goods and services) on the market. Double counting is avoided, meaning a single enterprise is counted only once, regardless of the number of projects it is supported through. If an enterprise is supported to develop more than one product, either through a single or more than one projects, it is counted as one. Indicator achievement is subject to project completion. **Disaggregation**: S3 thematic priority areas; industry; type of product (goods, services); product novelty (new, improved)
OUTPUT	Number of full-time equivalent (FTE) staff involved in project implementation	**Definition**: The number of staff that directly carry out activities related to the implementation of the project. Workforce may be existing or new. The measurement unit is "Full-time equivalent". Engagement of staff employed on the activities supported by the project less than full-time should be converted to the number of FTE employees by dividing the employees' scheduled hours with hours of the full-time workweek. **Disaggregation**: Employment duration (existing, newly employed); gender • Out of which: Number of full-time equivalent (FTE) researchers involved in the project (employed in enterprises) • Out of which: Vulnerable groups (minorities, migrants, disabled, other disadvantaged persons)

OUTPUTS	Value of new equipment purchased for innovation projects	**Definition**: The value of innovation equipment or machinery purchased with the support of the program. The machinery or equipment must be used for product development or customization of innovative products. **Disaggregation**: S3 thematic priority area; industry
OUTPUTS	Value of infrastructure development or upgrades for innovation projects	**Definition**: The value of infrastructure or facility development or upgrades made with the support of the program. The facilities must be used for product development or customization of innovative products. **Disaggregation**: S3 thematic priority area; industry
OUTPUT	Number of enterprises that received innovation advisory support	**Definition:** the number of enterprises that received innovation advisory support, such as advisory support in acquisition, protection and exploitation of intangible assets, application of norms and regulations that cover them, product development, design and testing, market research and analysis, development of marketing plans, preparation of feasibility studies or similar activities related to product innovation specifically related to the activities conducted through the supported project. **Disaggregation**: Innovation advisory support purpose

Appendix B
Researcher Survey Questionnaire

A. General Information About the Beneficiary

1. Please mark the option that applies to your case:

I am the project leader for the institution	1
I am not the project leader, but can provide detailed information	2

2. What was your role in this project?

3. What is your age?

Under 31 years	1
31-40 years	2
41-50 years	3
51-65 years	4
Over 65 years	5

4. Position in your institution at end of the project

Professor	1
Associate Professor	2
Chief Assistant Professor	3
Assistant Professor	4
Postdoctoral researcher	5
Doctoral student	6
Other (specify in space below)	7

5. Have you received funding from public programs for the continuation of this project after its end? (e.g., funds for research, scholarships, etc.)

Yes	1
No	2

6. From which program did you get funding for the continuation of this project the project ended?

B. About the Application Process

1. Please indicate the extent to which you disagree or agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
It was easy to identify and obtain information about the program					
Program's objectives were clear					
Support for helping with the application and clarifying application procedures was timely and relevant					
Application procedure was well explained					
Application procedure was easy to follow and fill					
Application period was sufficient					
The quantity and type of information required in proposals were adequate					
Eligibility criteria were clear					
Eligibility criteria were fair					
Selection process was fair					
Selection process was transparent					
It was easy to access the regulations of the program					
The regulations of the program were clear					
Time between application and final results of selection was adequate					
Time between communication of results of selection and receiving funding was adequate					
The rules in cases of non-compliance with the call for proposals were flexible					

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
There was feedback on the reasons why the project was approved	○	○	○	○	○
Contract negotiation procedure took adequate time	○	○	○	○	○
Contract negotiation was easy	○	○	○	○	○
The list of eligible costs was appropriate for the development of the project	○	○	○	○	○

2. Think about all the expenses incurred in preparing your application, such as the time to prepare paperwork, consultants, assistants, materials, etc. Please provide your best estimate of the total cost, in BGN, of preparing your application for this project. For example, if the total expense was one thousand BGN, write 1000.

3. Approximately, how many full person days (8 hours each) did it take you to prepare the application?

	NUMBER
Full person days	

4. What kind of human resources did you use to prepare your application? Select all that apply.

Administrative assistant	1
Lawyer or legal consultant	2
Accountant	3
Experts/ consultants	4
The project team prepared the application without any additional help	5
Other (please specify in the space below)	6

5. Were the costs for applying to the program (monetary and non-monetary) adequate when compared with the benefits?

Yes	1
No	2

6. Now you will be asked about the eligibility criteria for participating in the program. If you do not remember it, you can check it again. Do you think some eligibility criteria should be added, deleted, or changed?

	YES	NO	IF YES
Changed	○	○	What eligibility criteria would you change, and why?
Added	○	○	What eligibility criteria would you add, and why?
Deleted	○	○	What eligibility criteria would you delete, and why?

7. Now you will be asked about the selection criteria for participating the program. If you do not remember it, you can check it again. Do you think some selection criteria should be added, deleted, or changed?

	YES	NO	IF YES
Changed	○	○	What eligibility criteria would you change, and why?
Added	○	○	What eligibility criteria would you add, and why?
Deleted	○	○	What eligibility criteria would you delete, and why?

C. Project Execution and Resources Allocated to the Project

Intro: Now you will be asked about project execution and resources allocated to the project.

1. What is the main scientific field of this project?

NATURAL SCIENCES	
Mathematics	01
Computer and information sciences	02
Physical sciences	03
Chemical sciences	04
Earth and related environmental sciences	05
Biological sciences	06
Other natural sciences	07
ENGINEERING AND TECHNOLOGY	
Civil engineering	08
Electrical engineering, electronic engineering, information engineering	09
Mechanical engineering	10
Chemical engineering	11
Materials engineering	12
Medical engineering	13
Environmental engineering	14
Environmental biotechnology	15
Industrial Biotechnology	16
Nanotechnology	17
Other engineering and technologies	18
MEDICAL AND HEALTH SCIENCES	
Basic medicine	19
Clinical medicine	20
Health sciences	21
Health biotechnology	22
Other medical sciences	23
AGRICULTURAL SCIENCES	
Agriculture, forestry, and fisheries	24
Animal and dairy science	25
Veterinary science	26

Agricultural biotechnology	27
Other agricultural sciences	28
SOCIAL SCIENCES	
Psychology	29
Economics and business	30
Educational sciences	31
Sociology	32
Law	33
Political Science	34
Social and economic geography	35
Media and communications	36
Other social sciences	37
HUMANITIES	
History and archaeology	38
Languages and literature	39
Philosophy, ethics, and religion	40
Art (arts, history of arts, performing arts, music)	41
Other humanities	42

2. Are there other scientific fields related to this project?

Yes	1
No	2

3. What are other scientific field related to this project?

NATURAL SCIENCES	
Mathematics	01
Computer and information sciences	02
Physical sciences	03
Chemical sciences	04
Earth and related environmental sciences	05
Biological sciences	06
Other natural sciences	07

ENGINEERING AND TECHNOLOGY	
Civil engineering	08
Electrical engineering, electronic engineering, information engineering	09
Mechanical engineering	10
Chemical engineering	11
Materials engineering	12
Medical engineering	13
Environmental engineering	14
Environmental biotechnology	15
Industrial Biotechnology	16
Nanotechnology	17
Other engineering and technologies	18
MEDICAL AND HEALTH SCIENCES	
Basic medicine	19
Clinical medicine	20
Health sciences	21
Health biotechnology	22
Other medical sciences	23
AGRICULTURAL SCIENCES	
Agriculture, forestry, and fisheries	24
Animal and dairy science	25
Veterinary science	26
Agricultural biotechnology	27
Other agricultural sciences	28
SOCIAL SCIENCES	
Psychology	29
Economics and business	30
Educational sciences	31
Sociology	32
Law	33
Political Science	34
Social and economic geography	35
Media and communications	36
Other social sciences	37

HUMANITIES	
History and archaeology	38
Languages and literature	39
Philosophy, ethics, and religion	40
Art (arts, history of arts, performing arts, music)	41
Other humanities	42

4. How did you distribute the funding received? Leave 0 (zero) if not applicable. (Percentages must add up to 100)

	PERCENT
Machinery, equipment, instrumentation	
Space, rent incl. labs, research infrastructure	
Materials, supplies, inventory	
IT systems, specialized software, IT licenses, websites	
Researchers' salaries	
Other salaries	
Consulting services (e.g., feasibility studies, survey companies)	
Training and events	
Testing and certifications	
Intellectual property (patents, trademarks, copyrights)	
Marketing campaigns or public relations (PR) activities for project visibility	
Travel (fairs, exhibitions, conferences, etc.)	
Other (please specify in space below)	

5. Was the funding you received for this project delivered according to the terms of the contract signed with the program?

Yes	1
No (please specify in the space below)	2

6. Which of the following are the most important objectives of your project? (Select and rank up to 3 objectives. Write 1 for the most important, 2 for the second most important, 3 for the third most important.)

	RANK
Improve chances to get EU funding	
Publish scientific papers in peer-reviewed journals	
Present scientific papers in seminars and conferences	
Produce market-oriented research	
Develop a cadre of young researchers	
Collaborate with the private sector	
Collaborate with other researchers or research institutions	
Develop a new product, service, or process	
Upgrade a product, service, or process	
Develop or start a new enterprise, business, or spin-off	
Pursue intellectual property (patents, industrial design right, copyrights, etc.)	
Other (please specify in the space below)	

7. Did your institution make in kind or in cash contributions to this project?

IN CASH	
Yes	1
No	2
I don't know	3
Does not apply	4
IN KIND (E.G., RESEARCHERS, ADMIN SUPPORT, OFFICES, ETC.)	
Yes	1
No	2
I don't know	3
Does not apply	4

8. Please estimate the resources your institution contributed to this project (in BGN). For example, if your institution contributed with ten thousand BGN, enter 10000.

	NUMBER
a. Cash	
b. In kind (e.g., researchers, admin support, offices, etc.)	

9. Was the amount of financial support provided by the program sufficient to successfully complete your project objectives?

Yes	1
No	2

10. By what percentage should the financial support have been increased to successfully complete your project objectives?

11. What were the most important reasons why the amount of financial support provided by the program was not sufficient? Select and rank up to 3 reasons. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

	IMPORTANCE
Inadequate budget planning	
Increased costs of inputs (e.g., survey, materials, lab tests, staff, etc.)	
Unable to get financial support from my institution	
Unexpected costs occurred	
Budget clearing by responsible authority was inadequate	
Project's scope increased beyond the original plan	
Issues with procurement	
Other (please specify in space below)	

Please explain in more detail why the amount of financial support provided by the program was not sufficient

12. Was the amount of time allowed by the program for project implementation, including any extensions, sufficient to successfully complete your project objectives?

Yes	1
No	2

13. What were the most important reasons why the amount of time allowed by the program was not sufficient? Select and rank up to 3 reasons. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

	IMPORTANCE
I could not reduce my teaching workload	
I could not reduce other projects' workload I was engaged in	
I could not reduce other activities within my Institution (e.g., participation in boards)	
Other (please specify in space below)	

14. Please indicate the extent to which you disagree or agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
Administrative support provided by [A1] was easily accessible	○	○	○	○	○
Administrative support provided by the program was sufficient to help the project advance smoothly	○	○	○	○	○
Financial support was provided on time	○	○	○	○	○
Financial reporting requirements were acceptable	○	○	○	○	○
Monitoring requirements (e.g., narrative, indicators, etc.) were acceptable	○	○	○	○	○
Expert feedback from monitoring (visits, reports, discussions) under [program name] was appropriate	○	○	○	○	○
Data protection practices were satisfactory	○	○	○	○	○

15. What program support or services did you need during implementation that would have improved the outcomes of your project, and were not present? Mark all that apply.

Assistance in the preparation of project budgets
Assistance to hire foreign researchers
Better administrative support
Assistance with procurement
Access to research infrastructure and equipment
Assistance in preparation of monitoring reports
Assistance with finding additional funding sources
Assistance to establish collaborations
Other (please specify in space below)

16. In the future, how would you prefer program support or services to be provided?

The institution should provide technical experts	1
Eligible activities of the project should include hiring experts for program support	2
Both of the above	3

D. Results

1. Indicate the project results that you achieved in the following periods:
   a. During the project
   b. After project until today

If your project is still active, please enter any results that have been achieved thus far. All spaces need to be filled with a number. If you did NOT achieve a result, leave 0.

	DURING THE PROJECT	AFTER PROJECT UNTIL TODAY
Training activities (courses, workshops, etc.)		
Number of seminars, workshops and conferences attended domestically		
Number of seminars, workshops and conferences attended abroad		
PhD students hired		
Postdoctoral researchers hired		
Scientific publications in peer-reviewed journals		
Patent applications		
Patents granted		
Industrial designs		
Copyrights		
Transfer agreements		
Prototype		
New software development		
New technology development		
Other results (please specify in space below)		

2. Choose the most important factors that contributed to the achievement of the results. Select and rank up to 3 factors. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

	IMPORTANCE
Availability of financial resources	
Availability of human resources such as researchers or mentors	
Support of the research institution	
The way support program is designed and implemented	
Availability of research infrastructure	
Other (please specify in the space below)	

3. How many scientific research papers related to this project have you (or other team members) published in peer-reviewed journals so far? Select 0 if you have not published any paper related to this project.

4. How many, if any, collaborating partners did/do you have in the context of this project? Select 0 (zero) if you do not have any in a category. Partners are defined as parties with which you have a formal or informal agreement related to the project and who contribute to the project either in cash or in kind.

Domestic research partners	1
Foreign research partners	2
Diaspora research partners	3
Domestic industry partners	4
Foreign industry partners	5
Diaspora industry partners	6
There were no collaborating partners	7

5. Evaluate the overall quality of collaborations related to this project.

	EXTREMELY POOR	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE	EXCELLENT
Domestic research partners					
Foreign research partners					
Diaspora research partners					
Domestic industry partners					
Foreign industry partners					
Diaspora industry partners					

6. What was the nature of the collaborations related to this project? Mark all that apply.

Joint R&D project	1
Purchase of R&D services	2
Technological consultancy	3
Licensing/patent registration	4
Test of a new prototype	5
Preparation of technical documentation	6
Co-author research publication	7
Other (please specify in space below)	8

7. How many, if any, collaborative research projects have you engaged in after the completion of the project until today? Select 0 (zero) if you do not have any in a category.

	NUMBER
Collaborative projects with domestic researchers or research institutions	
Collaborative projects with foreign researchers or research institutions	
Collaborative projects with diaspora researchers or research institutions	
Collaborative projects with domestic enterprises	
Collaborative projects with foreign enterprises	

8. How do you evaluate the outcome of this project based on your expectations?

Above my expectations	1
It matched my expectations	2
Below my expectations	3

What is the main reason?

9. List any other public support programs from which you received funding related to science, technology, or innovation after the start of this project.

NO.	PROJECT NAME	FUNDING START YEAR
1		
2		
3		
4		

10. This is the last question of the survey. You previously indicated that scientific papers related to this project were published in peer-reviewed journals. Please list the publication(s) related to this project.

NO.	TITLE	NAME OF THE JOURNAL	YEAR OF PUBLICATION
1			
2			
3			

11. This is the last question of the survey. You previously indicated that scientific papers related to this project were published in peer-reviewed journals. Please list the 5 most important publications related to this project.

NO.	TITLE	NAME OF THE JOURNAL	YEAR OF PUBLICATION
1			
2			
3			

Appendix C
Firm Survey Questionnaire

A. General Information About the Beneficiary

Intro: This section of the survey will ask you general information about you.

1. Please mark the option that applies to your case:

I am the project leader	1
I am not the project leader, but can provide detailed information	2

2. What was your role in this project?

3. Have you received funding from public programs for the continuation of this? (e.g., funds for research, scholarships, etc.)

Yes	1
No	2

4. From which program did you get funding for the continuation of this project?

5. List any other public support programs (aside from this one) from which you received funding for any project related to science, technology, or innovation between 2015 and 2020

6. At the end the project, how many full and part time employees did the company have in the company, including you? Write 0 (zero) if there were no full-time or part-time employees

	NUMBER
Full time employees	
Part time employees	

7. Please indicate the highest level of education obtained by the chief executive officer of your company

Primary, elementary education or lower	1
Secondary education	2
Industrial/crafts vocational (1-3 years)	3
Technical/vocational (4+ years)	4
Grammar school	5
Bachelor's or equivalent level	6
Master's or equivalent level	7
Doctoral or equivalent level	8
I don't know	9

B. About the Application and Selection Process

1. Please indicate the extent to which you disagree or agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
It was easy to identify and obtain information about the program					
Program's objectives were clear					
Support for helping with the application and clarifying application procedures was timely and relevant					
Application procedure was well explained					
Application documentation was easy to follow and fill					
Application period was sufficient					
The quantity and type of information required in proposals were adequate					
Eligibility criteria were clear					
Eligibility criteria were fair					
Selection process was fair					
Selection process was transparent					
It was easy to access the regulations of the program					
The regulations of the program were clear					
Time between application and final results of selection was adequate					
Time between communication of results of selection and receiving funding was adequate					
The rules in cases of non-compliance with the call for proposals were flexible					
There was feedback on the reasons why the project was approved					
Contract negotiation procedure took adequate time					
Contract negotiation was easy					
The list of eligible costs was appropriate for the development of the project					

2. Think about all the expenses incurred in preparing your application, such as the time to prepare paperwork, consultants, assistants, materials, etc. Please provide your best estimate of the total cost, in BGN, of preparing your application for this project. For example, if the total expense was one thousand BGN, write 1000.

3. Approximately, how many full person days (8 hours each) did it take to prepare the application?

	NUMBER
Full person days	

4. What kind of human resources did you use to prepare your application? Select all that apply.

Administrative assistant	1
Lawyer or legal consultant	2
Accountant	3
Experts/ consultants	4
The project team prepared the application without any additional help	5
Other (please specify in the space below)	6

5. Were the costs for applying to the program (monetary and non-monetary) adequate when compared with the benefits?

Yes	1
No	2

6. Now you will be asked about the eligibility criteria for participating in the program. Do you think some eligibility criteria should be added, deleted, or changed?

	YES	NO	IF YES
Changed	○	○	What eligibility criteria would you change, and why?
Added	○	○	What eligibility criteria would you add, and why?
Deleted	○	○	What eligibility criteria would you delete, and why?

7. Now you will be asked about the selection criteria for participating the program. Do you think some selection criteria should be added, deleted, or changed?

	YES	NO	IF YES
Changed	○	○	What eligibility criteria would you change, and why?
Added	○	○	What eligibility criteria would you add, and why?
Deleted	○	○	What eligibility criteria would you delete, and why?

8. Why did you request financial support from this program? Mark all that apply. Note that financial institutions include private investors, venture capitalists, banks, and other financial agencies that provide funding.

Financial institutions did not give me credit	1
Financial institutions gave me credit, but it is very expensive or takes too long to get the funding (skip to E1)	2
Obtaining a grant from public sources was the only funding option (skip to E1)	3
We needed mentoring, information, or technical advice for upgrading or learning new technologies (skip to E1)	4
Other (specify in the space below) (skip to E1)	5

9. Please mark the reason(s) why financial institutions did not give you credit. Please mark all that apply.

I do not have a collateral	1
I do not have a long credit history	2
The project is risky and returns are uncertain	3
Other (please specify below)	4

C. Project Execution and Resources Allocated to the Project

Intro: Now you will be asked about project execution and resources allocated to the project.

1. What is the main area of economic activity related to this project?

ECONOMIC AREA	NACE CODE
Agriculture, Forestry and Fishing	A
Mining and Quarrying	B
Manufacturing	C
Electricity, Gas, Steam and Air Conditioning Supply	D
Water Supply; Sewerage, Waste Management and Remediation Activities	E
Construction	F
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	G
Transportation and Storage	H
Accommodation and Food Service Activities	I
Information and Communication	J
Financial and Insurance Activities	K
Real Estate Activities	L
Professional, Scientific and Technical Activities	M
Administrative and Support Service Activities	N
Public Administration and Defense; Compulsory Social Security	O
Education	P
Human Health and Social Work Activities	Q
Other (Please specify in the next page)	

2. What is the main Smart Specialization (S3) priority area for this project?

Informatics and ICT	1
Healthy life and biotechnology industries	2
Mechatronics and clean technologies	3
New technologies in creative and re-creative industries	4
None of these	5

3. How did you distribute the funding received? Leave 0 (zero) if not applicable.

	PERCENT
Machinery, equipment, instrumentation	
Space, rent	
Access to specialized equipment or laboratories	
Materials, supplies, inventory	
IT systems, specialized software, IT licenses, websites	
Salaries	
Consulting services (e.g., feasibility studies, survey companies, market research)	
Training	
Testing and certifications	
Intellectual property (patents, trademarks, copyrights)	
Marketing campaigns or public relations (PR) activities for project visibility	
Travel and events (fairs, exhibitions, conferences, etc.)	
Other (please specify in space below)	

4. Was the funding you received for this project delivered according to the terms of the contract signed with the program? For example, were the amounts received, disbursement times and conditions, etc., provided according to the terms of contract?

Yes	1
No (please specify in the space below)	2

5. Which of the following are the most important objectives of your project? (Select and rank up to 3 objectives. Write 1 for the most important, 2 for the second most important, 3 for the third most important.)

OBJECTIVE	NUMBER
Related to collaboration	
Collaborate with other private sector entities	
Collaborate with researchers or research institutions	
Related to capacity building	
Participate in international fairs	
Training of employees	
Develop innovation capacities and management skills	
Related to new products and spinoffs	
Pursue intellectual property (patents, industrial design right, copyrights, etc.)	
Develop a new product, service, or process	
Putting a new product, service, or process on the market	
Upgrade a product, service, or process	
Develop or start a new enterprise, business, or spin-off	
Other (please specify in the space below)	

6. Did your company make in kind or in cash contributions to this project?

IN CASH	
Yes	1
No	2
I don't know	3
Does not apply	4
IN KIND (E.G., RESEARCHERS, ADMIN SUPPORT, OFFICES, ETC.)	
Yes	1
No	2
I don't know	3
Does not apply	4

7. Please estimate the resources your institution contributed to this project (in BGN). For example, if your institution contributed with ten thousand BGN, enter 10000.

	NUMBER
a. Cash	
b. In kind (e.g., researchers, admin support, offices, etc.)	

8. Was the amount of financial support provided by the program sufficient to successfully complete your project objectives?

Yes	1
No	2

9. By what percentage should the financial support have been increased to successfully complete your project objectives?

10. What were the most important reasons why the amount of financial support provided by the program was not sufficient? Select and rank up to 3 reasons. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

	IMPORTANCE
Inadequate budget planning	
Increased costs of inputs	
Unable to get financial support from my institution	
Unable to ensure cofinancing	
Unexpected costs occurred	
Budget approved by the public entity was inadequate	
Project's scope increased beyond the original plan	
Issues with procurement	
Other (please specify in space below)	

Please explain in more detail why the amount of financial support provided by the program was not sufficient

11. Was the amount of time allowed by the program for project implementation, including any extensions, sufficient to successfully complete your project objectives?

Yes	1
No	2

12. What were the most important reasons why the amount of time allowed by the program was not sufficient? Select and rank up to 3 reasons. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

REASON	IMPORTANCE
Did not have enough financial resources	
Could not find qualified staff	
Delays in supply of raw materials	
Delays in production process	
Inadequate planning	
Other (please specify in space below)	

13. Please indicate the extent to which you disagree or agree with the following statements.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE NOR DISAGREE	AGREE	STRONGLY AGREE
Administrative support provided by the public entity was easily accessible	○	○	○	○	○
Administrative support provided by the program was sufficient to help the project advance smoothly	○	○	○	○	○
Financial support was provided on time	○	○	○	○	○
Financial reporting requirements were acceptable	○	○	○	○	○
Monitoring requirements (e.g., narrative, indicators, etc.) were acceptable	○	○	○	○	○
Expert feedback from monitoring (visits, reports, discussions) under the program was appropriate	○	○	○	○	○
Data protection practices were satisfactory	○	○	○	○	○

14. What program support or services did you need during implementation that would have improved the outcomes of your project, and were not present? Mark all that apply.

Guidance for intellectual property rights management	1
Guidance for certification and standard norms	2
Guidance for market penetration and/or commercialization	3
Establishing connections with international experts	4
Assistance in the preparation of project budgets	5
Better administrative support by the program	6
Assistance with procurement	7
Access to research infrastructure and equipment	8
Assistance in preparation of monitoring reports	9
Assistance with finding additional funding sources	10
Assistance to establish collaborations	11
Other (please specify in space below)	12

D. Results

1. Indicate the project results that you achieved in the following periods:
   a. During the project
   b. After project until today

All spaces need to be filled with a number. If you did NOT achieve a result, leave 0.

	DURING THE PROJECT	AFTER PROJECT UNTIL TODAY
Market-oriented research projects		
Defined an intellectual property right strategy		
Patent /Utility models applications		
Patents /Utility models granted		
Other intellectual property activities (e.g., industrial designs, copyrights, transfer agreements, etc.)		
New enterprise, business, or spin-off		
Prototype		
Products or services that are new to the firm		
Products or services that are new to the market		
New processes		
Upgraded products or services		
Upgraded processes		
New design for a product, process, or service		
New business model		
Expanded to new markets		
Develop a new innovation unit in the firm		
Improved the capabilities of employees		
Reorganized the firm or part of the firm		
Other results (please specify in space below)		

2. If the project led to the adoption of a new process or a new technology, were you be able to implement this new process or technology in your firm?

Yes	1
No	2

3. Which of the following stages of commercialization have you attained for results related to this project? Mark all that apply.

Have a product, service or process that is being sold	1
Have a product, service or process that is ready to be sold	2
Have a working prototype that is almost ready to be sold	3
Have a proof of concept for a product or process that can be sold in the future	4
Other (please specify in the space below)	5
The results that came out of this project will NOT be commercialized or are NOT likely to be commercialized	6

4. Select up to three of the most difficult challenges you company faced in commercialization of the project. Write 1 for the most important, 2 for the second most important, 3 for the third most important.

The project did not provide enough support for commercialization
Lack of time
Lack of financial resources
Lack of human resources
Lack of information about markets
Lack of companies interested
Legal complexity/ambiguity concerning commercialization
Competition
The project is not ready to be commercialized
Other (please specify in space below)

5. Choose the most important factors that contributed to the achievement of the results. Select and rank up to 3 factors. Write 1 for the most important, 2 for the second most important, 3 for the third most important

Availability of financial resources
Availability of human resources such as researchers or mentors
Support of the research institution
The way support program is designed and implemented
Availability of research infrastructure
Other (please specify in the space below)

6. Have you taken any of the following steps towards selling the product or process coming out of the project? Mark all that apply

Discussions/negotiations with a vendor or firm that will sell my product, service, or process
Participated in trade fairs to showcase my product, service, or process
Participated as advertiser in scientific/technical conferences
Presented my product or process in domestic market
Other (please specify below)

7. What percentage of the company's sales do you expect from the commercialization of the main result of the project?

Expected percentage of sales from commercializing the main results of the project
I don't know

8. Was this project effective in...

	YES	NO	DON'T KNOW
Improving the sales of the company?	1	2	3
Improving the productivity of the company?	1	2	3
Reducing the production costs of the company?	1	2	3
Improving the export performance of the company?	1	2	3
Allowing the company to access new markets?	1	2	3

9. Please indicate the following effects of the project, approximately:

If E9a=YES, by how much (in percentage) did the sales increase?
If E9b=YES, by how much (in percentage) did productivity improve?
If E9c= YES, by how much (in percentage) did production costs decrease?
If E9d= YES, by how much (in percentage) did export performance improve?
If E9e= YES, by how much (in percentage) did export performance improve?

10. Approximately when do you expect to recover the investment your company made for this project?

11. Has this project contributed to increase the numbers of employees in your company?

Yes	1
No	2
I don't know	3

12. How many additional workers were hired due to the project? Mark 0 (zero) if no additional full or part-time workers were hired.

Full time workers
Part time workers

13. How many, if any, collaborating partners did/do you have in the context of this project? Select 0 (zero) if you do not have any in a category. Partners are defined as parties with which you have a formal or informal agreement related to the project and who contribute to the project either in cash or in kind.

	NUMBER
Domestic research partners	
Domestic industry partners	
Diaspora research partners	
Diaspora industry partners	
Foreign research partners	
Foreign industry partners	

14. Evaluate the overall quality of collaborations related to this project.

	EXTREMELY POOR	BELOW AVERAGE	AVERAGE	ABOVE AVERAGE	EXCELLENT
Domestic research partners	○	○	○	○	○
Foreign research partners	○	○	○	○	○
Diaspora research partners	○	○	○	○	○
Domestic industry partners	○	○	○	○	○
Foreign industry partners	○	○	○	○	○
Diaspora industry partners	○	○	○	○	○

15. What was the nature of the collaborations related to this project? Mark all that apply.

Joint R&D project	1
Purchase of R&D services	2
Technological consultancy	3
Licensing/patent registration	4
Test of a new prototype	5
Preparation of technical documentation	6
Co-author research publication	7
Selling a product	8
Other (please specify in space below)	9

16. How many, if any, collaborative research projects have you engaged in after the completion of [A5] until today? Select 0 (zero) if you do not have any in a category.

	NUMBER
Collaborative projects with domestic researchers or research institutions	
Collaborative projects with foreign researchers or research institutions	
Collaborative projects with diaspora researchers or research institutions	
Collaborative projects with domestic enterprises	
Collaborative projects with foreign enterprises	

17. How do you evaluate the outcome of this project based on your expectations?

Above my expectations
It matched my expectations
Below my expectations
What is the main reason?

Appendix D
Administrative Costs

This appendix describes the administrative cost data provided by the program staff of the selected programs, any estimations or calculations made by program staff, and any adjustments made to the administrative cost data by the World Bank team.

D.1 Fundamental Research

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

The NSF does not have detail information on the fixed costs that can be attributed to individual programs. Therefore, fixed costs were estimated based on the personnel costs of the Fundamental Research program as a share of total NSF personnel costs, using the following formula:

$$\text{Fixed costs}_{FR} = \text{Fixed costs}_{NSF} \times \left(\frac{\text{Personnel costs}_{FR}}{\text{Personnel costs}_{NSF}} \right)$$

However, data for the total personnel costs for NSF were only available for 2019 and 2020, so an additional estimation was done to estimate total personnel costs from 2016-2018. The World Bank team assumed that personnel costs at NSF grew at the same rate as personnel costs at MoES (NSF's parent ministry), resulting in an annual growth rate of personnel costs of approximately 10 percent from 2016 to 2018.

EXTERNAL SERVICES

Costs for external evaluators of project proposals were estimated based on an estimated cost of 1,440 BGN per application multiplied by the number of applications received by the program per year. Costs for external services for M&E, advisory (costs related to members of NSF's temporary and permanent advisory committees), and other (such as legal services) were estimated based on the total cost to NSF for each of these services multiplied by the personnel costs of the Fundamental Research program as a share of total NSF costs.

Cost data for external experts for M&E were not available for 2017, so the overall costs for external services presented in this report are likely lower than the actual costs of external services for the program.

D.2 Vihren

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

The NSF does not have detail information on the fixed costs that can be attributed to individual programs. Therefore, fixed costs were estimated based on the personnel costs of the Vihren program as a share of total NSF personnel costs, using the following formula:

$$\text{Fixed costs}_{SV} = \text{Fixed costs}_{NSF} \times \left(\frac{\text{Personnel costs}_{SV}}{\text{Personnel costs}_{NSF}} \right)$$

EXTERNAL SERVICES

Costs for external evaluators of project proposals were estimated based on an estimated cost of 1,440 BGN per application multiplied by the number of applications received by the program per year. Costs for external services for M&E, advisory (costs related to members of NSF's temporary and permanent advisory committees), and other (such as legal services) were estimated based on the total cost to NSF for each of these services multiplied by the personnel costs of the Fundamental Research program as a share of total NSF costs.

D.3 ICT for a Single Digital Market in Science, Education, and Security and Electronic Health in Bulgaria

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

Fixed costs were estimated based on the personnel costs of the NIF program as a share of total SMEPA personnel costs, using the following formula:

$$\text{Fixed costs}_{\text{ICT}} = \text{Fixed costs}_{\text{MoES}} \times \left(\frac{\text{Personnel costs}_{\text{ICT}}}{\text{Personnel costs}_{\text{MoES}}} \right)$$

Cost data was not available to office equipment and ICT, so these costs were not included in this analysis; therefore, the actual fixed costs attributable to the program are likely higher than what is presented in this report

EXTERNAL SERVICES

There were no external services used by the program

D.4 Electronic Health in Bulgaria

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

Fixed costs were estimated based on the personnel costs of the NIF program as a share of total SMEPA personnel costs, using the following formula:

$$\text{Fixed costs}_{\text{eHealth}} = \text{Fixed costs}_{\text{MoES}} \times \left(\frac{\text{Personnel costs}_{\text{eHealth}}}{\text{Personnel costs}_{\text{MoES}}} \right)$$

Cost data was not available to office equipment and ICT, so these costs were not included in this analysis; therefore, the actual fixed costs attributable to the program are likely higher than what is presented in this report.

EXTERNAL SERVICES

There were no external services used by the program

D.5 Development of Product and Process Innovations

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

Costs for office space, utilities, and maintenance were estimated using a weight based on number of supported contracts under the DPPI program as a share of all contracts supported under DG OPIC.

Cost data was not available to office equipment and ICT, so these costs were not included in this analysis; therefore, the actual fixed costs attributable to the program are likely higher than what is presented in this report.

EXTERNAL SERVICES

External services costs were calculated from the external contracts funded by the program

D.6 National Innovation Fund

PERSONNEL COSTS

Personnel costs were calculated based on the salaries of program staff and the number of days per year they estimated working on the program.

FIXED COSTS

Fixed costs were estimated based on the personnel costs of the NIF program as a share of total SMEPA personnel costs, using the following formula:

$$\text{Fixed costs}_{\text{NIF}} = \text{Fixed costs}_{\text{SMEPA}} \times \left(\frac{\text{Personnel costs}_{\text{NIF}}}{\text{Personnel costs}_{\text{SMEPA}}} \right)$$

EXTERNAL SERVICES

External services costs were calculated from the external contracts funded by the program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