

CO-INNOVATION FOR GREATER IMPACT

Impact Study on RDI Collaboration

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ISSN 1797-7347
ISBN 978-952-457-670-3

BUSINESS FINLAND

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FOREWORD

Business Finland has three strategic target areas, which are **1) Economic Growth, 2) Sustainable Development and 3) Competitiveness**. Impact studies implemented in each target area and impact studies presenting their results comprise the actual and official method for monitoring Business Finland's success and impact.

Focus of this impact study was to concentrate on competitiveness target area. Competitiveness is key to ensuring long-term prosperity. By focusing on improving the competitiveness of both Business Finland customers and Finland, we avoid sub-optimizing economic growth in the short term. Aim of Business Finland is to strengthen customers' long-term competitiveness by supporting them in developing capabilities that are required for renewal and resilience. On a societal level, the goal is that Finland becomes a more attractive and resilient business landscape that is agile in reacting to external challenges.

In this impact study, evaluation targeted on the capabilities and RDI collaboration. Therefore it concentrated on the Business Finland's RDI collaboration instruments that are Co-Creation and Co-Innovation funding between companies and research organizations. Main questions were, how do Business Finland activities (Co-Creation

and Co-Innovation funding) succeed to improve competitiveness of innovation and operational environment in Finland? What kind of critical obstacles and bottlenecks have affected the possibilities to achieve the goals of Co-Creation and Co-Innovation funding when considering the competitiveness core area? How internal practices could be improved to streamline the funding process in Business Finland? How sustainability (economic, ecological, and social) might be considered at the customer and society level in promotion services?

The evaluation team of 4Front Oy and the Evidence Network Inc. (Canada) carried out this impact study. Business Finland wishes to thank the evaluators for their thorough and systematic approach. Business Finland expresses its gratitude to the steering group and all others who have contributed to the study.

Helsinki, November 2023
Business Finland

EXECUTIVE SUMMARY

Impact studies are the key method for monitoring Business Finland's success and impact in its strategic target areas. The purpose of this impact study was to assess how the attractiveness of the Finnish economy can be strengthened when compared to competitors, for example, in the fields of RDI collaboration and capabilities, and what would be the role of public interventions. This impact study was commissioned by Business Finland, and it has been jointly conducted by 4FRONT together with The Evidence Network Inc. The study, including all its data collection, was carried out between January and October 2023.

STUDY METHODOLOGY

The study started with an in-depth desk research of relevant Business Finland reports, as well as publications from other organisations and of the academic literature. This was followed with 28 stakeholder and expert interviews.

In order to properly assess the impact of both Co-Creation and Co-Innovation project funding, three separate online surveys were conducted. One for the research organisations that participated in Co-Creation projects, another for the research organisations that participated in Co-Innovation projects, and a third one for companies that participated in the Co-Innovation projects.

An econometric analysis was conducted to examine the impact of Business Finland's Co-Innovation funding on companies' turnover, job creation, and export performance. Business Finland's normal (that is, other than Co-Innovation) R&D funding beneficiaries were used as a control group.

An international benchmarking analysis was also conducted to compare the different national approaches to enhancing R&D collaboration between companies and

research organisations. Furthermore, five case studies were conducted to identify success factors of Co-Innovation projects, and to provide lessons learned.

Finally, a validation workshop of the study findings was organised with the objective to present and discuss study findings, validate draft conclusions and to discuss possible recommendations for future development.

HIGHLY RELEVANT INSTRUMENT – AT THE CORE OF BUSINESS FINLAND

Co-Innovation projects are joint projects in which research organisations and companies carry out simultaneously R&D projects in close cooperation. The projects promote high-quality research to accelerate the renewal and international growth of Finnish companies, as well as the building of competitive ecosystems. Co-Creation projects are shorter preparatory projects for the setting up of Co-Innovation consortia and plans.

Today, ambitious innovations aimed at international markets are increasingly complex and systemic. They often require a well-coordinated input from many different partners. In collaborative R&D each partner brings in

additional competences - research organisations bring in professional research networks and competence, and companies bring in technical, production and business perspectives, for example.

Particularly for small and medium-sized enterprises (SMEs), engaging in R&D collaboration is essential also for building their capabilities with regard to research and innovation, for broadening their competence networks and for providing access to value chains and internationalisation.

In European comparison, Finnish companies have traditionally ranked well in R&D collaboration, but this collaboration has mainly been of domestic nature. There is also a long tradition at Business Finland to support R&D collaboration for different themes, at different levels and with different funding services.

Together with other Business Finland services and strategic measures (e.g., programmes, ecosystems, Leading Company Initiatives) Co-Creation and Co-Innovation projects serve as the cornerstone of what is known as the National Partnership Model.



WIDELY UTILISED AND WELL-RESOURCED

Presently, Co-Creation and Co-Innovation projects are Business Finland's primary funding mechanisms to support collaboration for the design and preparation (Co-Creation) and for the conduction (Co-Innovation) of joint R&D between companies and research organisations.

Co-Innovation funding has emerged as a widely employed funding vehicle for the large and ambitious R&D projects, particularly in the effective realisation of Business Finland's innovation ecosystems and Leading Company Initiatives.

A significant allocation of effort and resources have been dedicated to Co-Innovation projects. Over the span of five-years from 2018 to 2022, a total of 136 Co-Innovation projects were completed, featuring an average of 4.6 partners in each and an average project size of EUR 4 million. Business Finland funding contribution amounted to EUR 212 million out of the total project volume of EUR 546 million.

TABLE E1. PROJECT DATA SYNTHESIS FOR 2018-2022 COMPLETED PROJECTS.

SOURCE: BUSINESS FINLAND.

	CO-CREATION	CO-INNOVATION
Number of joint projects (funding decisions = funded partners)	151 (276)	136 (627)
Number of Research Organisations / Companies (funded)*	276 / 0	216 / 411
Average size of project consortia (i.e., funded organisations)	1,8	4,6**
Average Business Finland funding per project (min-max)	90,190 €*** (18 k€ - 240 k€)	1.6 M€ (50 k€ - 9.8 M€)
Total volume of Business Finland's funding decisions (share)	13.6 M€ (62%)	212.4 M€ (39%)
Total matching funding (share)	8.5 M€ (38%)	334.2 M€ (61%)
Total cumulative project volumes	22.1 M€	546.4 M€
Average size of joint project	146,000€	4.0 M€

*411 CO-INNOVATION FUNDING DECISIONS FOR COMPANIES. INCLUDES AT LEAST 354 DIFFERENT COMPANIES. DOES NOT INCLUDE POSSIBLE NON-FUNDED PROJECT PARTNERS.

**AVERAGE SIZE OF CO-INNOVATION FUNDING VARIES GREATLY: 2020=EUR 3.2 MILLION, 2021=EUR 2.25 MILLION, 2022=EUR 0.9 MILLION.

***FOR CURRENT CO-CREATION, THE MAXIMUM AMOUNT OF BUSINESS FINLAND FUNDING IS EUR 60,000/PROJECT. PREVIOUSLY, THE SINGLE AMOUNT OF FUNDING HAS BEEN BIGGER.

During the period of 2018–2022, Co-Creation projects numbered similarly at 151; however, they were notably smaller both in terms of funding (average of EUR 146,000) and consortia size (average of 1.8 partners). Business Finland's contribution to Co-Creation projects amounted to EUR 13.6 million out of a total project volume of EUR 22.1 million.

In international comparison, the role of companies as project initiators and coordinators holds greater prominence in collaborative R&D programmes of other countries compared to Finland. In general, learning and networking are found to be the key benefits of collaborative research projects. At the same time, support for commercialisation and scaling up are common challenges of R&D collaboration programmes in all countries.

AMBITIOUS PROJECTS IN EVERY ASPECT

Co-Innovation projects are ambitious and complex to set up and conduct, often proving to be more intricate and demanding than initially envisioned. These projects are also thematically more connected to Business Finland programmes than normal R&D projects.

In Finland, Co-Innovation projects are mainly initiated and driven by research organisations. Research organisations in Finland also demonstrate higher levels of engagement and commitment to these projects compared to their corporate counterparts. This is a different approach to R&D collaboration than in most benchmarked countries, where joint projects are largely driven by companies.

The landscape of Co-Innovation projects encompasses a broad spectrum, ranging from substantial endeavors to smaller-scale initiatives. A particularly encouraging aspect is the significant involvement of SMEs as project participants within these ambitious R&D undertakings, underscoring promising prospects for knowledge exchange and capacity enhancement.

Effective design, establishment, and meticulous planning play pivotal roles in the success of Co-Innovation projects. Therefore, the availability of Co-Creation funding as an option aligns logically and proves to be highly beneficial in this context.

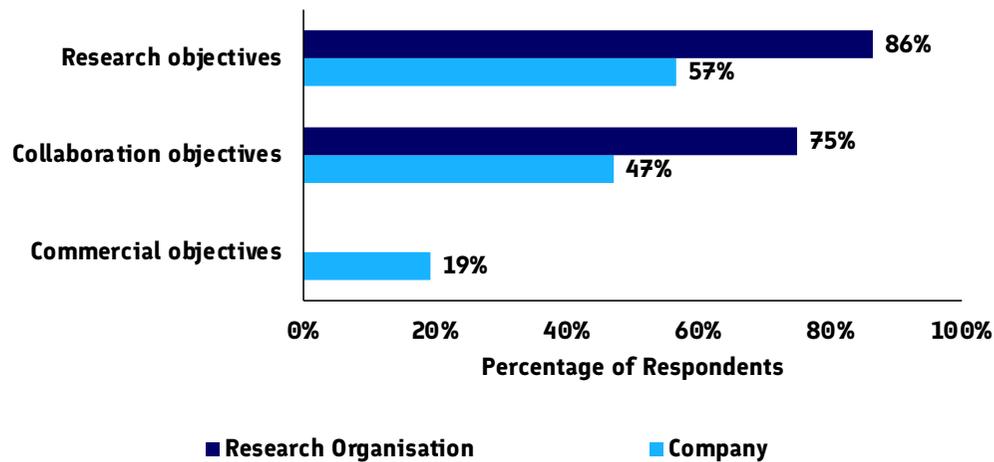


FIGURE E1. ACHIEVEMENT OF PROJECT OBJECTIVES IN CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS AND COMPANIES.¹ SOURCE: ONLINE SURVEYS. N = 96 RESEARCH ORGANISATIONS / 111 COMPANIES.

¹ Only companies were asked of the achievements of their commercial objectives.

SUCCESS BIASED TOWARDS RESEARCH ORGANISATIONS

Co-Creation and Co-Innovation projects have demonstrated notable success. A significant majority (77%) of Co-Creation project partners consider the projects at least moderately successful. In the case of Co-Innovation projects, a remarkable proportion of participants affirm their success, with 81% of companies and an impressive 98% of research organisations deeming these initiatives at least moderately successful. Research organisations largely attained their research and collaboration objectives, indicating a high level of success from their perspective. However, companies adopted a more critical stance toward the outcomes of the projects.

POSITIVE IMPACT ON COLLABORATION AND ECONOMIC PERFORMANCE

Co-Innovation projects have significantly expanded the R&D collaboration and competence networks of the involved partners. In this regard, major research

organisations have been pivotal for all project participants. However, it is important to note that the impact on international networks within Co-Innovation projects has been limited.

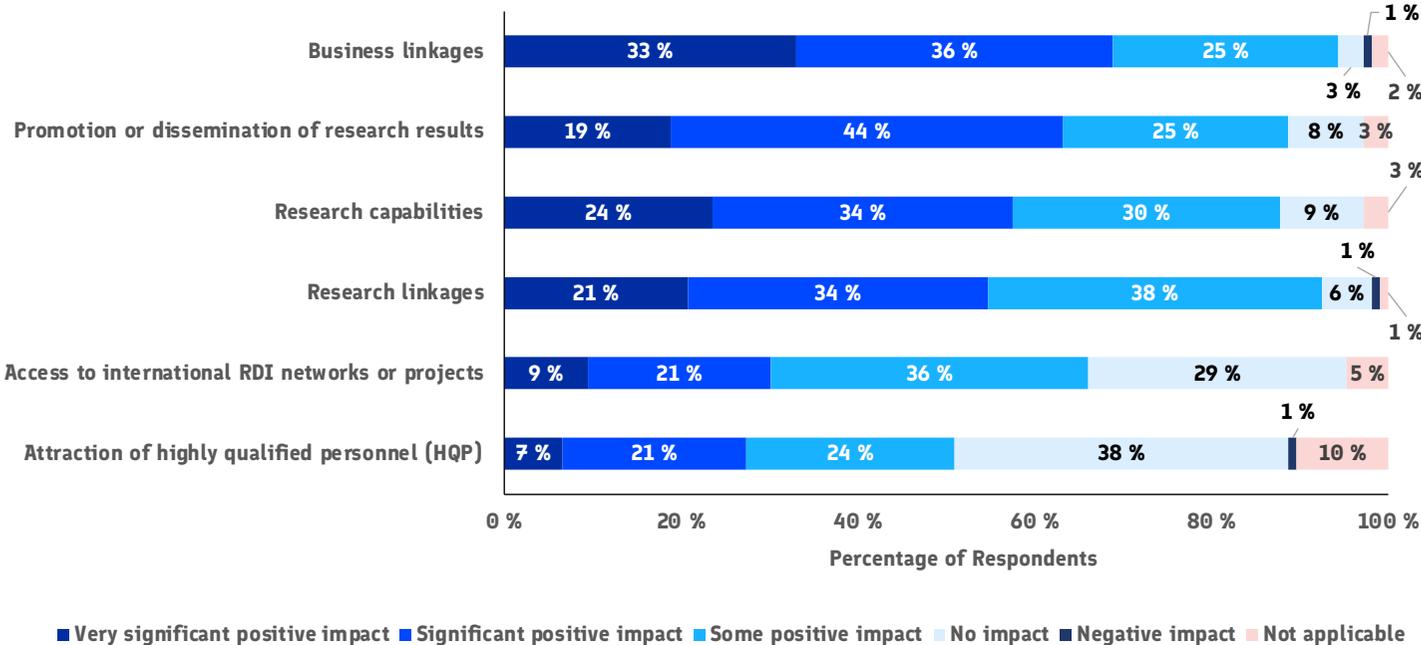


FIGURE E2. CO-CREATION PROJECTS' IMPACT ON CAPABILITIES AND LINKAGES. SOURCE: ONLINE SURVEY, N=106.



Moreover, the study reveals that Co-Innovation projects yield a notably stronger positive economic impact for participating companies compared to typical Business Finland R&D funding. Interestingly, there seems to be an economies of scale effect, amplifying the impact in larger projects.

Research organisations express higher satisfaction with the outcomes of Co-Innovation projects than their corporate partners. This discrepancy raises concerns about whether Co-Innovation projects may be excessively research-oriented and research-driven, potentially requiring a more balanced emphasis on application-oriented and business-driven approaches.

The project expectations for internationalisation and exports have proven challenging to fulfil. Projects often exceed initial time estimates for implementation, delaying subsequent commercialisation and internationalisation efforts. A shortage of appropriate funding for internationalisation further compounds this challenge.

RECOMMENDATIONS

Following five recommendations have been made to Business Finland to further improve the focus and impact of its Co-Creation and Co-Innovation funding:

1. More focus on companies. Currently Co-Innovation projects appear to better serve the needs of research organisations than companies, although companies are their primary target group. This could be done, for example, by opening the Co-Creation funding to all kinds of organisations.
2. Enhancing data monitoring, ensuring sufficient deal flow and thematic linkages in the Co-Creation-to-Co-Innovation process. Co-Innovation projects are often complex partnerships, which calls for broader and more consistent project data to be collected and made easily available for monitoring Co-Innovation project flows, connections, and overall status at Business Finland. It is important to know where new collaborative projects originate from, how they are linked to different Business Finland ecosystems and instruments, as well as how the topics continue and evolve after project period.
3. More support for the project preparation as well as sufficient time for the implementation of projects.

The key challenges of Co-Innovation projects are in the very beginning and towards their completion; finding suitable partners, finding a common ground for information sharing and later when results are to be turned into commercial success and exports. Support is needed for the beginning part and more time at the end.

4. Enhancing (strategic) ecosystem aspects. Co-Innovation funding is an important vehicle to implement Business Finland's large strategic platforms and ecosystems. This aspect should be communicated clearly.
5. More attention on supporting scaling and international collaboration. Difficulties in commercialisation, up scaling and internationalisation are pertinent challenges to Finnish R&D projects, and so also to Co-Innovation projects. It is a deliberate objective of Co-Innovation funding to address these challenges.

1. INTRODUCTION



1.1. BACKGROUND

This impact study was commissioned by Business Finland, and it has been jointly conducted by Kimmo Halme, Katri Haila, Kalle Piirainen, Heidi Uitto and Fabian Landes of 4FRONT together with Brian Barge and Mimosa Zhao of The Evidence Network Inc. The study has had a Steering Group chaired by Maija Lönnqvist (Ministry of Economic Affairs and Employment, MEE), with members Teija Palko (MEE), Esa Panula-Ontto (Business Finland, BF), Christopher Palmberg (BF), Timo Metsä-Tokila (BF), Jussi Kivikoski (BF), Hannu Kempainen (BF) and Jari Hyvärinen (BF). The study, including all its data collection, was carried out between January and October 2023.

1.2. OBJECTIVE OF THE STUDY

Impact studies are the key method for monitoring Business Finland's success and impact in its strategic target areas: 1) Economic Growth, 2) Sustainable Development and 3) Competitiveness. The overall aim of Business Finland is to strengthen customers' long-term

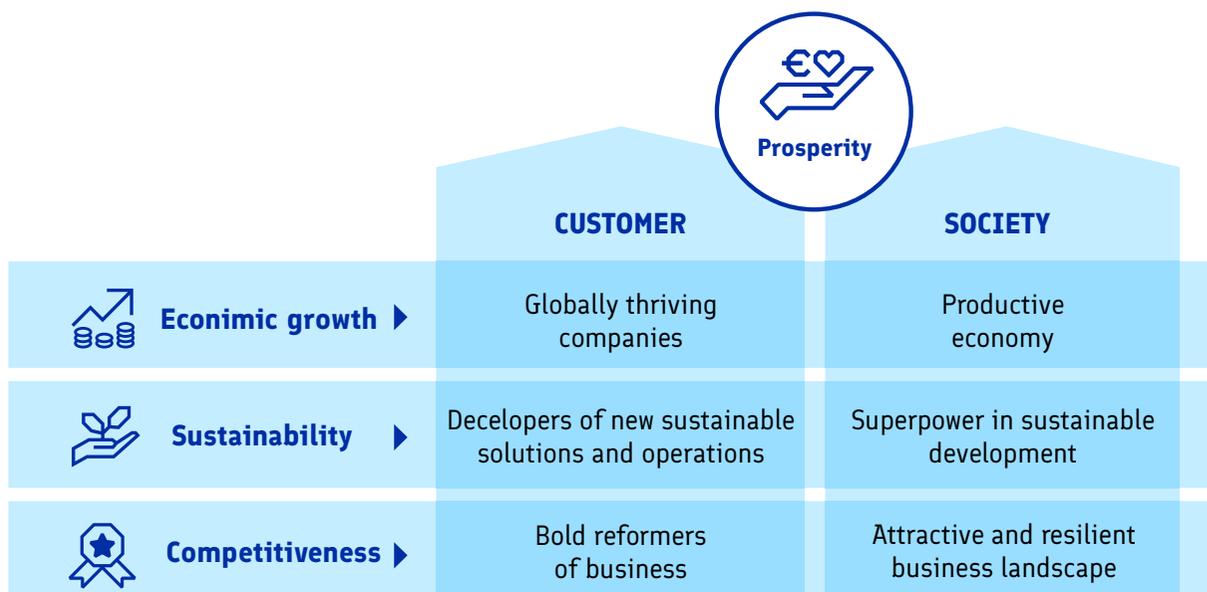


FIGURE 1. STRATEGIC TARGET AREAS OF BUSINESS FINLAND. SOURCE:

competitiveness by supporting them in developing capabilities that are required for renewal and resilience. On a societal level, the goal is that Finland becomes a more attractive and resilient business landscape that is agile in reacting to external challenges. The strategic target areas of Business Finland are depicted in Figure 1, whereas this study focuses on Business Finland’s impact in competitiveness at societal level, which is at the bottom right corner in the figure.

BUSINESS FINLAND STRATEGY².

The purpose of this impact study is to assess how the attractiveness of the Finnish economy can be strengthened when compared to its competitors, for example, in the fields of RDI collaboration and capabilities, and what would be the role of public interventions.

Competitiveness of both Finnish enterprises and Finland as an investment and business environment is mentioned in Business Finland’s strategy and strategy-related documents multiple times. Business Finland attaches competitiveness to ‘bold reform of business’,

2 Business Finland, Our Strategy for 2025. <https://www.businessfinland.fi/en/for-finnish-customers/strategy>



which implies innovation in business models, products and services, and an attractive business environment.³ In parallel to this study, Business Finland has conducted another impact study on competitiveness (Part 1), which focuses on the services that support the attractiveness of the Finnish innovation system (Invest in Finland, Work in Finland, Visit Finland, AV production incentive).

1.3. BUSINESS FINLAND IMPACT MODEL FOR COMPETITIVENESS

The focus of this impact study on competitiveness is to assess how the attractiveness of the Finnish economy has been strengthened with the help of the funding schemes of **Co-Creation** and **Co-Innovation**. The funding schemes aim to support collaborative research and innovation projects and support the creation of consortia consisting of companies and research organisations. As such, the study seeks to assess the effectiveness for beneficiaries of the funding schemes, as well as to estimate

³ E.g., Business Finland, Our Strategy for 2025. <https://www.businessfinland.fi/en/for-finnish-customers/strategy>

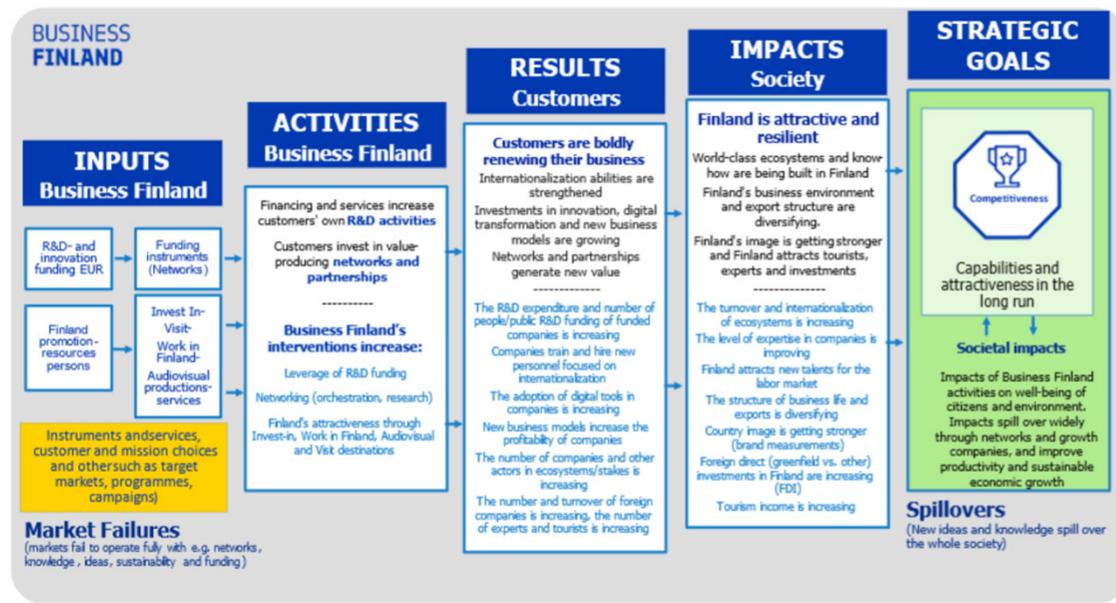


FIGURE 2. IMPACT MODEL FOR COMPETITIVENESS OF BUSINESS FINLAND. SOURCE: BUSINESS FINLAND.

the overall impact they have had on the broader competitiveness of the Finnish economy. The timely scope of this impact study includes the complete period of the funding schemes from 2018 – 2022.

Business Finland utilises the impact model with five dimensions to describe how selected interventions create impact and deliver on the strategic goal of competitiveness.

According to the impact model, Business Finland's role is to activate customers to build strong internationalisation-related capabilities and investments. Business Finland supports these goals through innovation funding,

advice services, and by creating valuable networks both in Finland and internationally. In other words, Business Finland interventions increase investments in RDI and intangible capital, which improve absorption capabilities of companies. In addition, new companies in Finland are crucial for improving critical mass in the Finnish business life. In the end, a large number of Finnish companies renew their businesses and seek growth especially with high value products and services.

At the customer level, the aim of Business Finland is that 1) customers are boldly renewing their businesses; 2) internationalisation abilities are strengthened; 3) investments in innovation, digital transformation and new business models are growing; and 4) networks and partnerships generate new value. Higher RDI collaboration increases the number of companies and other actors in ecosystems and networks. This leads to improved capabilities in terms of an increase in hiring and training of new personnel focused on internationalisation. In addition, the adoption of digital tools in companies is increasing. Moreover, the new business models increase the profitability of companies when commercialisation of products and services will be raised.

The capabilities that enable structural competitiveness are the same as those that form the basis for a resilient society. Finland is to become an attractive and resilient business landscape that is not only sustainable, but also agile in reacting to external challenges. Business Finland contributes to this goal by emphasising the importance of diversity in the business and research environment for rapid innovations and developing world-class ecosystems and expertise. In addition, Business Finland seeks to improve the attractiveness of Finland by contributing to a strong country brand and attracting inbound activity such as investment, visitors, and talent.

1.4. STUDY QUESTIONS

An evaluation framework was used as the foundation of this study, which contains a set of study questions for data collection and analysis. Table 1 provides an overview of the study questions in the terms of references and research plan. The conclusion section (Chapter 8) attempts to provide answers to these study questions based on the findings presented in Chapters 3-7.

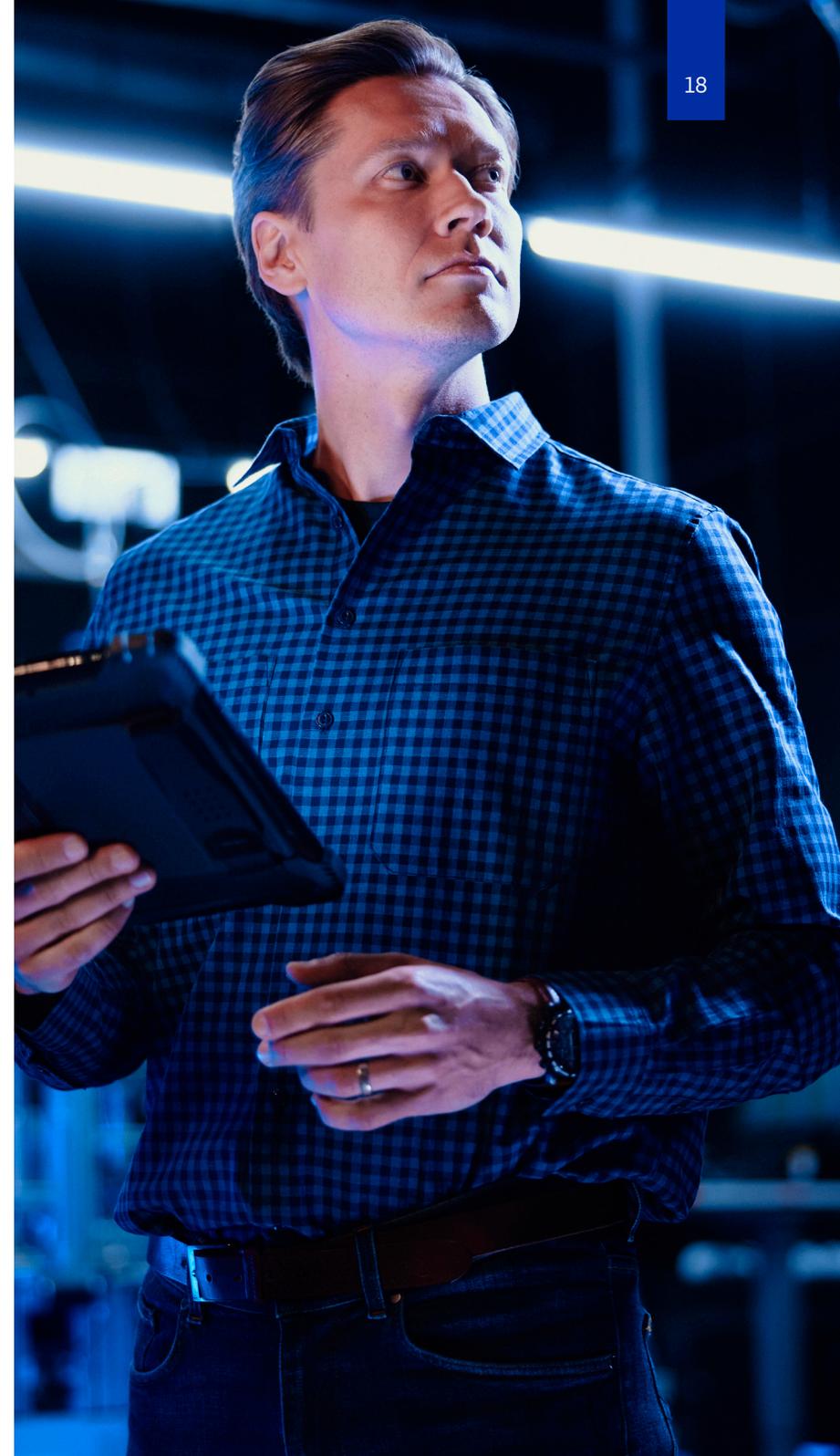


TABLE 1. STUDY QUESTIONS AND RELATED SUB-QUESTIONS.

STUDY QUESTIONS	SUB-QUESTIONS
<p>Q1: How do Business Finland activities (Co-Creation and Co-Innovation funding) succeed to improve competitiveness of innovation and operational environment in Finland?</p>	1.1 How has Co-Creation funding succeeded in activating companies and research organisations to collaborate?
	1.2 How many of these projects have proceeded as a Co-Innovation project?
	1.3 How has the R&D expenditure and number of R&D personnel via this R&D funding developed?
	1.4 How is the level of expertise in companies and research organisations improving?
	1.5 How have jobs, turnover, exports, and internationalisation developed so far (Co-Innovation funding)?
	1.6 Is Co-Innovation funding improving the adoption of digital tools (for example AI, robotics, automation) and new business models in companies?
<p>Q2: What kind of critical obstacles and bottlenecks have affected the possibilities to achieve the goals of Co-Creation and Co-Innovation funding when considering the competitiveness core area?</p>	
<p>Q3: How can sustainability (economic, ecological, and social) be considered at the customer and society level in promotion services?</p>	3.1 How can Business Finland's customers' impact on sustainability be measured (SDGs or other measures)?
	3.2 What kind of actions have promotion services already taken to improve sustainability?
<p>Q4: What are the future guidelines, suggestions, and recommendations on how Business Finland can improve RDI collaboration between companies and research organisations (in its five thematic focus areas)?</p>	

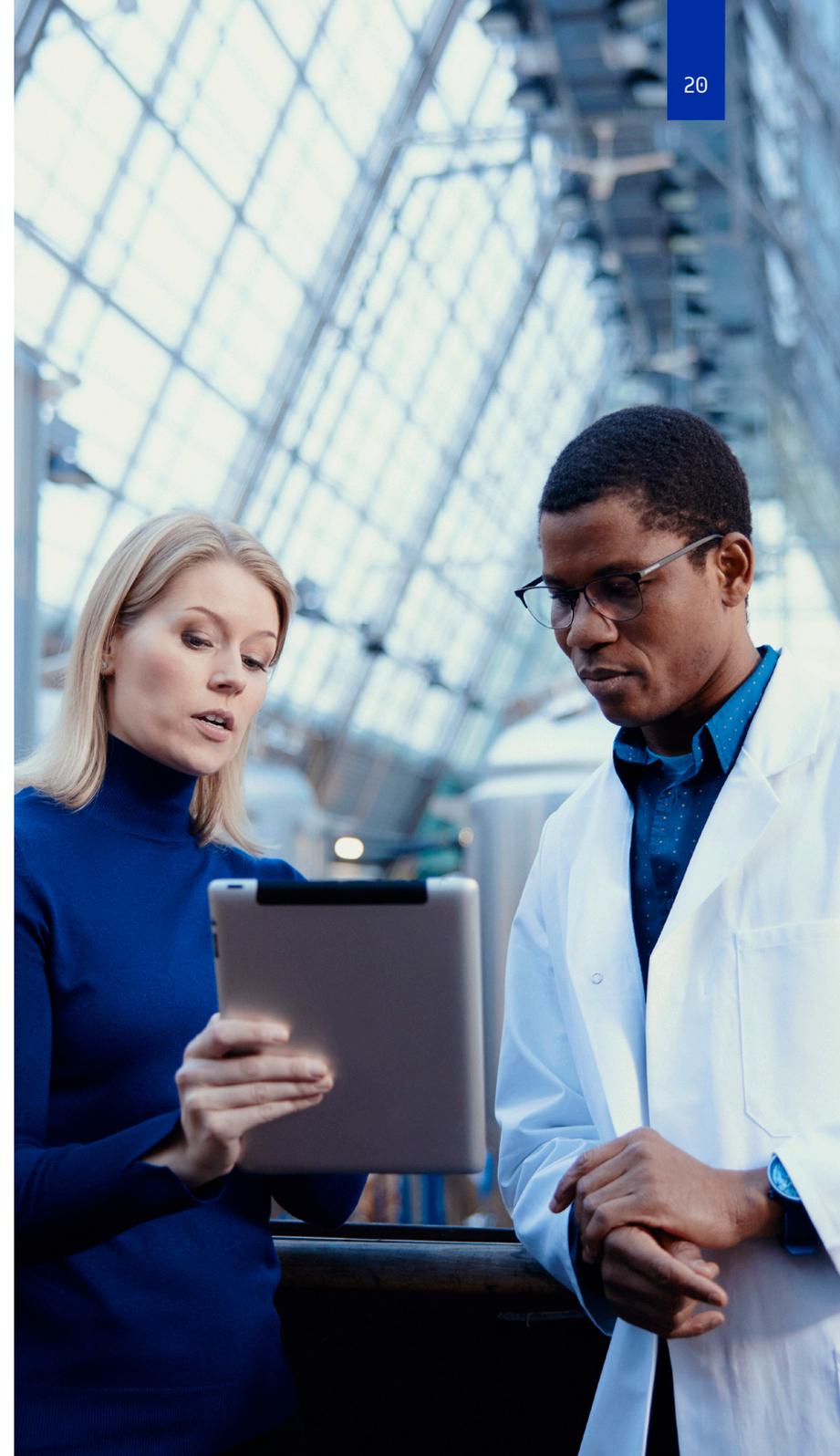
2. APPROACH AND METHODOLOGY

2.1. STUDY APPROACH

The impact study employed a wide range of quantitative and qualitative methods to analyse secondary documents, as well as newly collected data via interviews and online surveys. Figure 3 provides an overview on the study approach with different work packages and sub-tasks.

Although the study covers both Co-Creation and Co-Innovation projects, the primary focus of analysis is on the Co-Innovation projects, for which Co-Creation projects can be considered an optional preparatory phase. The contribution and impact of Co-Creation projects to Co-Innovation is also assessed.

The impact of Co-Innovation projects is assessed against the impact analysis framework described in Figure 4. Co-Innovation projects are intended to be particularly research intensive, collaborative, ambitious and internationally oriented R&D projects. To verify and highlight these characteristics, the setup, success, and impact



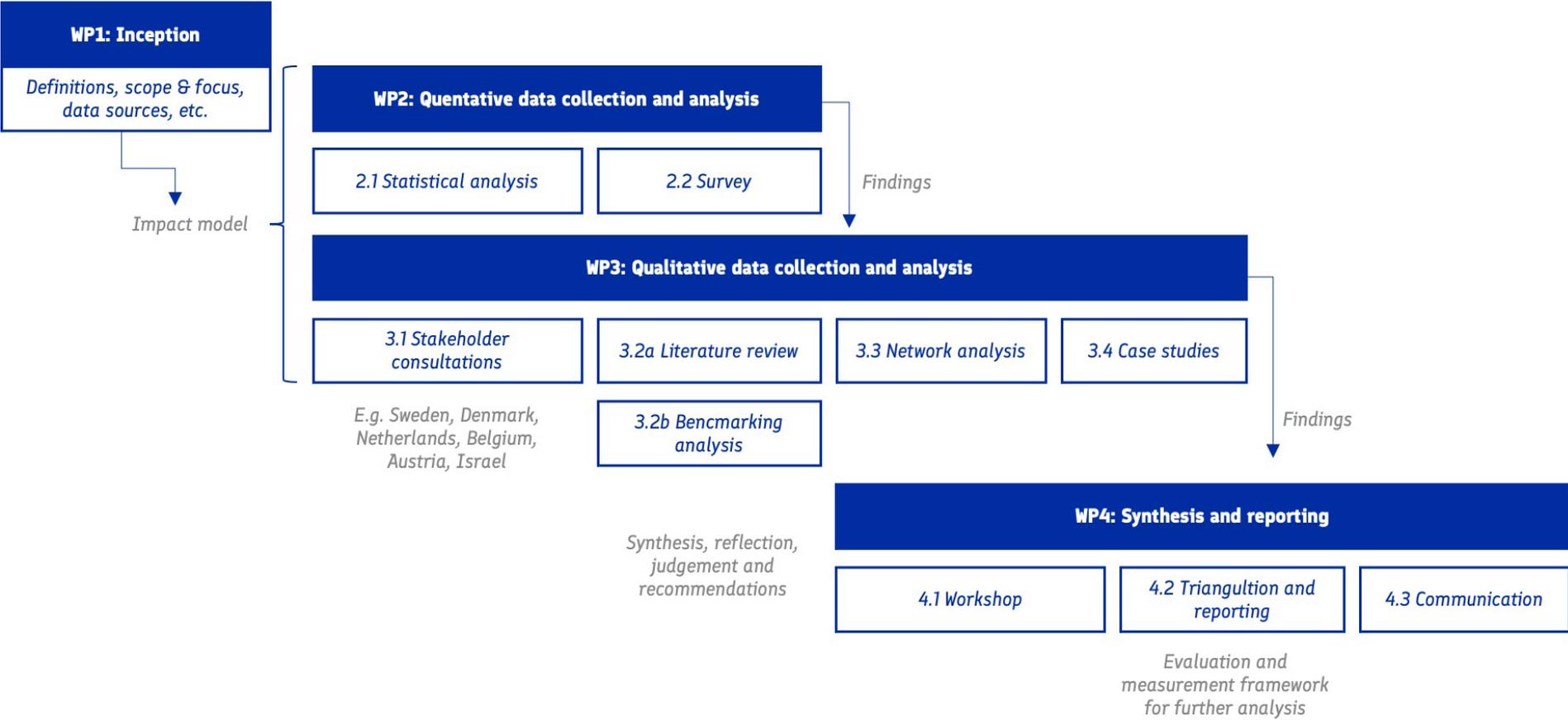


FIGURE 3. OVERVIEW ON THE APPROACH TO THE STUDY DESIGN.

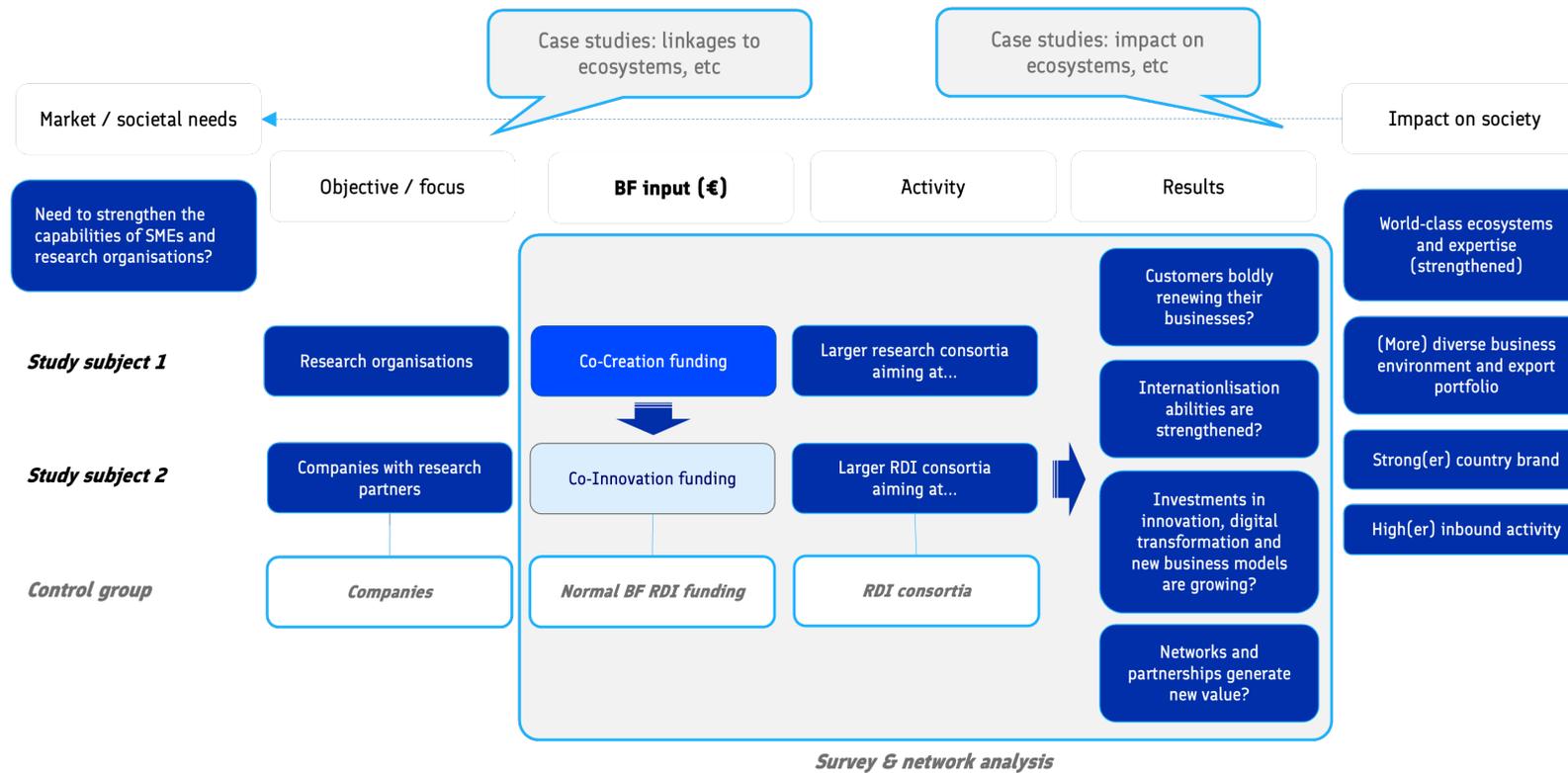


FIGURE 4. STUDY SET-UP FOR THE QUANTITATIVE ANALYSIS WITH THE CONTROL GROUP.

of Co-Innovation projects is compared against a control group consisting of ‘normal’ Business Finland funded R&D projects that were completed within the same time period.

Furthermore, qualitative case studies are used to dig deeper in Co-Innovation projects and to explain how these projects have been initiated and implemented in practice, and particularly how their impact has been generated, as well as the contribution of and benefits to different partners. The different cases and their conclusions are reported in Chapter 4.

2.2. KEY METHODOLOGIES

This section provides an overview on the methodologies that were applied for the collection and analysis of data as part of this study. To prepare the interview and survey design, an in-depth review of relevant Business Finland reports as well as publications from other organisations and academic literature was conducted.

Altogether 28 stakeholder and expert interviews were conducted. During the inception phase of the project, five familiarisation interviews with six key Business Finland personnel were conducted. In the second stage, the study team interviewed additional experts from Business Finland and beneficiary organisations.

TABLE 2. OVERVIEW OF CONDUCTED INTERVIEWS IN THE STUDY.

INTERVIEW TYPE	STAKEHOLDER GROUP	NUMBER OF INTERVIEWS
Familiarisation interviews	Business Finland	5
In-depth interviews	Business Finland/MEE	9
Beneficiary interviews	Companies/Research organisations	8
Case-study interviews	Companies/Research organisations	6
Total number of interviews		28

Some of the interviews with beneficiary organisations were conducted as part of the case studies. Table 2 shows the number of interviews conducted by interview type and stakeholder group.

In order to properly assess the impact of both Co-Creation and Co-Innovation project funding, three separate online surveys were designed. One survey for the participants of Co-Creation projects (i.e., research organisations), another survey for the research organisations in Co-Innovation projects, and a third one for companies in the Co-Innovation projects. Survey respondents were given an option to complete the survey in either Finnish or English, depending on their preferred language.

The surveys were designed based on The Evidence Network Inc. (TEN)'s proven Judgement of Attribution (JoA) methodology and focused on:

- the nature of participant engagement in the funding,
- the direct impact of the funding on participants' skills, knowledge, and networks,
- the indirect impact of the funding on participants' performance (e.g., employment, turnover, exports, etc.),
- participants' adoption of digital tools,
- achievements of initial objectives,
- barriers to success,
- networking enabled by funding instruments, and
- demographics/firmographics.

From May 22nd through June 13th, 2023, altogether 106 out of 276 (38%) lead research organisations that engaged with Co-Creation projects, 96 out of 216 (44%) lead companies, and 136 out of 411 (33%) lead research organisations that engaged with Co-Innovation projects responded to the web-based impact assessment surveys.

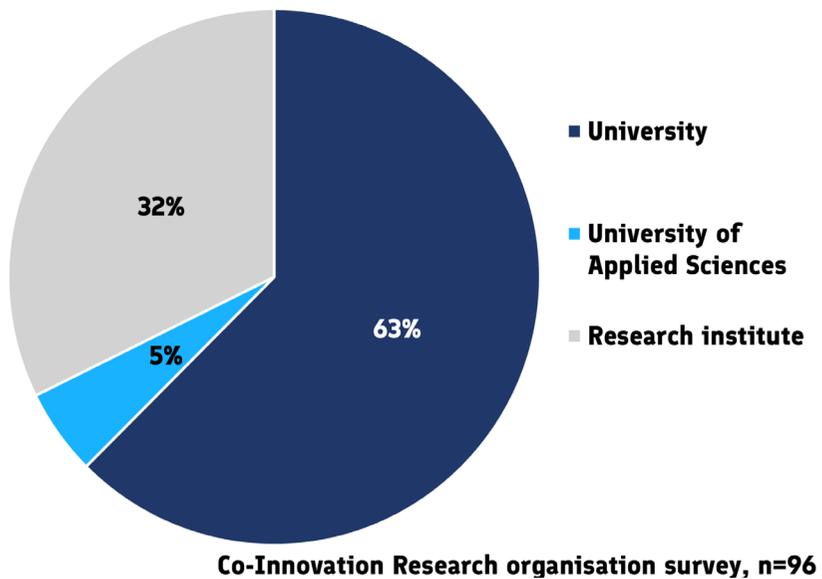
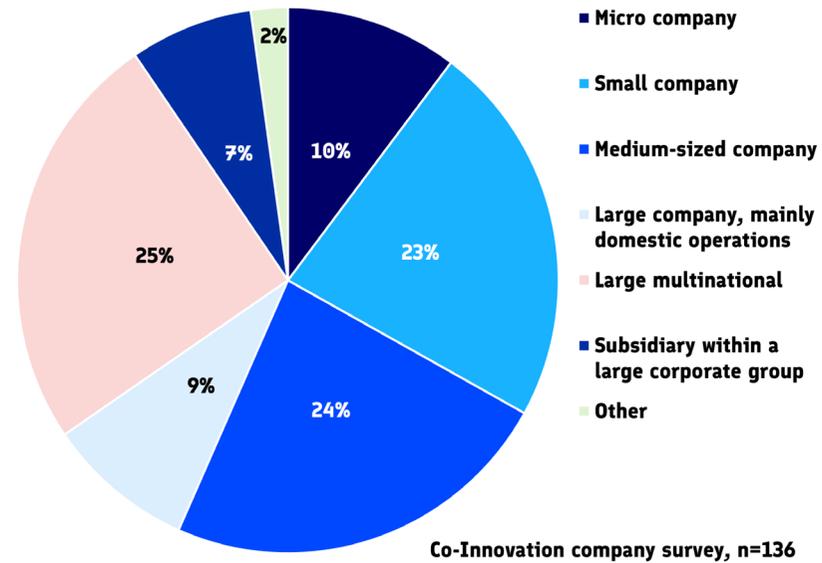
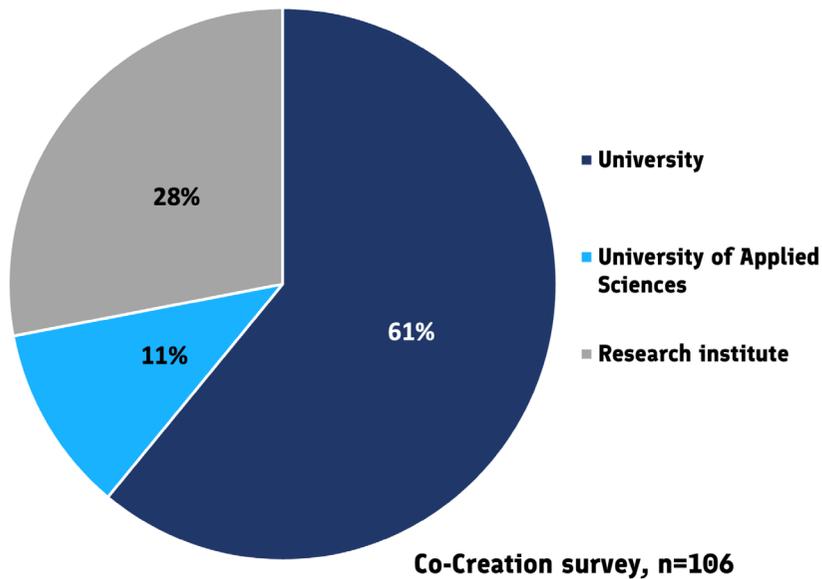


FIGURE 5. RESPONSE-RATES AND RESPONDENTS' PROFILE FROM THE THREE ONLINE SURVEYS.

To optimise response rates, three rounds of follow-up reminders were sent out to survey non-respondents via Snap Surveys software.

The response rates are considered sufficiently high to represent each of the three target groups. Fifty-seven per cent (57%) of respondents to the company survey small and medium-sized enterprises (SMEs). Figure 5 shows the overall profiles of the respondents to all three surveys.

The collected data were analysed with descriptive statistics and a segmentation analysis was conducted to understand results of the surveys for individual stakeholder groups. Further statistical analysis was applied in form of regression analysis to assess the effect of Co-Innovation on the impact on key economic indicators. To assess the role of Co-Innovation and Co-Creation in the creation of networks, a network analysis was conducted.

Furthermore, an **econometric analysis** employing



difference-in-differences (DiD) methodology for panel event studies was employed to examine the impact of Business Finland's Co-Innovation funding on SMEs' turnover, job creation, and export performance. The method estimates causal effect of a treatment (i.e. Business Finland's funding) for number of years (or lags) after the treatment. The study looks at t+4 years after the funding decisions were made. The causal effect has been estimated by comparing the average outcomes between the treatment and control groups. By assuming that the trends in the outcomes of the two groups would be similar without the intervention, the observed outcome of the control group functions as a proxy for the unobserved contrafactual trend for the treatment group.

The econometric analysis utilises Business Finland's normal (i.e., other than Co-Innovation) R&D funding beneficiaries as a control group. Therefore, the interpretation of the results differs slightly from the usual approach with DiD. The estimates imply how much better (or worse) the Co-Innovation funded firms are performing as compared to other companies that have received Business Finland R&D funding.

As some of the firms participating in Co-Innovation projects are very large, the sample has been restricted to those SMEs that have received only one Business Finland's subsidies during the study period. Determining the causal impact of a single project on large firms' economic outcomes may be fuzzy. For that reason, the focus of the study was on SMEs. The sample size was also reduced due to missing values in the data. The sample was limited to firms that had a balanced panel of observations for t-2 to t+4 years before and after the treatment. This naturally limits the newest projects out of the study. Furthermore, the Coarsened exact matching method was employed to get sample weights for the treatment and control groups to obtain a group of firms that are similar in terms of given variables.

Econometric modelling always entails some uncertainties and biases related to selection, sampling, unobserved heterogeneity, and the extent to which the model meets the underlying method assumptions. In this regard, available means have been utilised to minimise possible biases. For example, coarsened exact matching to make the treatment and control groups similar, fixed effects

estimation to control for time, invariant unobserved heterogeneity and control variables to control for economic cycles and other time variant heterogeneity. The results of the econometric analysis are shown in Chapter 6 and the methodology and data are further explained in Appendix 2.

An international **benchmarking analysis** was also conducted to compare the different national approaches to enhancing R&D collaboration between companies and research organisations. The cases were selected based on a preliminary list of countries that was provided in the terms of references.⁴

In each of the six countries, one specific policy instrument was selected to serve as a benchmarking case. The selection of policy instruments was done based on the EC-OECD STIP Compass repository data.⁵ The STIP Compass provides a comprehensive overview of innovation policy instruments with a related thematic area. The selection of benchmarking cases focused on policy

instruments in the selected countries, which have a similar thematic area than the BF funding instruments according to the STIP Compass. An overview of the selected policy instruments with their respective thematic areas are provided in Table 3. The benchmarking analysis was conducted based on a comprehensive analysis of documents available for each of the funding instruments. The main types of documents and sources that were analysed were programme website, guiding documents for funding, evaluations of the funding instruments as well as annual reports of the responsible organisations.

⁴ The only deviation from the initial list was replacing Belgium with the Czech Republic. The reason for that was that Belgium is a highly federalised state and responsibilities for providing R&D support are diffused with multiple regional actors. Therefore, a comparison would not have been advisable with the Finnish context.

⁵ The joint science, technology and innovation policy repository of the European Commission and the Organisation for Economic Co-operation and Development OECD. <https://stip.oecd.org/stip/>

TABLE 3. OVERVIEW OF THE RELATED THEMES OF THE PRE-SELECTED BENCHMARKING CASES.

	PROGRAMME	COLLABORATIVE RESEARCH AND INNOVATION	COMPETITIVE RESEARCH FUNDING	FINANCIAL SUPPORT TO BUSINESS R&D AND INNOVATION	COMMERCIALISATION OF PUBLIC RESEARCH RESULTS
SE	Challenge Driven Innovation		X	X	X
NL	PPP Allowance for Research and Innovation ⁶	X			X
CZ	TRIO programme		X	X	
DK	Grand Solutions	X		X	X
AT	Cooperation and Innovation Programme	X		X	
IL	Generic Technologies R&D Consortia – Magnet	X		X	
FI	Co-Creation	X	X	X	
	Co-Innovation	X	X	X	X

6 Formerly PPS-supplement.



Furthermore, **five case studies were conducted** to identify success factors of Co-Innovation projects, and to provide lessons learned. A further focus of the case studies was to study the connection to other Business Finland funding services and clusters, as well as to identify synergies or potential overlaps. The main selection criteria of case studies are described more in detail in Section 4.1. The analytical work on each of the case studies included: an in-depth analysis of available documentation and one or two interviews with representatives of a research organisation and/or of a company. The short case-report (1-2 pages) highlighting the key achievements and lessons learned can be found in Chapter 4.

A **validation workshop** of the study findings was organised on 30.8.2023 with the objective to present and discuss study findings, validate draft conclusions and to discuss possible recommendations for future development. This workshop included participants from the Ministry of Economic Affairs and Employment as well as from Business Finland. Two speakers from completed Co-Innovation projects (company and research organisations) were also invited to share their experiences. The workshop discussions have been included within the conclusions presented in this report.

3. CO-CREATION AND CO-INNOVATION FUNDING

3.1. RATIONALE FOR FUNDING COLLABORATIVE RESEARCH

Collaborative R&D amongst research organisations and companies – e.g., in forms of open innovation, clustering and a function of dynamic innovation ecosystems – continues to spread and increase. One reason behind the trend is that the **nature of R&D and innovation has become more co-creative and complex**, requiring more partnering, sourcing of specialised competence and ongoing collaboration. Statistics also confirm that collaborative companies tend to be more innovative than non-collaborative ones.⁷

Universities and public research play a crucial role in the process by providing knowledge and technology transfer to enterprises and in particular SMEs, although companies are today increasingly interconnected and linked to global value chains.

Finnish companies have often been criticised for

focusing too much on incremental innovation, hence being risk averse or lacking ambition in R&D.⁸ There is indeed a persistent need to encourage particularly SMEs to conduct more **ambitious and disruptive** R&D in order to innovate, transform and leapfrog in international markets. The transformative power of innovative SMEs is particularly called for in times of economic turbulence and of grand societal challenges.⁹ In this respect, the global R&D system has shown extraordinary resilience during recent economic downturns and shocks. Private and international VC funding for innovative SMEs has remained strong and even increased until the end of 2022 in Finland.¹⁰

The importance of domestic and international linkages for SME performance is widely documented.¹¹ These knowledge networks are also seen as an important asset by themselves.^{12 13} Indeed, there is a trend that leading SMEs are increasingly engaging in digital and platform economy, investing in professional networks, and gaining access to financing sources. The trend is however rather

⁷ e.g., Eurostat (2023) Community Innovation Survey 2022.

⁸ e.g., Ormala, E., Tukiainen, S., Mattila, J. (2014) Industrial Innovation in Transition, Aalto University.

⁹ Halme, K., Niiniranta, M-L. (2019) Taloutta ja yhteiskuntaa uudistava innovaatiopolitiikka. Työ- ja elinkeinoministeriö.

¹⁰ Venture Capital Suomessa 2022. Tietoja varainkeruusta, sijoituksista ja irtautumisista. Pääomasijoittajat 13.4.2023.

¹¹ e.g., OECD. SME and Entrepreneurship Outlook 2023, OECD. pp 65-66.

¹² Chesbrough, H. (2003) Open innovation: The New Imperative for Creating and Profiting from Technology, Harvard Business Press.

¹³ Corrado, R et al. (2013) The social and economic bases of network multiplexity: Exploring the emergence of multiplex ties. Strategic organisation, 2/2013.

uneven among the SMEs, and the challenge is to engage more and more companies into these knowledge networks and collaborative R&D. Smaller companies also tend to have less external R&D partners than larger ones.

For Finland, active R&D collaboration between companies, research organisations and public organisations has been considered one of the strong points of the national innovation system.¹⁴ Indeed, **Finnish companies have traditionally been very active in innovation collaboration.** In European Innovation Scoreboard 2022¹⁵ comparison, linkages across the national innovation system are undoubtedly the strongest performance point for Finland, scoring 224% of the EU average. Public-private co-publications¹⁶ score 382% of EU average and the collaboration of innovative SMEs with others scores 255%. Over the past seven years, these scores have increased significantly.

In a recent (2021) study on R&D collaboration between

companies and research organisations in Finland, 60% of respondents indicated that during the last 3-5 years, R&D collaboration between research organisations and companies has further increased. However, there were large differences between the types of research organisations (i.e., between universities and public research institutes). For public research institutes the anticipated benefit of collaborative R&D with private enterprises was the quality of research, while for universities it was 'other advantages' – perhaps indicating better access to funding. This finding is in line with earlier studies on universities' R&D collaboration with companies.¹⁷ At the same time, the partner companies indicated that their views had not been sufficiently taken into account when preparing and conducting the joint R&D project.¹⁸

Most countries implement some kind of policies to support SME networking, while the strongest focus area

14 e.g., Veugelers, R et al. (2009) The Evaluation of the Finnish National Innovation System, Ministry of Employment and the Economy, Ministry of Education, 2009.

15 European Commission. European Innovation Scoreboard 2022.

16 It is not sure how COVID-19 has impacted the score for co-publications, as for publications EIS 2022 uses less recent CIS 2020 data from 2019.

17 Access to Business Finland (earlier Tekes) funding for research organisations is usually linked to their collaboration with businesses. Earlier study of Tekes impact on capabilities raised the access to further Tekes funding as one of the key motivations for research organisations to engage in collaborative R&D projects with companies. In fact, 80% of research organisations indicated that access to Tekes research funding was of critical importance to them and the highest motivator for collaboration. Fortunately, the availability of public research funding in Finland has improved since the time of the study. For more information, see page 30 in Halme, J. Haila, J., Barge, B., Dalziel, M. Lemola, T., Hautamäki, A: The Impact of Tekes on Capabilities, Tekes Review 318/2015.

18 Ali-Yrkkö, Deschryvere, Halme, et al. (2021) Yritysten t&k-toiminta ja t&k-investointien kasvattamisen edellytykset, valtioneuvoston kanslia, Helsinki.

FIGURE 6. DISTRIBUTION OF NATIONAL POLICIES FOR SME NETWORK EXPANSION. NUMBER OF IDENTIFIED POLICIES IN BRACKETS. SOURCE: OECD SME AND ENTREPRENEURSHIP OUTLOOK 2023.

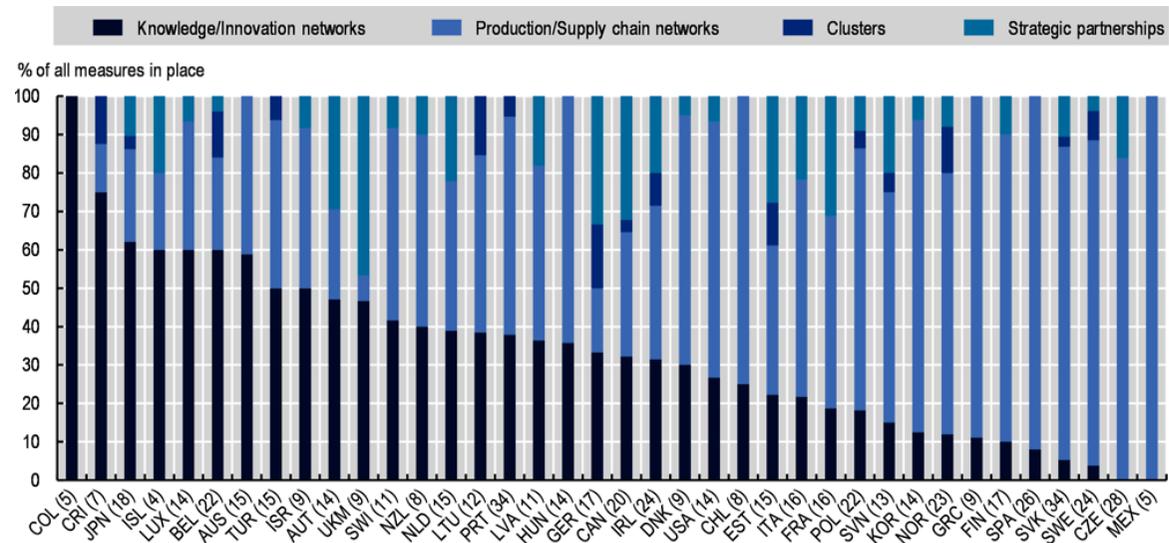
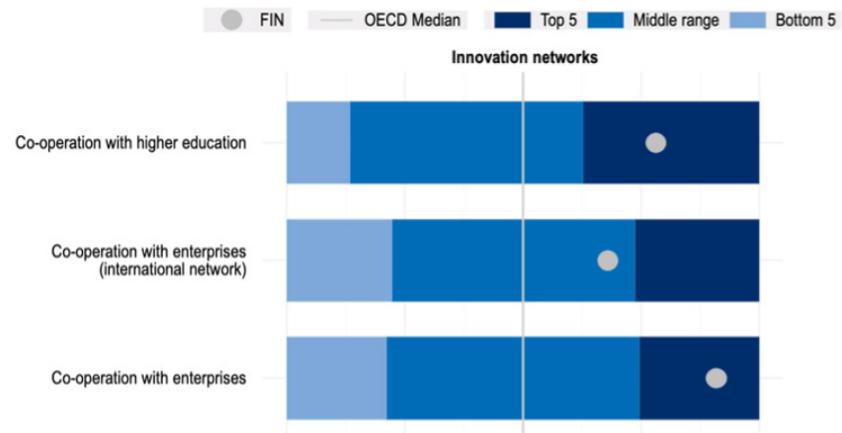


FIGURE 7. FINNISH SME INTEGRATION TO INNOVATION NETWORKS, AS COMPARED TO OECD (=100). SOURCE: OECD SME AND ENTREPRENEURSHIP OUTLOOK 2023.



of these policies is often towards production and supply chain networks (as compared to knowledge/innovation networks, strategic partnerships, or clusters). An EC/OECD (2023) scale-up study¹⁹ identified altogether 17 national SME networking policy measures in Finland, of which the great majority focused on production & supply chain networks.

A closer look shows that in the field of innovation, Finnish SMEs are indeed actively collaborating with higher education and with large enterprises, while the emphasis is on domestic networks.

3.2. EVOLUTION OF BUSINESS FINLAND'S COLLABORATIVE R&D FUNDING

With the introduction of Prime Minister Sipilä's government in 2015, public funding for R&D was radically cut and these reductions were reflected also in Tekes funding

for research organisations. Also the SHOK programme²⁰ was run down and major budget cuts implemented at universities and government research organisations. In particular, the cuts hit collaborative research between companies and research organisations.²¹ At the same time, **the focus of Tekes company R&D funding was geared more towards (shorter-term) impact on growth and internationalisation, and the focus of research organisation research funding more towards collaborative research and co-development with companies** (hence Co-Innovation). However, since the introduction of the national R&D intensity target of 4% and the national RDI roadmap by the Marin government in 2019, more funding has been directed to collaborative R&D again.

A number of quantitative impact assessments of Tekes funding have been conducted over the years, with slightly different models, but with repeatable and robust results: Tekes funding has on average had a neutral-positive effect on the growth, productivity, employment and exports of

19 The 2023 EC-OECD Science, Technology and Innovation Policy (STIP) Survey.

20 The Strategic Centres of Science, Technology and Innovation, SHOK programme.

21 Halme, K. et al. (2021) Business Finlandin arviointi: innovaatioita, kasvua ja kansainvälistymistä. Työ- ja elinkeinoministeriö.

companies in the long term.²² An impact assessment conducted for the European Commission supports these findings, and estimates that receiving a grant from Tekes has had a positive impact on job creation and R&D intensity among beneficiaries.²³ For comparison, the impact of Tekes subsidies is rather similar to that of the Research and Innovation Actions of Horizon 2020.²⁴

In terms of spill-over effects, it has been estimated in the study conducted in 2013 that funding beneficiaries internalise only approximately 60% of the benefits, indicating a significant spill-over to partners and society through knowledge and technology transfer.²⁵ A previous impact study²⁶ focused specifically on funding for large enterprises and research organisations and mapped BF services that target RDI and competitiveness. The studies

also point out that the effects are, however, highly heterogeneous and it is common in other risk-taking endeavours that their returns vary greatly between beneficiaries. Additionally, there are methodological challenges that make isolating the net impact of public funding near impossible. One of the main challenges is the fact that a large portion of comparable enterprises at a given time are either beneficiaries or recently have been, which makes it challenging to isolate the net impact of funding.

Technically, Business Finland has a limited number of notified funding instruments, two of them are RDI grants/subsidies and loans. These instruments are used within funding services or funding schemes such as Co-Creation and Co-Innovation, the foci of the impact study.

22 Ylhäinen, Rouvinen, Kuusi (2016) Katsaus yksityisen t&k-toiminnan ja sen julkisen rahoituksen vaikuttavuuteen, Valtioneuvoston selvitys- ja tutkimustoiminnan julkaisusarja 57/2016; Halme, Kimmo, Annu Kotiranta, Mika Pajarinen, Kalle A. Piirainen Petri Rouvinen, Vesa Salminen, and Ilkka Ylhäinen (2018) Efforts of Finnvera, Finpro, and Tekes in Promoting Internationally Oriented SMEs – Impact Study, Business Finland, Helsinki, FI; Viljamaa, K., Piirainen, K., Kotiranta, A., Karhunen, H., Huovari J. (2014) Impact of Tekes Activities on Productivity and Renewal, Tekes Reviews 315/2014, Finnish Funding Agency for Technology and Innovation – Tekes, Helsinki, FI.

23 Fornaro et al. (2018) Evaluation of Tekes R&D Funding for the European Commission – The Interim Report, Report 8/2018, Business Finland, Helsinki, FI.

24 Piirainen, Kalle A. (editor), Kimmo Halme, Tomas Åström, Neil Brown, Martin Wain, Kalle Nielsen, Xavier Potau, Helka Lamminkoski, Vesa Salminen, Janne Huovari, Anti Kekäläinen, Henri Lahtinen, Hanna Koskela, Erik Arnold, Patries Boekholt, Helene Urth (2018) How can the EU Framework Programme for Research and Innovation increase the economic and societal impact of RDI funding in Finland? Publications of the Government's analysis, assessment and research activities 8/2018, Prime Minister's Office, Helsinki FI.

25 Viljamaa, K., Piirainen, K., Kotiranta, A., Karhunen, H., Huovari J. (2014) Impact of Tekes Activities on Productivity and Renewal, Tekes Reviews 315/2014, Finnish Funding Agency for Technology and Innovation – Tekes, Helsinki, FI.

26 Piirainen, K., Halme, K., Järvelin, A.-M., Fångström, T., Engblom, H., Mensink, A., Åström, T. (2019): The Big 3, Report 4/2019, Business Finland.

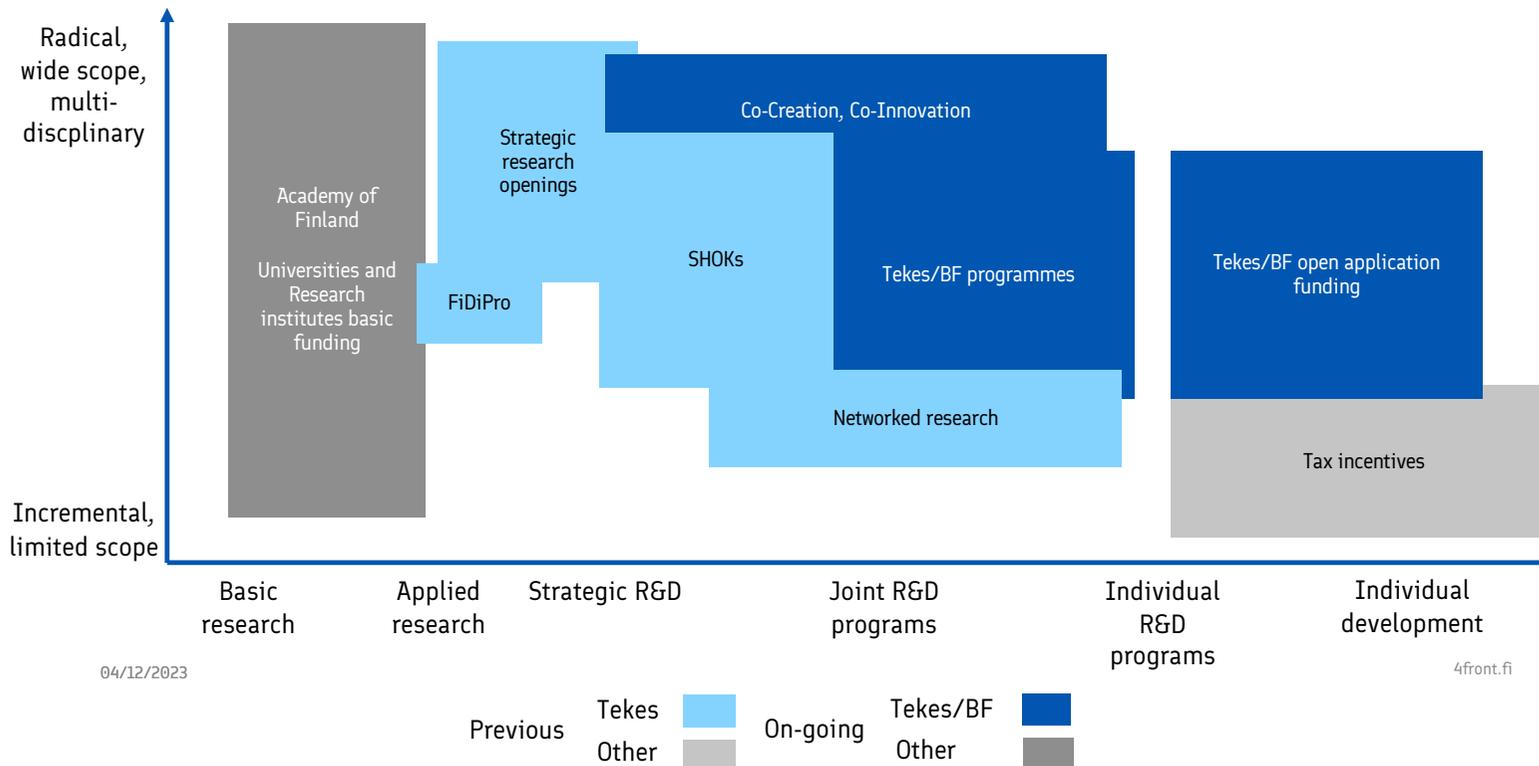


FIGURE 8. POSITION OF BUSINESS FINLAND’S FUNDING INSTRUMENTS ON THE CONTINUUM FROM BASIC RESEARCH TO INDUSTRIAL PRODUCT DEVELOPMENT (X-AXIS) AND SCOPE OF RDI CONDUCTED UNDER THESE PROGRAMMES/INSTRUMENTS (Y-AXIS).²⁶

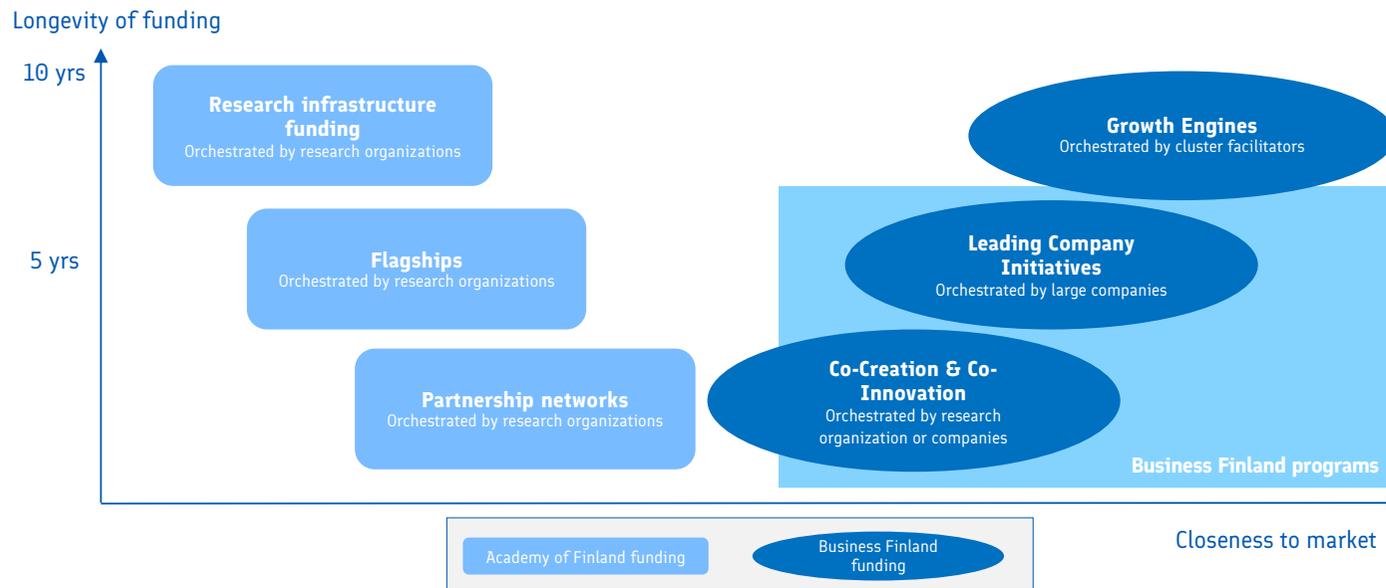
The Co-Creation and Co-Innovation funding instruments were originally formed in 2017 during the development of Business Finland. The public research funding mandate was carried over to the Co-Creation and Co-Innovation pair of instruments, which superseded to some extent the previous SHOK programme, Strategic Research Openings (SROs, Strategiset tutkimusavaukset), and Networked research (Elinkeinoelämän kanssa verkottunut

tutkimus, EVET). The new services stressed equal footing between researchers, industry, and common interest, which made a difference compared to the earlier approaches, which were focused either on research or innovation. Figure 8 illustrates the position of

Co-Creation and Co-Innovation in relation to the previous funding instruments they replaced.

Co-Creation was designed as a demonstration and pre-study for research organisations aiming to prepare for a Co-Innovation project. Co-Creation was similar to previous Strategic Research Openings in its goals, with a stated goal to engage in scientifically ambitious research with enterprise partners based on a jointly developed idea. However, instead of multiple years and up to EUR 10 million in volume, Co-Creation funding had a maximum duration of 4-6 months instead of years and a budget of maximum EUR 100,000.

²⁶ Piirainen, K., Halme, K., Järvelin, A-M., Fängström, T., Engblom, H., Mensink, A., Åström, T. (2019): The Big 3, Report 4/2019, Business Finland.



NATIONAL PARTNERSHIP MODEL FOR ECOSYSTEM BUILDING

Further to the Prime Minister Sanna Marin's Government Programme (2019), a national Partnership Model (kansallinen kumppanuusmalli) was developed for the implementation of

FIGURE 9. THE PARTNERSHIP MODEL - ALIGNMENT OF DIFFERENT FUNDING INSTRUMENTS FOR COLLABORATIVE R&D. SOURCE: BUSINESS FINLAND & ACADEMY OF FINLAND, 2020.

The aims of Co-Innovation funding were to develop new solutions, products and services, and to develop them towards the markets, with a consortium of at least three enterprises and a number of research organisations and teams. The maximum duration was two years.²⁷ Co-Innovation projects were administratively Joint Actions where at least one research organisation and three enterprises participate, and at least two of whom have applied for Business Finland Funding. The administrative arrangement was similar to the previous funding for Group Projects provided by Tekes.

National RDI Roadmap focused on the areas with the highest growth. Such a partnership model was jointly elaborated by the Academy of Finland and Business Finland, with the aim to ensure an overall view and long-term engagement of relevant partners to the development of world class ecosystems in Finland. Significant additional funding was also allocated to the implementation of this partnership model. The following figure presents the respective funding concepts and their roles in the partnership model.

In this model, Co-Creation and Co-Innovation funding represents the basis of collaborative research, feeding

into larger and longer-term collaborative structures, as well as into internationalisation via Business Finland programmes. During the piloting of the Partnership Model, Co-Innovation projects were activated in those themes that were considered relevant for the Leading Company Initiatives (Veturiyrittäjärahoitus) and ecosystems funding. The evaluation of Business Finland Ecosystem funding²⁸ emphasises that the above is a long-term funding approach. The aim was to create an open ecosystem with a critical mass of research and business opportunities, and with an established roadmap for direction. Co-Creation and Co-Innovation were among the central funding instruments for the implementation of collaborative research projects under the umbrella of these ecosystem roadmaps.

3.3. CO-CREATION AND CO-INNOVATION FUNDING

Presently Co-Creation grants are available for research organisations, and the maximum available subsidy is EUR

100,000, at a rate of 60% of total project cost. The goal of the funded project should be to “independently conduct basic or industrial research or experimental development, or distribute the results of these activities through education, publications or data transfers”. The funding is mainly targeted to implement feasibility studies, proof of concepts, and preparations for a larger grant application.²⁹

In a Co-Creation project, a research organisation identifies and defines a research problem and elaborates a research plan for it, to attract business partners for the co-funding and joint implementation of the plan through a Co-Innovation project. Technically Co-Creation projects are four-to-six-month **preparatory projects**, which are conducted solely by the research organisations. During this time all partner organisations and companies prepare their own Business Finland applications for the collective Co-Innovation project.

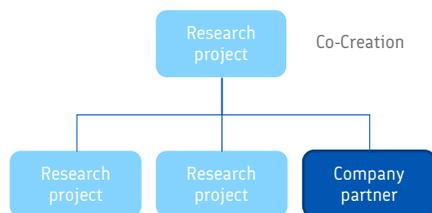
The project applications need to demonstrate international novelty of ideas, potential applicability, true relevance and need, as well as sufficient capabilities of network partners to both conduct the research, as well

28
29

Zegel, S. et al. (2022) Evaluation of Ecosystem Funding Instruments and Partnership Model. Technopolis B.V. and 4FRONT.
Business Finland. Co-Creation Funding service description.

Co-Creation projects (276 partners, typically 1-2 partners)

4-6 month's preparation project, with a total cost EUR 100,000 with 60% BF funding

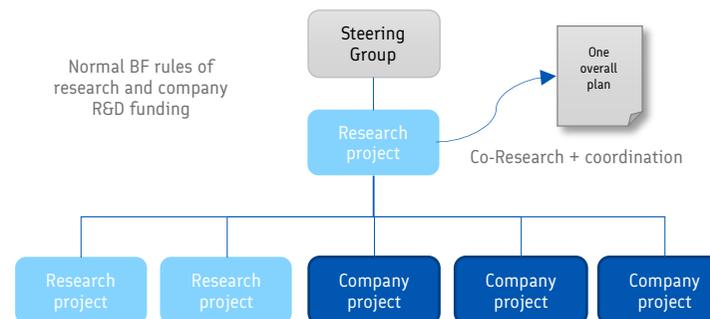


Funding services:
2018-2022

Co-Creation Co-Creation X

Co-Innovation projects (627 partners, ideally 5-8 partners)

Normal BF rules of research and company RGD funding



Funding services:

2018-2019

Co-Research Co-Research RGD, Tempo, Kiito, etc. RGD, Tempo, Kiito, etc. RGD, Tempo, Kiito, etc.

2020-2022

Co-Innovation, Research Co-Innovation, Research Co-Innovation, Company Co-Innovation, Company Co-Innovation, Company

FIGURE 10. ILLUSTRATION OF TYPICAL PROJECT SET-UPS UNDER CO-CREATION AND CO-INNOVATION FUNDING SCHEMES. SOURCE: STUDY TEAM.

as to disseminate and deliver the results into practice. Preference is given to projects that boost SMEs' growth, internationalisation and ecosystems. At least one of the following requirements must be met: collaboration with foreign research organisation, a minimum three-month international researcher mobility, international technology transfer or licensing, or organised international exchange of information.

Co-Innovation grants and loans are applicable for projects related to a preceding Co-Creation project, or

other projects that already have been initiated. At minimum, Co-Innovation projects need a consortium of two enterprises. If the consortium includes a research organisation, the minimum number of enterprises rises to three. At least two partners need to be eligible for Business Finland funding and apply for grants. Partners are also eligible to join the consortium without Business Finland funding. The set-up of projects under Co-Creation and Co-Innovation is provided in Figure 10.

Unlike in other company R&D projects, Business Finland requests Co-Innovation consortia to set up joint Steering Groups.

Company R&D projects or consortia projects funded by Business Finland, do not normally need to have joint steering groups. Only research projects run by research organisations have steering groups. However, for joint Co-Innovation projects, Business Finland requests consortia to set up a joint Steering Group to monitor project progress, and to steer the overall direction and to share the results.

A Co-Innovation project comprises parallel sub-projects conducted by research organisations and enterprises. Each of the partners will receive their own funding decision. The subsidy rate for research organisations' research projects is 60-80% depending on the level of international collaboration and the terms which are the same for Business Finland research funding.³⁰ The terms for company RDI projects are in principle the same as for all Business Finland company RDI projects. **However, in**

practice Business Finland funding terms vary according to the nature (e.g., research intensity, level of risk, international ambition, etc.) of the project within certain ranges, and Co-Innovation projects tend to be on the high-risk end of the scale, and therefore receive higher subsidy rates than average company RDI projects.

In 2023 some changes were introduced to the Business Finland funding. For instance, in joint projects, any single sub-project may not be more than 70% of the total volume of the joint project, and research organisations' share must not exceed 70% of the total project volume.³¹

³⁰ In short, Business Finland funds company research work primarily through grants, and the development and piloting work primarily through (soft) R&D loans. In practice, funding is decided case by case and is often a combination of these. Normally SMEs can receive grants up to 50% of project costs, while for Midcap and Large companies the share is 40%. Respectively, SMEs and Midcaps can receive R&D loans up to 70% of project costs, while large companies can receive only 50% of costs and are required to outsource at least 15% of services from SMEs. In Co-Innovation, no single project, nor the share of research projects in a consortium can exceed 70% of total project costs.

³¹ Business Finland. Co-Innovation Funding service description. <https://www.businessfinland.fi/en/for-finnish-customers/services/funding/cooperation-between-companies-and-research-organisations/co-innovation>

TABLE 4. OVERVIEW OF THE TWO FUNDING SCHEMES.

	CO-CREATION	CO-INNOVATION
MAIN OBJECTIVES	<p>For preparing joint actions between companies and research organisations to specify research questions together with private sector companies to demonstrate relevance of research and develop consortia.</p> <p>Collaboration parties work on a new research idea together, which may proceed to a joint Co-Innovation project, providing companies with significant international business opportunities and research organisations with the opportunity to conduct high-quality scientific research.</p>	<p>For joint actions between companies and research organisations that enable increased business competitiveness and significant new international business. The funding strengthens the expertise of the research organisation and accelerates the utilisation of research data in the companies' R&D activities and the development of new export products. Both domestic and international networks.</p>
ELIGIBLE BENEFICIARIES	Public Research Organisations (Universities, public (sector) research institutes, colleges), also in consortia with private companies.	Consortia that include both research organisations and private companies. Minimum 2 enterprises, or 3 enterprises and one research organisation.
ELIGIBLE PROJECTS	Feasibility studies and PoCs conducted by PROs	Parallel applied research and industrial RDI projects
NO. OF FUNDED PARTNERS	276	627
DURATION OF FUNDING SERVICE	2018 – 2022	2018 - 2022

3.4. FUNDING VOLUMES

Table 5 summarises the funding decisions for those Co-Creation and Co-Innovation projects that have been initiated since 2018 and concluded by the end of 2022.

TABLE 5. FUNDING DECISIONS OF COMPLETED CO-CREATION AND CO-INNOVATION PROJECTS BETWEEN 2018-2022. EACH PROJECT PARTNERS REPRESENTS A SEPARATE FUNDING DECISION. SOURCE: BUSINESS FINLAND.

Year	CO-CREATION FUNDING			CO-INNOVATION FUNDING		
	Total funding, €	Decisions	Av. Funding, €	Total funding, €	Decisions**	Av. Funding, €
2017				16 515 602	59	279 925
2018	3 474 750	85	40 879	109 618 587	322	340 430
2019	2 958 798	69	42 881	73 207 043	205	357 107
2020	6 047 730	88	68 724	12 063 176	35	344 662
2021	1 137 380	34	33 452	670 000	4	167 500
2022				295 400	2	147 700
GRAND TOTAL	13 618 658	276	49 343	212 369 808	627	338 707

Table 5 shows the funding volumes for both funding services per year and by financial instrument (i.e., grants and loans). It should be noted that the numbers in the table only represent closed projects, hence funding volume for

previous years are lower, as most projects from the last few years have not been closed yet. Average funding for Co-Creation and Co-Innovation projects is presented in Table 6.

TABLE 6. PROJECT DATA SYNTHESIS FOR 2018-2022 COMPLETED PROJECTS. SOURCE: BUSINESS FINLAND.

	CO-CREATION	CO-INNOVATION
Number of joint projects (funding decisions = funded partners)	151 (276)	136 (627)
Number of Research Organisations / Companies (funded)*	276 / 0	216 / 411
Average size of project consortia (i.e., funded organisations)	1,8	4,6**
Average Business Finland funding per project (min-max)	90,190 €*** (18 k€ - 240 k€)	1.6 M€ (50 k€ - 9.8 M€)
Total volume of Business Finland's funding decisions (share)	13.6 M€ (62%)	212.4 M€ (39%)
Total matching funding (share)	8.5 M€ (38%)	334,2 M€ (61%)
Total cumulative project volumes	22.1 M€	546.6 M€
Average size of joint project	146 k€	4.0 M€

*411 CO-INNOVATION FUNDING DECISIONS FOR COMPANIES. INCLUDES AT LEAST 354 DIFFERENT COMPANIES. DOES NOT INCLUDE POSSIBLE NON-FUNDED PROJECT PARTNERS.

**AVERAGE SIZE OF CO-INNOVATION FUNDING VARIES GREATLY: 2020=EUR 3,2 MILLION, 2021= EUR 2,25 MILLION, 2022= EUR 0,9 MILLION.

***FOR CURRENT CO-CREATION, THE MAXIMUM AMOUNT OF BUSINESS FINLAND FUNDING IS EUR 60,000/PROJECT. PREVIOUSLY, THE SINGLE AMOUNT OF FUNDING HAS BEEN BIGGER.

TABLE 6 ALSO DEPICTS THE DIFFERENCE IN SIZE OF BOTH FUNDING SCHEMES, HIGHLIGHTING THAT CO-INNOVATION PROJECTS ARE SIGNIFICANTLY LARGER BOTH ON AVERAGE (EUR 4.0 MILLION VS. EUR 146,000) AND OVERALL (EUR 546.6 MILLION VS. EUR 221 MILLION), AS COMPARED TO CO-CREATION.

Figure 11, in turn, shows the linkage of Co-Innovation and Co-Creation to other Business Finland programmes.

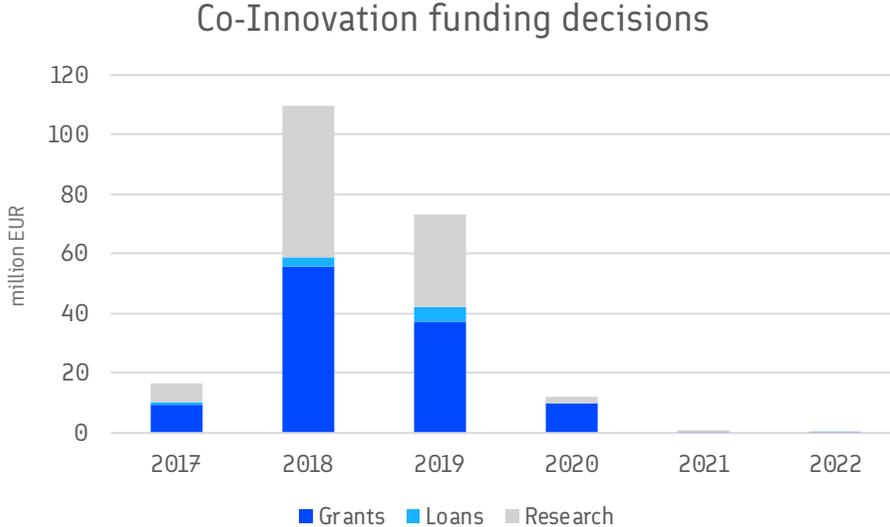
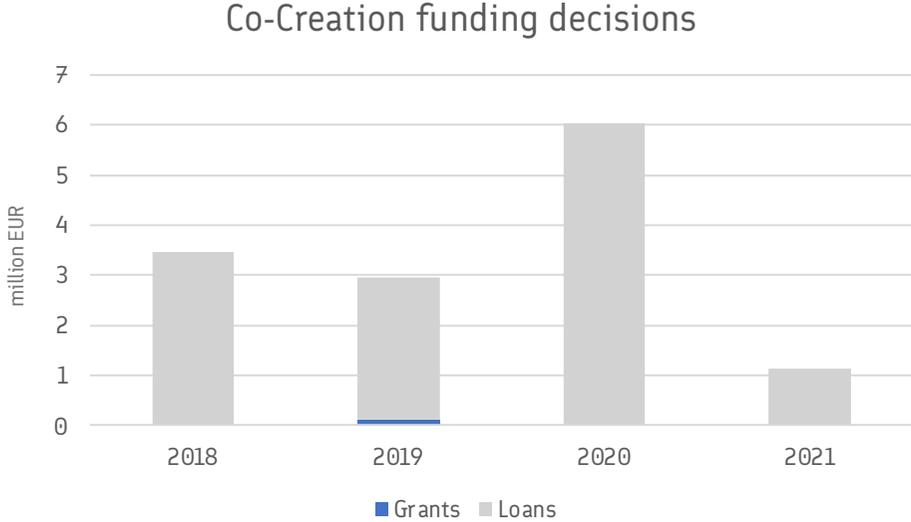


FIGURE 11. OVERVIEW ON THE FUNDING VOLUME OF FINALISED PROJECTS PER YEAR. SOURCE: BUSINESS FINLAND.

Co-Creation projects are small preparatory projects funded with grants to research organisations. Co-Innovation projects are larger both in volume and in size of consortia, with on average 4,6 partners and a project budget of EUR 4,0 million.



The success rate of Co-Innovation funding applications has been reasonably high (63%), while the success rate of Co-Creation applications has been at the 'normal' Business Finland approval level (30%).³² As applications for Co-Innovation projects often already had a Co-Creation phase, this is an indicator that the Co-Creation phase improves the quality of applications for Co-Innovation projects, yielding a higher success rate.

Roughly one third (31%) of companies in Co-Innovation projects reported having linkages to Business Finland programmes, 4% in Business Finland's Leading Companies Initiative (Veturi) and 5% in EU funding. The following Figure 12 indicates the thematic linkages Co-Creation and Co-Innovation projects have had with Business Finland programmes. The figure shows that clear majority of Co-Creation and Co-Innovation project topics are aligned with Business Finland programme themes.

³² Situation 11/2020: 127 out of 202 Co-Innovation applications approved, while only 81 out of 266 Co-Creation applications approved. Source: Business Finland presentation, 10.11.2020.

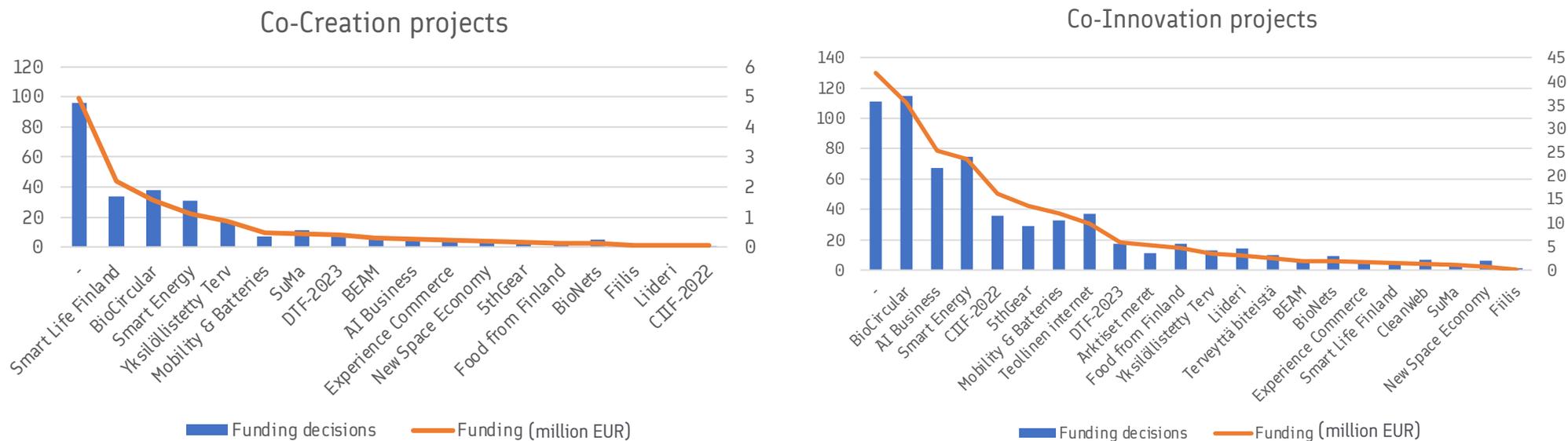


FIGURE 12. LINKAGES OF CO-CREATION (LEFT) AND CO-INNOVATION (RIGHT) PROJECTS WITH BUSINESS FINLAND PROGRAMMES. SOURCE: BUSINESS FINLAND.

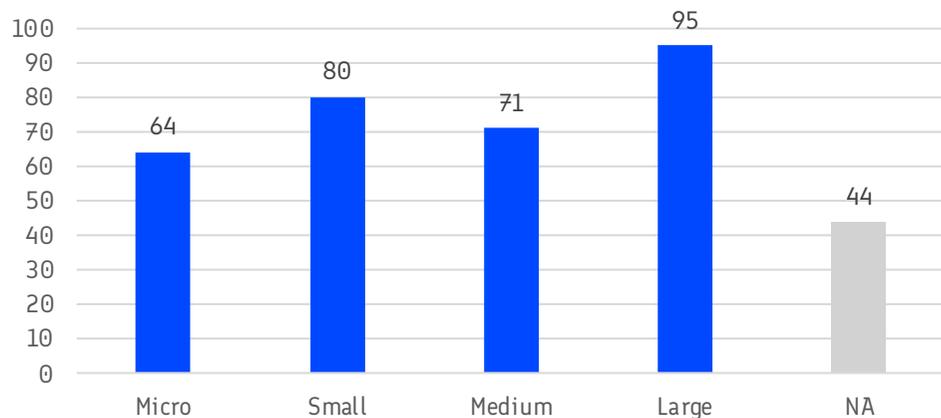


FIGURE 13. DISTRIBUTION OF CO-INNOVATION FUNDING BENEFICIARY COMPANIES ACCORDING TO SIZE CATEGORIES AT THE YEAR OF THE FUNDING DECISION. SOURCE: BUSINESS FINLAND AND TAX INFORMATION (VEROTIETO), 2023. SIZE INFORMATION NOT AVAILABLE FOR 44 PROJECT COMPANIES.



Co-Innovation projects engage surprisingly many SMEs. They represent a clear majority (roughly 70%) of Co-Innovation company project partners.

It has been an assumption that Co-Innovation projects mainly engage larger companies with professional research capabilities. However, when analysing the size distribution of Co-Innovation participant companies from the tax data, it reveals that in fact **small and medium-sized companies represent a clear majority (roughly 70%) of company partners**, and large companies roughly 30%.³³

4. PROJECT CASE STUDIES

Co-Innovation projects are often complex and ambitious joint research efforts. This Chapter of the report describes six practical cases of Co-Innovation projects to highlight the nature and magnitude of these projects. The selection of the cases is explained in the beginning of Chapter, while a short synthesis and comparison of all analysed cases can be found at the end of the Chapter.

4.1. SELECTION OF CASES

The five case studies were carried out to identify success factors and provide lessons learned from the Co-Creation and the Co-Innovation funding. The main selection criteria of the case studies were the following: a) the cases represent Co-Creation and/or Co-Innovation joint projects, b) the cases also include projects that have been developed from Co-Creation to Co-Innovation, and c) the cases show linkages to Business Finland's programmes, Business Finland's Leading Company Initiative and Business Finland's Orchestration of Growth Engines. Furthermore, at least one case should not be connected to any BF programmes.

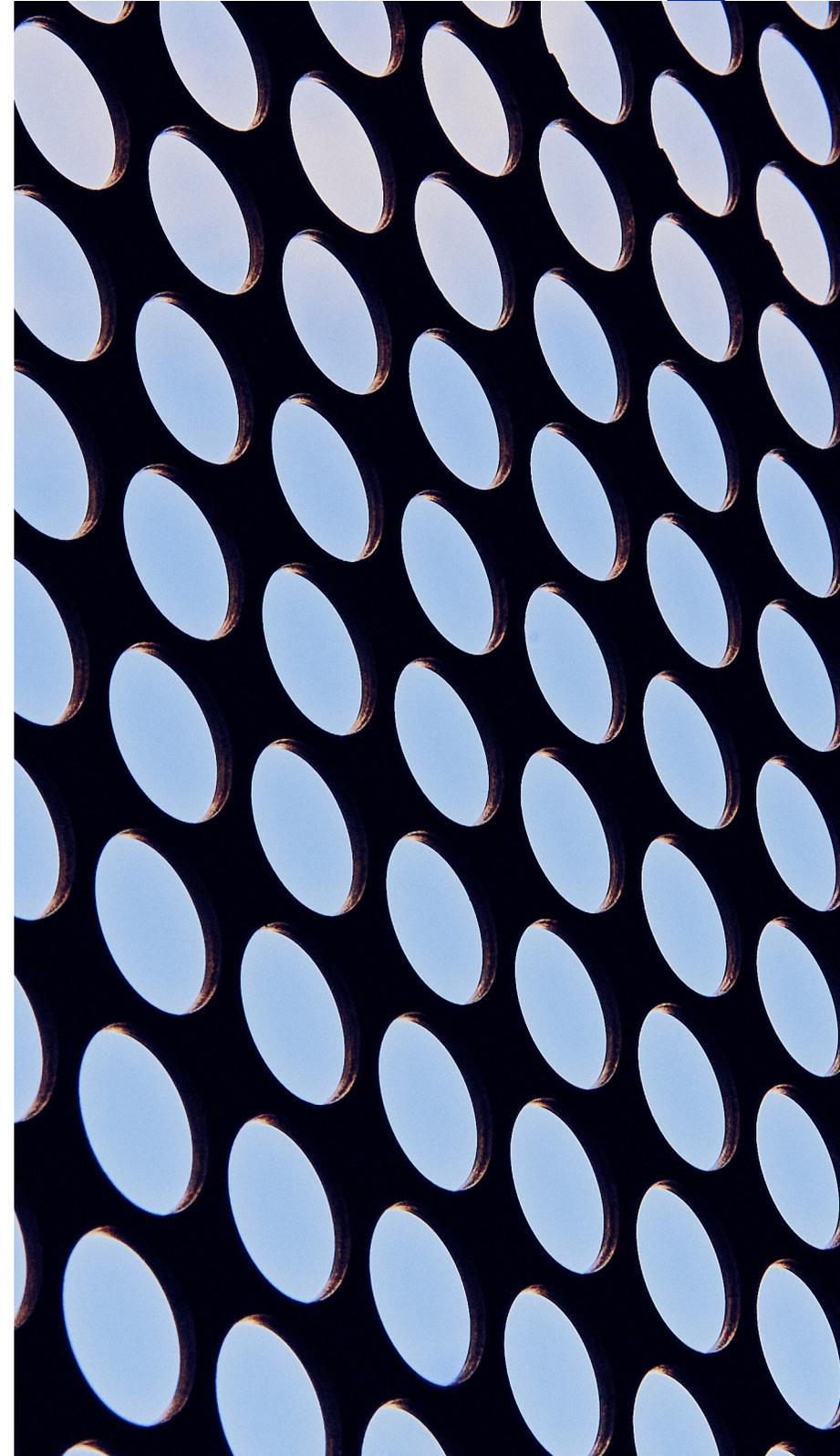


TABLE 7. SELECTION CRITERIA FOR THE CASE STUDIES AS WELL AS THEIR COVERAGE.

		SUSBINCO	BATCIRCLE	5G VIIMA	ICORY	HUMOR
Preceded by Co-Creation project?			X			X
Link to BF programme?		Bio-Circular 2019-2022	Bio-Circular 2019-2022	5th Gear 2014-2019	Bits of Health 2014-2018	No
Link to Leading Company Initiative?		Expand Fibre		Nokia		
Link to Growth Engine orchestration?		CLIC Innovation: 4Recycling ecosystem				
SECTOR	ICT, Electronics			X	X	X
	Energy, climate and environment	X	X			
	Industry	X	X			
	Health, wellbeing				X	
	Services					
Research partners		7	6	7	3	5
Company partners		11	12	10	4	3
BF funding (million EUR)		5-10	5-10	5-10	<5	<5

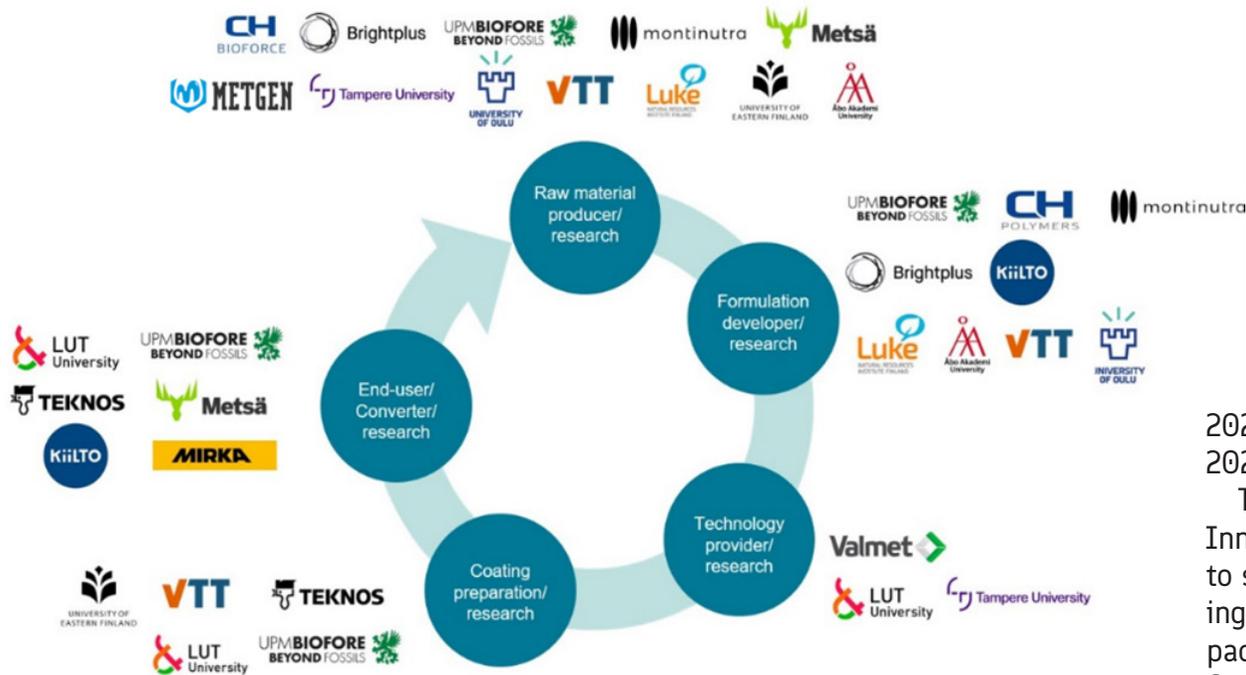


FIGURE 14. ILLUSTRATION OF SUSBINCO VALUE CHAIN AND PARTNER NETWORK. SOURCE: SUSBINCO.

4.2. CASE DESCRIPTIONS

4.2.1. SUSBINCO

The ‘sustainable bio-based binders and coatings’ (SUSBINCO) Co-Innovation project develops sustainable solutions for various fiber-based materials, such as packaging, gaskets, coatings, adhesives, and others. SUSBINCO has been granted altogether EUR 10.1 million Co-Innovation funding from the Bio and Circular Economy Programme in partnership with the ExpandFibre veturi, and the project runtime was originally between September

2021 and November 2023, but has been extended to July 2024.

The SUSBINCO partnership is adjacent to CLIC Innovation’s 4Recycling ecosystem, the aim of which is to solve the “plastics challenge”, which entails developing bio-based alternative and substitute materials for e.g., packaging, and developing technologies and processes for plastics recycling and/or circular business models. 4Recycling has four foci, including Functional bio-based and circular solutions, that each have their own R&D roadmap (for more detail, see the recent evaluation Zegels 2022, Evaluation of Ecosystem Funding Instruments and Partnership Model, Business Finland).

Many of the partners have a long-standing collaboration around the various aspects of fiber technology. The industrial partners of SUSBINCO, with their own parallel research projects, are CH-Polymers, Metsä Board, Mirka, Montinutra, Teknos, and UPM. In addition, Brightplus, CH-Bioforce, KiiLto, MetGen, and Valmet Technologies will participate in the project through in-kind work and steering. The consortium is a mix of established forest industry enterprises and newer partners with a focus on sustainable

solutions and more refined wood-based products. The RDI has progressed into a piloting phase, and in the last months of the project, the planned activities include piloting coatings, testing of biodegradability in soil and aquatic environments, repulpability testing, and eco-toxicity evaluation, that together precede commercial product development.

According to the interviews, one of the main challenges faced by Co-Innovation participants is finding enterprise partners and demarcating the common public RDI and private IP generation. In the case of SUSBINCO the project has been defined by the core enterprise partners in a collaborative process, after which the challenges were opened to additional enterprise interested and RPO partners for consideration.

The demarcation problem comes down to the question (from the enterprise standpoint) of delineating which questions and problems can be solved in a public research project without losing control of potentially valuable IP and having to divulge too much information and data to be published. From the enterprise standpoint, the expectation is that those who provide financial and/or in-kind should have control over the publication of results. This

creates a disincentive for being involved in the public side of Co-Innovation.

Another challenge raised is the administrative burden with regard to project selection in relation to project volume and runtime. In the case of SUSBINCO, cycle from laboratory (TRL 1-3) to piloting and demonstration (TRL 5-7) is typically much longer than the statutory two years, with the added challenge of developing circular and sustainable products. In addition, innovative SMEs have challenges in terms of eligibility for funding, which creates additional challenges for consortium building. The stakeholders compared the application process to EU Framework programme and indicated that in some ways it is even more difficult due to the IP considerations, but project volume and runtimes are considerably smaller.

4.2.2. BATCIRCLE FINLAND BASED CIRCULAR ECOSYSTEM OF BATTERY METALS

The Finland-based circular ecosystem of battery metals – named as the BATCircle³⁴ started in 2019. The BATtobe, which preceded the BATCircle, was initiated for the planning of a Finland-based circular ecosystem of battery metals in 2018. The common goals of the BATCircle1.0 and 2.0 have been to conduct high-quality research at the academy-industry interface to increase the competitiveness and business potential of Finnish partners in the battery metals sector, to enhance co-operation between research organisations and industry, and to bring new feasible and sustainable innovations and products to the market. The BATCircle is like a brand.

The BATCircle consortium has received Business Finland's Co-Creation funding and thereafter Co-Innovation funding. The BATCircle1.0, which consisted of 23 companies, six research organisations and two municipalities, was carried out in 2019-2021. The follow-up project BATCircle2.0 (2021-2024) was established under Business Finland's "Batteries from Finland"

programme. The BATCircle2.0 consortium consists of four universities (Aalto University, University of Eastern Finland, Lappeenranta-Lahti University of Technology LUT, University of Oulu), two research institutes (Geological Survey of Finland GTK & VTT Technical Research Centre of Finland), seven large companies and eight SMEs. In the BATCircle2.0, circularity of battery metals has been emphasised and the trend chart has been extended to cover Ni-rich batteries such as NMC (Nickel Manganese Cobalt) batteries. It should be noted that some consortium partners are different from the first phase. The total budget of the BATCircle2.0 is EUR 19 million, of which Business Finland's Co-Innovation funding consisted of EUR 9.8 million. Part of Business Finland's funding was allocated from the Bio-Circular Programme (2019-2022).



FIGURE 15. BATCIRCLE PROJECT MEMBERS. SOURCE: BATCIRCLE WEBSITE³⁵.

The BATCircle is a unique ecosystem in Finland as the BATCircle focuses only on battery materials and their

circulation. The BATCircle has a joint research plan and the research is carried out both in company-specific confidential R&D projects and in public research by the research organisations. The companies are also cooperating in the public research. Based on the interviews, research organisations involved in Co-Innovation projects received raw materials and assistance from industry for research purposes, while industry partners in Co-Innovation projects received new ideas for their R&D/I projects.

In case of the BATCircle, the Steering Committee has three annual meetings. The Principal Investigator of the project is the Chair of the Committee and Business Finland takes part in the meetings. The Steering Committee of the Co-Innovation project discusses only the public research of the consortium. Based on the interviews, the knowledge exchange can be classified as limited, since companies do not usually share their confidential R&D/I projects.

By 2021, the BATCircle resulted in about 39 peer-reviewed publications, 30 published theses, 13 technical reports, 41 conference reports, 7 magazine articles, 40

35 BATCircle. <https://batcircle.aalto.fi/en>

talks and interviews, of which dozens have been completed.³⁶ So far, the main direct impact of the Co-Innovation funding has been the generation of new knowledge and expertise in the field of recycling of battery metals. The BATCircle matches well with current competence needs. Based on the interviews and the recent studies, there is a growing lack of experts throughout the battery value chain.³⁷

The Co-Innovation funding has had a direct impact on networking capabilities, on technical capabilities and on access to technology and resources of the BATCircle. According to the interviewees, the strength of the BATCircle is that the students and young researchers have learned about both new battery technology, and the battery technology market in the joint industry-academia project. The members of the BATCircle have also been active in EU level decision-making and in international R&D projects. The BATCircle consortium members have been often identified as a partner for example, in the EU Horizon calls. Furthermore, the BATCircle2.0 has an extended network of national and international stakeholders in the form of an

Advisory Board. Based on the interviews, there is a need to develop tools so that international partners could be also allowed to participate in the Co-Innovation projects.

Based on the interviews, the BATCircle has had an indirect impact on building a new factory, strengthening the infrastructure of the Finnish battery industry and formation of new jobs. For instance, the consortium partner opened the large-scale battery recycling plant in Harjavalta in spring 2023. Because the results of the company-specific R&D projects are confidential, the available information on development of new export products is scarce. It should be noted that the interviewees emphasised that there is a need to develop the funding of the commercialisation phase after the RDI phase. For instance, it was mentioned that Business Finland could serve as a matchmaker and invite an investor to participate in the follow-up of a Business Finland project (e.g., the Co-Innovation project).

³⁶ BATCircle Final Report 2019-2021.

³⁷ Söderholm, J. et al. (2022) A study of the demand for expertise in the battery cluster and attractiveness of education in the field. Publications of the Ministry of Economic Affairs and Employment 2022:29.; National Battery Strategy 2025. Ministry of Economic Affairs and Employment Sector Report 2021:2.

4.2.3. 5G VIIMA

The 5G VIIMA (5G Vertical Integrated Industry for Massive Automation) is aimed at pushing 5G technology forward to address the critical requirements for wireless infrastructure coming from factory and campus network industries.

The 5G VIIMA Co-Innovation project consisted of seven research organisations (Aalto University, Centria University of Applied Sciences, Oulu University of Applied Sciences, University of Oulu, Tampere University, Turku University of Applied Sciences and VTT) and 10 companies. In total, the 5G VIIMA had 27 partners.³⁸ Some companies invested in it just to follow the project. The 5G VIIMA was carried out during 2019-2021. The Business Finland's Co-Innovation funding for the 5G VIIMA was a total of EUR 7.5 million. In addition, the 5G VIIMA received Business Finland's funding from the 5thGear 2014-2019 programme and research funding (EUR 300,000) from the participating companies.

There was not a preceding project, whereas many of the 5G VIIMA partners, especially the academic organisations,

had previously co-operated with each other. Each research group had an existing network, which made the formation of the consortium easier. The 5G VIIMA had a joint research plan, which presented the academic research. In addition, the companies had separate confidential project plans. Based on the interviews, the remarkable benefit of the Co-Innovation funding was that the academic and industrial partners worked in close collaboration for the advancement of wireless solutions in the society. The project included practical experiments inside a Nokia base station factory and in a controlled semi-open outdoor and indoor industry campus (Kalmar Test Yard, ABB/VTT Labs and Port of Oulu).

The 5G VIIMA had two main regular meetings. First, four times a year a Steering Committee meeting, chaired by Nokia. The Project Coordinator, whose work time was divided between the University of Oulu and Nokia, facilitated the preparation. The main purpose of the meeting was to share information and approve budget use. Secondly, the consortium had monthly technical status meetings, chaired by the coordinator, for discussing

technical topics regularly. Business Finland participated in both meetings. In addition to the feedback, the advantage was that Business Finland informed the 5G VIIMA about possibilities to present the project at the Business Finland events. After face-to-face kick-off and first face-to-face regular meetings and workshops, the remaining events and meetings were held online because of the Covid-19 pandemic. Some experiments were not allowed to be done in the testbed of the company due to the Covid-19. Instead, these experiments were performed in the laboratory and/or via simulations.

The 5G VIIMA resulted in 24 developed assets and 70 scientific publications.³⁹ The key success factors were the practical trials at Kalmar Industry Campus in Tampere, ABB Smart Grids in Helsinki, Port Oulu Industry Campus in Oulu and Nokia Digital Factory in Oulu. The 5G VIIMA meant that 5G was developed further for the use of the industry. The sharp focus of the 5G VIIMA was a strength. Based on the interview, the demonstrations that most accurately represent the real environment gave valuable

information on speed, safety and usability of the knowledge transfer. New business models for deploying private 5G were investigated. On other hand, the long investment cycle and the conservative attitudes towards changes (e.g., concerning the remote work capabilities) may hinder the implementation of the use of 5G in the industry. Based on the experiences of the 5G VIIMA, a two-year Co-Innovation project for the development of the new export products in the industrial environment is too limited. It is sufficient for assuming some new technology demonstration, but it is still far from assuming market entry. The life cycle of existing machines and equipment is longer in the industry compared to the consumer services. For instance, the use of robotics and artificial intelligence (AI) have developed fast in the industry although not as fast as in consumer services.

The 5G VIIMA has had a major impact on new wireless tools concerning 5G for industry, remote operations (e.g., remotely-controlled RTG cranes), high-quality wireless data (e.g., high-accuracy radio positioning and sensing

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5GVIIMA. <https://cuttingcables.fi/project-highlights/>

in industrial environments and visualisation platforms), and video services (e.g., algorithms for object identification).⁴⁰ In all, there are a number of examples of how new wireless opportunities have been brought to wider audiences. Furthermore, the 5G VIIMA has had an indirect impact on public awareness of the added value of the wireless mobile technology into society. The wireless 5G technology may contribute to value creation within different industrial fields.

In conclusion, the Business Finland's Co-Innovation funding had an impact on different types of capabilities, including, capabilities on knowledge and competence development, interdisciplinary competencies, RDI collaboration, networking, product testing capabilities and development of new business models in the industrial environment.

4.2.4. ICORY

ICory (An intelligent customer-driven solution for orthopaedic and paediatric surgery care) aims at building a

next-generation patient-centric digital solution for orthopaedic and paediatric surgery care.

The multidisciplinary ICory consortium consisted of three research organisations (University of Oulu, VTT and University of Helsinki), two Finnish university hospitals (Oulu University Hospital, Helsinki University Hospital), six Finland-based companies (Buddy HealthCare, Lenovo, Near Real, Rehaboo, Solteq, Triumph Gamification) and collaboration with hospitals both in Singapore (National University of Singapore NUS, KK Women's and Children's Hospital KKH, National University Hospital, NUH) and Australia (RMIT University). The ICory project received Business Finland's Co-Innovation funding for EUR 1.4 million in 2018-2021. In addition to Co-Innovation, ICory received Business Finland's Bits of Health programme funding.

The ICory partners did not have previous experience working together. Based on the interviews, the formation of the consortium and preparation of the Co-Innovation application took two years. It may be a challenge to get together the required number of companies, which meet the impact criteria of Business Finland. On other hand,

40 5GVIIMA. <https://cuttingcables.fi/project-highlights/>



the length of the application process may discourage companies from applying. Further, changes in participant companies during the application phase may complicate and lengthen the process. The consortium had a joint research plan, and in addition, separate plans for the companies and the hospitals. The consortium used internal workshops as co-creation processes. The Steering Committee, of which the Chair was from the consortium, had two annual meetings per year. Business Finland participated in the Steering Committee meetings.

The Co-Innovation funding garnered success for the participating research organisations (high number of publications), hospitals (the solutions are already in global use) and involved companies (improved innovations). The Co-Innovation funding is internationally rare in its simultaneous funding of research organisations, companies and hospitals. However, the collaboration would have been easier if there had been a joint pool for funding of both Finnish and international partners.

The ICory resulted in 22 scientific articles, two Ph.D. theses, a number of M.Sc. theses both in Finland and in Singapore and outputs in a number of seminars. The

Co-Innovation funding had direct impact on the formation of new knowledge, technology, expertise, innovation capabilities and international networks. The main challenge of the ICory was the postponement of clinical trials due to the Covid-19 pandemic. However, the consortium was allowed to extend the project period for completing the clinical trials both in Finland and in Singapore.

Based on the interviews, the ICory project was most successful for those companies which courageously aimed at the international market from the beginning. Based on the outcome of the ICory, it is critical to customize the solution to the needs of target markets. Approaching international hospital markets is challenging. Furthermore, the very recent study proved that co-creation and user involvement have positive impacts on company performance in terms of their innovation business growth and revenue, and the study further stressed the importance of different activities, actors, capabilities, and international activities in co-innovation.

Despite the fact that Singapore turned out to be a closed market, Singapore is an important gate for the Asian markets. Although the ICory project did not have direct impact

on sales in Singapore, the ICory has had indirect impact on business growth and revenue of Finnish companies. For instance, one company is carrying out clinical trials in Singapore. The development of new technological solutions has continued in Singapore so that Finnish companies have also received support from the local funds. ICory has resulted in four follow-up projects in Singapore, which have different themes (e.g., breast cancer, rehabilitation etc.) in each hospital. Currently, the scale of collaboration is larger than before and continues between the Nordics and Singapore.

In the case of ICory, it was not possible to get artificial intelligence (AI) solutions to be co-created further within Singapore ecosystem. At the time when ICory was introduced, Singapore has just faced significant national level data protection challenges that were hindering the interest of hospitals related to AI solution co-creation and validation.

The project also showed that it is important to test the introduced solutions first in the domestic market and to take into consideration the administrative practices and regulatory requirements before suggesting the solution

in research trials in Singapore. This finding is in line with the previous studies concerning data access challenges in the interface of AI companies and hospitals.⁴¹

The main added value of the Co-Innovation funding was the ability to build novel ecosystems of research organisations, companies and hospitals from Finland and Singapore to work together to co-create and validate the new innovative solutions. Several follow-up projects (e.g., StrokeData) were created based on the ICory. All in all, the Co-Innovation funding of ICory has a strong indirect impact on digitalisation of healthcare services, both on domestic and international co-innovation and international growth of Finnish companies.

Although clinical trials did not show statistically significant difference in between the ICory solution and the standard solution in the evaluated hospitals, the qualitative studies that were conducted showed that the ICory solution did however improve the patient experience and patient satisfaction in the evaluated hospitals.

⁴¹ Aets, R., Pikkarainen, M., Xu, Y. & Andersson, S. (2023) Overcoming hospital resistance in an international innovation co-creation. *Technological Forecasting & Social Change* 187 (2023) 122195.

4.2.5. HUMOR

The HUMOR (Human Optimised XR) project focused on virtual reality, XR (extended reality), AR (augmented reality) and VR (virtual reality) applications. The HUMOR project aimed at the compatibility of XR hardware, software and content with humans and at a global de facto standard for XR product development.⁴² The HUMOR consortium consisted of five universities (Aalto University, University of Helsinki, University of Eastern Finland, Tampere University and University of Oulu) and three companies (CubiCasa Oy, Dispelix Oy and SeeTrue Technologies Oy). In addition, the project partners were Huawei Technologies Oy, Collaprimo Oy, Savox Communications Oy, Alter – Experience Ideas Oy, KONE Oyj, OptoFidelity Oy, Rakka Creative Oy, UKI Arkkitehdit Oy, Upknowledge Oy, Varjo Technologies Oy, Visual Components Oy and Yleisradio Oy.⁴³

The preparation of the application for Business Finland's Co-Creation funding was started by the University of Oulu in the autumn of 2018. From the beginning, the team of

five universities aimed at a business-driven project. The company partners brought new knowledge and enabled the use of the newest equipment. The consortium partners varied in relation to the level of previous collaboration. Some companies did not have previous experience working together with the university partners nor in the projects funded by Business Finland. The HUMOR project succeeded to develop from Co-Creation to Co-Innovation. The sum of Co-Innovation funding was EUR 2.3 million (2021-2022).

The consortium had a joint project plan and the companies had separate project plans. The university-driven research was discussed at the Steering Committee meetings, which was chaired by the Project Coordinator. Representatives of Business Finland were invited to the meetings. Business Finland participated in the Steering Committee meetings in the beginning of the project and in the final project seminar.

At the time when the HUMOR project started, the Covid-19 pandemic started. The problem of data collection was

⁴² Human Optimized XR.

⁴³ Human Optimized XR. About. <https://humanoptimizedxr.org/wp/sample-page/>

solved by collecting data remotely. The participants joined the experiment from their homes.⁴⁴ Based on the interview, the remote working slowed the finding of common ground in the consortium at the beginning of the project. All the consortium meetings were arranged remotely except the kick-off meeting and the final project seminar.

The HUMOR project achieved its targets successfully. Because the results of the company projects were not published, detailed information on the commercialisation phase of the project, new business activities and the export products is not available.

The Co-Creation and Co-Innovation funding had direct impact on formation of new knowledge and technology. The interdisciplinary project generated new knowledge about XR products and user experience. As a result of the co-operation, the university partners of the HUMOR project developed new open AR glasses, which can be modified by the user. The alternative platforms are closed ecosystems. In the case of using various XR hardware, which were manufactured by the companies, the universities presented

the results of the company specific experiments to the respective companies only. Otherwise, the results of the use of the companies' XR hardware were published only at a general level.

According to the interviews, the main impact of the Co-Innovation funding was on networking. The trust between partners was good even if the consortium was new. Partly, the collaboration will continue in the future. For instance, the R&D platform of open AR glasses will be further developed by the university partners. On the other hand, there are examples of other consortia concerning virtual reality, which are led by a Finnish research organisation at the EU level. It should be noted that for some partners the collaboration with many partners was not the main drive to participate in the HUMOR consortium. Instead, the interesting topic of the HUMOR projects was the motivation factor. Based on the interview, cooperation between one research organisation and one company would be more suitable in the case of specialised topics.

Based on the interview, the main challenges took place

⁴⁴ Human Optimized XR. How to run VR experiments in the era of social isolation? <https://humanoptimizedxr.org/wp/how-to-run-vr-experiments-in-the-era-of-social-isolation/>



during the application phase. There were challenges to compile a large consortium. It was difficult to have five universities in the consortium due to the funding criteria of Business Finland, in particular with regard to the level of the expected export value in case of many research organisations. Furthermore, it was challenging to compile company partners in the consortium so that the preparation of the company's R&D project would be a part of the consortium application at the right time. According to the interviewee, Business Finland, which is familiar with the companies in Finland, should take a more active role in identifying and matchmaking the potential consortium partners. The best option would be to suggest complete consortiums with a rough outline of the research and development objectives. It should be noted that the issue of intellectual property rights (IPR) may, in some cases, inhibit the collaboration between the university and the company, in particular a large international company. According to the interviewee, the role of the professional project coordinator in the preparation of the successful HUMOR application was remarkable.

Finding suitable partners and common ground is often challenging.

4.3. SYNTHESIS AND LESSONS

4.3.1. OVERVIEW

Across the cases, the main contribution appears to be enabling and/or increasing collaboration between enterprises, researchers, and clients/users. The beneficiaries of the Co-Creation and Co-Innovation projects report that the projects have contributed to new networks, partners, knowledge exchange and other similar forms of behavioural additionality. In some cases the R&D has been developed further since Co-Innovation project has been completed and has already resulted in tangible investments, in some others, the Co-Innovation project's next step is a continuation of work towards product development.

The challenges with using Business Finland Co-Innovation funding seem to boil down largely to the interplay of finding a common ground and suitable R&D interest between research organisations and enterprises, demarcating the common ground for public research and private generation of intellectual properties, as well as finding a suitable number of partners that are eligible for

Business Finland's funding. It seems that isolating core R&D and IP from public research is a key issue particularly for large enterprises.

The project stakeholders were rather critical of the project application process and noted that the opaque communication of expectations for the projects from the funding agency, complex make-up of parallel public research and private R&D projects, as well as the eligibility criteria for SMEs tend to make negotiation process even more challenging.

The following Table 8 summarises key messages from five case studies representing Co-Innovation projects.

TABLE 8. SYNTHESIS OF CO-INNOVATION CASE STUDY FINDINGS AND LESSONS.

	CONTRIBUTION OF CO-INNOVATION	LESSONS
SUSBINCO	Co-Innovation funding has enabled collaboration to develop new sustainable bio-based materials. The project has contributed the development of testing and piloting stage.	The challenges in Co-Innovation relate to consortium and contract negotiations, a major part of which is deciding the borders of public research project and private IP generation. In practice this amounts to imbalance between the resource commitment to building a successful consortium and the project volume.
BATCIRCLE	The Co-Innovation funding has had a direct impact on networking capabilities, on technical capabilities and on access to technology and resources for the partners. Indirectly, the project (-s) contributed to investments in the infrastructure, the large-scale battery recycling plant and recruitment.	There is a need to develop the funding of the commercialisation phase after the RDI phase and to enhance dialogue and to develop the practices of the Steering Committee meetings. Business Finland should foster exchange of data e.g., by encouraging companies to present information more openly, which would promote building of competitive ecosystems at the national level.
5G VIIMA	The key success factors were the practical trials of the wireless 5G technology in the industrial environment. Project had impact on different types of capabilities e.g., capabilities on knowledge and competence development, interdisciplinary competencies, RDI collaboration, networking, product testing capabilities and development of new business models in the industrial environment.	A two-year Co-Innovation project for the development of the new export products in the industrial environment is too limited. The variation of the life cycle between branches of business should be taken into consideration in the funding of co-innovation.
ICORY	The main added value of the funding was the ability to combine research organisations, companies and hospitals i.e. user environment. Co-Innovation and user involvement have positive impact on R&D outcome and capabilities. There are several follow-up projects. The Co-Innovation funding of ICory has a strong indirect impact on digitalisation of healthcare services.	Co-Innovation funding would be needed between Finland and different countries to make the international solution co-creation and validation easier. The Co-Innovation application process (e.g., funding criteria concerning expected export of the companies, the number of partners in the consortium), and a possibility of only one project plan should be further developed (instead of all companies, hospitals and research organisations having own separated project plans).
HUMOR	The interdisciplinary project generated new knowledge about XR products and user experience. The main impact of the Co-Innovation funding was on networking. Partly, the collaboration will continue in the future. For instance, the R&D platform of open AR glasses will be further developed by the university partners.	The application phases of the Co-Creation and Co-Innovation funding were heavy in relation to the resources of the project. The funding criteria especially concerning the expected export value of the Co-Innovation funding were considered difficult in case of a consortium, which consisted of five universities and three companies. Business Finland should further develop its support for creation of ecosystems. For instance, Business Finland could take a more active role in identifying and matchmaking the potential consortium partners.

5. MOTIVATION, ADDITIONALITY AND SUCCESS

This chapter analyses Co-creation and Co-Innovation project partners' motivations to join projects, their expectations on these projects, as well as their perceptions on the contribution and additionality of the project, as well as the overall success of their projects. Wider project impacts are presented in the next chapter. The results presented in this Chapter are mainly composed of three separate and complementary project partner surveys conducted in the study; a survey of Co-Creation project partners, a survey of Co-Innovation research organisation partners and a survey of Co-Innovation company partners. The survey results are occasionally complemented with interview findings.

5.1. PROJECT MOTIVATION AND PARTNER ENGAGEMENT

From the interviews, experts uniformly confirmed that both companies and research organisations in Finland have a strong need for collaborative R&D funding. Multiple interviewees highlighted that there are rarely sufficient resources within SMEs to engage in R&D activities, and often companies choose to outsource R&D via subcontractors. This however results in the risk of missing out on

learning and networking effects of collaborative R&D projects, which are vital for the long-term competitiveness of companies. It was noted that SMEs in particular are dependent on public support for their collaborative R&D projects. Figure 16 shows that the main motivation among the survey respondents for participation in Co-Creation projects is to get access to domestic networks, expertise and large-scale R&D partners. Access to international networks is the least motivating factor.

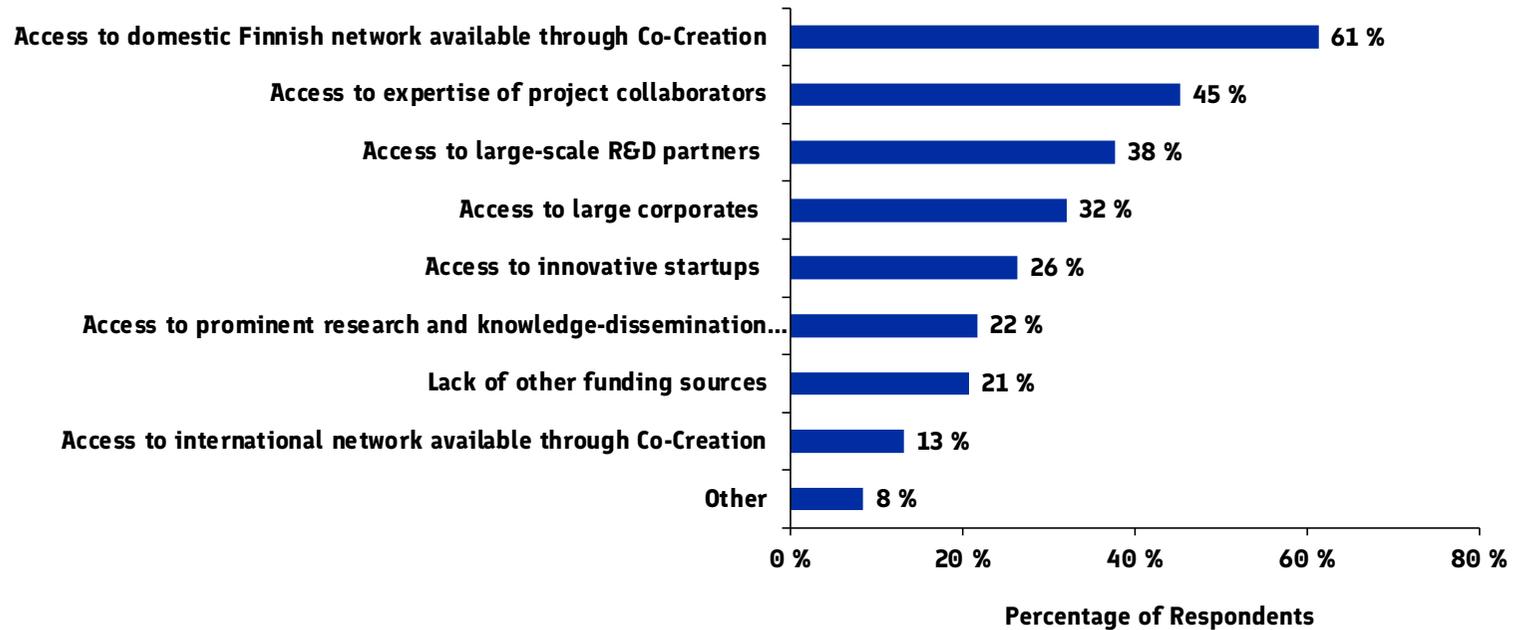


FIGURE 16. MOTIVATION FOR PARTICIPATION IN CO-CREATION PROJECTS. SOURCE: ONLINE SURVEY, N=106.

The motivation for participating in Co-Innovation consortia reflects the dominating role of research organisations in orchestrating the consortia. Figure 17 shows, the majority of company respondents indicated that they were approached / invited to the Co-innovation consortia by a different organisation. Hence, they did not initiate the project. However, in the case of research organisations,

Business Finland's Co-Innovation was the most appropriate instrument for funding their project ambitions.

This is reflected by interviewees, who highlighted that most projects are initiated by research organisations, who then aim to involve other companies in their Co-Innovation projects.

Most Co-Innovation projects are initiated by research organisations.

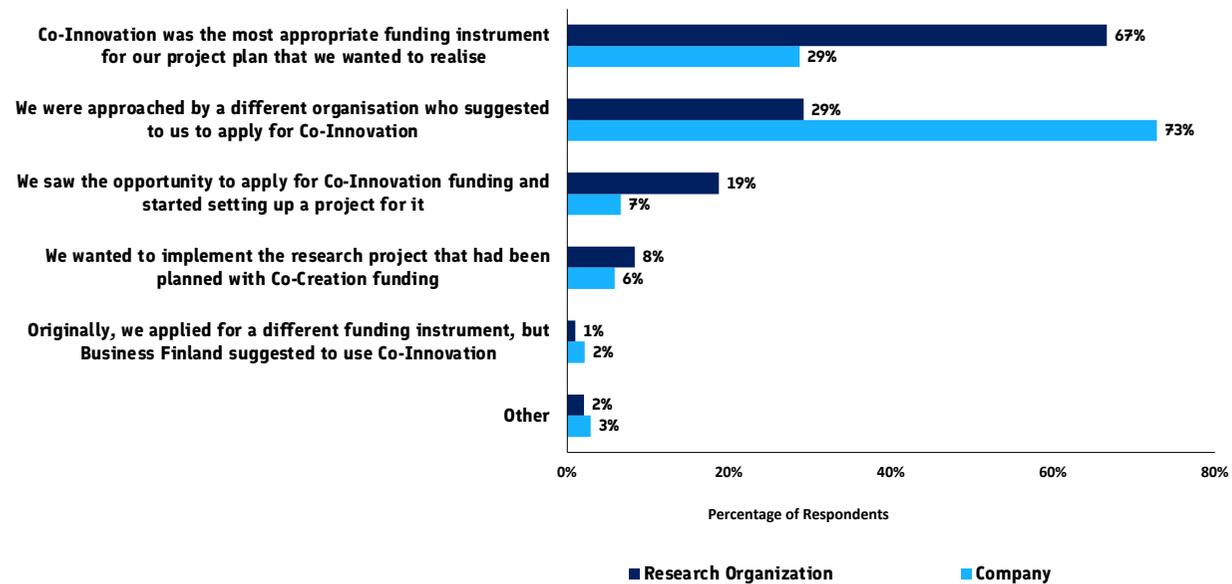
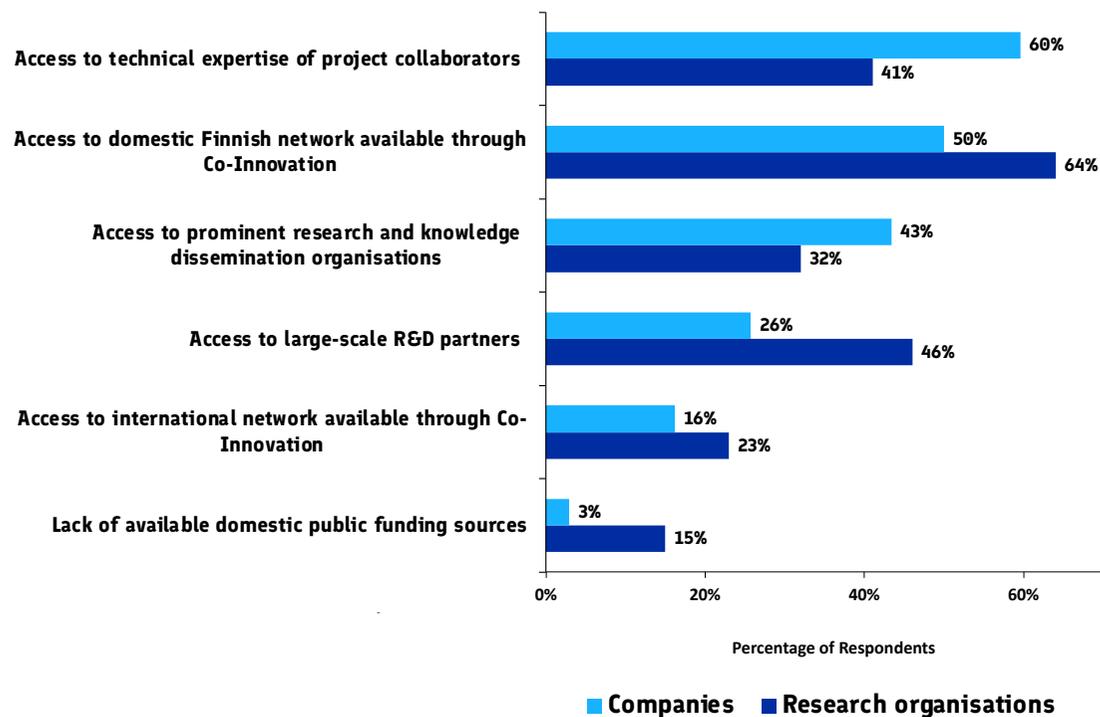


FIGURE 17. MOTIVATIONS FOR PARTICIPATION IN CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS AND COMPANIES. SOURCE: ONLINE SURVEYS, N= 96 COMPANIES / 136 RESEARCH ORGANISATIONS.



As seen in Figure 18, the main expectations differ slightly between research organisations and companies. Both expected to achieve a better access to domestic Finnish network, while for companies access to technical expertise and research and knowledge organisations was mentioned to be of higher importance. Research organisations on the other hand highlighted the access to technical expertise and access to large-scale R&D partners as important expectations on their participation in Co-Innovation. This shows that both types of organisations expect to gain access to the main strengths of other organisation, showing high complementarity in the expectations of the survey respondents.

FIGURE 18. MAIN EXPECTATIONS IN CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS AND COMPANIES. SOURCE: ONLINE SURVEYS. N= 96 COMPANIES / 136 RESEARCH ORGANISATIONS.

The level of engagement to Co-Innovation projects is higher in research organisation than in companies.

Both research organisations and companies agreed that the level of engagement in collaborative consortia of research organisations is higher than it is for private sector consortium members (see Figure 19).

It was shared by almost all interviewees, that research organisations generally take a more active role in Co-Innovation projects, as they are also often the

coordinating organisation. As research organisations are often the initiating party, it is them who assemble the consortium and mobilise the relevant companies for a research project. In fact, one interviewee mentioned that this can be a large part of the Co-Creation phase, in which research organisations approach different companies in order to develop a Co-Innovation project.

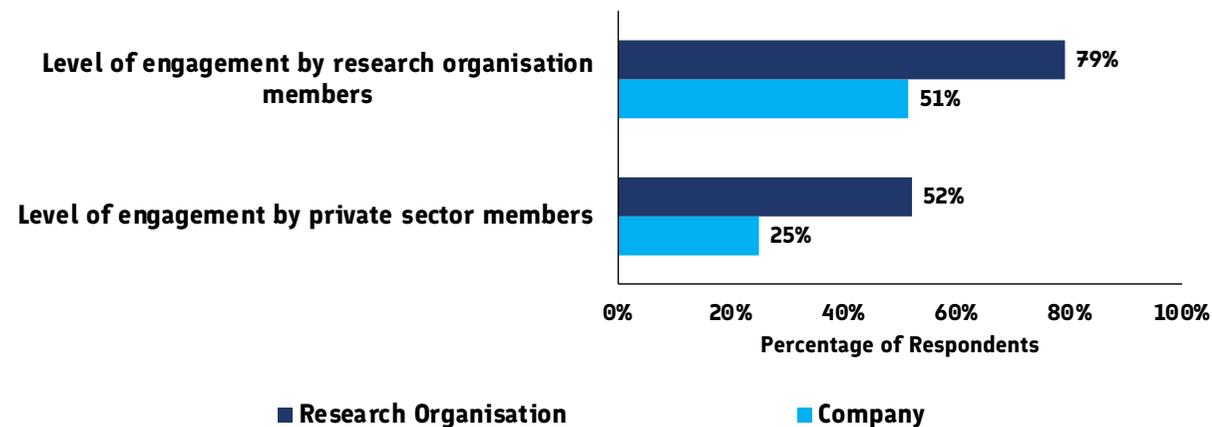


Figure 19. Partners' level of engagement in Co-Innovation projects for research organisations and companies. Source: Online Surveys. N = 96 Companies / 136 Research Organisations.

“Concrete collaboration comes naturally in projects where there are joint interests and/or existing business relationships. However, sometimes Co-Innovation projects are more like a combination of separate projects. Then the only “joint” collaboration are the steering groups where everyone shares what they have done. Sometimes this can already be valuable, but for concrete collaboration a strong coordination role is need.”

-Interviewee from Business Finland

Interviewees identified various factors which can favour concrete and intensive collaboration among consortium partners in Co-Innovation consortia. For example, **existing business relationships often make collaboration easier**, as consortium members already have built trust and shared collaboration processes.

Furthermore, developing a **clear approach to intellectual property rights** from inception is important to ensure all parties are aware of their rights to potential project outcomes. Often, lack of involvement from companies is also the result of potential risks of sharing sensitive data or information with project partners.

If consortium partners agree on clear guidelines on the disclosure of data and information as well as intellectual property during the consortium formation, collaboration may be easier during the project.

Altogether formulation of **clear expectations and commitments as part of the consortium agreements is key to avoid misunderstandings** or conflicts during project implementation. While it was highlighted that these consortium agreement negotiations can take a long time, it is also crucial to be clear about the commitment that each participant is going to bring to the project.

It is also important to highlight the **benefits of extending R&D collaboration**. Many interviewees from Business Finland mentioned that learning and changes in processes and thinking are more likely to be achieved if concrete collaboration takes place. These benefits however are not always recognised and creating many parallel projects (instead of one consortium) may often seem easier in the beginning. Thus, it is important both for the Business Finland advisors, as well as for project coordinators to communicate the benefits and added value of collaboration.

There is clear input additionality of Co-Creation and Co-Innovation funding, as the majority of projects would not have been initiated without Business Finland's support.

5.2. ADDITIONALITY OF RECEIVED FUNDING

There is evidence that Co-Creation funding provides clear input additionality for the envisioned projects, as 74% of respondents from the Co-Creation survey indicate that the project would not have been initiated at all without Business Finland funding, and only 4% stated that the project would have been implemented in the same manner without the availability of Co-Creation funding from Business Finland. The same is true for Co-Innovation projects, as 88% of companies and 93% of research organisations agreed or strongly agreed that the Co-Innovation funding allowed them to undertake research and innovation projects, that would have not been possible otherwise.

These results indicate that there are no overlaps with other funding instruments or funding organisations in Finland, as beneficiaries do not seem to have other funding opportunities to finance their collaborative innovation projects. In addition, **55% of companies stated that**

For the majority (55%) of company partners RDI collaboration was new. They had not participated in any collaborative RDI project during the past five years.

they have not participated in any other collaborative research or innovation projects during the past five years. Both research organisations and companies agreed to the same extent that Co-Innovation funding helped to increase the quality and the ambition of their R&D projects. More importantly, only 29% of respondents from the Co-Creation survey agreed that the project would have been realised at smaller scale without the Business Finland funding. This shows the importance of Business Finland funding for Co-Creation and Co-Innovation: research and innovation potential would have been lost without Business Finland's activities.

Interviewees from Business Finland highlighted the high involvement of Business Finland advisors during the early stage of a Co-Creation project, in order to coach applicants/beneficiaries and support them in forming consortia. Thus, not only the financial additionality of the funding, but also the coaching and advising activities from Business Finland experts play a key role in enabling companies and research organisations to initiate projects, which otherwise would not been realised.

5.3. PROJECT IMPLEMENTATION, SUCCESS AND RESULTS

Figure 20 shows that both research organisations and companies are highly satisfied with the overall administration of the funding. They both agree to a similar extent that the reporting requirement, the time elapsed between proposal submission and funding decision, the availability of information and the amount of funding were sufficient and appropriate. It should be noted, that preceding the submission of applications, applicants are usually in contact with Business Finland for a long time to ensure the application fulfils the requirements and is of sufficient quality, hence by the point of submission of the project proposals,

Business Finland has already conducted checks on the eligibility and completeness of applications. Further, only successful applicants were among the target group of the survey, potentially producing a positive bias towards these questions. Nevertheless, the results of the survey indicate a high quality of the administration of applications and projects by Business Finland.

A somewhat surprising result is that the **amount of available funding was seen as appropriate by a large majority of respondents**, both for Co-Innovation and Co-Creation. In an environment of scarcity of resources, economic operators usually demand more resources than there are available.

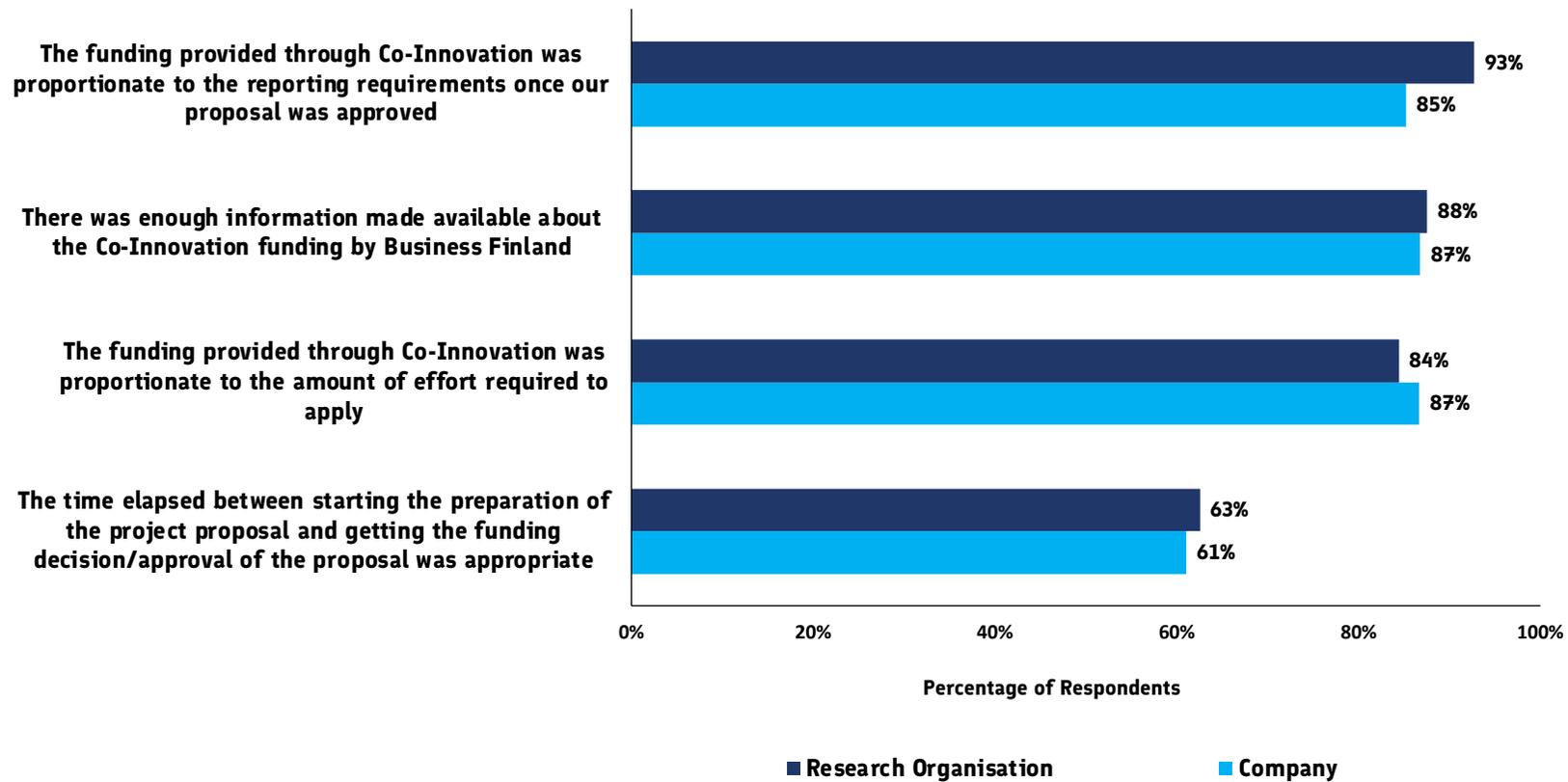


FIGURE 20. RESPONDENTS' SATISFACTION WITH THE ADMINISTRATION OF CO-CREATION AND CO-INNOVATION FUNDING. SOURCE: ONLINE SURVEY. N= 96 COMPANIES / 111 RESEARCH ORGANISATIONS.

Both research organisations and companies were highly satisfied with the amount of funding available.

The above stands in some contrast with results from interviews, where it was highlighted by multiple interviewees that Co-Creation budgets are generally too small to build a solid project proposal with a sufficiently large consortium. Research organisations often have their own resources to support in the development in project proposals, thus from the perspective of project managers the resources might seem to be appropriate. This however favours large institutions with many resources and thorough experience in applying for third party funding, which was mentioned by some of the interviewees.

When it comes to Co-Innovation projects, interviewees stressed that the preparation of Co-Innovation projects is very time consuming and requires a lot of effort from the coordinating organisation. With good preparation, it has been reported that Co-Innovation projects can be implemented comparatively smoothly, but initial investments in the preparations of the projects must be made.

Figure 21 shows that **research objectives of Co-Innovation projects were mostly achieved**, especially as stated by research organisations. Altogether 87% of research partners achieved almost all their research objectives, compared to only 56% of company partners. Commercial objectives were achieved to a very low extent by companies, hinting at challenges in applying developed

solutions in a business environment. Interviewees pointed out that commercial success of a project could only be seen after a longer period once international value chains or new business processes have been fully implemented and start to yield results. After the completion of a Co-Innovation project, these results can't usually be seen, as it takes time to transform innovation into business cases.

The overall success of Co-Creation has been judged positively, as 77% of respondents indicated that their Co-Creation project has been highly or moderately successful. Yet only 42% of Co-Creation projects proceeded to a Co-Innovation project. Thus, even though a Co-Creation project does not result in a Co-Innovation project, respondents see some degree of success in these projects.

In general, research organisations considered their Co-Innovation projects to be highly successful, since almost all respondents considered their projects to be at least moderately successful. Companies however have a more mixed perception of the success of their projects, with only 38% of respondents judging the projects as highly successful. While this response is still overall positive, it clearly shows that research organisations perceive projects as more successful compared to companies.

For research organisations, Co-Innovation projects have been successful and fulfilled their research and collaboration objectives. For companies, the picture is less positive. Particularly commercial objectives have not been met.

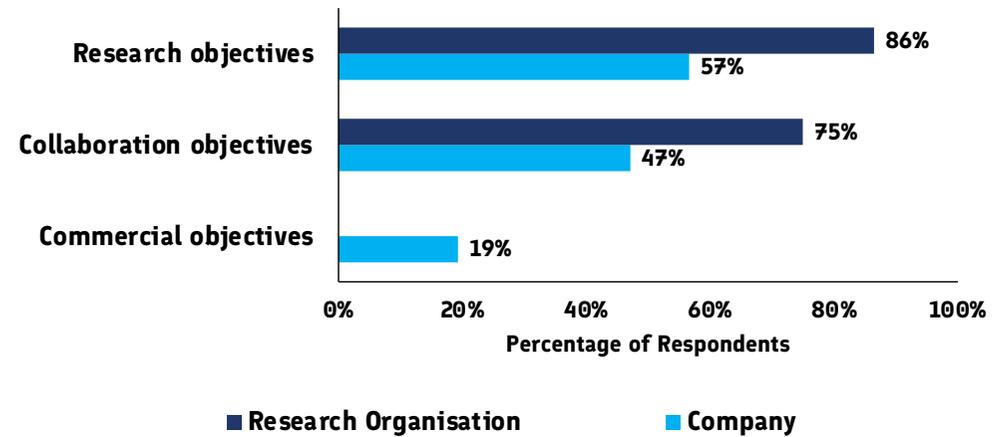


FIGURE 21. ACHIEVEMENT OF PROJECT OBJECTIVES IN CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS AND COMPANIES.⁴⁵ SOURCE: ONLINE SURVEYS. N= 96 COMPANIES / 111 RESEARCH ORGANISATIONS.

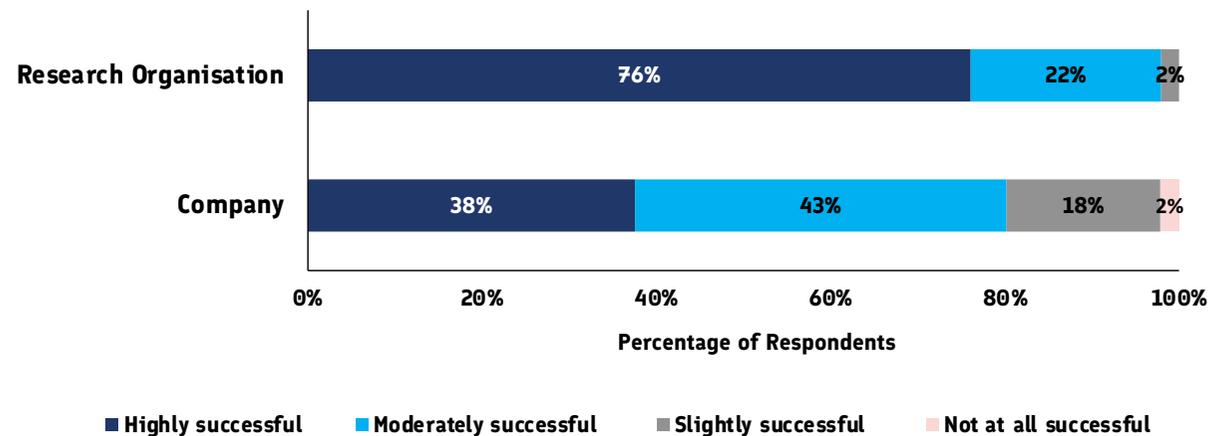


FIGURE 22. OVERALL SUCCESS OF CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS AND COMPANIES. SOURCE: ONLINE SURVEYS. N= 96 COMPANIES / 136 RESEARCH ORGANISATIONS.

⁴⁵ Only companies were asked of the achievements of their commercial objectives.

6. IMPACT ON COLLABORATION AND CAPABILITIES

This Chapter of the report looks more closely on the impact of Co-Creation and Co-Innovation projects on networking, extending the collaboration and on building capabilities of project partners. The results and network analyses are based on survey responses and complemented with interview findings.

6.1. IMPACT ON NETWORKING AND COLLABORATION

A network analysis of all survey respondents was conducted to determine the role that Co-Creation and Co-Innovation funding instruments have played within the innovation ecosystem in Finland (Figure 23). It is important to note that these figures do not reflect the innovation network in its entirety; it is a depiction of Co-Creation's and Co-Innovation's role within the network respectively, based on the information provided by survey respondents (i.e., lead research organisations and lead companies). To this end, it is expected that each of the large collaborator nodes (e.g., VTT, Tampere University, etc.) will have their own networks, which are not depicted in the following figures.

In the following network figures (Figure 23), the colour of the nodes is based on the type of organisation. The first network questions inquired about a respondent's key collaborators as a result of participation in Co-Creation or Co-Innovation project and the second about the role that Co-Creation or Co-Innovation may have played in establishing or bettering those connections. As illustrated in the legend, turquoise represents the lead organisation; gold represents the research organisation collaborators; purple represents the company collaborators, and grey represents other collaborators such as embassies, non-profit organisations (NPOs), and other stakeholders, etc. Figure 23 provides an illustration of the network graphs. It depicts the relationships that lead organisations to be established with other organisations as a result of Co-Innovation and Co-Creation projects.

As illustrated in Figure 23, the lines connecting each of the nodes are an indication of the connections that exist within the network. A significant number of respondents indicated that Co-Creation or Co-Innovation played a role in establishing or advancing the connection between their organisation and key collaborators (denoted as the

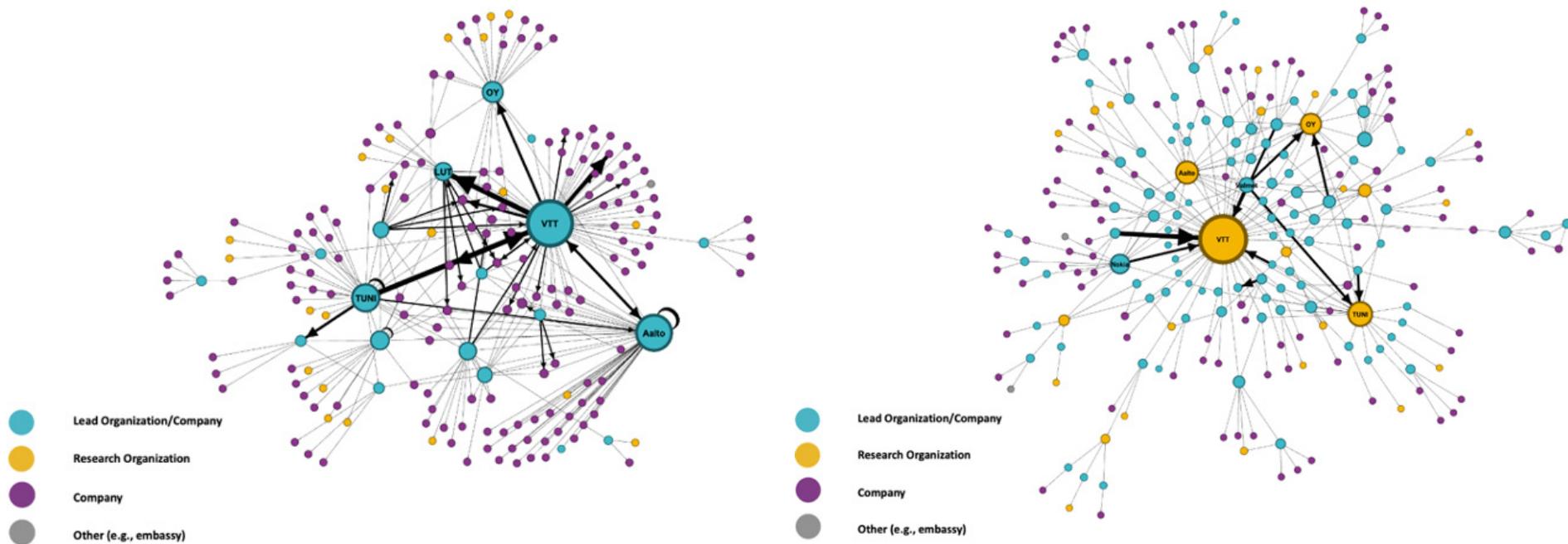


FIGURE 23. VISUALISATION OF CO-INNOVATION NETWORKS BY RESEARCH ORGANISATIONS (LEFT) AND BY COMPANIES (RIGHT).

outgoing links – the lines with arrows pointing away from the Co-Creation or Co-Innovation funding). Over 90% of the survey respondents (across the three surveys) indicated that Co-Creation and Co-Innovation funding have facilitated their connections with project partners.

As depicted in the research organisation network visualisations, in addition to the robust partnerships among prominent lead organisations, most of the connections are established between lead research organisations and companies.

The network chart for Co-Innovation partner companies illustrates that the primary connections occur between lead companies and well-known research organisations (e.g., VTT). Moreover, the peripheral placement (rather than clustering) of the purple dots (representing company project members) suggests that leading companies have engaged with various companies in their collaborations. In summary, the important nodes emerging from this analysis include: VTT Technical Research Centre of Finland, Aalto University, Tampere University and University of Oulu.

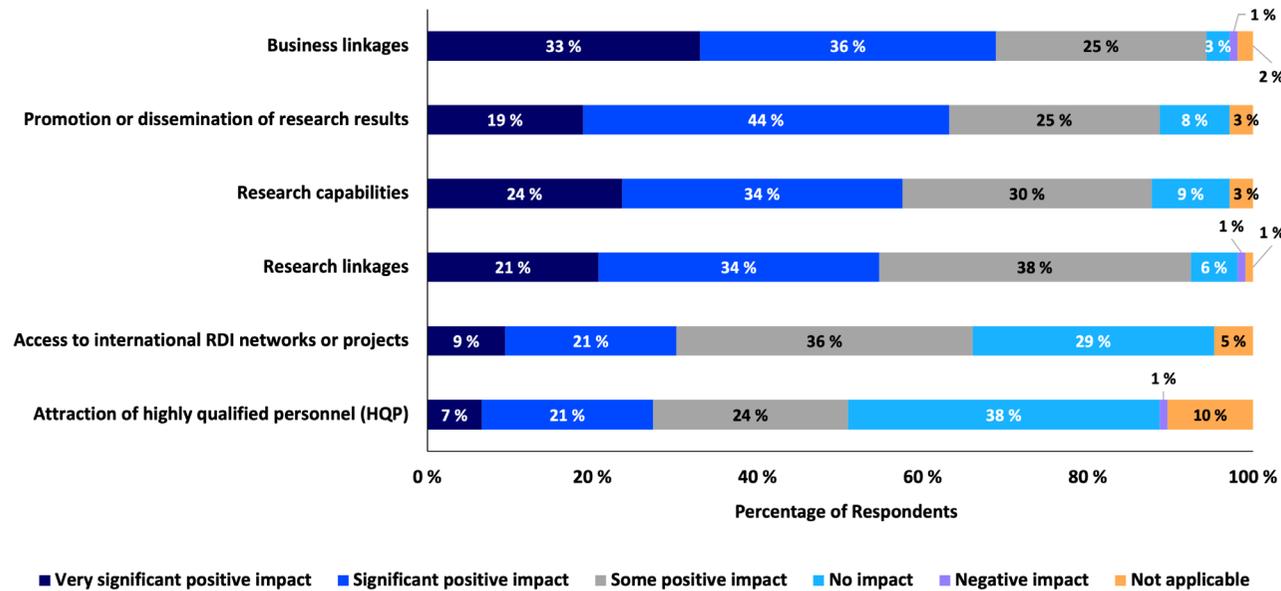


FIGURE 24. CO-CREATION PROJECTS' IMPACT ON CAPABILITIES AND LINKAGES. SOURCE: ONLINE SURVEY. N = 106.

6.2. IMPACT ON COMPETENCE AND CAPABILITIES

This section analyses the impacts of Co-Creation and Co-Innovation projects on the individual company level, focusing on impacts on their competences and capabilities. Co-Creation had positive impacts mainly on business linkages, dissemination of research results and research capabilities. This can be explained by the focus of Co-Creation on consortium and project formation, as well as the fact that Co-Creation projects are usually led and initiated by research organisations. Notably, impact on access to international RDI networks or projects has been limited. Results are shown in Figure 24. Generally, impacts on both performances and capabilities yielded higher results for universities compared to research

institutes or universities of applied sciences. On average, respondents from universities considered the impacts to be more positive compared to the rest of the respondents.

As seen in Figure 24, impacts of Co-Innovation on beneficiary capabilities focus on their research and business linkages and their research and technical capabilities. This shows that Co-Innovation has been improving beneficiaries' capabilities and linkages, reflecting the highly technical nature of Co-Innovation projects and the collaborative focus of the implementation. Interviews also support the view that Co-Innovation projects have helped to develop new technical and research capabilities, citing multiple examples ranging from new patents, new business relationships, scientific publications or better access to technical infrastructure. However, both company and

International collaboration increases already high level of coordination effort of Co-Innovation. Results and outcomes from internationalisation are likely to come years after project completion.

research organisation respondents were not able to identify impacts on either international R&D networks or international operational experience. Interviewees agreed with challenges in internationalisation of Co-Innovation projects and achieving impacts on internationalisation of business and research organisations.

Multiple possible factors have been raised in interviews regarding the challenges in internationalisation. Firstly, some industries have altogether low export potential, for example power grid operators. It was mentioned by interviewees from Business Finland (see following quote) that the requirement to have an international or export development aspect in projects makes it difficult to engage companies or municipalities with low international potential in Co-Innovation projects.

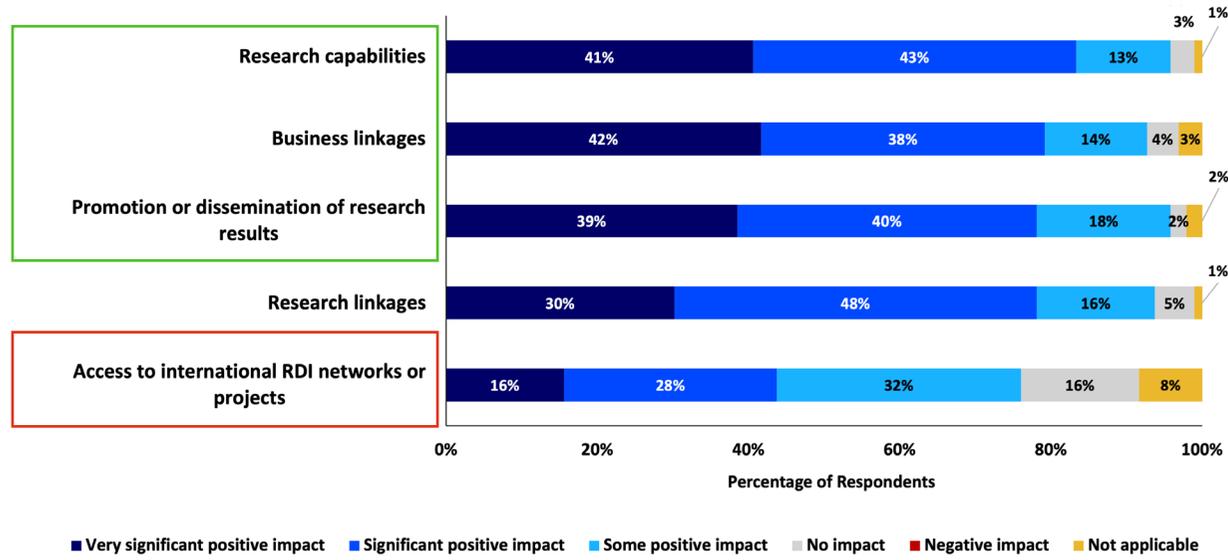
“One difficulty is that there is no export potential in some companies, so co-innovation is difficult. If some partners only operate locally and some internationally, then it is difficult to apply to co-innovation. This applies for example to the energy sector (FINGRID, local power producers etc.).”

-Interviewee from Business Finland

Furthermore, while Co-Innovation projects require a **high coordination effort** from the leading organisation, adding international partners to consortia makes it even more challenging. This is an especially challenging task when negotiating the rights and usage of created intellectual property or sharing of business sensitive information and data. As an opportunity, interviewees from Business Finland highlighted a potential to better link Co-Innovation projects to EU or other international projects. This could be achieved for example by allowing co-financing Co-Innovation projects with EU funding.

Similar to other impacts of Co-Innovation, the impact on internationalisation or developing exports usually cannot yet be observed or measured by the end of a Co-Innovation project. Creating an international value chain or exporting new services or products can take several years, and it is usually **well beyond the time-span of a Co-Innovation project**. These projects are likely to help to initiate or advance such export developments in Finnish companies, but the results and outcomes of these efforts are to be seen only after several years.

Research Organization Survey



Company Survey

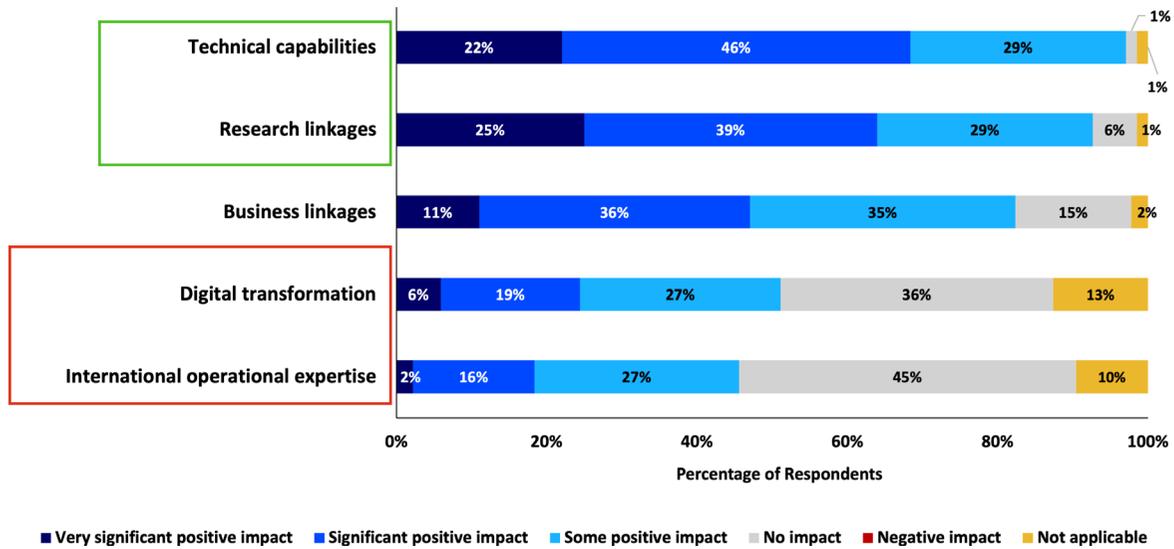
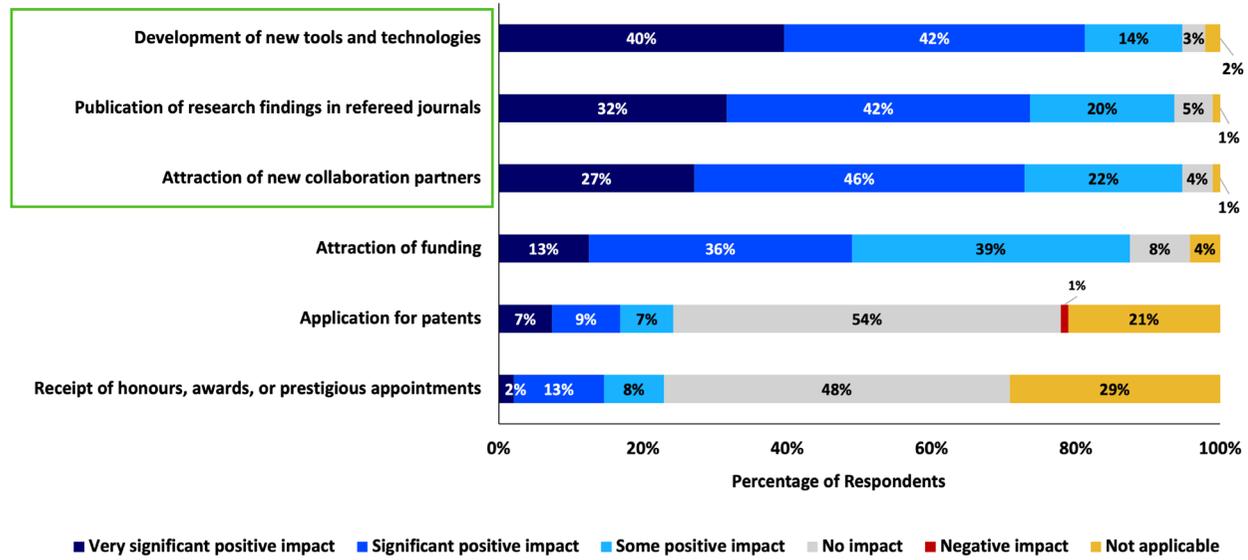


FIGURE 25. IMPACT ON CAPABILITIES AND LINKAGES AT CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS (ABOVE) AND COMPANIES (BELOW). SOURCE: ONLINE SURVEYS. N= 96 COMPANIES / 136 RESEARCH ORGANISATIONS.

Research Organization Survey



Company Survey

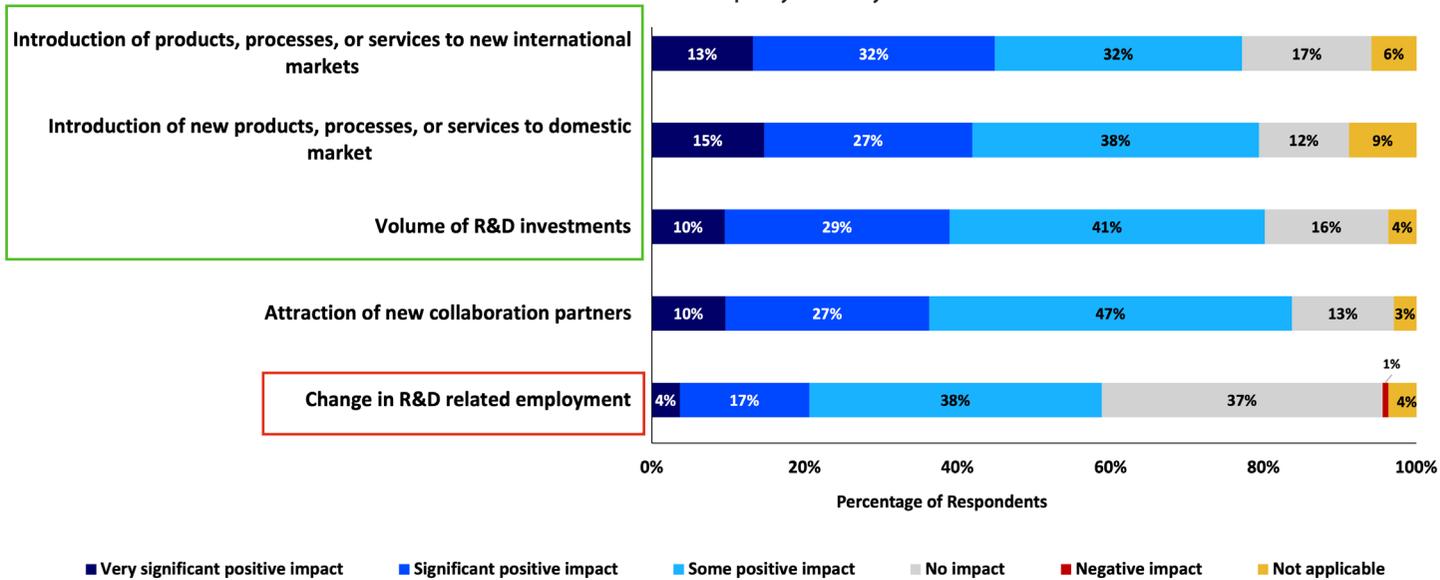


FIGURE 26. IMPACT ON PERFORMANCE AT CO-INNOVATION PROJECTS FOR RESEARCH ORGANISATIONS (ABOVE) AND COMPANIES (BELOW). SOURCE: ONLINE SURVEYS. N= 96 COMPANIES / 111 RESEARCH ORGANISATIONS.

As shown in Table 9, the average impact of Co-Innovation projects on companies' capabilities varies by company size. Micro and small companies reported the highest average impact on international expertise and research and business linkages, while large companies mainly reported positive impacts on access to technology and attraction

of personnel, showing that Co-Innovation is effective in supporting both small and large companies. Furthermore, Co-Innovation impacts on both capabilities and performance are on higher than average if companies have ambitious growth plans.

TABLE 9. AVERAGE IMPACT ON CAPABILITIES BY COMPANY TYPE⁴⁶.

	MICRO/ SMALL COMPANY (N=45)	MEDIUM- SIZED COMPANY (N=32)	LARGE COMPANY (N=46)	SUBSIDIARY (N=10)	OTHER (N=3)
TECHNICAL CAPABILITIES	3,91	3,97	3,98	3,6	3
ACCESS TO TECHNOLOGY	3,49	3,47	3,7	3,4	3,33
ACCESS TO SPECIALISED FACILITIES OR RESOURCES	3,38	3,12	3,27	2,89	3,5
ATTRACTION OF HIGHLY QUALIFIED PERSONNEL (HQP)	2,93	2,89	3,26	2,56	3
INTERNATIONAL OPERA- TIONAL EXPERTISE	2,83	2,75	2,71	2,5	2
RESEARCH LINKAGES	3,96	3,67	3,93	3,6	3,33
BUSINESS LINKAGES	3,51	3,4	3,44	3,2	3,33
DIGITAL TRANSFORMATION	2,78	2,96	3,07	2,56	3,67

⁴⁶ Average based on five-point Likert scale, where 1= negative impact, 2=no impact, 3=some positive impact, 4=significant positive impact, 5=very significant impact.



Impact on outputs for research organisations of Co-Innovation projects have mainly been on attraction of collaboration partners, research publications and developing new tools or technologies. Companies reported significantly lower impact on their performance as a result of Co-Innovation projects. The main impacts identified from Co-Innovation projects were the volume of R&D investment as well as introduction of new products and processes both in Finland and in international markets. While this seems to be in contrast with the discussion above on difficulty of international elements of Co-Innovation projects, only 13% of company respondents stated that they had achieved a significant positive impact on new products and processes in international market. While still being high on the ranking, the overall impact on performance reported by companies is lower compared to research organisations. Research institutes considered more positive impacts on their capabilities compared to universities or universities of applied sciences. In particular, research institutions reported a significantly higher average positive impact on international RDI networks and on commercialisation of research results, compared to other research organisations.

6.3. ECONOMIC IMPACT OF CO-INNOVATION PROJECTS

CONTRIBUTION TO BUSINESS PERFORMANCE

As part of the online survey, companies estimated the contribution of Co-Innovation projects to their business performance with four indicators (turnover, export sales, R&D investments and R&D employment), as seen in Figure 27. Generally, **higher increases were reported on turnover and R&D related investments**, pointing towards the ability of Co-Innovation to mobilise financial resources to boost innovative activities in companies. Changes in R&D related employment was significantly lower. Based on crosstabulation of survey responses with the size of the firm, it seems that the impact of the subsidy on firms' performance in terms of turnover growth and R&D related job creation is slightly higher with small and micro size firms.

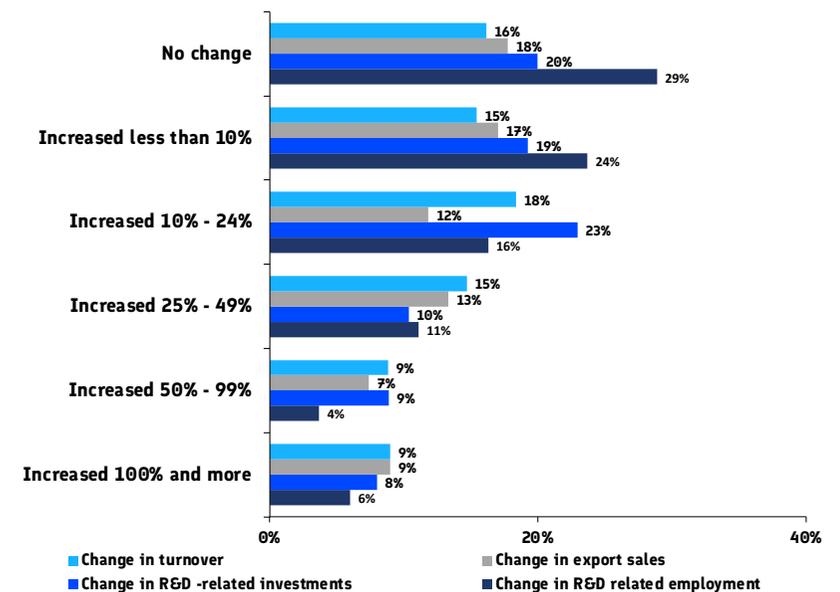


FIGURE 27. ESTIMATED CHANGE IN KEY BUSINESS PERFORMANCE INDICATORS AS A RESULT OF CO-INNOVATION PROJECT. SOURCE: ONLINE SURVEY. N = 135 COMPANIES.

There seems to be an economies-of-scale effect, in which larger Co-Innovation projects also yield greater impact.

The regression analysis of survey results reveals that companies that participated in projects with a greater amount of funding were more likely to attribute impact to the Co-Innovation project on their improvements to the volume of R&D investments, to the introduction of products, processes, or services to new international markets, to the attraction of private financing or investments, as well as to the attraction of public funding and R&D related employment.

Hence there seems to be an economies-of-scale effect in Co-Innovation projects, in which the projects with larger budgets also yield greater impact on companies' performance and capabilities. The same phenomenon was identified for research organisations, where respondents participating in larger projects were more likely to report greater positive impacts on their organisations' performance and capabilities.

FINDINGS OF THE ECONOMETRIC ANALYSIS

This section presents the results of the econometric contrafactual analysis. The analysis looks at Co-Innovation funding's impact on SME turnover, job creation and

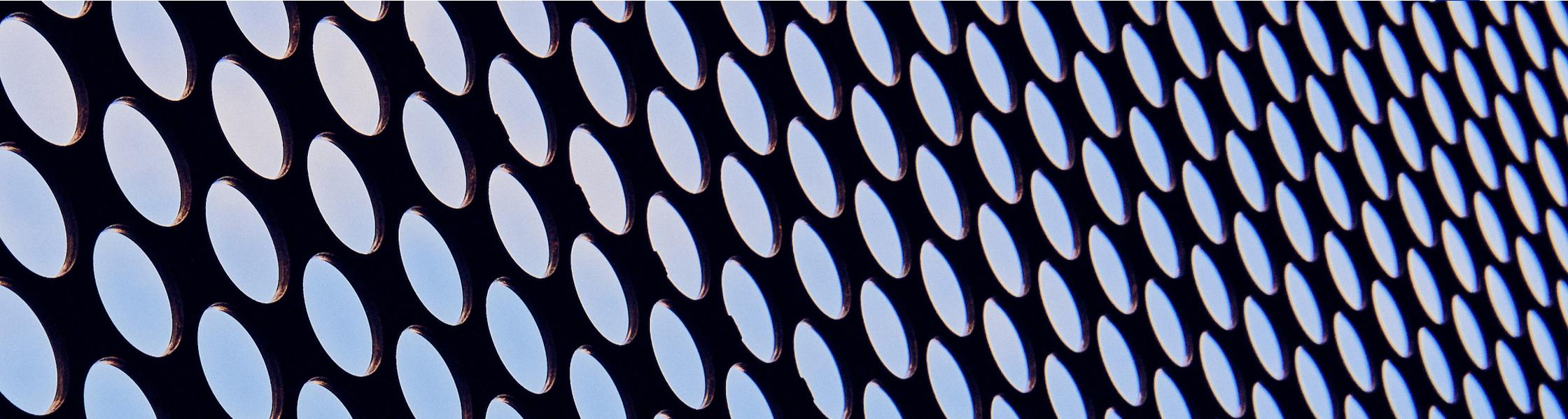
exports, and is compared to the results of other companies that have received Business Finland's R&D funding.

The estimated results for Co-Innovation funding's impact on SME performance in terms of turnover, job creation and exports are presented in Table 10.

TABLE 10. ESTIMATED RESULTS OF CO-INNOVATION FUNDING'S IMPACT ON ECONOMIC PERFORMANCE OF SMES.

	LOG OF TURNOVER	LOG OF TURNOVER	LOG OF JOB CREATION	LOG OF JOB CREATION
	Coefficient (sta- tistical signifi- cance level)	Standard error	Coefficient (statistical significance level)	Standard error
LEAD2 (T-2)	-0.181	0.000	-0.108	0.041
LAG0 (T+1)	0.077*	0.040	0.068**	0.033
LAG1 (T+2)	0.073	0.046	0.097**	0.039
LAG2 (T+2)	0.134**	0.054	0.134***	0.039
LAG3 (T+4)	0.223***	0.067	0.215***	0.058
CALENDAR YEARS	Yes		Yes	
TREATMENT YEARS	Yes		Yes	
OTHER CONTROLS	Yes		Yes	
NO. OF OBSERVATIONS	1597		1594	
R2 (OVERALL)	0.67		0.82	
CLUSTERED S.E.	Yes		Yes	

STATISTICAL SIGNIFICANCE OBTAINED BY THE T-TEST FOR THE DIFFERENCE IN MEANS REPORTED IN THE COEFFICIENT COLUMNS, WHERE *, ** AND *** INDICATE STATISTICAL SIGNIFICANCE AT THE 10%, 5% AND 1% LEVELS.



The analysis shows that the SMEs participating in Co-Innovation projects perform better after the treatment (i.e., funding decision) in terms of turnover growth and job creation as compared to their counterparts (i.e., SMEs receiving other types of R&D funding from Business Finland). The impact grows as more years have passed after the intervention. Results are statistically significant (see Figure 28). The previous studies have shown that regular Business Finland R&D funding has had a positive impact on turnover growth and job creation. The estimates for export growth are less robust, as the model yields a low R² value.⁴⁷

SMEs participating in Co-Innovation projects perform better regarding their turnover growth and job creation, compared to SMEs receiving other types of Business Finland R&D funding. The difference increases over time.

⁴⁷ See earlier Business Finland Impact Studies, e.g., Halme, K., Kotiranta, A. et al. (2018); Halme, K., Salminen, V. et al. (2018); Fondaro, P. et al. (2020); Koski, H. et al. (2020); Kässi, O. (2022); Ali-Yrkkö, J. et al. (2020).

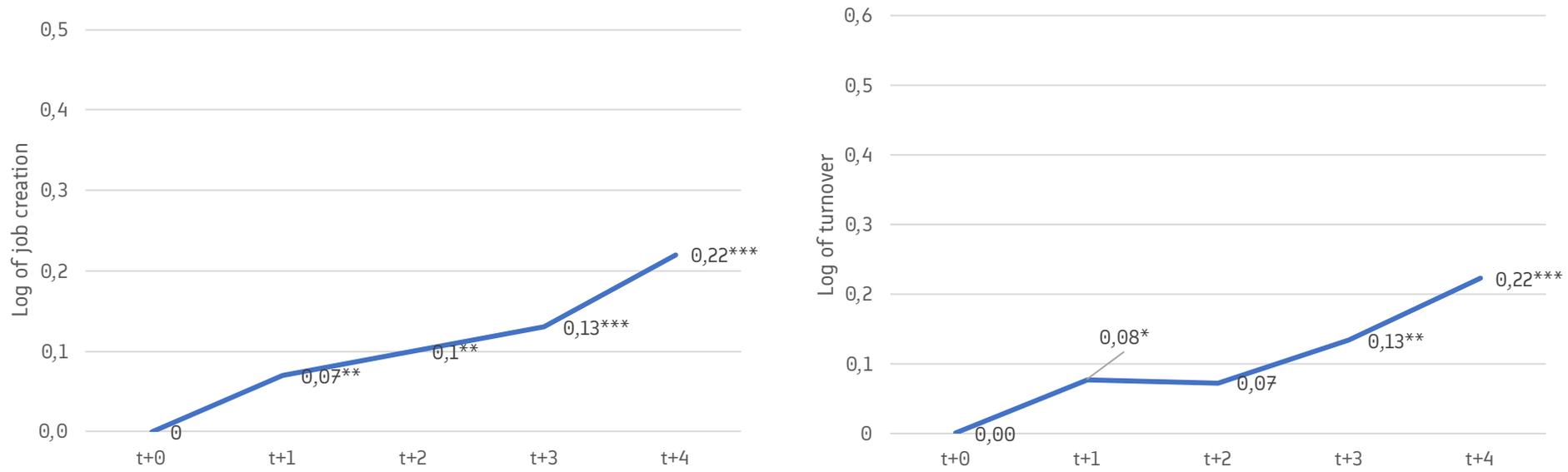


FIGURE 28. THE IMPACT OF CO-INNOVATION FUNDING IN THE DEVELOPMENT OF SME TURNOVER (LEFT) AND JOB CREATION (RIGHT) AS COMPARED TO OTHER BUSINESS FINLAND SME CLIENTS.⁴⁸

In terms of turnover growth, the first two years after the treatment do not show clear statistical significance, but the results for years +3 and +4 are statistically significant (95% and 99% confidence intervals). After the third year

the Co-Innovation funding accounts for 13% higher turnover and after the fourth year 22% higher turnover than its counterparts. Based on previous evaluations on Business Finland R&D subsidies, the impact of regular Business Finland subsidies also have a positive impact on economic

⁴⁸ Statistical significance obtained by the t-test for the difference in means reported in the graphs, where *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

performance.⁴⁹ In this study even higher impact can be seen, partly due to the subsidy but also due to the benefits of innovating in a consortium consisting of various actors such as research organisations, SMEs and large firms.

In terms of job creation, the impact is positive, growing and statistically significant since the first year after the treatment. The SMEs participating in Co-Innovation have increased staff by 7% after the first year, by 10% after the second year, by 13% after the third year and by 22% after the fourth year.



7. INTERNATIONAL COMPARISON

This Chapter provides a description of those collaborative R&D funding instruments that have been selected as benchmarks for Business Finland's Co-Innovation funding, as well as a short synthesis of their key characteristics and possible takeaways for Finland.

7.1. INTRODUCTION AND SELECTION OF BENCHMARKS

The international benchmarking analysed six different national approaches to enhancing R&D collaboration between companies and research organisations. The six countries covered were Sweden, the Netherlands, Check republic, Denmark, Austria, and Israel.

7.1.1. SWEDEN: CHALLENGE DRIVEN INNOVATION

The Challenge-Driven Innovation (CDI) program by Vinnova was initiated in 2011 to address societal challenges through long-term collaborative innovation projects. CDI's primary focus is on projects related to the UN's Sustainable Development Goals (SDGs). The program funds visionary projects based on needs identified by applicant organisations, providing incremental funding across three stages. Throughout the three stages,

Vinnova's relative share of the project budget gradually decreases, reflecting the expectation that the project will secure additional funding from other sources to ensure long-term sustainability:

- **Stage 1:** Projects can apply for and receive incremental funding from Vinnova. The funding amount starts from SEK 500,000 and aims to support the initial development and validation of the project's concept or solution.
- **Stage 2:** Instead of direct funding from Vinnova, projects focus on further refining their concept, conducting research, and collaborating with partners to advance their solutions. This stage is crucial for building a functional business model and ensuring the solution's technical feasibility.
- **Stage 3:** The third and final stage provides the opportunity for projects to receive additional funding from Vinnova, up to a maximum of SEK 20 million. The funding aims to support the implementation and scaling of the developed solution, with an emphasis on achieving significant societal impact. Projects work towards disseminating the solution, complying with regulations, and considering the needs and perspectives of intended users.

CDI has supported a significant number of projects and engaged a diverse range of participants, including universities, private companies, and research institutes. On average, there are 12 project partners per project. The projects aim to tackle complex problems by focusing on specific sub-challenges and developing technical solutions.

7.1.2. NETHERLANDS: PUBLIC-PRIVATE PARTNERSHIP ALLOWANCE FOR R&D (PPP-ALLOWANCE)

The Netherlands Enterprise Agency (RVO), operating under the Dutch Ministry of Economic Affairs and Climate Policy provides funding for private-public partnerships (PPPs) that will carry out R&D. The partnerships must consist at least of one entrepreneur and one research organisation, whereas risks and results of the project must be shared with the complete partnership. The scheme is orchestrated by the Dutch **Top consortiums for Knowledge and Innovation (TKIs)**, which are private not-for profit organisations (foundations) with the objective to organise research and innovation activities within the triple helix. There are 12 TKIs in the Netherlands focusing on specific sectors. Companies can request to join a TKI by showing

that their innovation ambitions fit with the research agendas of the respective TKI.

To setup a project, companies make private contributions to PPP projects that fit within the jointly drawn up programming of a TKI. The TKI submits the project proposal to the RVO, who matches each privately invested Euro with 0,30 Euros. The TKI is fairly independent on how to use this ‘earned’ allowance. They can either set-up collaborative research projects that are in line with the R&D ambition of the investor via open calls or channel the allowance back to the source (the initial private investor). With their contribution, companies basically purchase non-exclusive research according to their knowledge demands. The TKIs can also fund networking or communication activities with the PPP allowance. Between 2013–2019, the average annual budget of the PPP-allowance was EUR 105 million funding in the total of 2 252 collaborative research projects.

The 2020 evaluation of the PPP-allowance concluded that the scheme made a substantial contribution to more R&D in the PPP-context, making more and better connections between research organisations and private

R&D actors, encouraging knowledge and risk sharing. An important benefit of the architecture of the funding scheme is that SMEs hardly need to know anything about the PPP-allowance, as the TKIs organise the call. Companies can approach a TKI with a research need and an innovation project, and TKIs will facilitate the relevant and knowledgeable research organisation and provide the funding for the research organisation.

7.1.3. CZECH REPUBLIC: TRIO PROGRAMME

The Czech Ministry of Industry and Trade is providing support for collaborative research and innovation via the TRIO programme. It originated in 2016 as a result of the Czech Smart Specialisation Strategy. The programme seeks to develop the Czech Republic's Industry 4.0 by focusing on the following Key Enabling Technologies (KETs):

- **Photonics**
- **Micro- and nanoelectronics**
- **Nanotechnology**
- **Industrial biotechnology**
- **Advanced materials**
- **Advanced manufacturing technologies**

The co-financing rate of the support ranges from 25% to 80% depending on the lead organisation and the type of research conducted. The project proposals must always include at least one company and one research organisation, and research results of funded projects must be publicly available. Research organisations can lead applications, but it is discouraged as they must provide the co-financing from other non-public sources.

During the period of 2016–2018, the TRIO programme allocated funding worth of 3.62 billion CZK (around EUR 150 million) to 346 projects.⁵⁰

⁵⁰ Research, Development and Innovation Council. Analysis of the Existing State of Research, Development and Innovation in the Czech Republic and a Comparison with the Situation Abroad in 2018. <https://www.vyzkum.cz/FrontClanek.aspx?idsekce=8304&ad=1&attid=932065>

7.1.4. DENMARK: GRAND SOLUTIONS

The Grand Solutions programme of the Innovation Fund Denmark (IFD) is a highly innovative initiative aiming to create value through the development of new knowledge, processes, systems, products, and solutions to address societal challenges. There is no sectoral focus of the programme, but the project must provide value for both public and private organisations in Denmark, while also addressing the prioritised needs of Danish citizens, the state, regions, and municipalities. The projects typically last from one to five years, and any legal entity involved in the project activities, whether in Denmark or abroad, can apply for funding.

While collaboration in project proposals is not mandatory, there are strong financial incentives for applicants to apply as collaborative projects, either with an SME or a research organisation in the consortium. Furthermore, the project applications are requested to place emphasis on an investment plan beyond the time frame of the commitment of the IFD, to ensure sustainability of innovation projects. Since the start of the Grand Solutions programme in 2015, in total of 412 projects have been funded.

In 2022, the IFD invested almost 1 billion DKK (around EUR 134 million) in research & innovation projects via the Grand Solutions programme.

7.1.5. AUSTRIA: COOPERATION AND INNOVATION PROGRAMME (COIN)

The Austrian Research Promotion Agency (FFG) in collaboration with the federal Ministry for Labour and the Economy of Austria has provided funding for cooperative research and innovation as part of the Cooperation and Innovation Programme (COIN) since 2008.

Projects must always be collaborative, as there is a minimum of four project partners of which three must be SMEs. In practice, consortiums are large, with about five to ten partners per project on average. The consortium must collaborate on a joint research, development, or innovation project that ideally results in new products, processes, or services, as well as additional knowledge and competencies among the partners. Since the COIN programme targets of a group that does not have much prior experience with funding applications and management, the FFG provides targeted consulting services to ensure

the participation of SMEs in the funding program. These easily accessible consulting services help SMEs to make high-quality submissions and to reduce any apprehension they may have. At the same time, the wide range of topics results in an exceptionally diverse array of submitted projects. So far, in total of 286 projects have been funded.

7.1.6. ISRAEL: MAGNET PROGRAMME (GENERIC TECHNOLOGIES R&D CONSORTIA)

The MAGNET (acronym in Hebrew for Generic Pre-Competitive R&D) programme by the Israeli Innovation Authority focuses on unique research themes with the objective to add value to Israel's society through technology transfer between public research and the private sector. It aims to improve the distribution of knowledge and cooperation between consortium partners, which may otherwise be difficult to achieve. Based on needs of participating companies, scientists employed in public universities or research organisations are provided with the opportunity to work up to 50% of their time at the company that is applying for funding. Usually, consortia between the companies and research organisations are created as legal entities.

This incentive program comprises three types of consortia:

- **Industrial consortium:** The consortium aims to connect technology leaders from Israeli industry, operating on a global scale, and researchers from academia with extensive knowledge in relevant fields. The consortium aims to develop products with the potential to have a substantial impact on the Israeli economy. Companies can receive up to 66% of the project budget, while research organisations can receive 100% of the budget (80% as a grant, 20% from the consortium companies).
- **Knowledge-Building Consortium:** The consortium focuses on applied academic studies in fields where industry is not yet actively involved in the R&D process but holds potential for advancement through knowledge development. Industrial companies participate in a supportive and mentoring role within the consortium. Companies can receive a grant and initial exposure to technologies that are developed, and the right to use the IP developed within the framework of the consortium. Research organisations can receive 100% of the project budget (80% as a grant, 20% from the consortium companies).
- **Ma'agadon:** The consortium is designed for a select group of companies seeking focused technological development. These companies receive assistance from a small number of academic researchers, and the outcomes of this collaboration can significantly influence their business activities. Companies can receive up to 55% of the project budget and research organisations can receive 100% of the project budget (80% as a grant, 20% from the consortium companies).



7.2. COMPARATIVE ANALYSIS

The analysed support schemes are diverse and serve slightly varying objectives. Direct comparison to Co-Innovation funding of Business Finland is not possible and desirable, as all funding instruments derive from different contexts. However, all of them aim to support collaboration between companies and research organisation to enable innovation projects. Thus, the aim of this comparative analysis is to point out common features and main differences, that can inspire learnings for Business Finland. Table 11 provides an overview on the main characteristics of the funding instruments that were analysed as part of the benchmarking analysis.

TABLE 11. MAIN CHARACTERISTICS OF THE BENCHMARKING CASES.

	SE	NL	CZ	DK	AT	IL
ANNUAL BUDGET (MILLION EUR)	52,4	104,5	75	134	-160 ⁵⁰	N/A
EXISTING FUNDING POSSIBLE FOR FOREIGN ENTITIES	Yes	No	No	Yes	max. 20% of the budget	No
SECTORAL FOCUS	Focus on SDGs	Focus on top sectors (TKIs)	focus on KETs	No focus	No focus	Focus on High-tech
FUNDED RESEARCH STAGES	All stages	All stages	All stages	All stages	Industrial research	Industrial research
COLLABORATION REQUIREMENT	Mandatory	Mandatory	Mandatory	Incentivised	Mandatory	Mandatory
FUNDING PROCEDURE	Open call	Negotiated with initiating company	Open call	Open call	Open call	Open call
RESULTING IPR	Internal to consortium	Open	Internal to consortium	Internal to consortium, RO has right to publish own results	Internal to consortium	Ownership lies at RO, companies have the right to use IP

Almost all the funding schemes have a requirement of collaboration among research organisations and companies for projects eligible for funding. The only exception is the Grand Solution scheme from Denmark, in which there is a financial incentive in form of higher co-financing rates for forming collaborative consortia. Usually, research organisations can be reimbursed for up to 100% of the incurred project costs, while companies do need to commit to co-financing their projects to same extent. Further, analysed funding instruments from the Netherlands and Israel involve a direct reimbursement for the research organisations by the participating companies (i.e., in cases where research organisations receive 100% of the funding, a share of that must be provided by the participating companies).

A common theme discovered among all instruments is the request for project steering groups that include the project beneficiaries and in-kind participants, who do not receive funding but participate with in-kind commitments in the projects. Most funding schemes allow consortia to protect the intellectual properties that are developed in form of patents or other means. The instruments from Denmark and Israel enable the participating research

organisations to publish their own results from the project, similar to the procedure in Co-Innovation projects. The only exception is the Netherlands, where all resulting intellectual property must be open and public, as the idea is that the programme enables companies to purchase non-exclusive research that is tailored to their needs and demands. The role of intermediaries, such as networks or innovation brokers differs. Most calls are organised via open funding calls. In the case of the Netherlands, the TKIs play a crucial role in orchestrating and organising the projects, and in Austria, intermediaries can apply for their own projects.

In most of the collaborative R&D schemes, the role of companies is more central than in Co-Innovation funding.

7.3. KEY TAKEAWAYS FOR BUSINESS FINLAND

While the above analysis shows the diversity of the programmes and contexts, this section summarises key takeaways for Business Finland. They should be considered carefully in the national contexts of each funding instrument, but they still might provide some insights or inspirations for the further development of Co-Innovation project concept.

In most analysed benchmarking cases, **the role of companies as initiators and coordinators** of projects is more central than compared to Co-Innovation funding of Business Finland. Companies are also mostly seen as the main beneficiary and user of the outcomes of collaborative projects. Often, companies approach research organisations with concrete innovation challenges or knowledge deficits and form a collaborative project on that basis. In the Netherlands, the PPP allowance practically enables companies to purchase research, and in turn, in the Ma'agadon consortiums in Israel, companies have to bear parts of the costs arising to participating research organisations. In addition, the main target groups of the studies programmes in Denmark and Austria are companies

and not research organisations (especially SMEs in the case of Austria).

For the funding instruments where evaluations have been available, the evaluations concluded that one of the most important benefits is the **learning and networking effect** of the collaboration projects. The evaluation of the COIN programme in Austria highlighted the learning effect for SMEs who usually do not engage in regular R&D activities, and the Swedish CDI programme was highly successful in enabling knowledge transfers and developing lasting relationships among consortium partners.

Commercialisation is a common challenge to all these collaborative R&D funding schemes. The sequential financing model of CDI is one approach to address this challenge.

A challenge faced by many analysed instruments is the commercialisation and scale-up of innovation projects. Different ways to tackle this challenge have been identified within the analysed benchmarking cases:

- The strong role of the TKIs in the **Netherlands** in developing and coordinating the projects aims to ensure continued usability of project results. As TKIs have a central role in the project and a high degree of authority, they can develop their own follow-up projects to ensure sustainability of developed innovations.
- The **Grand Solutions programme in Denmark** has a specific requirement for project application to provide an investment plan for continuing the project after the commitment of the IFD is over. This can be in form of a business case or financing plan.
- The **CDI programme in Sweden** offers a fourth stage of funding which focuses on scaling up a developed idea globally, with the aim to support the project beneficiaries to roll out their developed innovation internationally.

The **sequential financing model of CDI programme in Sweden** has been identified as a clear success factor of the programme to develop and mature both the technical solution but also consortium and business relationships. If a project matures through the project stages, the consortium typically grows while the coordinator of the project is rarely replaced, showing that the network is growing but maintaining its core objective.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. OVERALL CONCLUSIONS

Based on the study findings, the following overall conclusions are made. A synthesis of key study findings can be found in Appendix 1.

HIGHLY RELEVANT INSTRUMENT – AT THE CORE OF BUSINESS FINLAND

Innovation is increasingly complex and systemic, hence more and more generated in collaboration with different partners. This trend is also reflected in the EU Framework Programmes, where joint projects are increasingly large, complex, long, and more strategic, and therefore increasingly require professional preparation and coordination.

Promotion of R&D collaboration is not only important and necessary for the innovation process, but also equally essential for building the future capabilities of the Finnish businesses with regard to research and innovation ambition, broader networking and internationalisation. This is particularly important in themes and topics where new

approaches and competences are required, such as in sustainability.

In European comparisons (e.g., Community Innovation Survey, CIS), Finnish companies have traditionally been ranked as very active in R&D collaboration, but this collaboration has mainly been domestic. There is also a long tradition at Business Finland (and its predecessors) to support R&D collaboration for different themes, different levels and with different funding services.

Together with other Business Finland services and strategic measures (e.g., programmes, ecosystems, Leading Company Initiatives) Co-Creation and Co-Innovation projects serve as the cornerstone of what is known as the National Partnership Model.

WIDELY UTILISED AND WELL-RESOURCED

Presently, Co-Creation and Co-Innovation projects are Business Finland's primary funding mechanisms to support collaboration for the design and preparation (Co-Creation) and for the conduction (Co-Innovation) of joint R&D between companies and research organisations.

Co-Innovation funding has emerged as a widely employed funding vehicle for the large and ambitious R&D projects, particularly in the effective realisation of Business Finland's innovation ecosystems and Leading Company Initiatives.

A significant allocation of effort and resources have been dedicated to Co-Innovation projects. Over the span of five-years from 2018 to 2022, a total of 136 Co-Innovation projects were completed, featuring an average of 4,6 partners in each and an average project size of EUR 4 million. Business Finland funding contribution amounted to EUR 212 million out of the total project volume of EUR 546 million.

During this period, Co-Creation projects numbered at 151; however, they were notably smaller both in terms of funding (average of EUR 146,000) and consortia size (average of 1,8 partners). Business Finland's contribution to Co-Creation projects amounted to EUR 13.6 million out of a total project volume of EUR 22.1 million.

In international comparison, the role of companies as project initiators and coordinators holds greater prominence in collaborative R&D programmes of other countries compared to Finland. In general, learning and networking

are found to be the key benefits of collaborative research projects. At the same time, support for commercialisation and scaling up are common challenges of R&D collaboration programmes in all countries.

ATTENTION TO SYSTEMATIC MONITORING

The Co-Innovation funding instrument has undergone evolutionary changes, incorporating numerous adjustments and refinements over time to strike the right balance between research and business perspectives.

At the same time, the decisions related to Co-Innovation funding have lacked systematic tracking. A precise overview of Co-Innovation funding at Business Finland is lacking, including details such as the number and nature of projects, partner involvement, funding allocation, thematic focus, etc. This study is the first full overlook of these instruments, and it provides more evidence on how these instruments work in practice, what are their added value, results, as well as the impact generated.

On a project level, Co-Innovation projects have been mandated to establish joint steering groups wherein

Business Finland representatives participate as observers. This move has significantly amplified hands-on project monitoring.

The study substantiates that Co-Innovation funding has been widely embraced, emerging as a vital tool in propelling and streamlining extensive and ambitious R&D ventures. Notably, it plays a critical role in funding Business Finland's innovation ecosystems and catalysing the Leading Company Initiatives.

AMBITIOUS PROJECTS IN EVERY ASPECT

Co-Innovation projects are ambitious and complex to set up and conduct, often proving to be more intricate and demanding than initially envisioned. These projects are also thematically more connected to Business Finland programmes than normal R&D projects.

In Finland, Co-Innovation projects are mainly initiated and driven by research organisations. Research organisations in Finland also demonstrate higher levels of engagement and commitment to these projects compared to their

corporate counterparts. This is a different approach to R&D collaboration than in most benchmarked countries, where joint projects are largely driven by companies.

The landscape of Co-Innovation projects encompasses a broad spectrum, ranging from substantial endeavors to smaller-scale initiatives. A particularly encouraging aspect is the significant involvement of SMEs as project participants within these ambitious R&D undertakings, underscoring promising prospects for knowledge exchange and capacity enhancement.

Effective design, establishment, and meticulous planning play pivotal roles in the success of Co-Innovation projects. Therefore, the availability of Co-Creation funding as an option aligns logically and proves to be highly beneficial in this context.

SUCCESS BIASED TOWARDS RESEARCH ORGANISATIONS

Co-Creation and Co-Innovation projects have demonstrated notable success. A significant majority (77%) of Co-Creation project partners consider the projects at least moderately successful. In the case of Co-Innovation projects, a remarkable proportion of participants affirm their success, with 81% of companies and an impressive 98% of research organisations deeming these initiatives at least moderately successful.

Research organisations largely attained their research and collaboration objectives, indicating a high level of success from their perspective. However, companies adopted a more critical stance toward the outcomes of the projects.

POSITIVE IMPACT ON COLLABORATION AND ECONOMIC PERFORMANCE

Co-Innovation projects have significantly expanded the R&D collaboration and competence networks of the involved partners. In this regard, major research organisations have been

pivotal for all project participants. However, it is important to note that the impact on international networks within Co-Innovation projects has been limited.

Moreover, the study reveals that Co-Innovation projects yield a notably stronger positive economic impact for participating companies compared to typical Business Finland R&D funding. Interestingly, there seems to be an economies of scale effect, amplifying the impact in larger projects.

Research organisations express higher satisfaction with the outcomes of Co-Innovation projects than their corporate partners. This discrepancy raises concerns about whether Co-Innovation projects may be excessively research-oriented and research-driven, potentially requiring a more balanced emphasis on application-oriented and business-driven approaches.

The project expectations for internationalisation and exports have proven challenging to fulfil. Projects often exceed initial time estimates for implementation, delaying subsequent commercialisation and internationalisation efforts. A shortage of appropriate funding for internationalisation further compounds this challenge.

8.2. ANSWERS TO SPECIFIC STUDY QUESTIONS

Impact studies are the key method for monitoring Business Finland's success and impact in its strategic target areas; namely economic growth, sustainable development and competitiveness. This study has assessed Business Finland's impact on competitiveness, which is divided into two parts. Firstly, strengthening Business Finland's customers' long-term competitiveness by supporting them in developing capabilities that are required for renewal and resilience. Secondly, on a societal level Finland should become a more attractive and resilient business landscape that is agile in reacting to external challenges. The following section synthesises the study findings in response to specific study questions.

8.2.1. HOW HAS BUSINESS FINLAND ACTIVITIES SUCCEEDED TO IMPROVE COMPETITIVENESS OF INNOVATION AND OPERATIONAL ENVIRONMENT IN FINLAND?

The answer to this question is presented by utilising the following six sub-questions.

HOW HAS CO-CREATION FUNDING SUCCEEDED IN ACTIVATING COMPANIES AND RESEARCH ORGANISATIONS TO COLLABORATE?

The general logic behind Co-Innovation funding is that by encouraging companies and research organisations to engage into collaborative R&D projects, it will drive for bigger and more ambitious R&D projects, higher quality of research and more professional networks of partners. This is likely to push more ambitious innovation and facilitate business growth also beyond current markets. In the long term, these projects are expected to contribute to building companies' and research organisations' capabilities by extending their R&D partnerships and building their experience in conducting collaborative R&D in multi-actor

networks. It is the role of Co-Creation funding to encourage and facilitate the design and setting up of these networks, to identify and engage capable partners, as well as to provide additional means for elaborating high quality R&D application for Co-Innovation funding.

Co-Creation funding has indeed proven important for gathering the necessary consortia and for the elaboration of good research plans. For most projects, Co-Creation funding has clearly had a positive impact on business linkages and research capabilities, but there has been less contribution in providing access to international RDI networks or in attracting highly qualified personnel. Altogether 92% of projects indicate they have been able to attract new partners for consortia. In Co-Innovation projects, **over half (55%) of the participant companies had no recent prior engagements in R&D collaboration.**

The Co-Creation funding has been targeted for research organisations as an **additional incentive to design and set up Co-Innovation projects.** Co-Creation projects are preparatory projects by their nature. They offer lucrative, but short-term funding for the design and set-up of complex collaborative Co-Innovation projects. Good preparation of Co-Innovation projects is essential for their

success. Although Co-Creation projects are short in duration (6 months) and individual funding amounts (max EUR 60, 000) are small compared to actual research projects, the Co-Creation funding has turned out to be an attractive and functional incentive. Hence, it has been **reasonably widely utilised.** Most Co-Creation project participants agree that Business Finland's funding was proportionate to the application (83%) and to the reporting requirements (93%).

It has been the role **solely of research organisations** to carry out Co-Creation projects, thus all funding has been directed to them. Usually this is done in small consortia in which one or two organisations take the task of designing the Co-Innovation project applications and gathering the necessary partners. The basic assumption is, that professional research organisations have the necessary capacity and competence for this, particularly compared to smaller companies. It is not certain that companies, even if encouraged, could and would design and set up equally good Co-Innovation project proposals. At the same time, the **lack of early company engagement in the design** of Co-Innovation projects may be one reason

why companies have altogether been less engaged and less satisfied with their outcomes compared to research organisations in Co-Innovation projects.

The role and share of research organisations have been increasing in Co-Innovation projects over time, and research organisation are most often acting as consortium leaders in the projects. If Co-Creation projects were mainly carried out by companies instead of research organisations, the Co-Innovation projects would probably be somewhat differently focused, perhaps less ambitious in research, and more oriented in their application. The key question is then would they be able to attract and engage professional research organisations. An ideal solution would be to **engage both research organisations and companies in same Co-Creation projects**, when possible.

HOW MANY OF THESE PROJECTS HAVE PROCEEDED AS A CO-INNOVATION PROJECT?

Unfortunately, the available project **funding data does not provide a sufficient and precise picture** of how

many or which of the Co-Creation projects have succeeded and moved to Co-Innovation projects. Based on the survey responses, 77% of Co-Creation project respondents indicate that their project had been highly or at least moderately successful. Over the period analysed (2018-2022), there were altogether 151 completed Co-Creation projects, of which it is estimated that **one quarter to up to half have proceeded to Co-Innovation projects**. Based on the survey, 46% of Co-Creation project participants stated that the project had resulted in a Co-Innovation project (42%), or a Co-Innovation project application was currently in process (4%). This can be considered as a high estimate. When asking the same question from completed Co-Innovation projects, the response was significantly lower. Only 23% of the company partners and 16% of research organisation partners said their Co-Innovation project originated from a Co-Creation project. It is possible that many Co-Innovation project partners are not aware of any preparatory projects, as Co-Creation projects were typically conducted by few partners only. Moreover, it is fully acknowledged that setting up a Co-Innovation project is demanding, and it is not easy to compile large

R&D consortia and gather the required matched funding from companies. Yet the **share of Co-Creation projects at least entering to the Co-Innovation application stage could be somewhat higher.**

HOW HAS THE R&D EXPENDITURE AND NUMBER OF R&D PERSONNEL VIA THIS R&D FUNDING DEVELOPED?

According to the survey results, **Co-Innovation funding has clearly increased the R&D volume and ambitions of its project participants.** A great majority of partners (93% of research organisations and 88% of companies) in Co-Innovation projects consider they would not have otherwise (without Business Finland funding) undertaken a research project of similar scale and resources. Altogether 80% of participant companies stated that the project had at least some positive impact on R&D related investments and 8% of participant companies stated the impact was very significant (more than 100% growth). This is very positive. The stated impact on R&D related employment was not equally strong, but still positive. Altogether 71% of companies reported some positive impact and respectively

6% reported a positive impact of more than 100% in R&D related employment. A closer analysis reveals that companies involved in larger Co-Innovation projects received on average a greater positive impact than those in smaller projects. Hence, there seems to be an **economies-of-scale effect with regard to R&D related investments and employment** in Co-Innovation projects.

HOW IS THE LEVEL OF EXPERTISE (TRAINING AND HIRING NEW PERSONNEL) IN COMPANIES AND RESEARCH ORGANISATIONS IMPROVING?

The **main motivation** particularly for companies to join Co-Innovation projects is to build their expertise and capabilities. The key motivators for company and research partners respectively, were 1) access to technical expertise [60% companies / 41% research partners], 2) access to domestic networks [50%/64%], and 3) access to research and knowledge [43%/32%].

Research organisations were rather successful in achieving their research (86%) and collaboration (75%) objectives, while **company participants were less**

successful (57% and 47% respectively), and particularly so regarding commercial objectives (47%).

Project impact in improving the access to qualified personnel or expertise for companies has been very low. Only 7% companies consider Co-Innovation project had a very significant impact in attracting highly qualified personnel and only 2% for access to international operational expertise. The analysis shows that the impact in attracting highly qualified personnel was somewhat more positive in large companies (than in small or medium-sized companies). The impact for research organisations has been somewhat more positive; 10% for highly qualified personnel, 16% for access to international RDI networks and 30% for research linkages.

HOW HAVE JOBS, TURNOVER, EXPORTS, AND INTERNATIONALISATION DEVELOPED SO FAR? (CO-INNOVATION PROJECTS)

Most survey respondents consider their Co-Innovation project generated at least some **positive change** in various areas of business performance; in turnover (84%), export sales (82%), R&D related investments (80%) as well as in R&D related employment (71%). Indeed, the econometric analysis confirms **that SMEs in Co-Innovation projects show better economic performance than those SMEs receiving other Business Finland R&D funding.**⁵¹ Already by the end of the first year, the turnover of Co-Innovation funded SMEs has increased on average 8% (with a 90% confidence interval) compared to the SMEs receiving other Business Finland R&D funding. This positive impact increases over time. After the third year, the statistically significant impact is 13% and after the fourth year becomes 22%. The results are similar regarding job creation.

What comes to R&D personnel, one in every five (21%)

⁵¹ Keeping in mind that in practice Business Finland financial conditions for SMEs in Co-Innovation projects were more attractive than normal Business Finland R&D funding conditions for SMEs. On average, 93% of Co-Innovation project funding for SMEs was grants (only 7% loans), while for normal R&D projects the funding was 23% grants and 77% loans.

companies reported that the Co-Innovation project had a very significant or significant positive impact on R&D related employment.

IS CO-INNOVATION FUNDING IMPROVING THE ADOPTION OF DIGITAL TOOLS (FOR EXAMPLE AI, ROBOTICS, AUTOMATION) AND NEW BUSINESS MODELS IN COMPANIES?

Co-Innovation funding has had **limited impact in enhancing digitalisation**. Only 6% of companies report that the project had a very significant positive impact in digital transformation and 25% of companies indicate the projects had a very significant or significant impact. In comparison, the impact was much less than the impact on technical capabilities or research linkages of companies.

Furthermore, companies did not specifically report introducing new business models, but **nearly half of the companies** (45%) reported the projects had a very significant or significant impact on introducing **new products, processes, or services** most often to international markets.

8.2.2. WHAT KIND OF CRITICAL OBSTACLES AND BOTTLENECKS HAVE AFFECTED THE POSSIBILITIES TO ACHIEVE THE GOALS OF CO-CREATION AND CO-INNOVATION FUNDING WHEN CONSIDERING THE COMPETITIVENESS CORE AREA?

Finding suitable partners and forming a well-functioning consortium can be difficult. This is likely to include negotiations on partners roles, co-funding, rights to generated results and IPR, etc. as well as any considerations of **partners suitability, eligibility, and capacity** to conduct demanding research or to commercialise anticipated results. This is particularly the case when engaging smaller companies.

Naturally most of the stakeholders appreciate the Co-Creation funding available. However, the role of Co-Creation is somewhat criticised by stakeholders in the sense, that at the same time it is a relatively large amount of funding for writing an application for an existing partnership, but the funding is not necessarily sufficient for forming a functional Co-Innovation consortium from the ground up.

Access to competent R&D personnel and skills is critical to companies. The key barriers to business success reported by Co-Innovation companies were lack of competent employees (41%), too long time between product concept and launch (39%), and financial constraints (36%). The challenges of **research organisations** were somewhat different. Their key barriers were 1) funding limitation (77%), 2) competence gaps (45%) and administrative challenges (41%). This largely explains why the key motivation for research organisations to participate in Co-Innovation projects was access **to appropriate funding.**

The project participants report a need to further develop the Co-Innovation application process and funding criteria. The current application process is considered too long with respect to the project funding period and the projects resources. In addition, variation of innovation life cycles across different sectors should be noticed.

The preparation and assessment of Co-Innovation projects can be difficult and slow. Both research organisations and companies were least happy with the elapsed time between starting project preparation and getting the

funding decision from Business Finland. There have been challenges to build the consortia because of weaknesses of the companies (economic situation or the amount of Business Finland funding already). **It is evident that large, professional research organisations are playing a central role** in the R&D networks amongst both research organisations and companies.

There are some very big Co-Innovation projects with large company consortia, particularly from the earlier years of the funding scheme. The experience has then shown that **very large project consortia are often complex, difficult to manage** and therefore not necessarily very effective. Hence, the Co-Innovation concept has been further developed during its lifespan, with the latest revisions in 2023. More emphasis has been put on appropriate partner composition and consortium size, quality of project plans, sufficient business orientation and management structures (requiring a joint steering group). In strategic (i.e., highly relevant) collaborative research, the sharing of proprietary information and the ownership of generated **intellectual property** play a very important role.

The perception is that the anticipated time and **effort needed for the design and setting up of new Co-Innovation projects is perhaps underestimated, and the commercial and export-related expectations for these projects are often optimistic and not in good balance with project durations and the complexity of projects.**

The case studies have highlighted the **differences in innovation life cycle durations** across sectors. The progress and pace of development varies across fields, and it is difficult to fit projects from all sectors in a similar timeframe. The Co-Innovation project duration is sometimes considered far too ambitious (short) to be realistic. Larger and complex projects tend to take longer to conduct. Furthermore, when time falls short, it often has consequences for the later phases of the project – utilisation, commercialisation, export, etc. These are indeed the weak points of Co-Innovation projects. Hence, more flexibility and proper consideration of sufficient time scale is called for.

8.2.3. HOW CAN SUSTAINABILITY (ECONOMIC, ECOLOGICAL, AND SOCIAL) BE CONSIDERED AT THE CUSTOMER AND SOCIETY LEVEL IN PROMOTION SERVICES?

HOW CAN BUSINESS FINLAND'S CUSTOMERS' IMPACT ON SUSTAINABILITY BE MEASURED (SDGS OR OTHER MEASURES)?

The project impact on customer sustainability (footprint), nor Business Finland's customers impact on sustainability (handprint) have not been systematically followed or monitored in Co-innovation projects, and therefore its current status is unclear. What is known is that **the majority of the Co-Innovation projects are addressing challenges that are relevant and often directly linked to sustainability, as well as to other Business Finland's priority themes** (indicated with high linkages to programme themes).

Hence, **the share and volume of Co-Innovation projects that are directly linked to Business Finland's strategic priorities and key instruments (such as**

ecosystems and Leading Company Initiatives) could be easily monitored.

Furthermore, since customer impact on sustainability is a priority to Business Finland, this should be **clearly communicated also in Co-Innovation funding calls, and built into the project application questions, so that the related project objectives can be designed, and eventually project results and wider impacts can be monitored and assessed.**

The specific role of Co-Innovation funding is to **support capacity building and capability enhancing** particularly among the smaller companies by engaging them in larger R&D consortia and competence networks. This applies much to ESG competences, too. Hence, the impact of Co-innovation on Business Finland customers' ESG capabilities could be monitored.

Sustainability is not only a societal requirement, it is also the largest growth sector globally. Many innovations related to sustainability are by nature radical, systemic or result societal changes for example in market behaviour.

Such innovations typically benefit from co-development and **often require more (than normal) piloting and market testing.** This could be considered in some Co-Innovation projects and the related results monitored.

WHAT KIND OF ACTIONS HAVE PROMOTION SERVICES ALREADY TAKEN TO IMPROVE SUSTAINABILITY?

Sustainability is a cross-cutting objective for Business Finland and there are specific objectives and measures to this end.⁵² The measures and their monitoring are constantly developed at Business Finland.

Most Business Finland's priority themes and strategic instruments (such as ecosystems) are closely linked to sustainability. In addition, Business Finland's promotion services are harnessed to support these strategic themes. In relation to those, Co-Creation and Co-Innovations projects are merely instruments that are utilised for implementation.

Regarding Co-Creation and Co-Innovation funding, sustainability is not specifically mentioned in calls, funding

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For more details, see: Halme, et al. (2022) Superpower in Sustainable Development – from ambition to action. Business Finland.

objectives, selection criteria, in cost categories or funding incentives. The study has not found that sustainability has been in any ways specifically emphasised in Co-Innovation funding, nor have any specifically targeted actions in promotion services been identified.

8.3. RECOMMENDATIONS

Based on the study conclusions, the following recommendations are made to improve the Co-Innovation funding concept and its impact.

RECOMMENDATION 1. MORE FOCUS ON COMPANIES.

Currently Co-Innovation projects appear to better serve the needs of research organisations than companies, although companies are their primary target group. There are several aspects that should be addressed and considered:

- Opening and promoting **Co-Creation funding for all kinds of organisations**, to engage companies from the very design of Co-Innovation applications.
- Encouraging the elaboration of **joint research agendas or roadmaps** by groups of companies and research organisations, which in turn would provide a thematic umbrella for collaborative projects.
- Emphasising the **market, utilisation and scalability aspects** and incentives of Co-Innovation projects.
- Prioritise **companies chairing the joint project steering groups**.
- Include **experimentation and piloting** as part of the project tasks.
- Allow flexibility for **new partners to join collaborative consortia** during the course of project.

**RECOMMENDATION 2. ENHANCING DATA MONITORING,
ENSURING SUFFICIENT DEAL FLOW AND THEMATIC
LINKAGES IN THE CO-CREATION-TO-CO-INNOVATION
PROCESS.**

Co-Innovation projects are often complex partnerships, which calls for broader and more **consistent project data** to be collected and made easily available for monitoring Co-Innovation project flows, connections, and overall status. It is important to know where new collaborative projects originate from, how they are linked to different Business Finland ecosystems and instruments, as well as how the topics continue and evolve after the project period.

- In order to develop Co-Creation as a funding instrument, **more systematic and precise data are needed specifically on which Co-Creation projects have proceeded to Co-Innovation.**
- Co-Creation and Co-Innovation can also be utilised **as a means to encourage and activate new collaboration and openings in strategic themes.**

RECOMMENDATION 3. MORE SUPPORT FOR THE PREPARATION AND SUFFICIENT TIME FOR THE IMPLEMENTATION OF PROJECTS.

The key challenges of Co-Innovation projects are in the very beginning and towards their completion; finding suitable partners, finding a common ground for information sharing and later when results are to be turned into commercial success and exports. Support is needed for the beginning part and more time at the end. These could be supported, for example by:

- Implementing effective communication strategies and practices to foster multidisciplinary engagement in projects.
- Managing relationships with partners and the broader ecosystem.
- Allocating sufficient time and resources for project design and setup, including in particular clarification of IPR procedures, etc.
- Allowing longer project timeframe (than two years), especially for challenging projects with low TRL.
- Considering sequential or progress-related optional funding decisions (2+3 years, for example).



RECOMMENDATION 4. ENHANCING (STRATEGIC) ECOSYSTEM ASPECTS.

Co-Innovation funding is an important vehicle to implement Business Finland's large strategic platforms and ecosystems. This aspect should be communicated clearly.

- Utilise Co-Innovation more generally as an ecosystem instrument.
- Accepting higher risks in Co-Innovation projects when they are closely linked / critical to achieving ecosystem-related objectives.

RECOMMENDATION 5. MORE ATTENTION ON SUPPORTING SCALING AND INTERNATIONAL COLLABORATION.

Difficulties in commercialisation, up scaling and internationalisation are pertinent challenges to Finnish R&D projects, and to Co-Innovation projects. It is a deliberate objective of Co-Innovation funding to address these challenges. Therefore, attention should be drawn to the following:

- Attracting & engaging more international partners at the inception of Co-Innovation projects (planning phase), as well as in project steering groups.
- Exploring thematic and operational linkages between Co-Innovation projects and EU-projects, for example via ecosystems and other platforms.
- Considering thematic calls under joint European challenges / topics.
- Considering joint calls with foreign sister organisations, such as Vinnova of Sweden.
- Ensuring sufficient resources for the planning and actions of internationalisation.

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APPENDICES

APPENDIX 1. SUMMARY OF KEY FINDINGS

CONDUCTED ANALYSES	KEY MESSAGES
Contextual analysis (Sections 3.1 & 3.2)	<p>Nature of innovation has become more collaborative.</p> <p>Challenge-driven policy calls for ambitious and disruptive innovation.</p> <p>Finnish companies traditionally active in innovation collaboration, but less internationally.</p> <p>National partnership model (2020) with increased emphasis on innovation ecosystems, where Co-Innovation is one key instrument of Business Finland.</p>
Analysis of funding volumes, structures and operations (Sections 3.3 & 3.4)	<p>Co-Creation projects are smaller preparatory projects aiming for Co-Innovation.</p> <p>Co-Innovation projects are seen as an approach to structure and steer large collaborative research projects.</p> <p>There has been some evolution of selection criteria. There is a reasonably high success rate (63%) in selection of Co-Innovation projects.</p> <p>Co-Innovation projects are thematically more linked to Business Finland programmes than normal Business Finland R&D projects.</p> <p>Surprisingly majority of company partners are SMEs.</p> <p>Finding suitable, committed and eligible enterprise partners is typically the main challenge in setting up a Co-Innovation consortium.</p>

<p>Project case studies (Chapter 4)</p>	<p>Partners valued the funding for R&D collaboration. Strong variation of innovation life cycles across sectors. Complex projects require longer development times. More attention on the utilisation of project results / commercialisation. Export requirements considered challenging. International collaboration requires also suitable funding. There is a perceived mismatch between stated goals and ambitions for the funding, and the funding terms, project volumes and durations.</p>
<p>Participant surveys for companies and research organisations (Chapter 5 & Section 6.2)</p>	<p>Co-Innovation was the most appropriate funding source for research organisations to collaborate with companies. Co-Innovation projects have been largely initiated and coordinated by research organisations. Research organisations' engagement is significantly higher than that of the companies. Projects clearly extend the competence networks. Over half of the partner companies had no other recent engagements in R&D collaboration. The amount of received funding was considered largely sufficient. Research organisations had largely (76%) achieved their research and collaboration objectives and considered Co-Innovation projects successful. Companies were much more critical (38%) about project success and results. For research organisations, projects enhance research capabilities and business linkages. For small companies highest impact was on research linkages, for large companies in technical capabilities. There appears to be an economies of scale effect in projects, i.e., that larger projects perform better.</p>
<p>Network analysis (Section 6.1)</p>	<p>Large research organisations are playing a central role in the R&D networks amongst both research organisations and companies. The impact of Co-Innovation projects on international RDI networks was weak for both research organisations and for companies.</p>

International benchmarking (Chapter 7)	Business Finland approach to R&D collaboration differs from other countries. The role of companies as project initiators and coordinators is more central in other countries. Learning and networking are key effects of R&D collaboration. Support to commercialisation and scaling up is a common challenge to all. Benchmark: the gradual financing model from Swedish CDI.
Econometric impact analysis (Section 6.3)	SMEs in Co-Innovation projects have better economic performance than SMEs receiving other Business Finland R&D funding. Positive impact increases over time.

APPENDIX 2. DESCRIPTION OF THE ECONOMETRIC ANALYSIS

METHODOLOGY AND DATA

The econometric analysis employs the difference-in-differences (DiD) methodology for panel event studies, also referred as staggered adoption design,⁵³ to examine the impact of Business Finland's co-innovation subsidy on SMEs' turnover, job creation, and export performance. DiD is a rigorous quasi-experimental design widely used in economics⁵⁴ to estimate causal effects of state aid on firms' performance when randomised controlled trials are not feasible. This methodology allows us to assess the causal impact of a treatment (in this case, receiving co-innovation subsidy) by comparing changes in outcomes over time between treated and untreated groups. The study looks at t-2 to t+4 years before and after the treatment.

The study utilises a panel dataset covering a 6-year period, including repeated observations on treated and control

group firms' turnover, job creation, export activities, given state aid and a list of control variables. The treated group comprises SMEs that have participated the BF's co-innovation funding during the study period, whereas the control group consists of firms that have received other type of R&D subsidies from Business Finland. **Essentially, this analysis is answering the question: what the impact of co-innovation subsidy is comparing to regular R&D subsidy.**

The investigation is restricted to SMEs since Co-Innovation is funding for a wide stratum of firms from micro firms to multinationals. The impact of a co-innovation project on large firms is likely to be small and statistically insignificant. Moreover, due to data limitations and missing values, the time frame is restricted t-2 to t+4 to create a balanced panel of data. The years further away from the intervention included a large share of missing values which might have biased the estimates. Hence those firms are excluded from the sample. The total number of observations for each regression vary from 1285 - 1597 depending on the available observations for the outcome

53 Clarke and Schythe (2020) Implementing panel event study. IZA Institute of Labor Economics. Discussion paper series. IZA DP No. 13524

54 Esim, Martikainen et al. (2022) Business Finlandin TKI-tukien vaikuttavuus. Loppuraportti TEM:in yritystyökyien vaikuttavuusjaostolle.

variable. The data is collected from Business Finland and Vainu database.

To ensure that the DiD estimates are robust, an optimal control group should consist of firms that are similar to those that are treated in terms of their potential to grow, which is often difficult to observe. Indeed, one of the key assumptions of the DiD methodology is the parallel trends assumption, which holds that the treatment and control groups would have experienced similar trends in the absence of treatment. This means that, in the absence of state aid, the outcomes for treated and untreated firms would have evolved similarly over time. The study utilizes Business Finland's non-collaboration-based R&D subsidy recipients as a control group. The benefit of this strategy is that it can be assumed that the firms in both treatment and control groups are similar in terms of their R&D capabilities. I.e., using firms with a negative financing decision as a control group would most likely overestimate the treatment effect as the firms would likely differ in their capabilities. Ideally for DiD analysis, the control group would consist of firms that also participate in collaborative projects albeit without co-innovation subsidy. This

setting would allow us to obtain the impact of the subsidy on the firms' performance. However, with the available data, using other BF clients as the control group is the best data strategy. This entails that the results are to be interpreted as "how much additionality has co-innovation subsidy brought about for the firms comparing to other type non-collaboration-based BF R&D subsidy". In the analysis, the funding decisions years are standardised in a way that the observations on both the treatment and control groups are organised in a panel according to the distance to the funding decision ($t-2\dots t+3$).

Moreover, the study is employing a set of strategies to minimize selection into treatment bias and omitted variable bias. Firstly, it is employing the fixed effects estimation, which helps to overcome some of the omitted variable bias through looking at the within estimate, i.e., the variance within units over time. This strategy controls for unobserved time-invariant heterogeneity (e.g., ability, willingness). Time variant heterogeneity is controlled by using control variables in the equation. The errors are clustered around business IDs. Secondly, it is using

coarsened exact matching (CEM)⁵⁵ to create cohorts of treated and control group firms that are similar to each other based on selected dummy variables and bins of continuous variables, i.e., firm size, firm age, value added by processing and sector. CEM yields weights for all cohorts, which are then utilised in the estimation. This ensures that the control and treatment groups are similar in their characteristics.

The equation for estimating the event study is:

$$\ln Y_{it} = \alpha + \beta_3 \text{Lag3}_{it} + \dots + \beta_1 \text{Lag1}_{it} + \gamma_0 \text{Lead0}_{it} + \dots + \gamma_2 \text{Lead2}_{it} + X_{it} + \mu_i + \mu_t + \varepsilon_{it}$$

Where, $\ln Y_{it}$ is the natural logarithm of the outcome variable (turnover, job creation and exports respectively), the β_i s are the lags and γ_i s are the leads. As is generally standard, the reference period is set as -1 so that the lead 0 will be the period immediately preceding the intervention⁵⁶. X_{it} is the vector of control variables, μ_i is the fixed effects for firms and μ_t is the fixed effects for time. ε_{it} is the error term.

55 Iacus, King and Porro (2021) Causal Inference without Balance Checking: Coarsened Exact Matching. Political Analysis, Volume 20, Issue 1, Winter 2012, pp. 1 – 24.

56 Clarke and Schythe (2020) Implementing panel event study. IZA Institute of Labor Economics. Discussion paper series. IZA DP No. 13524.

EMPIRICAL FINDINGS

The estimation results for Co-Innovation participations impact on SME's performance in terms of turnover, job creation and exports are presented in Table 11. The analysis shows that the **SMEs participating Co-Innovation projects perform better after the treatment (i.e., received funding) in terms of turnover growth and job creation as compared to their counterparts, i.e., SMEs receiving other types of R&D funding from Business Finland. The impact grows as more years have passed after the intervention.** The results are statically significant. The estimates for export growth are less certain, as the model yields a low R2 value.

The estimated lag coefficients display **statistically significant coefficients for majority of the years after the treatment, suggesting that there was a clear increase in turnover after among the Co-Innovation firms compared to other BF clients. The effect gets larger the more years have passed after the treatment.** The Co-Innovation funding has increased the turnover of the SMEs on average 7% comparing to other BF clients by the end of the first year. After the third year, the treatment

effect was 13% and after fourth year 22%. The results are statistically significant, and the fitness of the model is rather good as indicated by R2 value 0.67. The results for the year t+1 are not reported here, as they were not statistically significant in 90% confidence level.

Furthermore, the above trend is similar for job creation and exports. For job creation, all the lag coefficients are statistically significant. In the end of the treatment year, the jobs in treated firms had increased on average by 7% comparing to other BF clients. The treatment effect after second year was 10%, after third year 13% after fourth year 21%. For job creation, the model fit is good as indicated by the R2 0.82.

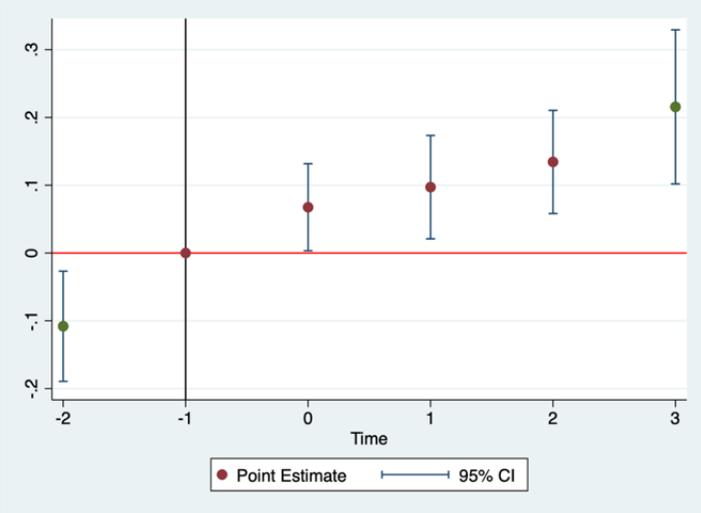
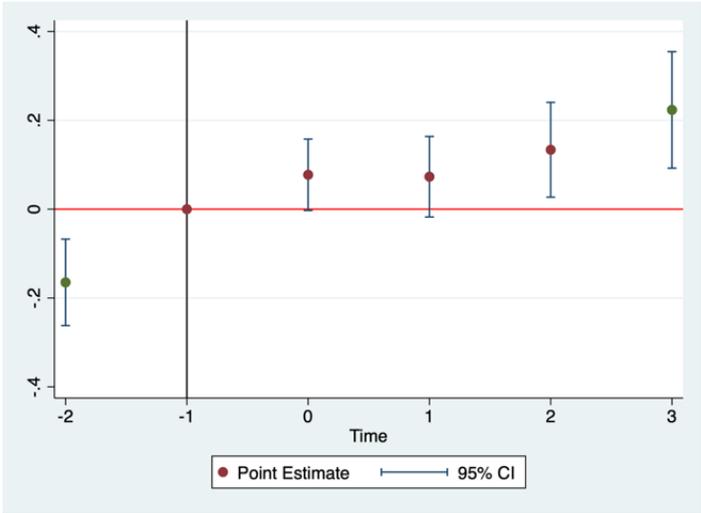
In terms of exports, the results are less robust as indicated by R2 0.29. The estimated lag coefficients are statistically significant only after the third year. After the third year, the data indicates that exports have been on average 13% higher amongst the Co-Innovation firms and after fourth year 22% higher. However, due to lower R2 value, some uncertainty remains in the estimates regarding exports.

APPENDIX 2. TABLE 1. ESTIMATION RESULTS OF CO-INNOVATION FUNDING'S IMPACT ON SMES' ECONOMIC PERFORMANCE.

	LOG OF TURNOVER	LOG OF TURN-OVER	LOG OF JOB CREATION	LOG OF JOB CREATION	LOG OF EXPORTS	LOG OF EXPORTS
	Coefficient (statistical significance level)	Standard error	Coefficient (statistical significance level)	Standard error	Coefficient (statistical significance level)	Standard error
LEAD2 (T-2)	-0.000	0.000	-0.108	0.041	-0.046	0.128
LAG0 (T1)	0.077*	0.040	0.068**	0.033	0.260	0.161
LAG1 (T2)	0.073	0.046	0.097**	0.039	0.182	0.146
LAG2 (T2)	0.134**	0.054	0.134***	0.039	0.324*	0.172
LAG3 (T4)	0.223***	0.067	0.215***	0.058	0.817***	0.191
CALENDAR YEARS	Yes		Yes		Yes	
TREATMENT YEARS	Yes		Yes		Yes	
OTHER CONTROLS	Yes		Yes		Yes	
NO. OF OBSERVATIONS	1597		1594		1285	
R2 (OVERALL)	0.67		0.82		0.29	
CLUSTERED S.E.	Yes		Yes		Yes	

Statistical significance obtained by the t-test for the difference in means reported in the last column, where *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

APPENDIX 2. FIGURE 1. TURNOVER OF FIRMS (LEFT) AND JOB CREATION (RIGHT)



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